ACADEMY MOC ESSENTIALS®



PRACTICING OPHTHALMOLOGISTS CURRICULUM 2014-2016

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Practicing Ophthalmologists Curriculum Authors and Financial Disclosures

The Practicing Ophthalmologists Curriculum was developed by a group of dedicated ophthalmologists reflecting a diversity of background, training, practice type and geographic distribution.

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The Academy gratefully acknowledges the contributions of the Vitreous Society, the Macula Society and the American Society of Retina Specialists.

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Background on Maintenance of Certification (MOC)

Developed according to standards established by the American Board of Medical Specialties (ABMS), the umbrella organization of 24 medical specialty boards, Maintenance of Certification (MOC) is designed as a series of requirements for practicing ophthalmologists to complete over a 10-year period. MOC is currently open to all Board Certified ophthalmologists on a voluntary basis; time-limited certificate holders (ophthalmologists who were Board Certified after July 1, 1992) are required to participate in this process. All medical specialties participate in a similar process.

The roles of the American Board of Ophthalmology (ABO) and the American Academy of Ophthalmology relative to MOC follow their respective missions.

The mission of the American Board of Ophthalmology is to serve the public by improving the quality of ophthalmic practice through a process of certification and maintenance of certification that fosters excellence and encourages continual learning.

The mission of the American Academy of Ophthalmology is to advance the lifelong learning and professional interests of ophthalmologists to ensure that the public can obtain the best possible eye care.

The role of the ABO in the MOC process is to evaluate and to certify. The role of the Academy in this process is to provide resources and to educate.

Background on the Practicing Ophthalmologists Curriculum (POC)

At the request of the ABO, the Academy developed the Practicing Ophthalmologists Curriculum (POC), a knowledge base that identifies and defines areas of knowledge important to the delivery of quality eye care as a basis for the content of examinations for the MOC process. The content in the POC is comprised of the information deemed as the most relevant clinical information for a practicing ophthalmologist.

The ABO has agreed that their Periodic Ophthalmic Review Test (PORT) and closed-book Demonstration of Ophthalmic Cognitive Knowledge (DOCK) examinations will be based on the POC. The ABO is solely responsible for creating the PORT and DOCK exams and for certifying MOC candidates. The Academy has developed study tools based on the POC to assist doctors preparing to meet these MOC requirements.

Organization of the POC

The Practicing Ophthalmologists Curriculum comprises 10 practice emphasis areas (PEA), plus Core Ophthalmic Knowledge. The ABO has designated the following as practice emphasis areas:

- Comprehensive Ophthalmology
- Cataract/Anterior Segment
- Cornea/External Disease
- Glaucoma
- Neuro-Ophthalmology and Orbit
- Oculoplastics and Orbit
- Pediatric Ophthalmology/Strabismus
- Refractive Management/Intervention
- Retina/Vitreous
- Uveitis

In addition to two practice emphasis areas of choice, every diplomate sitting for the DOCK examination will be tested on Core Ophthalmic Knowledge. Core Ophthalmic Knowledge is defined as the fundamental knowledge every practicing ophthalmologist must have whatever their area of practice.

Each PEA is categorized into topics presented in an outline format for easier reading and understanding of the relevant information points by the reader. These outlines are based on a standard clinical diagnosis and treatment approach found in the Academy's Preferred Practice Patterns.

For each topic, there are Additional Resources that may contain journal citations and reference to textbooks. These resources are supplemental to the topic outline, and should not be necessary for MOC exam preparation purposes.

Creation of the POC

The POC was developed by panels of practicing ophthalmologists in each of the ten practice emphasis areas. The panels reflect a diversity of background, training, practice type and geographic distribution, with more than 90 percent of the panel members being time-limited certificate holders.

The panels ranked clinical topics (diseases and procedures) in terms of clinical relevance to the subspecialist or comprehensive ophthalmologist. The panelists created outlines for the topics deemed Most Relevant, based on what an ophthalmologist in a specific practice emphasis area needs to know to provide competent, quality eye care (i.e., directly related to patient care). These outlines were reviewed by subspecialty societies and the American Board of Ophthalmology.

Revision Process

The POC is intended to be revised every three years. The POC panels will consider new evidence in the peer-reviewed literature, as well as input from the subspecialty societies, the American Board of Ophthalmology and the Academy's Self-Assessment Committee, in revising and updating the POC.

Prior to a scheduled review the POC may be changed only under the following circumstances:

- A Level I (highest level of scientific evidence) randomized controlled trial indicates a major new therapeutic strategy
- The FDA issues a drug/device warning
- Industry issues a warning

Anatomy
1. Anatomy of the retina12
Diagnostic Tests
2. Fluorescein angiography15
3. Optical coherence tomography19
4. Echography (ultrasound)23
Macular Diseases
5. Age-related macular degeneration
6. Ocular histoplasmosis syndrome
7. Angioid streaks
8. Pathologic myopia (myopic degeneration)45
9. Central serous chorioretinopathy
10. Epiretinal membrane
11. Vitreomacular traction syndrome57
12. Macular hole
Retinal Vascular Diseases
13. Hypertensive retinopathy65
14. Diabetic retinopathy
15. Branch retinal vein occlusion
16. Central retinal vein occlusion (CRVO)82
17. Branch retinal artery occlusion
18. Central retinal artery occlusion93
19. Sickle cell retinopathy
20. Retinopathy of prematurity

21. Retinal telangiectasis	110
22. Acquired retinal macroaneurysm	117
23. Cystoid macular edema	120
Chorioretinal Inflammations	
24. Selected white dot syndromes	
25. Multiple evanescent white dot syndrome	137
26. Multifocal choroiditis with panuveitis	140
27. Sarcoidosis	143
28. Intermediate uveitis/pars planitis	146
29. Endophthalmitis associated with filtering or inadvertent blebs	150
30. Acute onset postoperative endophthalmitis	153
31. Endogenous endophthalmitis	158
32. Chronic or delayed onset endophthalmitis following cataract surgery	166
33. Necrotizing herpetic retinitis: acute retinal necrosis (ARN) and progressive outer re (PORN)	tinal necrosis 170
33. Necrotizing herpetic retinitis: acute retinal necrosis (ARN) and progressive outer re (PORN)	tinal necrosis 170 174
 33. Necrotizing herpetic retinitis: acute retinal necrosis (ARN) and progressive outer re (PORN) 34. Toxoplasmosis	tinal necrosis 170 174 179
 33. Necrotizing herpetic retinitis: acute retinal necrosis (ARN) and progressive outer re (PORN)	tinal necrosis 170 174 179 183
 33. Necrotizing herpetic retinitis: acute retinal necrosis (ARN) and progressive outer re (PORN)	tinal necrosis 170 174 179 183 186
 33. Necrotizing herpetic retinitis: acute retinal necrosis (ARN) and progressive outer re (PORN)	tinal necrosis 170 174 179 183 186
 33. Necrotizing herpetic retinitis: acute retinal necrosis (ARN) and progressive outer re (PORN)	tinal necrosis 170 174 179 183 186 192
 33. Necrotizing herpetic retinitis: acute retinal necrosis (ARN) and progressive outer re (PORN)	tinal necrosis 170 174 179 183 186 192 192 198
 33. Necrotizing herpetic retinitis: acute retinal necrosis (ARN) and progressive outer re (PORN)	tinal necrosis 170 174 179 183 186 192 192 198
 33. Necrotizing herpetic retinitis: acute retinal necrosis (ARN) and progressive outer re (PORN)	tinal necrosis
 33. Necrotizing herpetic retinitis: acute retinal necrosis (ARN) and progressive outer re (PORN)	tinal necrosis 170 174 179 183 186 192 192 198 202 205

43. Posterior vitreous detachment	
Peripheral Retinal Abnormalities	
44. Traumatic breaks	
45. Horseshoe tears	
46. Giant retinal tear	
47. Atrophic holes	
48. Lattice degeneration	
49. Rhegmatogenous retinal detachment	
50. Traction retinal detachment	
51. Exudative retinal detachment	
52. Degenerative retinoschisis	
Posterior Segment Trauma	
53. Commotio retinae	
54. Choroidal rupture	
55. Sclopetaria	
56. Scleral ruptures and lacerations	
57. Ocular penetrating and perforating injury	
58. Intraocular foreign body	
59. Hemorrhagic choroidal detachment	
60. Serous choroidal detachment	
61. Post-traumatic endophthalmitis	
62. Sympathetic ophthalmia	
63. Shaken baby syndrome	
Retinal Toxicity	
64. Drug Toxicity (posterior segment)	

65. Phototoxicity of the posterior segment	291
Tumors	
66. Nevus of the choroid	296
67. Melanoma of the ciliary body and choroid	299
68. Retinoblastoma	303
69. Melanocytoma or magnocellular nevus	306
70. Choroidal osteoma	309
71. Vascular tumors of the choroid and retina	
72. Choroidal metastasis	
73. Ocular and central nervous system lymphoma	
Surgery	
74. Lasers	
75. Intravitreal Injections	
76. Pars plana vitrectomy	330
77. Vitrectomy for selected macular diseases	
78. Vitrectomy for posterior segment complications of anterior segment surgery	
79. Pneumatic retinopexy	
80. Scleral buckle surgery	
81. Vitrectomy for complex retinal detachment	

Anatomy of the retina

I. Describe relevant aspects of the basic anatomy

A. Vitreous

- 1. Transparent gel composed of a collagen and hyaluronan matrix
- 2. Central core and peripheral cortical vitreous
 - a. Firmly attached to inner eye at
 - i. The optic nerve head
 - ii. Major vessels
 - iii. Vitreous base (firmly adherent)

B. Neurosensory retina

- 1. Derived from the inner layer of the optic cup
- 2. Histological layers have been identified
 - a. Internal limiting membrane (ILM)
 - b. Nerve fiber layer (NFL; formed from axons of the ganglion cells)
 - c. Ganglion cell layer (GCL)
 - d. Inner plexiform layer (IPL)
 - e. Inner nuclear layer (INL)
 - f. Middle limiting membrane (MLM)
 - g. Outer plexiform layer (OPL)
 - h. Outer nuclear layer (ONL; photoreceptor nuclei)
 - i. External limiting membrane (ELM)
 - j. Photoreceptor inner and outer segment junction (IS/OS)
- 3. The macular center has lateral displacement of the inner nuclear layer that minimizes light scatter and thereby optimizes central visual acuity
- 4. The peripheral (anterior) retina terminates anatomically at the ora serrata and is supported at this junction by the vitreous base
- 5. The central retinal artery branches primarily into 4 anatomic quadrants and supports the metabolic demands of the inner neurosensory retina

C. Retinal pigment epithelium

- 1. Derived from the outer layer of the optic cup
- 2. Pigments within the RPE absorbs excess light
- 3. Phagocytosis and catabolism of photoreceptor outer segments

- 4. Participates in the photo-transduction visual cycle with rhodopsin regeneration and metabolism as well as nutrient transport across Bruch membrane
- 5. Maintains the dehydrated state of the sub-retinal "potential" space
- 6. Tight junctions form the outer blood-retinal barrier
- 7. Involved in retinal wound healing

D. Bruch membrane

1. Layers of collagen and elastin between the RPE and the choriocapillaris

E. Choroid

- 1. Posterior aspect of the uveal coat
- 2. Blood enters through the short posterior and long anterior ciliary arteries ands exits through the vortex veins
- 3. Comprised of arteries, melanocytes, stromal cells, veins and the choriocapillaris
- 4. The choriocapillaris provides vasculature for the metabolic demands of the RPE and outer neurosensory retina

F. Sclera

- 1. Irregularly arranged collagen in a proteoglycan matrix
- 2. Outer coat of globe from the limbus posteriorly to the optic nerve region

II. Describe clinical correlations

A. Vitreous

- 1. Traction at vitreoretinal interface can lead to retinal breaks
- 2. Opacities within vitreous can lead to visual obscuration (i.e., syneresis, hemorrhage)

B. Neurosensory retina

- 1. Initial visual processing and organization
- 2. The posterior chamber can be safely entered surgically, anterior to the ora serrata and posterior to the ciliary body (injections, sclerotomies)
- 3. A cilioretinal artery (origin of the artery is from the choroid) may spare the fovea in the setting of a central retinal artery occlusion

C. Retinal pigment epithelium

- 1. Genetic defects, drugs, Vitamin A deficiency and aging can negatively impact the cellular health and RPE viability
- 2. Hypertrophy, hyperplasia and metaplasia of the RPE may be seen in various pathologic states

D. Bruch membrane

- 1. Oxidative/lipid materials accumulate throughout life
- 2. Certain diseases and metabolic states may increase fragility or compromise permeability

E. Choroid

- 1. Affected by systemic cardiovascular risk factors
- 2. Melanocytes can transform into melanoma cells
- 3. Inflammation and swelling my lead to chorioretinal folds
- 4. Serous fluid or blood may accumulate in the suprachoroidal space

F. Sclera

- 1. Permeability allows for fluid outflow (e.g., uveo-scleral outflow) and drug delivery
- 2. Thinnest areas are most susceptible to rupture
 - a. Near the muscle insertions
 - b. At the equator

Additional Resources

- 1. AAO, Basic and Clinical Science Course. Section 4: Ophthalmic Pathology and Intraocular Tumors, 2013-2014.
- 2. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.

Fluorescein angiography

I. List the indications/contraindications

A. Indications

- 1. Retinal vascular disease
 - a. Diabetic retinopathy
 - b. Retinal vein occlusion
 - c. Retinal artery occlusion
 - d. Other (e.g. macroaneurysm, coats, sickle cell retinopathy...)
- 2. Cystoid macular edema
- 3. Inherited disorders of retina and choroid and macular dystrophies
- 4. Toxic retinopathies
- 5. Posterior uveitis and white dot syndromes of the retina
- 6. Age-related macular degeneration and central serous retinopathy
- 7. Choroidal and retinal tumors
- 8. Other

B. Contraindications

- 1. Pregnancy (relative contraindication)
- 2. Allergy to sodium fluorescein (relative contraindication)
 - a. History of anaphylaxis to sodium fluorescein (absolute contraindication)

II. Describe the pre-procedure evaluation

- A. Explain procedure and obtain informed consent
- B. Ask about any allergic reactions in the past
- C. Dilate pupils

III. List the alternatives to this procedure

- A. Color photography
- B. Optical coherence tomography
 - 1. Provides cross-sectional structural information but does not provide information on active vascular function such as leakage, obstruction

C. Indocyanine green angiography

- 1. Peak absorption and emission in near infrared allowing greater transmission through blood and abnormal pigment.
- 2. Larger molecule than sodium fluorescein and 98% protein bound leaks minimally from choroidal circulation allowing better visualization of choroidal vasculature
- 3. Requires digital videoangiography
- 4. Less side effects than fluorescein angiography but may include:
 - a. Nausea
 - b. Vomiting
 - c. Pruritus
- 5. ICG is an iodine-based dye and is contraindicated in patients with allergies to iodine or shellfish

IV. Describe the technique

- A. IV injection of 5 ml sodium fluorescein in a 10% concentration
- B. Sodium fluorescein absorbs blue light at wavelength 465 495 nanometers.
 - 1. Camera system includes filter to allow only blue light to reach eye
- C. Sodium fluorescein emits yellow-green light at wavelength 520 530 nanometers
 - 1. Camera system includes filters to allow only emitted yellow-green light to reach film or digital processor
- D. Timed sequence of photographs (digital or film camera)
- E. Stereoscopic pairs
 - 1. Recent advances include ultra-wide field fluorescein angiography
 - 2. Up to 200 degrees imaging
 - 3. Assessment of peripheral retinal abnormalities including peripheral vascular non-perfusion

V. List the complications of the procedure, their prevention and management

A. Common side effects: yellowing of skin, yellow-orange urine color

- B. Complications
 - 1. Extravasation and local tissue necrosis which can be very painful if significant volume of the dye infiltrates
 - 2. Nausea, vomiting
 - 3. Pruritus, urticaria
 - 4. Vasovagal reaction (extreme caution with FA in patients with congestive heart failure, bradycardia...)
 - 5. Allergic reaction

- a. Usually urticaria, pruritus
- b. Can often be managed with antihistamine
- c. Pretreatment with antihistamines possible when known mild to moderate allergic reaction is present
- 6. Anaphylaxis
 - a. Can be deadly
 - b. Injectable epinephrine (e.g. Epi-pen, crash cart) should be available to treat emergently
 - c. Ambu bag or similar for ventilation in emergency
- 7. Thrombophlebitis
- 8. Death (see anaphylaxis)

VI. Describe considerations in interpretation of procedure

A. Achieving a good quality fluorescein angiogram

- 1. Adequate dilation and clear media
- 2. Experienced photographer
- 3. Adequate image contrast
- 4. Sharp focus
- 5. Accurate field definition
- 6. Stereoscopic images

B. Accurate interpretation of the fluorescein angiography

- 1. Physiological perfusion of the choroid is patchy in the posterior pole and normally complete prior to complete retina vascular filling
- 2. Retinal vascular filling phases include arterial, arteriovenous (early venous laminar and late venous laminar filling), venous (complete arterial and venous filling) and reperfusion phases
- 3. Delayed retinal transit time from initial arterial filling to complete venous filling may be seen with retinal artery and vein occlusions as well as carotid and ophthalmic artery obstruction
- 4. Determination of pathology in retina, retinal pigment epithelium, and/or choroid
- 5. Interpretation of hyper or hypofluorescence by layer
 - a. Hyperfluorescence may be due to
 - i. enhanced transmission of dye ("window defect") through an RPE defect causing early hyperfluorescence with late attenuation
 - abnormal vascularization (neovascularization, telangiectasia, microaneurysms, etc.)
 causing progressive leakage and increase in the size and intensity of the
 hyperfluorescent dye

- iii. pooling which refers to leakage into a confined space (e.g. pigment epithelial detachment or PED)
- iv. staining, which refers to late absorption of the dye by collagenous or fibrous tissue, e.g. scar, without any evidence of late leakage
- b. Hypofluorescence may occur due to
 - i. blockage of dye transmission due to pigments (melanin, hemoglobin, lipofuscin, xanthophyll)
 - ii. decreased vascular perfusion (retinal vascular occlusion or choroidal abnormalities)

VII. Describe the follow-up care

- A. Band-aid over needle site
- B. Observe patient for any late adverse reaction to fluorescein

VIII. Describe appropriate patient instructions

A. Remind patient that urine will be orange for 24 - 48 hours

Additional Resources

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Fluorescein and Indocyanine Green Angiography: Technique and Interpretation, 2nd ed., 1997.
- 3. AAO, Focal Points: Advances in Posterior Segment Imaging Techniques, Module #7, 1999.
- 4. Kylstra JA, Brown JC, Jaffe GJ, et al. The importance of fluorescein angiography in planning laser treatment of diabetic macular edema. Ophthalmol 1999;106:2068-73.
- 5. Maninvannan A, Piskova J, Farrow A, et al. Ultra-Wide- Field Angiography of the Ocular Fundus. Am J Ophthalmol 2005;140:525-27.
- 6. AAO, Focal Points: Neovascular Age-Related Macular Degeneration, 2010.
- 7. AAO, Focal Points: Update on the Management of Diabetic Retinopathy, 2011.
- 8. AAO, Indocyanine Angiography. Preliminary Procedure Assessment. Ophthalmology 1998:105:1564-69.

Optical coherence tomography

I. List the indications/contraindications

A. Indications

- 1. Macular diseases Optical coherence tomography (OCT) is of value in the evaluation of
 - a. Vitreomacular interface disorders
 - i. Posterior vitreous detachment (PVD)
 - ii. Vitreomacular traction (VMT)
 - iii. Epiretinal membrane (ERM)
 - iv. Lamellar macular hole
 - v. Early macular hole
 - vi. Full thickness macular hole
 - b. Macular diseases
 - i. Cystoid macular edema (CME)
 - ii. Diabetic retinopathy and CME
 - iii. Retinal vascular disease and macular edema
 - iv. Subretinal fluid (SRF)
 - v. Central serous chorioretinopathy
 - vi. Age-related macular degeneration, nonexudative and exudative forms
 - vii. Other causes of choroidal neovascular membrane and SRF including
 - i) myopic degeneration
 - ii) Presumed ocular histoplasmosis (POHS)
 - iii) Choroidal rupture
 - viii. Macular toxicity disorders
 - i) hydroxychloroquine
 - ix. Retinal and macular dystrophies
 - x. Chorioretinal inflammatory diseases
 - xi. Retinal detachments, tractional and rhegmatogenous
 - xii. Trauma
 - xiii. Other
- 2. Optic nerve diseases OCT may be of value in

- a. Vitreopapillary traction
- b. Glaucomatous optic neuropathy
- c. Papillitis
- d. Ischemic optic neuropathy
- e. Optic disc edema
- f. Other

B. Contraindications

- 1. Poor media clarity (relative contraindication)
- 2. Poor patient cooperation (relative contraindication)

C. OCT clinical utilities

- 1. Clinical decision making
 - a. Diagnosis and assessment of therapy for retinal vascular diseases such as diabetic macular edema and choroidal diseases such as exudative AMD
 - i. Assess response to various anti-VEGF therapeutics (e.g. bevacizumab, ranibizumab, aflibercept)
 - ii. Assess response to intravitreal corticosteroids
- 2. Monitoring of course of disease
- 3. Patient education
- 4. Clinical research

II. Describe the pre-procedure evaluation

A. Explain procedure

B. Pupillary dilation provides optimal imaging

1. Scan can be adequately obtained through undilated pupils, but the resulting image at times may lack clarity or be truncated

C. Assess media clarity

1. Scan obtained through hazy media may be of poor quality

D. Assess patient cooperation

1. Poor patient cooperation may limit the scan quality due to poor fixation

III. List the alternatives to this procedure

- A. Macular contact lens examination at the slit-lamp biomicroscope
- B. Fluorescein angiography
- C. Indocyanine green angiography

- D. Confocal scanning laser ophthalmoscopy
- E. Scanning laser polarimetry

IV. Describe the technique

A. Underlying physical principles

- 1. Low-coherence interferometry measures optical reflectance
- 2. 820 nm infrared light
- 3. Non-contact technique (different from ultrasonography)
- 4. Requires optically clear media (different from ultrasonography)
- 5. "Time Domain" OCT
 - a. 10 µm axial and 20 µm transverse resolution
 - b. Slower image acquisition time
 - c. 400 A scans per second, 6 B scans per analysis
 - d. 2 dimensional images
- 6. "Spectral Domain" OCT
 - a. 5 µm axial resolution and 20 µm transverse resolution
 - b. more rapid image acquisition time
 - c. Up to 40,000 A scans per second, as many as 128 B scans per analysis
 - d. 3 dimensional reconstructions
 - e. Decreased motion artifact
 - f. Image registration
- B. Pupil dilation (optional)
- C. Comfortably position the patient in front of the machine; properly align the scanning module
- D. Optimize the scan image
- E. Select the scan acquisition protocol
- F. Select the scan analysis protocol
- G. Archive and/or print the scan results

V. Describe considerations in interpretation of this procedure

A. Acquisition of a good quality OCT scan

- 1. Adequate pupillary dilation
- 2. Clear ocular media
- 3. Steady patient fixation

- 4. Proper scanning module alignment
- 5. Appropriate scan image optimization

B. Accurate OCT scan interpretation - qualitative information

- 1. Review cross sectional anatomy
 - a. Identification of morphological changes in tissue layers atrophy, edema, thickening, distortion
 - b. Interpretation of changes in the relative reflectivity of tissue layers hyporeflectivity, hyperreflectivity
- 2. Accurate OCT scan interpretation quantitative information
- 3. Retinal thickness/volume measurement
- 4. Retinal thickness map
- 5. Retinal nerve fiber layer thickness/volume measurement
- 6. Retinal nerve fiber layer thickness map
- 7. 3D and en face reconstructions and review of layers
- 8. Serial, comparative review and analysis

Additional Resources

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. Carl Zeiss Ophthalmic Systems, Inc. Optical Coherence Tomographer Model 3000, User manual. Germany, 2002.
- 3. Joel S. Schuman, Carmen A. Puliafito, James G. Fujimoto. Optical Coherence Tomography of Ocular Disease, Second Edition. Slack Incorporated, 2004.
- 4. Massin P, Girach A, Erginay A, et al. Optical coherence tomography: a key to the future management of patients with diabetic macular oedema. *Acta Ophthalmol Scand* 2006;84:466-74.
- 5. AAO, Focal Points: Optical Coherence Tomography in the Management of Retinal Disorders, Module #11, 2006.
- 6. AAO, Preferred Practice Patterns. Diabetic Retinopathy: Diagnostic Procedures, Oct 2011
- 7. AAO, Preferred Practice Patterns. Age-related Macular Degeneration: Diagnostic Procedures, Oct 2011.
- 8. AAO, Preferred Practice Patterns. Idiopathic Macular Hole, Sept 2008.

Echography (ultrasound)

I. List the indications for use in vitreoretinal conditions

A. B scan (2 dimensional acoustic image)

- 1. If complete or partial media opacities are present, B scan can be used to identify and characterize
 - a. Posterior vitreous detachment
 - b. Vitreous hemorrhage or inflammation
 - c. Vitreomacular Traction
 - d. Retinal detachment and/or retinal tear
 - e. Choroidal detachment
 - i. Serous
 - ii. Hemorrhagic
 - f. Intraocular foreign bodies
 - i. Detection
 - ii. Localization
 - iii. Density
 - g. Intraocular tumors
 - h. Posterior segment trauma
- 2. If ocular media are clear, B scan is useful in assessing characteristic echogenic features (including vascularity) and in measuring height and diameter of
 - a. Ciliary body lesions
 - i. High resolution ultrasound
 - ii. Ultrasound biomicroscopy (UBM)
 - b. Choroidal tumors and masses such as choroidal melanoma, metastasis, hemangioma, granuloma, nevus, osteoma, and hemorrhage
 - c. Scleral lesions
 - i. Calcium deposition
 - ii. Tumor invasion (choroidal melanoma)
 - iii. Tumor extension (choroidal melanoma)
 - iv. Posterior scleritis sclerochoroidal thickening with sub Tenon fluid and T-sign

B. A scan (one-dimensional acoustic image)

1. Tumor diagnosis: echodensity of a melanoma

- 2. Measures density/reflectivity
- 3. Analysis of internal reflectivity for choroidal masses
 - a. Common highly reflective lesions include vascular tumors such as choroidal hemangioma
 - b. Medium lesions may be metastatic
 - c. Medium to low reflective lesions are typically choroidal melanoma

II. List the contraindications

A. Ruptured globe

- 1. Use extreme caution in patients with an open globe
- 2. May demonstrate a foreign body
- 3. Avoid pressure on the globe

III. Describe the pre-procedure evaluation

A. Explain safety of ultrasound

- 1. No radiation exposure
- B. Relatively low-cost
- C. Non-invasive test

IV. List the alternative tests to this procedure

- A. Computed tomography (radiation exposure)
- B. Magnetic resonance imaging scan (MRI)
 - 1. Avoid with intraocular foreign body
- C. Ocular coherence tomography (OCT)
 - 1. Requires clear ocular media

V. Describe the instrumentation and technique

- A. Topical anesthetic
- B. Contact examination if possible (probe applied directly to the globe through methylcellulose gel).
- C. Examination may occur through closed lids.
- D. Standard probe positions
 - 1. Transverse
 - 2. Longitudinal

- 3. Horizontal macula/posterior pole
- 4. Vertical macula/posterior pole

VI. Describe the complications of the procedure, their prevention and management

- A. Corneal abrasion
- B. Intraocular content extrusion in an open globe

VII. Describe the considerations in interpretation of this procedure

- A. If the B scans are of good quality, the following characteristics can be analyzed
 - 1. Topographic features of the lesion
 - a. Location
 - b. Shape
 - 2. Quantitative changes
 - a. Internal vascularity and reflectivity
 - 3. Kinetic features
 - a. Vitreous movement is more fluid compared to relative stability or stiffness of the neurosensory retina
 - i. In a vitreous separation, the vitreous gel appears
 - i) Thinner
 - ii) More mobile
 - iii) Moves in a flowing manner
 - ii. Retina
 - i) Thicker
 - ii) Stiffer
 - iii) Linear
 - iii. These special characteristics of the vitreous gel can help determine if the patient has a vitreous versus retinal detachment.
 - iv. Choroidal detachment is thicker, nonmobile, convex and more peripheral without insertion into the nerve unlike RD

B. If the B scans are of poor quality, consider the following causes of artifact:

- 1. Insufficient methylcellulose gel on the eye (poor contact)
- 2. Gas or air bubble within the eye
- 3. Silicone oil which attenuates the sound waves and causes artifactual elongation of the globe

4. May need to image directly on the globe (rather than through the lids)

Additional Resources

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. Green RL and Byrne SF. Diagnostic Ophthalmic Ultrasound in Retina 4th edition, St. Louis: Mosby, 2001, 224-306.

Age-related macular degeneration

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of the disease

1. Theories include oxidative stress, genetics, ischemia and inflammation

B. List the pertinent elements of the history

- 1. Non-neovascular ("dry") AMD
 - a. May be asymptomatic
 - b. Mild to moderate metamorphopsia
 - c. Difficulty with adjustment from bright to dim light
 - d. Poor contrast sensitivity
 - e. Reduced visual acuity
 - f. Color vision abnormalities
- 2. Neovascular (exudative or "wet") AMD
 - a. Metamorphopsia
 - b. Central scotoma
 - c. Blurred vision
 - d. Reduced visual acuity
 - e. Color abnormalities

C. Describe pertinent clinical features

- 1. Non-neovascular ("dry") AMD
 - a. Drusen
 - b. Retinal pigment epithelium (RPE) pigmentary changes
 - c. Geographic atrophy
- 2. Neovascular ("wet") AMD
 - a. Subretinal fluid
 - b. Intraretinal fluid/edema
 - c. Sub-retinal pigment epithelial fluid
 - d. Subretinal and intraretinal blood
 - e. Hard exudate
 - f. Elevation of the retinal pigment epithelium (RPE)
 - g. Choroidal neovascularization

D. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Slit lamp biomicroscopy demonstration of drusen and associated retinal and pigment epithelial changes
- 2. Fluorescein angiography
- 3. Indocyanine green angiography (useful in atypical neovascular AMD such as polypoidal choroidopathy)
- 4. Optical coherence tomography (useful in assessing the subretinal fluid and intraretinal edema in patients with neovascular AMD, helpful in determining re-treatment paradigm)
- 5. Fundus autofluorescence imaging
 - a. Used to track RPE health
 - b. Progression of geographic atrophy

II. Define the risk factors

- A. Age is typically >50 years with increasing risk for each decade thereafter
- B. Family history
- C. More common in people of northern European extraction
- D. Light colored irises
- E. Smoking
- F. Diet antioxidants protective; lack of these is a risk
- G. Genotype
 - 1. Complement Factor H variants
 - 2. ARMS2-HTRA1 variant
 - 3. LIPC: a gene associated with HDL cholesterol pathway

III. List the differential diagnosis

A. Non-neovascular AMD

- 1. Hereditary disease
 - a. Pattern dystrophy
 - i. Adult onset foveomacular vitelliform dystrophy
 - ii. Butterfly
 - iii. Reticular
 - iv. Fundus pulverulentus
 - b. Stargardt disease
 - c. Best disease

- d. Central areolar choroidal dystrophy
- e. Mallatia leventinese
 - i. Radiating pattern of drusen
 - ii. Dominantly inherited
- f. Sorsby fundus dystrophy
- 2. Myopic degeneration
- 3. Central serous choroidopathy
- 4. Angioid streaks
- 5. Macular telangiectasis
- 6. Inflammatory Disease
 - a. Multifocal choroiditis
 - b. Punctate inner choroiditis
 - c. Acute posterior multifocal placoid pigment epitheliopathy
- 7. Toxicities
 - a. Chloroquine /hydroxychloroquine
 - b. Phenothiazines

B. Neovascular AMD

- 1. Myopic degeneration
- 2. Ocular histoplasmosis syndrome
- 3. Angioid streaks
- 4. Multifocal choroiditis
- 5. Idiopathic choroidal neovascularization (CNV)
- 6. Idiopathic central serous chorioretinopathy
- 7. Juxtafoveal retinal telangiectasis or macular telangiectasis
- 8. Hereditary disease
 - a. Mallatia leventinese
 - i. Often associated with CNV
 - b. Sorsby fundus dystrophy
 - i. Develop bilateral subfoveal CNVM around age 40

IV. Describe patient management in terms of treatment and follow-up

A. Medical therapy options for non-neovascular AMD

29

- 1. Age-Related Eye Disease Study (AREDS) formulation (Vitamins A, C, E and Zinc (plus Copper to reduce zinc induced anemia)
 - a. Category 3
 - i. >1 large druse (>125 μ m) in either eye
 - ii. Numerous intermediate drusen
 - iii. Non-central geographic atrophy
 - b. Category 4
 - i. Exudative AMD in fellow eye
 - ii. Central atrophy in the fellow eye
- 2. Smoking cessation
- 3. AREDS2 currently investigating whether or not long chain omega-3 fatty acids and macular xanthophylls (lutein and zeaxanthin) have any additional protective effect, in addition to lowering the dose of beta-carotene and/or zinc

B. Medical therapy options for neovascular AMD

- 1. Anti-vascular endothelial growth factor (VEGF) therapy by intravitreal injection
 - a. Intravitreal injection technique may include
 - i. Informed consent
 - i) Local risks (endophthalmitis, etc. see below)
 - ii) Theoretical systemic risk of anti-VEGF treatment
 - ii. Topical or subconjunctival anesthetic
 - iii. Povidone iodine to ocular surface, eyelid and lashes
 - iv. Lid speculum, and avoid needle contamination with eyelid margin or lashes
 - v. Injection 3.5 4.0 mm posterior to limbus
 - vi. Assess ocular perfusion by IOP check or vision assessment (if HM or better IOP should be OK)
 - vii. Option to view optic nerve perfusion
 - viii. Pre and/or post treatment topical antibiotics regimen optional
 - i) Endophthalmitis risk estimated to be 1/1000 to 1/2000
 - ii) Topical antibiotics have not been shown to protect against endophthalmitis and may encourage antibiotic resistance
 - b. Anti-VEGF agents
 - i. Ranibizumab (Lucentis®)
 - i) Vision often improves and then remains stable for up to 2 years (MARINA, ANCHOR studies)

- (i) 90% of patients the same or better compared to baseline visual acuity with treatment
- (ii) 34% (MARINA) to 40% (ANCHOR) of eyes had visual acuity gain of 15 or more letters (ETDRS chart)
- (iii) Mean visual acuity improvement 6.6 (MARINA) to 11.3 letters (ANCHOR) on ETDRS chart
- ii. Bevacizumab (Avastin®),- not FDA approved for AMD treatment
 - CATT trial demonstrates equivalency between ranibizumab and bevacizumab.
 Slight advantage to monthly versus PRN treatments with ranibizumab at 1 and 2 years
- iii. Aflibercept (Eylea®)
 - i) FDA approved for treatment of exudative AMD
 - ii) VIEW1 and VIEW 2 demonstrate equivalency to ranibizumab. May require fewer injections.
- iv. Pegaptanib sodium (Macugen®)
 - i) Currently, rarely used due to limited efficacy
- 2. Intravitreal triamcinolone has also been given for neovascular AMD (off-label use)
 - a. Triamcinolone in conjunction with PDT may prolong the PDT treatment effect, according to some studies

C. Laser surgery therapy options for neovascular AMD

- 1. Thermal laser photocoagulation surgery for extrafoveal and juxtafoveal CNV if classic CNV or well-defined CNV
 - a. List the indications/contraindications
 - i. Indications
 - i) Choroidal neovascularization (CNV) Macular Photocoagulation Study Guidelines
 - (i) Extrafoveal greater than or equal to 200 microns from the foveal center (well-demarcated, now rarely used)
 - Juxtafoveal 1-199 microns from the foveal center (careful patient selection, known high recurrence, outdated therapy in wake of anti-VEGF treatment)
 - (iii) Subfoveal (outdated therapy in wake of anti-VEGF treatment)
 - ii. Contraindications
 - i) Poorly defined CNV on FA
 - ii) Subfoveal
 - iii) Serous pigment epithelial detachment (serous PED)

- b. Describe the instrumentation, anesthesia and technique (should be treated within 7-10 days of fluorescein angiogram)
 - i. Instrumentation
 - i) Contact lens for visualization of posterior pole (Goldman, Yannuzzi, or indirect optic lens such as Mainster or Volk lenses)
 - ii) Laser (argon green, krypton, diode)
 - iii) Projection of magnified image of FA outlining the CNV location
 - ii. Anesthesia
 - i) Topical
 - ii) Retrobulbar
 - iii. Technique
 - i) Obtain informed consent
 - ii) Outline lesion with light laser spots, 100 microns beyond its margins
 - iii) Apply confluent spots (100-200 micron size, 0.5 to 1.0 second) directly to lesion with enough laser power to achieve uniform whitening
- c. List the complications of the procedure, their prevention and management
 - i. Bruch membrane rupture with associated subretinal hemorrhage
 - ii. RPE rip (thermally induced tissue contraction)
 - iii. Incidental or inadvertent foveal treatment
 - iv. Persistent or recurrent CNV
 - v. Complications associated with retrobulbar anesthesia
- d. Describe the follow-up care
 - i. Return exam with FA 2 to 4 weeks after treatment (looking for persistence)
 - ii. Second return exam with FA at 6 weeks (high rate of recurrence, juxtafoveal greater than extrafoveal)
 - iii. Retreat as indicated for persistence or recurrence
- 2. Photodynamic therapy for predominantly classic and small subfoveal minimally classic CNV
 - a. List the (common) indications
 - i. Exudative (neovascular) age-related macular degeneration
 - i) Subfoveal, predominantly classic choroidal neovascularization (CNV)
 - ii) Small, active, subfoveal, minimally classic or occult CNV
 - iii) Selected, juxtafoveal CNV (unproven)
 - ii. Myopic subfoveal CNV
 - iii. CNV secondary to Ocular Histoplasmosis Syndrome

- iv. Other causes of subfoveal CNV
- v. Choroidal Hemangioma
- vi. Central serous chorioretinopathy
- b. Pre-procedure imaging
 - i. Fluorescein angiography required within 28 days of PDT treatment
 - i) Identify exact type, location, and extent (lesion size) of disease process
 - ii) Laser spot size calculation
 - (i) Greatest linear diameter of CNV lesion and margin of 500 microns
- c. Describe the instrumentation, anesthesia and technique
 - i. Anesthesia
 - i) Topical (e.g., proparacaine)
 - ii. Technique
 - i) Infused drug dose based on patient body surface area
 - ii) Laser delivery using predetermined spot size, energy, and duration
 - iii. Treatment course
 - i) Treatment approximately every 3 months if disease process is still active (e.g. CNV leaking on FA)
 - ii) For neovascular AMD, total average verteporfin treatment number to stop CNV leakage was 5.5 times over two years in phase III testing
 - iii) Combination treatment with intravitreal corticosteroids or anti-VEGF drugs may enhance efficacy or decrease need for retreatment (case series only)
- d. List the complications of the procedure/therapy, their prevention and management
 - i. Visual acuity loss or central scotoma worsening
 - i) Transient-common (ranging hours to 2 weeks in duration)
 - ii) Permanent-rare (2-4%): No further treatment if severe, acute vision loss persists more than 2 weeks after a given treatment
 - ii. Retinal pigment epithelial atrophy after repeated treatments
 - iii. Extravasation
 - i) Close monitoring of venipuncture site during infusion
 - ii) Stop infusion immediately upon any signs of extravasation
 - iv. Back or chest pain (during infusion of drug)
 - v. Photosensitivity
 - i) Cover skin and shield eyes during day when outdoors (pre-treatment counseling important to prevent this complication)

- ii) Duration depends on photosensitizing drug (e.g., 5 days for verteporfin)
- iii) Standard burn wound care if occurs. Compliance with skin protection guidelines needs to be stressed
- e. Describe appropriate patient instructions
 - i. Expect some degree of decreased vision immediately after treatment
 - ii. Possible mild to moderate ocular ache or foreign body sensation the day of treatment (typically from contact lens)
 - iii. Vision should steadily improve back towards pre-treatment baseline within 2 weeks in most cases
 - iv. Patient should call immediately with
 - i) Significant visual worsening
 - ii) Persistent visual loss (beyond 2 weeks)
 - iii) Skin changes such as rash or burning
 - v. Protect skin and eyes from direct sun exposure (or halogen lights) after each treatment for 2-5 days

D. Surgical therapy options

- 1. Submacular surgery
 - a. Hemorrhage evacuation and CNV extraction
- 2. Macular translocation
- 3. Pneumatic hemorrhage displacement

E. Describe the natural history and prognosis

- 1. Non-neovascular AMD
 - a. Progressive visual dysfunction, including decreasing contrast sensitivity (need for more light to see/read), and decreasing vision
 - b. Progression to central geographic atrophy or neovascular AMD is associated with number of drusen and severity of pigmentary abnormality
 - c. Patients can develop paracentral geographic atrophy and eventually central geographic atrophy with severe vision loss
 - i. This process can take years (prognosis 'fair')
- 2. Neovascular AMD
 - a. Patients with untreated classic CNV have steady central visual loss over weeks to months
 - b. TAP (Visudyne) study documented natural history of untreated subfoveal CNV lesions with classic component
 - i. 62% eyes had 3 lines visual acuity loss at 2 years
 - ii. 30% eyes had 6 lines visual acuity loss at 2 years

- c. Patients with untreated occult CNV or a mixture of classic and occult CNV have a less predictable pattern of visual loss and may have slower course of vision loss
 - i. Up to 50% of subfoveal lesions without classic CNV will develop classic CNV within 1 year. This is associated with more rapid visual acuity loss

V. List the complications of treatment, their prevention and management

A. Thermal laser photocoagulation surgery

- 1. Macular hemorrhage
- 2. Absolute scotoma
- 3. Foveal burn
- 4. Visual acuity loss

B. Photodynamic therapy

- 1. Macular hemorrhage
- 2. RPE tear
- 3. Unexplained vision loss
- 4. RPE atrophy

C. Intravitreal injections and surgical therapy

- 1. Endophthalmitis
- 2. Retinal tear
- 3. Retinal detachment
- 4. Vitreous hemorrhage
- 5. Cataract
- 6. Corneal abrasion
- 7. Elevated intraocular pressure immediately following injection

VI. Describe disease-related complications

A. Progression to neovascular AMD from non-neovascular AMD

- 1. Development of CNV
- 2. Development of disciform scar
- B. Progression to geographic atrophy
- C. Progressive central vision loss
- D. Charles-Bonnet syndrome visual hallucinations with area of central scotoma
- E. Depression secondary to vision loss

VII. Describe appropriate patient instructions

- A. Use of Amsler grid
- B. Counsel availability of FDA-approved home preferential hyperacuity perimetry
- C. Nature of visual loss (central, not total blindness)
- D. Risk of fellow eye involvement in eyes with advanced AMD (central GA or CNV)
 - 1. AREDS demonstrated a 43% risk of development of advanced AMD by 5 years in the fellow eye
- E. Prompt reevaluation if vision change
- F. Value of zinc and anti-oxidant supplementation (AREDS supplement)
- G. Chronicity of treatment (anti-VEGF therapy and/or long term follow-up of disease)
- H. Use of low vision aids and rehabilitation
- I. Behavior modification (e.g. smoking cessation)
- J. Consider AMD support group
- K. Counsel familial implications
- L. Counsel availability of commercially available genetic testing (value of these currently unclear)

Additional Resources

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- 2. AAO, Ophthalmology Monographs 11. Laser Photocoagulation of the Retina and Choroid, 1997.
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Ocular histoplasmosis syndrome

I. Approach to establishing the diagnosis

A. Describe the etiology of the disease

- 1. Ocular histoplasmosis syndrome (OHS) is believed to be due to exposure (infection) to *Histoplasma Capsulatum* via the respiratory tract
- 2. Patients are thought to have had a respiratory flu-like illness as children/ juvenile or young adults
- 3. The organism may then spread through the bloodstream from the lungs to the choroid

B. Define the relevant aspects of epidemiology of the disease

- 1. Exposure to carrier animals (chickens/birds)
- This condition occurs most frequently in patients who live near the Ohio River and Mississippi River valley areas and watershed areas but identical clinical findings may be found in individuals from non-endemic areas
- 3. 90% of individuals with typical OHS fundus appearance have a positive Histoplasma antigen skin test

C. List the pertinent elements of the history

- 1. Asymptomatic if no choroidal neovascularization (CNV) or central macular lesions
- 2. Central scotoma, visual loss and metamorphopsia if subfoveal CNV develops

D. Describe pertinent clinical features

- 1. Atrophic "punched-out" choroioretinal scars in mid to far retinal periphery
- 2. Peripapillary atrophic pigmentary changes
- 3. CNV (arising from macular scars or peripapillary scars)
- 4. Absence of vitreous cells

II. Define the risk factors

A. Exposure to Histoplasma as a child, juvenile or young adult

III. List the differential diagnosis

- A. Multifocal choroiditis and panuveitis syndrome
- B. Punctate inner choroidopathy
- C. Coccidiomycosis
- D. Multifocal toxoplasmosis
- E. Diffuse unilateral subacute neuroretinitis

- F. Vitiliginous choroiditis
- G. Age-related macular degeneration (AMD)
- H. Myopic degeneration with CNV
- I. Idiopathic CNV

IV. Describe patient management in terms of treatment and follow-up

- A. If no CNV is present
 - 1. Observation

B. If CNV develops

- 1. Anti-vascular endothelial growth factor (VEGF) therapy by intravitreal injection
 - a. Bevacizumab (Avastin) off label use
 - b. Ranibizumab (Lucentis) is approved by the FDA for CNV only in AMD. Use for treating any other CNV is on an off-label basis.
 - c. Pegaptanib sodium (Macugen), rarely used due to poor efficacy
- 2. Thermal laser photocoagulation surgery for extrafoveal and juxtafoveal CNV if classic CNV or well-defined CNV
 - a. Macular Photocoagulation Study (MPS) demonstrated reduced risk of severe visual loss
- 3. Photodynamic therapy for subfoveal or juxtafoveal CNV
- 4. Intravitreal or sub Tenon triamcinolone has also been given for CNV due to OHS (off-label use)
 - a. Triamcinolone by intravitreal injection in conjunction with PDT has been reported
- 5. Surgical excision of CNV
 - a. Efficacy was not demonstrated in Subretinal Surgery Trial

V. List the complications of treatment

- A. Extension of laser burn or scar into fovea if treatment is initially extrafoveal or juxtafoveal thermal laser photocoagulation surgery
- B. Complications of PDT including light sensitivity, visual loss, back pain, dye reaction
- C. Complications of intravitreal injection including infection, vitreous hemorrhage, retinal tear, cataract, retinal detachment
- D. Complications of pars plana vitrectomy including retinal detachment, hemorrhage
- E. Recurrence of CNV despite treatment

VI. Describe disease-related complications

A. Loss of central vision due to subfoveal CNV

VII. Describe appropriate patient instructions

- A. Amsler grid for both eyes
- B. Prognosis depends on location of atrophic scars

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Laser Photocoagulation of the Retina and Choroid, 1997, p.150, 152-153,162,171-173,190-191.
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Angioid streaks

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Represent discontinuities or breaks in a calcified and thickened Bruch membrane
- 2. Develop in the second or third decade
- 3. Dual mechanism may be causative
 - a. Primary abnormality of the fibers in Bruch membrane
 - b. Increased presence of metal salts or tendency for their pathologic deposition, resulting in brittleness of the membranes

B. Define the relevant aspects of epidemiology of the disease

- 1. Incidence and prevalence are unknown
- 2. Most cases are idiopathic
- 3. Systemic disease associations
 - a. Pseudoxanthoma elasticum
 - b. Ehlers-Danlos Syndrome
 - c. Paget disease of bone
 - d. Sickle cell disease
 - e. Idiopathic
 - f. Hemochromatosis
 - g. Beta Thalassemia

C. List the pertinent elements of the history

- 1. Affected patient is likely asymptomatic
- 2. If choroidal neovascularization (CNV) complicates angioid streaks, then patient may notice
 - a. Metamorphopsia
 - b. Blurred central vision

D. Describe pertinent clinical features

- 1. Dark reddish/brownish irregular bands or lines
 - a. Surround and then radiate from the optic nerve
 - i. May have no apparent optic nerve connection
 - b. Deeper than retinal vessels
 - c. Crack-line appearance

- 2. Associated retinal findings
 - a. Peau d'orange appearance (pseudoxanthoma elasticum)
 - b. Typical sickle cell findings

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Optical Coherence Tomography
 - a. Retinal edema or subretinal fluid overlying angioid streak can suggest choroidal neovascularization
- 2. Fluorescein angiography
 - a. Angioid streaks are hyperfluorescent on early frames of fluorescein angiography due to overlying atrophic retinal pigment epithelium (RPE)
 - b. Fluorescence persists late

II. Define the risk factors

A. Mode of inheritance depends on any underlying associated condition

- 1. Autosomal recessive
 - a. Pseudoxanthoma elasticum
 - b. Sickle cell disease
- 2. Autosomal dominant
 - a. Paget disease of the bone
 - b. Ehlers-Danlos Syndrome

III. List the differential diagnosis

- A. Normal retinal vessels
- B. Pseudo angioid streaks in high myopia
- C. Age-related macular degeneration (AMD)
- D. Traumatic choroidal rupture
 - 1. Usually circumpapillary

IV. Describe patient management in terms of treatment and follow-up

- A. Describe the natural history, outcome, and prognosis
 - 1. Visual acuity usually normal as long as no complications develop
 - 2. Visual fields normal
 - 3. Electroretinography (ERG) and electro-oculography (EOG) normal

V. Describe disease-related complications

A. Most significant visual complication

- 1. CNV from breaks in Bruch membrane
- 2. Treatment
 - a. Intravitreal anti-vascular endothelial growth factor treatment (anti-VEGF) (off-label)
 - b. Argon laser surgery (extrafoveal lesions)
 - c. Photodynamic therapy (off-label)
 - d. Combination therapy

B. Systemic complications associated with underlying conditions

- 1. Pseudoxanthoma elasticum
 - a. GI hemorrhage
 - b. Seizures
 - c. Cardiovascular complications
- 2. Sickle cell disease
 - a. Infections (Pneumococcal)
 - b. Stroke
 - c. Acute Chest Syndrome
- 3. Paget disease of bone
 - a. Osteoarthritis
 - b. Heart Failure
 - c. Sarcoma
- 4. Ehlers-Danlos syndrome
 - a. Skin fragility/scarring
 - b. Arthritis/joint instability
 - c. Organ rupture
- 5. Hemochromatosis
 - a. Iron overload with secondary organ damage
 - i. Diabetes
 - ii. Cardiac disease
 - iii. Cirrhosis of the liver
- 6. Beta-Thalassemia

VI. Describe appropriate patient instructions

- A. Use safety eyeglasses because minor blunt injury can cause choroidal rupture and subretinal hemorrhage
- B. Regularly check vision with an Amsler grid monocularly
- C. Report any changes in vision immediately to the ophthalmologist

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Ophthalmology Monographs 18. A Compendium of Inherited Disorders and the Eye, 2006.
- 3. AAO, Ophthalmology Monographs 2. Electrophysiologic Testing in Disorders of the Retina, Optic Nerve, and Visual Pathway, 2nd ed., 2001.
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Pathologic myopia (myopic degeneration)

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. "High" myopia has been defined as myopia > 6 diopters, axial length >26 mm and may be associated with progressive degenerative changes of the posterior pole
- 2. Cause of myopic degeneration is unknown
 - a. Genetic predisposition is likely
 - i. More common in Asia

B. Define the relevant aspects of epidemiology of the disease

- 1. Idiopathic
- 2. More common in patients of Asian descent
- 3. Myopia can be seen in systemic conditions including
 - a. Down syndrome
 - b. Marfan syndrome
 - c. Ehlers-Danlos syndrome
 - d. Stickler syndrome

C. List the pertinent elements of the history

- 1. Use of glasses, contact lens, history of refractive corrective surgery
- 2. Central visual impairment
 - a. Metamorphopsia
 - b. Blurred vision

D. Describe pertinent clinical features

- 1. Clinical features include one or more of the following:
 - a. Posterior pole features
 - i. Long axial length (measured on A or B scan)
 - ii. Peripapillary atrophy or crescent
 - iii. Tilting of optic disc
 - iv. Staphyloma of the posterior pole
 - v. Straightening of the retinal vessels
 - vi. "Tigroid" appearance to the fundus (prominent choroidal vasculature due to attenuated retinal pigment epithelium (RPE) pigmentation)

- b. Macular features
 - i. Lacquer cracks (rupture of Bruch membrane)
 - ii. Choroidal neovascularization (CNV)
 - iii. Fuchs' spots (pigment clump most likely due to spontaneous involution of CNV or hemorrhage)
 - iv. Foveal atrophy
 - v. Hemorrhage
- c. Macular hole (with or without retinal detachment)
- d. Myopic tractional maculopathy (myopic foveoschisis)

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Fluorescein angiography
- 2. B scan to determine axial length (A- or B-scan)
 - a. Supplemental/confirmatory but not necessary for diagnosis
- 3. Optical coherence tomography to evaluate macular structural abnormalities and for presence of fluid exudation
 - a. Intraretinal and/or subretinal fluid

II. Define the risk factors

- A. Myopia greater than 6 diopters
- B. Possible association between myopia and education level and reading

III. List the differential diagnosis

- A. Age-related macular degeneration
- B. Angioid streaks
- C. Ocular histoplasmosis
- D. Coloboma

IV. Describe the patient management in terms of treatment and follow-up

- A. If CNV develops
 - 1. Describe laser surgery therapy options for neovascular AMD
 - a. Photodynamic therapy for small subfoveal and juxtafoveal CNV
 - i. VIP Pathologic Myopia Study
 - b. Thermal laser photocoagulation surgery for extrafoveal CNV if classic CNV or well-defined

CNV

- 2. Anti-vascular endothelial growth factor (VEGF) therapy
 - a. Bevacizumab (Avastin)
 - i. Off label use
 - b. Ranibizumab (Lucentis)
 - i. FDA approved for CNV due to AMD. Use for treating other CNV is an off-label use.
 - c. Aflibercept (Eylea)
 - i. FDA approved for CNV due to AMD. Use for treating other CNV is an off-label use.
 - d. Pegaptanib sodium (Macugen)
 - i. FDA approved for CNV only in AMD. Use for treating any other CNV is on an off-label basis.
- 3. Observation for small extrafoveal CNV may be considered as stabilization without significant visual loss may occur
- B. If macular hole or posterior retinal detachment
 - 1. Pars plana vitrectomy

V. List the complications of treatment, their prevention and management

A. Complications of thermal laser surgery

- 1. Scar enlargement
- 2. Central scotoma
- 3. Recurrence of CNV

B. Complications of PDT

- 1. Visual loss
- 2. Light sensitivity
- 3. Dye extravasation

C. Complications of surgery or intravitreal injections

- 1. RD
- 2. Retinal Tear
- 3. Cataract
- 4. Infection
- 5. Vitreous hemorrhage

VI. Describe disease-related complications

- A. CNV
- B. Fuchs spot
- C. Foveal atrophy or fibrosis
- D. Macular hole
- E. Posterior retinal detachment with or without macular hole
- F. Macula schisis
- G. Retinal tear and rhegmatogenous retinal detachment

VII. Describe appropriate patient instructions

- A. Amsler grid
- B. Safety glasses

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Laser Photocoagulation of the Retina and Choroid, 1997, p.150,152-153,163-163,173-175,199-200.
- 3. AAO, Focal Points: Laser Management of Choroidal Neovascularization, Module #5, 1993, p.6-7.
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- 5. Verteporfin in Photodynamic Therapy Study Group. Photodynamic therapy of subfoveal choroidal neovascularization in pathologic myopia with verteporfin. 1-year results of a randomized clinical trial -VIP report no. 1. *Ophthalmology*. 2001;108:841-52.
- 6. Yoon JU, Byun YJ, Koh HJ. Intravitreal anti-VEGF versus photodynamic therapy with verteporfin for treatment of myopic choroidal neovascularization. Retina. 2010 Mar;30:418-24.

Central serous chorioretinopathy

I. Describe the approach to establishing the diagnosis

A. Mechanism

1. Localized neurosensory retinal detachment in the macula due to one or more areas of serous detachment and leak of the retinal pigment epithelium (RPE)

B. Define the relevant aspects of epidemiology of the disease

- 1. Typically idiopathic and unilaterally symptomatic, although fluorescein angiographic evidence of bilaterality is common
- 2. Related to elevated corticosteroid levels in the body
 - a. Exogenous routes of administration
 - i. Intravenous
 - ii. Oral
 - iii. Intra-articular
 - iv. Intra-muscular
 - v. Epidural
 - vi. Topical
 - vii. Periocular
 - viii. Inhaled
 - b. Endogenous
- 3. Central serous chorioretinopathy (CSC) has also been described with:
 - a. Pregnancy
 - b. Systemic lupus erythematosus
 - c. Organ transplantation
 - d. Hemodialysis
 - e. Cushing syndrome
 - f. Multiple myeloma
- 4. May be associated with significant stress
- 5. Most prevalent in patients between 20 40 years of age
- 6. More common in men than women
- C. List the pertinent elements of the history
 - 1. Central visual impairment

- a. Metamorphopsia
- b. Blurred vision
- c. Central relative scotoma
- d. Micropsia
- e. Decreased color vision

D. Describe pertinent clinical features

- 1. Localized serous retinal detachment
- 2. Serous RPE detachment (may or may not be visible)
- 3. Yellow spot in the center of the fovea
- 4. Small yellow subretinal precipitates
- 5. Hyperopic shift
- 6. Abnormal Amsler grid testing
- 7. Atypical presentations
 - a. Bullous serous retinal detachments
 - b. Multiple serous RPE detachments
 - c. Cloudy subretinal fluid
 - d. Choroidal neovascularization
- 8. Chronic CSC
 - a. "Pseudoretinitis pigmentosa" due to pigment migration created by chronic subretinal fluid and an atrophic retina
- E. Describe appropriate testing and evaluation for establishing the diagnosis
 - 1. Fluorescein angiogram
 - a. Focal leakage at the RPE
 - b. Pooling of fluorescein into the serous retinal detachment
 - c. Transmission defects are common in both eyes
 - d. Expanding dot common
 - e. "Smoke stack" leakage pattern less common
 - f. "Descending tract" of gravitating RPE disruption inferior to central lesions highly specific sign of CSC on angiography
 - 2. Optical coherence tomography
 - a. Acute phase shows subretinal fluid
 - b. Serous retinal pigment epithelial detachment (PED)
 - c. Small defect in the RPE

- 3. Indocyanine green angiography suggestive of focal choroidal vascular compromise
 - a. Multifocal choroidal hyperpermeability
 - b. Hypofluorescent areas
- 4. Fundus autofluorescence imaging
 - a. Hyper- and hypo-autofluorescent may non-invasively reflect dysfunctional / atrophic RPE

II. Define the risk factors

- A. Male gender
- B. Corticosteroid use, including systemic therapy, local injections, nasal steroid sprays, topical therapy and inhalers
- C. Status post transplant surgery (often patients are on immunosuppressive drugs)
- D. Pregnancy
- E. Stress
- F. "Type A personality"
- G. Systemic lupus erythematosus (e.g. choroiditis)

III. List the differential diagnosis

- A. Choroidal neovascularization (CNV)
- B. Cystoid macular edema
- C. Vogt-Koyanagi-Harada syndrome
- D. Age-related macular degeneration (AMD)
 - 1. Particularly retinal PED
 - 2. Polypoidal choroidal vasculopathy

IV. Describe patient management in terms of treatment and follow-up

- A. Observation
- B. Focal laser to area of leakage can be considered if symptoms persist more than 4 6 months
 - 1. Accelerates fluid resolution
 - 2. Final visual acuity with or without laser is similar
 - 3. Recurrence rates similar
 - 4. Psycho/social/economic factors may dictate a need for rapid resolution
- C. Photodynamic therapy with verteporfin (full or reduced fluence)
 - 1. Off-label use. Limited case series show resolution of SRF in acute and chronic CSR with improvement of visual acuity

D. Oral Rifampin systemic oral therapy has been reported to successfully treat chronic CSR

1. Limited case series

V. List the complications of treatment, their prevention and management

- A. Scotoma from laser spot, esp. if central or paracentral
- B. Secondary choroidal neovascularization (CNV)
- C. Photosensitivity, dye extravasation, back pain from verteporfin treatment

VI. Describe disease-related complications

- A. Loss of central vision due to chronic detachment of the macula and retinal pigment epithelial degeneration
- B. Secondary choroidal neovascularization
- C. Micropsia
- D. Metamorphopsia

VII. Describe appropriate patient instructions

- A. Amsler grid
- B. Instruct patient that this condition typically improve in 3 6 months or sooner
- C. Recurrences occur in
 - 1. 30 50% of patients
 - 2. Most recurrences occur within 1 year of the first episode
 - 3. Fellow eye involvement is common
- D. Instruct to avoid corticosteroid use and reduce stress

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Epiretinal membrane

I. Describe the approach to establishing the diagnosis

A. Definition of disease

- 1. Contraction/ proliferation of cellular tissue on the surface of the retina that may or may not cause visual symptoms
 - a. Glial cells of retinal origin
 - b. Fibrocytes
 - c. Retinal pigment epithelial cells
- 2. Other names for this condition include
 - a. Macular pucker
 - b. Cellophane maculopathy
 - c. Surface wrinkling retinopathy

B. Define the relevant aspects of epidemiology of the disease

- 1. Etiology
 - a. Epiretinal membrane (ERM) typically occurs in a patient with a posterior vitreous detachment (PVD) but can be associated with other ocular conditions including
 - i. Trauma
 - ii. Retinal tear
 - iii. Retinal venous occlusion
 - iv. Diabetic retinopathy
 - v. Uveitis
 - vi. Hereditary retinopathy
 - vii. Retinal detachment
 - viii. Vitreoretinal surgery
- 2. May occur at any age, more common in patients over 50 years

C. List the pertinent elements of the history

- 1. Central visual impairment
- 2. Blurred vision
- 3. Metamorphopsia

D. Describe pertinent clinical features

1. Surface of the inner retina has shiny, glistening appearance

- 2. Retinal striae and/ or folds
- 3. Cystoid macular edema/retinal thickening
- 4. Retinal whitening, cotton wool spots or hemorrhage (rare)
- 5. Membrane opacification
- 6. Macular vascular tortuosity/ straightening
- E. Describe appropriate testing and evaluation for establishing the diagnosis
 - 1. Slit lamp biomicroscopy with contact lens
 - 2. Binocular indirect ophthalmoscopy with 360 degree scleral depression (search for retinal tears)
 - 3. Optical coherence tomography
 - 4. Fluorescein angiogram

II. Define the risk factors

- A. Posterior vitreous detachment
- B. History of retinal abnormalities (uveitis, retinal detachment, diabetic retinopathy, retinal tear)
- C. Trauma

III. List the differential diagnosis

- A. Congenital vascular tortuosity
- B. Macular hole
- C. Vitreomacular traction syndrome
- D. Proliferative vitreoretinopathy
- E. Retinal vein occlusion
- F. Cystoid macular edema (CME)
- G. Combined hamartoma of the retina and retinal pigment epithelium

IV. Describe patient management in terms of treatment and follow-up

- A. Observation if patient is asymptomatic or symptoms are mild
- B. Pars plana vitrectomy with epiretinal membrane (with or without ILM) peeling for patients with significant visual symptoms
- V. List the complications of treatment, prevention and management
 - A. Complications of surgery, e.g., cataract, retinal tear, retinal detachment
 - B. Recurrence of ERM despite successful surgery

VI. Describe the disease-related complications

- A. Persistent metamorphopsia
- B. Loss of central vision due to chronic CME
- C. Retinal pigment epithelial degeneration
- D. Diplopia from secondarily ectopic fovea

VII. Describe appropriate patient instructions

- A. Amsler grid
- B. Periodic evaluation

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- 3. AAO, Focal Points: Epiretinal Membrane, May 2009.
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- 6. AAO, Focal Points: Optical Coherence Tomography in the Management of Retinal Disorders, Module #11, 2006.

Vitreomacular traction syndrome

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

1. Persistent vitreous macular and/or peripapillary traction in an eye with a partial posterior vitreous detachment

B. Define the relevant aspects of epidemiology of the disease

- 1. Typically idiopathic
- 2. Can be associated with other ocular conditions that cause shrinkage of the vitreous including
 - a. Inflammatory diseases
 - b. Vascular occlusions
 - c. Metabolic diseases
- 1. Most prevalent in older patients (>60 years)

C. List the pertinent elements of the history

- 1. Central visual impairment
 - a. Metamorphopsia
 - b. Blurred vision

D. Describe pertinent clinical features

- 1. Macula
 - a. Localized traction on the retina with or without retinal striae
 - b. Cystoid macular edema (CME)
 - c. Epiretinal membrane often associated
 - d. Localized traction detachment
 - e. Avulsion of a retinal vessel
- 2. Peripapillary
 - a. Blurred disc margins due to retinal elevation
 - b. Grey color to peripapillary retina

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Optical coherence tomography (OCT)
- 2. B scan ultrasound
- 3. Fluorescein angiogram may show leakage of perifoveal vessels

II. Define the risk factors

- A. Age
- B. Female gender

III. List the differential diagnosis

- A. Cystoid macular edema (CME)
- B. Epiretinal membrane

IV. Describe patient management in terms of treatment and follow-up

- A. Observation
- B. Ocriplasmin (Jetrea) intravitreal injection (FDA approved for vitreomacular adhesions (VMA))
 - 1. One fourth of the treated eyes had resolution of VMA
- C. Pars plana vitrectomy (PPV) can be considered if visual acuity decreases, macula is edematous or detached

V. List the complications of treatment, their prevention and management

- A. Standard complications of pars plana vitrectomy (PPV) (retinal tear, detachment, endophthalmitis)
- B. Macular hole formation
- C. Intravitreal injection of ocriplasmin (Jetrea)
 - 1. Vitreous hemorrhage
 - 2. Retinal tear
 - 3. Endophthalmitis
 - 4. Cataract

VI. Describe disease-related complications

- A. Loss of central vision due to foveal atrophy
- B. Traction retinal detachment
- C. Macular hole
- D. Vitreous hemorrhage

VII. Describe appropriate patient instructions

A. Amsler grid

B. Instruct patient that spontaneous separation of adherent vitreous may occur

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- 2. AAO, Focal Points: Macular Surface Disorders, Module #4, 1996.
- 3. Gass JD. *Stereoscopic Atlas of Macular Diseases: Diagnosis and Treatment*. 4th ed. St Louis: Mosby; 1997.
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Macular hole

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Localized perifoveal vitreous detachment
- 2. Persistent foveal attachment
- 3. Traction on the fovea

B. Define the relevant aspects of epidemiology of the disease

- 1. Typically idiopathic
- 2. May be associated with other ocular conditions including:
 - a. Myopia
 - b. Blunt trauma to globe (i.e. soccer ball)
- 3. Idiopathic holes
 - a. Occur at an approximate rate of 8 per 100,000 per year
 - b. Most prevalent in patients 50 80 years old
 - c. More common in women
- 4. In idiopathic cases, bilateral macular holes develop in 10% of patients

C. List the pertinent elements of the history

- 1. Central visual impairment
 - a. Metamorphopsia
 - b. Blurred vision
 - c. Central scotoma

D. Describe the pertinent clinical features

- 1. Clinical features of macular hole
 - a. Stage 1
 - i. Deep foveal yellow spot or ring
 - ii. Due to outer retinal detachment
 - b. Stage 2
 - i. Full thickness hole
 - ii. Less than 400 microns in diameter
 - c. Stage 3
 - i. Full thickness hole

- ii. Greater than 400 microns in diameter
- iii. With or without a cuff of subretinal fluid
- d. Stage 4
 - i. Same findings as stage 3
 - ii. Plus a complete posterior vitreous detachment (PVD)
 - iii. With or without overlying condensed vitreous
- 2. Possible clinical features associated with traumatic macular hole:
 - a. Choroidal rupture
 - b. Retinal pigment epithelial (RPE) alteration in the macula
 - c. Epiretinal membrane
- 3. Possible clinical features associated with myopic macular hole
 - a. Typically smaller holes
 - b. Degenerative macular changes including
 - i. Lacquer cracks
 - ii. Fuchs spot
 - c. Posterior pole detachment (particularly if posterior staphyloma)
- 4. Retinal detachment from idiopathic macular hole (rare)
- E. Describe appropriate testing and evaluation for establishing the diagnosis
 - 1. Binocular slit lamp ophthalmoscopy or contact lens examination
 - 2. Watzke-Allen test
 - 3. Optical coherence tomography
 - 4. Fluorescein angiogram

II. Define the risk factors

A. Idiopathic holes

- 1. Age
- 2. Female gender
- 3. History of macular hole in fellow eye

B. Traumatic holes

- 1. Direct globe trauma
- C. Myopic holes
 - 1. Myopia

III. List the differential diagnosis

- A. Cystoid macular edema
- B. Lamellar hole
- C. "Pseudo" macular hole with epiretinal membrane
- D. Solar retinopathy

IV. Describe the patient management in terms of treatment and follow-up

A. Traumatic macular holes

- 1. Observation for a period of months even with full thickness hole as spontaneous closure can occur especially in pediatric population (unknown what percentage will spontaneously close)
- 2. Consider pars plana vitrectomy if hole remains (see surgical management below)

B. Idiopathic and myopic holes

- 1. Stage 1
 - a. Observation
- 2. Stages 2,3
 - a. Ocriplasmin (Jetrea)
 - i. Off label
 - ii. Intravitreal injection
 - iii. May release vitreomacular adhesion (FDA approved)
 - iv. May close a macular hole
 - i) Smaller holes (≤ 400 microns) did better
 - v. May obviate the need for vitreous surgery
- 3. Stages 2,3,4
 - a. Pars plana vitrectomy with gas tamponade
 - i. Best results if hole is less than 1 year old
 - ii. Surgical success rate (closure of macular hole) greater than 90%
 - iii. Vision improvement may be dramatic (e.g. 20/20)
 - iv. Most modern series 20/40 or better in 40-60% of patients
 - v. Tamponade can be achieved with silicone oil
 - i) Lower closure rates
 - ii) Less vision recovery has been reported
 - vi. Internal limiting membrane peeling at the time of pars plana vitrectomy is common

and generally thought to increase closure rates and reduce reopening rates

vii. Use of adjuvants (TGF beta, platelet concentrate, autologous serum) is of historical interest only

V. List the complications of treatment, their prevention and management

A. Ocriplasmin (Jetrea)

- 1. Retinal tear / detachment related to injection or PVD induction
- 2. Endophthalmitis
- 3. Cataract
- 4. Elevated eye pressure
- 5. Subconjunctival hemorrhage
- 6. Uveitis

B. Vitrectomy

- 1. Cataract (typically nuclear sclerosis)
- 2. Complications of surgery including visual field defect, retinal tear, retinal detachment, ocular hypertension, cataract (PSC)
- 3. Macular damage, especially macular pigmentary disruption

C. General

1. Late hole re-opening

VI. Describe disease-related complications

- A. Loss of central vision due to foveal atrophy
- B. Posterior retinal detachment (rare)

VII. Describe appropriate patient instructions

- A. Amsler grid
- B. Risk of fellow eye involvement

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Hypertensive retinopathy

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Acute and/or chronic elevation of systemic blood pressure (BP)
- 2. Cause of 90% of cases of hypertension is unknown
- 3. Multiple other etiologies, often rare, such as unilateral renal artery stenosis

B. Define the relevant aspects of epidemiology of the disease

- 1. Prevalence of hypertension (defined at systolic $BP \ge 130$ or diastolic $BP \ge 85$, or treatment with anti-hypertensive medication) estimated at 65 million adults in U.S.
- 2. Hypertension is a factor in 69% of all cardiovascular disease

C. List the pertinent elements of the history

- 1. History of hypertension may be known or not established
- 2. Usually without ocular symptoms
- 3. May have visual loss as a result of secondary complications

D. Describe pertinent clinical features

- 1. Multiple systems proposed to grade severity
- 2. In general, 5 stages of retinopathy are recognized (Modified Scheie classification)
 - a. Grade 0
 - i. No changes
 - b. Grade 1
 - i. Barely detectable arteriolar narrowing
 - c. Grade 2
 - i. More evident generalized narrowing with some focal constriction and arteriovenous (A/V) crossing changes
 - d. Grade 3
 - i. Changes of Grades 1 and 2 with addition of hemorrhages, exudates, and cotton-wool spots
 - e. Grade 4
 - i. Grade 3 changes plus optic disc edema
- 3. Changes may also affect the choroid
 - a. Elschnig spots
 - i. Result of lobular nonperfusion of choriocapillaris

- ii. Tan, lobule sized patches
- iii. Become hyperpigmented with hypopigmented margin in healed stage
- b. Siegrist streaks
 - i. Linear configuration of hyperpigmentation
 - ii. Follows meridional course of choroidal arteries
- c. Focal RPE detachments may occur
- d. May develop secondary serous retinal detachment
- 4. Acute malignant hypertensive retinopathy/choroidopathy
 - a. Associated with severe hypertension, usually of rapid onset, typically can be seen in renal failure and eclampsia
 - b. Clinical featues include cotton wool spots, intraretinal hemorrhages, serous retinal detachment, and capillary obliteration.
 - c. Focal intraretinal periarteriolar transudates can appear at the precapillary level (smaller, deeper and less white than cotton-wool spots)
 - d. On fluorescein angiogram, multifocal retinal pigment epithelial leakage can be seen with wedge shaped peripheral choroidal defects
 - e. Treatment is emergent with aggressive blood pressure management
- 5. Late findings may include
 - a. Retinal telangiectasis
 - b. Severe retinal vessel sclerotic changes
 - c. Optic atrophy

II. Define the risk factors

- A. African-Americans at greater risk
- B. Age
- C. Obesity
- D. Smoking

III. List the differential diagnosis

- A. Diabetic retinopathy
- B. Atherosclerotic retinopathy
- C. Central retinal vein occlusion
- D. Radiation retinopathy
- E. Neuroretinitis

F. Toxemia of pregnancy

IV. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcome and prognosis

- 1. Predisposes to ocular vascular complications noted below
- 2. Retinal arteriolar narrowing is associated with a twofold increase in cardiovascular events in the subsequent five years

B. Describe medical therapy options

- 1. Refer to primary care provider to manage BP and search for causes of secondary hypertension
- 2. If BP not elevated, primary care provider should begin workup to rule out diabetes and other systemic diseases which can create similar ocular findings

V. Describe disease-related complications

A. Associated with

- 1. Branch vein occlusion
- 2. Central vein occlusion
- 3. Arteriolar macroaneurysms
- 4. Non-arteritic anterior ischemic optic neuropathy
- B. May worsen course of diabetic retinopathy
- C. May develop retinal ischemia
- D. May develop late optic nerve atrophy

VI. Describe appropriate patient instructions

- A. Maintain good BP control
- B. Seek regular ophthalmologist follow-up visit to monitor more severe findings

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Diabetic retinopathy

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Exact mechanisms unknown
- 2. Our knowledge of diabetes comes largely from
 - a. Animals with experimental diabetes
 - b. Vascular cell culture experiments
- 3. Potential causes of diabetic retinopathy
 - a. Elevated blood sugar levels (hyperglycemia or poor control)
 - b. Oxidative stress
 - c. Inflammation
 - d. Relative hypoxia/ischemia
 - e. Hemodynamic factors
 - f. Genetic component

B. Define relevant aspects of the epidemiology of the disease

- 1. Prevalence of diabetes mellitus and retinopathy
 - a. Type 1 diabetes (5-10% of patients with diabetes)
 - i. Rarely will type 1 diabetics have retinopathy at diagnosis
 - ii. 90% of type 1 diabetics develop retinopathy after 10-15 years
 - iii. 25% of type 1 diabetics develop proliferative disease
 - b. Type 2 diabetes (90-95% of patients with diabetes)
 - i. 30% of type 2 diabetics have retinopathy at diagnosis
 - ii. 50% of type 2 diabetics not requiring insulin have retinopathy after 15 years
 - iii. 80% of type 2 diabetics requiring insulin have retinopathy after 15 years
 - iv. Accelerating incidence in the US

C. List the pertinent elements of the history

- 1. Duration of diabetes mellitus
- 2. Type of diabetes mellitus
- 3. Glycemic control (including blood glucose and HgbA1c levels)
- 4. Visual symptoms (including blurred central vision, metamorphopsia, and floaters)
- 5. History of systemic conditions

- a. Systemic hypertension
- b. Cardiovascular disease
- c. Renal disease
- d. Neuropathy
- e. Lipid disorder
- f. Pregnancy
- g. Anemia (can exacerbate diabetic retinopathy)

D. Describe pertinent clinical features

- 1. Disease progression
- 2. Normal retinal appearance
- 3. Mild non-proliferative diabetic retinopathy (NPDR): microaneurysms only
- 4. Moderate NPDR: more than just microaneurysms but less than severe NPDR
- 5. Severe NPDR: no signs of proliferative retinopathy and any of the following
 - a. More than 20 intraretinal hemorrhages in each of 4 quadrants
 - b. Definite venous beading in 2+ quadrants
 - c. Prominent intraretinal microvascular abnormalities (IRMA) in 1+ quadrants
- 6. Proliferative diabetic retinopathy (PDR)
 - a. Any of the following
 - i. Neovascularization of the retina, optic disc, or iris
 - ii. Vitreous/preretinal hemorrhage

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Fluorescein angiography
- 2. Fundus photography
- 3. Optical coherence tomography (OCT)

II. Define the risk factors

A. For progression of diabetic retinopathy

- 1. Elevated hemoglobin HbA1c levels
- 2. Increased duration of diabetes mellitus
- 3. Systemic hypertension
- 4. Hyperlipidemia
- 5. Severe diabetic retinopathy in the contralateral eye

III. List the differential diagnosis

- A. Radiation retinopathy
- B. Parafoveal telangiectasis
- C. Retinal vein occlusion
- D. Eales disease
- E. Ocular ischemic syndrome
- F. Sickle cell retinopathy
- G. Retinal artery occlusion
- H. Retinal macroaneurysm

IV. Describe patient management in terms of treatment and follow-up

A. Systemic management options for diabetes mellitus

- 1. Weight management
- 2. Control of blood glucose (diet, oral hypoglycemic agents and/or insulin)
- 3. Control of systemic blood pressure
- 4. Treatment of dyslipidemia
- 5. Treatment of renal disease

B. Treatment options for diabetic macular edema

- 1. Foveal center involvement
 - a. Anti-VEGF agents
 - i. Subsequent laser may be deferred
 - ii. Re-injections may be necessary
 - iii. Laser may be safely deferred
 - b. Laser photocoagulation surgery for clinically significant macular edema (CSME) as defined by the Early Treatment of Diabetic Retinopathy Study (ETDRS)
 - i. Retinal thickening within 500 microns from the center of the fovea
 - ii. Lipid hard exudates with associated retinal thickening within 500 microns from the center of the fovea
 - iii. Retinal thickening greater than one disc area in size within one disc diameter in distance from the center of the fovea
 - iv. Relative contraindication: capillary non-perfusion of more than half the perifoveal ring
- 2. Procedure for macular laser treatment
 - a. Informed consent

- b. Argon or diode laser attached to slit-lamp biomicroscope
- c. Recent fluorescein angiogram
- d. Macular contact lens
- e. Consider retrobulbar anesthesia
- f. Treat microaneurysms and/or areas of retinal thickening (avoid fovea)
 - i. Modified ETDRS focal treatments
- g. Adjust laser power to achieve light-grey laser burns
- h. Typical initial laser settings
 - i. 50-100 micron spot size
 - ii. 70-200 milliwatts power (start with low power and adjust upward as necessary)
 - iii. 0.1 seconds duration
- 3. Other intravitreal pharmaceutical injections
 - a. Triamcinolone acetate (off-label), with or without focal macular laser photocoagulation
- 4. Vitrectomy surgery
 - a. Vitreomacular traction causing macular edema (select cases)

C. Treatment of proliferative diabetic retinopathy

- 1. Indications for panretinal photocoagulation (defined by Diabetic Retinopathy Study, DRS) for High-risk proliferative disease:
 - a. Eyes having any 3 of the 4 following high risk factors:
 - i. Retinal neovascularization
 - ii. Neovascularization at the optic disc (NVD)
 - iii. Severe neovascularization
 - i) More than 1/4 disk area of NVD (ref. DRS photo 10A)
 - ii) More than ¹/₂ disc area in size with vitreous hemorrhage (VH)
 - iv. Vitreous or pre-retinal hemorrhage
 - b. Neovascularization of iris (NVI) or anterior chamber angle (rubeosis)
 - c. Traction retinal detachment with any associated high risk features
- 2. Technique of initial panretinal photocoagulation (PRP)
 - a. Informed consent
 - b. Slit-lamp biomicroscopic laser or indirect ophthalmoscopic laser
 - c. Typical initial laser settings
 - i. 200-500 micron spot size
 - ii. 0.1-0.2 second exposure

- iii. 200-250 mW power
- d. Titrate power to achieve light-grey burns
- e. Non-confluent treatment outside of the macular region from the vascular arcades to the periphery
- f. Typically >1200 total burns given
- g. Can be divided into several sessions
- 3. Indications for vitrectomy surgery
 - a. Nonclearing vitreous hemorrhage
 - b. Tractional detachment threatening or involving the macula
 - c. Vitreomacular traction causing macular edema
- 4. Other indications for intravitreal anti-VEGF therapy (off-label)
 - a. Delay in laser surgery is anticipated
 - b. Reduce risk of bleeding during vitrectomy surgery

V. List the complications of treatment, their prevention and management

A. Focal macular laser photocoagulation

- 1. Inadvertent laser to fovea
- 2. Increase in retinal edema
- 3. Choroidal non-perfusion
- 4. Choroidal neovascularization
- 5. Corneal erosion/ abrasion

B. Panretinal photocoagulation surgery

- 1. Inadvertent macular or foveal treatment
- 2. Worsening of diabetic macular edema (when possible, focal laser should be done prior to PRP)
- 3. Extension of tractional retinal detachment
- 4. Secondary angle closure from choroidal swelling
- 5. Choroidal neovascularization
- 6. Serous retinal detachment
- 7. Dilated pupil, loss of accommodation
- 8. Altered dark adaptation and peripheral visual field (expected)
- 9. Transient myopia (expected)
- 10. Complications of retrobulbar anesthesia

C. Intravitreal pharmaceutical injection
- 1. Infectious endophthalmitis
- 2. Chemical (sterile) endophthalmitis
- 3. Vitreous hemorrhage
- 4. Retinal tear/detachment

D. Vitrectomy surgery

- 1. Rhegmatogenous retinal detachment /proliferative vitreoretinopathy
- 2. Progressive cataract in phakic eyes
- 3. Optic atrophy
- 4. Anterior hyaloidal fibrovascular proliferation
- 5. Infectious endophthalmitis
- 6. Phthisis

VI. Describe disease-related complications

A. Visual loss due to

- 1. Chronic macular edema which may result in central retinal atrophy with visual loss over time
- 2. Diabetic macular ischemia
- 3. Vitreous hemorrhage
- 4. Tractional retinal detachment
- 5. Neovascular glaucoma
- 6. Subretinal fibrosis/CNV associated with retinal hard exudates
 - a. This is a rare condition that has been shown to be associated with increased serum lipid levels and retinal hard exudates in the retina

VII. Describe appropriate patient instructions

- A. Maintain good glycemic control
- B. Maintain good blood pressure control
- C. Maintain good lipid control
- D. Have regular dilated eye exams (Usually at least annually)
- E. Symptoms of macular edema and vitreous hemorrhage (blurred vision and floaters) should trigger prompt consultation with ophthalmologist
- F. The merits of laser photocoagulation and vitrectomy should be reviewed by the ophthalmologist to encourage the timely treatment of diabetic retinopathy before visual impairment occurs

Additional Resources

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Preferred Practice Pattern Committee, Retina Panel: Diabetic Retinopathy Preferred Practice Pattern, 2008.
- 3. AAO, Laser Photocoagulation of the Retina and Choroid, 1997, p.63-95.
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Branch retinal vein occlusion

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Exact mechanisms unknown
- 2. The retinal vein and artery share a common adventitial sheath
- 3. Arteriosclerosis of the artery may result in pressure on the vein and cause thrombus
- 4. Occur at the crossing of an artery with a vein, generally when the artery is on top of the vein

B. Define the relevant aspects of epidemiology of the disease

- 1. More common in patients 50 years or older
- 2. Increased association with
 - a. Diabetes mellitus
 - b. Hypertension
 - c. Hyperlipidemia

C. List the pertinent elements of the history

- 1. History of systemic diseases such as
 - a. Diabetes mellitus
 - b. Hypertension
 - c. Peripheral vascular disease
 - d. Coronary artery disease
- 2. History of ocular disease
 - a. Primary open-angle glaucoma
 - b. Visual acuity impairment
 - c. Blurred central vision

D. Describe pertinent clinical features

- 1. Stereoscopic dilated fundus exam
 - a. Venous tortuosity and intraretinal hemorrhages in the affected sector
 - b. Macular edema
 - c. Cotton-wool spots
 - d. Retinal neovascularization
 - e. Capillary dropout
 - f. Collateral vessels around the occlusion site or extending to an adjacent unaffected retinal

watershed

- g. Capillary non-perfusion
- h. Neovascularization
- i. Other features of chronic hypertensive retinopathy (i.e. arteriovenous crossing changes)
- 2. Ischemic BRVO
 - a. More severe form of the disease with more extensive ischemia and more pronounced findings as above

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Fundus photographs
- 2. Fluorescein angiography, to assess perfusion and macular edema
- 3. Optical coherence tomography (OCT), for macular edema

II. Define the risk factors

A. Systemic diseases

- 1. Hypertension
- 2. Diabetes mellitus
- 3. Systemic inflammatory disorders (e.g., systemic lupus erythematosus)
- 4. Hyperlipidemia
- 5. Peripheral vascular disease
- 6. Coronary artery disease

B. Ocular disease

- 1. Primary open-angle glaucoma
- 2. Local inflammation (toxoplasmosis, etc.)

III. List the differential diagnosis

- A. Diabetic retinopathy
- B. Hypertensive retinopathy
- C. Radiation retinopathy
- D. Hemi-central retinal vein occlusion
- E. Macular telangiectasia
- F. Epiretinal membrane

IV. Describe patient management in terms of treatment and follow-up

A. Describe medical therapy options

- 1. Treatment of associated systemic conditions, if present
 - a. Systemic hypertension
 - b. Dyslipidemia
 - c. Diabetes mellitus
- 2. Management of glaucoma, if present
- 3. Management of Macular Edema Secondary to BRVO
 - a. Intravitreal anti-vascular endothelial growth factor (VEGF) agents
 - i. FDA Approved: Ranibizumab 0.5mg (Lucentis)
 - ii. Off label, not FDA approved: Bevacizumab (Avastin)
 - b. Intravitreal corticosteroids
 - i. FDA Approved: Dexamethasone 0.7mg (Ozurdex)
 - ii. Off label, not FDA approved: Triamcinolone (Kenalog)

B. Describe retinal therapy options

- 1. Focal macular laser photocoagulation surgery
 - a. Indications
 - i. Persistent angiographic macular edema for more than 3 months, and
 - ii. Visual acuity 20/40 or worse
 - b. Technique
 - i. Informed consent
 - ii. Recent fluorescein angiogram to guide therapy
 - iii. Light grid pattern using 50-100 micron spot size
 - iv. Laser power titrated to a light gray color
 - v. Leaking microvascular abnormalities are treated directly and collateral vessels are avoided
- 2. Sector panretinal photocoagulation surgery
 - a. Indications
 - i. Neovascularization of the retina, optic disc, or iris
 - ii. Vitreous hemorrhage
 - b. Technique
 - i. Informed consent
 - ii. 200-500 micron spot size
 - iii. Laser power of moderate intensity

- iv. Application to areas of nonperfusion adjacent to the neovascularization, avoiding the fovea
- v. Space treatments 1 burn width apart
- 3. Vitrectomy surgery
 - a. Indications
 - i. Non-clearing vitreous hemorrhage
 - ii. Tractional retinal detachment threatening the macula
 - iii. Recalcitrant macular edema

V. List the complications of treatment, their prevention and management

A. Intravitreal injections

- 1. Infectious endophthalmitis
- 2. Retinal tear or rhegmatogenous retinal detachment
- 3. Vitreous hemorrhage
- 4. Cataract

B. Laser therapy

- 1. Inadvertent treatment of the fovea with laser
- 2. Reduced central contrast sensitivity in region of scatter laser
- 3. Choroidal neovascularization from laser burn site

C. Vitrectomy surgery

- 1. Infectious endophthalmitis
- 2. Rhegmatogenous retinal detachment

D. Intravitreal corticosteroids

- 1. Infectious or sterile endophthalmitis
- 2. Cataract
- 3. Elevated intraocular pressure
- 4. Rhegmatogenous retinal detachment

VI. Describe disease-related complications

- A. Macular edema
- B. Retinal neovascularization
- C. Vitreous hemorrhage
- D. Traction retinal detachment

VII. Describe appropriate patient instructions and follow up

A. For ocular conditions

- 1. Ischemic BRVO: monthly for 3 to 4 months for neovascularization
- 2. Macular edema
 - a. Anti-VEGF: every 4-6 weeks
 - b. Ozurdex: every 4-6 months
 - c. Laser: every 3 to 4 months
 - d. Combination therapy of the above may be considered
- 3. Vision rehabilitation: as needed

B. Associated systemic conditions

1. As per patient's primary care physician

Additional Resources

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Ophthalmology Monographs 11. Laser Photocoagulation of the Retina and Choroid, 1997.
- 3. AAO, Ophthalmology Monographs 2. Electrophysiologic Testing in Disorders of the Retina, Optic Nerve and Visual Pathway, 2nd ed., 2001.
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Central retinal vein occlusion (CRVO)

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Exact mechanisms unknown, may be multifactorial
- 2. Likely the result of a thrombus formation at the optic nerve
- 3. Rarely may have systemic diseases associated with hypercoagulability, which carry a higher likelihood of bilateral CRVO

B. Define the relevant aspects of epidemiology of the disease

- 1. More common in patients 50 years or older
- 2. Approximately 10% are bilateral
- 3. Increased association with
 - a. Diabetes mellitus
 - b. Systemic hypertension
 - c. Hyperlipidemia
 - d. Primary open-angle glaucoma (POAG)

C. List the pertinent elements of the history

- 1. Systemic conditions
 - a. Diabetes mellitus
 - b. Hypertension
- 2. Ocular symptoms
 - a. Blurred central vision
 - b. Floaters
 - c. Ocular pain (associated with advanced CRVO, neovascular glaucoma or phthisis)

D. Describe pertinent clinical features

- 1. Funduscopic findings
 - a. Macular edema
 - b. Retinal hemorrhages
 - c. Venous tortuosity
 - d. Cotton-wool spots
 - e. Capillary dropout (as seen on fluorescein angiography)
 - f. Retinal neovascularization

- g. Optic disc collateral vessels (weeks to months following the onset)
- h. Glaucomatous disc changes in ipsilateral or contralateral eye
- 2. Afferent pupil defect may occasionally be present
- 3. Neovascularization of the iris and/or angle (best seen on undilated exam) can lead to neovascular glaucoma
- 4. Elevation of intraocular pressure (IOP) in one or both eyes
- 5. Glaucomatous optic disc changes

E. Describe appropriate laboratory testing for establishing the diagnosis

- 1. Fluorescein angiography
 - a. To evaluate degree of ischemia
 - b. To evaluate macular edema
- 2. Fundus photography
- 3. Optical coherence tomography
 - a. To evaluate for macular edema

F. Describe the classification of CRVO

- 1. Ischemic form
 - a. More severe form of the disease
 - b. Worse visual acuity on presentation
 - c. Presence of relative afferent pupillary defect
 - d. Greater extent of retinal hemorrhages
 - e. Presence of cotton-wool spots
 - f. Greater extent of retinal non-perfusion on fluorescein angiography
 - g. More severe electroretinographic changes
 - h. Higher risk for disease-related complications
- 2. Non-ischemic form
 - a. Milder form of the disease
 - b. May present with good visual acuity (>20/200)
 - c. Fewer retinal hemorrhages and cotton-wool spots
 - d. No relative afferent pupillary defect
 - e. Perfused retina on fluorescein angiography
 - f. May resolve fully with good visual outcome or may progress to the ischemic type

II. Define the risk factors

- A. Systemic hypertension
- B. Diabetes mellitus
- C. Primary open-angle glaucoma
- D. Underlying coagulopathy

III. List the differential diagnosis

- A. Diabetic retinopathy
- B. Hypertensive retinopathy
- C. Radiation retinopathy
- D. Anemia or blood dyscrasias (e.g. leukemia)
- E. Ocular ischemic syndrome
- F. Hyperviscosity syndrome
- G. Acute hemorrhagic retinopathy

IV. Describe patient management in terms of treatment and follow-up

A. Systemic management

- 1. Treat systemic associated conditions, if present
- 2. Consider discontinuing oral contraceptives
- 3. Consult with primary care provider to manage hypertensive medications
- 4. Recommend cessation of smoking
- 5. Consider aspirin or other platelet inhibition
- 6. Consider work-up for hypercoagulable state in younger patients

B. Ocular management

- 1. Panretinal photocoagulation laser indications
 - a. Neovascularization of the retina, optic disc, or iris
 - b. Vitreous hemorrhage
 - c. Neovascular glaucoma
- 2. Management of glaucoma, if present
- 3. Laser photocoagulation for macular edema is not effective per CVOS study
- 4. Management of macular edema secondary to CRVO
 - a. Intravitreal anti-vascular endothelial growth factor (VEGF) agents
 - i. FDA Approved: Ranibizumab 0.5mg (Lucentis)
 - ii. FDA Approved: Aflibercept 2mg (Eylea)

- iii. Off label, not FDA approved: Bevacizumab (Avastin)
- b. Intravitreal corticosteroids
 - i. FDA Approved: Dexamethasone 0.7mg (Ozurdex)
 - ii. Off label, not FDA approved: Triamcinolone (Kenalog)
- c. Combination therapy of the above may be considered

V. List the complications of treatment, their prevention and management

- A. Inadvertent treatment of the fovea
- B. Choroidal neovascularization
- C. Loss of visual field
- D. Risks of anti-VEGF injections
 - 1. Endophthalmitis
 - 2. Retinal detachment, retinal tear
 - 3. Vitreous hemorrhage
 - 4. Cataract

E. Risk of corticosteroids

- 1. Immune suppression
- 2. Cataract formation
- 3. Glaucoma
- 4. Endopthalmitis

VI. Describe disease-related complications

- A. Neovascular glaucoma
- B. Macular edema
- C. Retinal neovascularization
- D. Vitreous hemorrhage

VII. Describe appropriate patient instructions

- A. Ischemic CRVO: monthly follow-up for 3 months per clinician judgement
- B. Non-ischemic CRVO: every 2 to 4 months for macular edema or conversion to the ischemic type
- C. Associated medical conditions: as per patient's primary care physician
- D. Vision rehabilitation: as needed

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Electrophysiologic Testing in Disorders of the Retina, Optic Nerve and Visual Pathway, 2nd ed., 2001, p85-89.
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Branch retinal artery occlusion

I. Describe the approach to establishing the diagnosis

A. Describe the etiology/multifactorial nature of this disease

- 1. Embolization (most common cause)
 - a. Carotid or cardiac source most common
 - i. Cholesterol emboli (Hollenhorst plaque)
 - i) Refractile, yellow
 - ii. Platelet-fibrin emboli
 - i) Gray
 - ii) Associated with large vessel atherosclerosis
 - iii. Calcific emboli
 - i) White and result from diseased heart valves
 - b. Other causes (rare)
 - i. Tumors (atrial myxoma)
 - ii. Corticosteroid emboli (complication of retrobulbar or intralesional corticosteroid injection)
 - iii. Right-to-left cardiac defect associated with:
 - i) Fat emboli (long bone fractures)
 - ii) Amniotic fluid emboli (pregnancy complication)
 - iii) Leukoemboli (endocarditis, Purtscher retinopathy, vasculitis)
 - iv) Talc emboli (IV drug users)
- 2. Inflammatory causes
 - a. Giant cell (temporal) arteritis (2% of cases) (more likely in central retinal artery occlusion
 - b. Systemic lupus erythematosus
 - c. Behçet disease
 - d. Other vasculitides
- 3. Hypercoagulation disorders
 - a. Oral contraceptives
 - b. Polycythemia
 - c. Pregnancy
 - d. Neoplasia

- 4. Sickling hemoglobinopathies
- 5. Infectious (with secondary vasculitis)
 - a. Syphilis
 - b. Toxoplasmosis
 - c. Bartonella ("Cat scratch" disease)
- 6. Miscellaneous
 - a. Hemorrhage under an atherosclerotic plaque
 - b. Arterial spasm i.e. migraine
 - c. Ruptured macroaneurysm
 - d. Susac syndrome (Retinocochleocerebral vasculopathy)
 - e. Idiopathic

B. Define the relevant aspects of epidemiology of the disease

- 1. Male predominance
- 2. 90% involve branch arteries of the temporal retina
- 3. Seventh decade most common
- 4. In younger patients (<30 years)
 - a. Atheromatous disease is much less likely etiology
- 5. Retinal vascular occlusive disease
 - a. 38% branch artery occlusion
 - b. 58% central retinal artery occlusion
 - c. 5% cilioretinal artery occlusion

C. List the pertinent elements of the history

- 1. Unilateral painless, abrupt onset of segmental visual field defect corresponding to the affected retina
- 2. Possible history of amaurosis fugax

D. Describe pertinent clinical features

- 1. Superficial opacification or whitening (edema) along the distribution of a branch retinal artery
- 2. Most intense whitening/opacification seen at distal borders of ischemic areas due to axoplasmic damming and ischemic necrosis
- 3. Narrow, irregular caliber of branch retinal artery
- 4. "Box car" (segmentation) of the blood column
- 5. Emboli may be seen
- 6. Arterial to arterial collaterals can develop and are virtually pathognomonic for previous branch

retinal artery obstruction.

- 7. A relative afferent pupillary defect may be seen
- E. Describe appropriate testing and evaluation for establishing the diagnosis
 - 1. Ophthalmoscopy
 - 2. Fluorescein angiography
 - 3. Immediate erythrocyte sedimentation rate and C-reactive protein in eyes without visible embolus if temporal arteritis is suspected
 - 4. Blood pressure measurement
 - 5. Possible blood tests (when clinically indicated)
 - a. Fasting blood glucose
 - b. Complete blood count (CBC)
 - c. Lipid profile
 - d. Hypercoagulation workup
 - e. Antinuclear antibodies
 - f. Rheumatoid factor
 - g. Specific treponemal assay (FTA-ABS, MHA-TP)
 - h. Toxoplasma gondii titer if suspected
 - i. Bartonella sp. titer if suspected
 - 6. Carotid artery ultrasound and cardiac echography

II. Define the risk factors

- A. Smoking
- B. Oral contraceptive use
- C. IV drug abuse
- D. Systemic diseases
 - 1. Hypertension
 - 2. Cardiac valvular disease
 - 3. Diabetes mellitus
 - 4. Giant cell arteritis
 - 5. Autoimmune diseases

III. List the differential diagnosis

A. Central retinal artery occlusion

- B. Cilioretinal artery occlusion
- C. Commotio retinae
- D. Other causes of retinal whitening (myelinated nerve fiber layer, infectious retinopathies)
- E. Other causes of segmental necrosis, e.g., acute retinal necrosis

IV. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcome, and prognosis

- 1. Most (80%) improve to 20/40 or better without treatment
- 2. Work in nonhuman primates suggests that the retina sustains irreversible ischemic damage when the arterial flow is obstructed for 90-100 minutes
- 3. Vision may improve centrally due to resolution of acute ischemic edema
- 4. Visual field defects commonly persist
- 5. Neovascularization is extremely rare

B. Describe medical therapy options

- 1. Management is directed at preventing contralateral or recurrent ipsilateral events and central nervous system events
- 2. Anticoagulation may be considered with Aspirin, Clopidogrel (Plavix), or Warfarin based on the cause of the obstruction
- 3. Consider hospital admission if systemic symptoms (i.e., stroke in evolution) and neurology or vascular consultation for further workup
- 4. Immediate treatment may be attempted (often unsuccessfully) with goal of acutely lowering intraocular pressure (IOP)
 - a. Immediate ocular massage with finger or fundus contact lens
 - b. Lower IOP with topical or oral agents
 - c. Goal of above maneuvers is to help dislodge embolus to location downstream where less retina is involved

C. Describe surgical therapy options

- 1. Anterior chamber paracentesis
 - a. Additional maneuver to attempt to lower IOP
- 2. Carotid/cardiac surgery if indicated by vascular surgery
- 3. Very rarely considered, a YAG laser disruption of visible embolus in the retinal arteriole has been described for cases of severe visual loss

V. List the complications of treatment, their prevention and management.

A. Anterior chamber paracentesis

- 1. Cataract in phakic persons if lens capsule is violated
- 2. Hyphema
- 3. Endophthalmitis
 - a. Use topical povidone iodine and a lid speculum
 - b. Have patient remain vigilant for early signs of infection

VI. Describe disease-related complications

A. Anterior segment neovascularization is extremely rare

VII. Describe appropriate patient instructions

- A. Smoking cessation
- B. Maximize medical health
 - 1. Improve diet
 - 2. Exercise
 - 3. Good primary care follow up

C. Control associated medical conditions

- 1. Hypertension
- 2. Diabetes mellitus
- D. Any change in vision in fellow eye should be reported promptly (within 60 min if possible) to an ophthalmologist
- E. Repeat eye examination in about 1 month
- F. Present to emergency room if any neurological symptoms occur

Additional Resources

- 1. AAO, Basic and Clinical Science Course. Section 12:Retina and Vitreous, 2013-2014.
- 2. AAO, Electrophysiologic Testing in Disorders of the Retina, Optic Nerve and Visual Pathway, 2nd ed., 2001, p. 85-88.
- 3. AAO, Focal Points: Retinal Arterial Obstruction, Module #1, 1994, p. 3-7.

Central retinal artery occlusion

I. Describe the approach to establishing the diagnosis

A. Describe the etiology/multifactorial nature of this disease

- 1. Embolization (most common cause)
 - a. Carotid or cardiac source most common
 - i. Cholesterol emboli (Hollenhorst plaque)
 - i) Refractile, yellow
 - ii. Platelet-fibrin emboli
 - i) Gray (associated with large vessel atherosclerosis)
 - iii. Calcific emboli
 - i) White(from diseased heart valves)
 - b. Other causes (rare)
 - i. Tumors (atrial myxoma)
 - ii. Corticosteroid emboli (complication of retrobulbar or intralesional corticosteroid injection)
 - iii. Right-to-left cardiac defect associated with:
 - i) Fat emboli (long bone fractures)
 - ii) Amniotic fluid emboli (pregnancy complication)
 - iii) Leukoemboli (endocarditis, Purtscher retinopathy, vasculitis)
 - iv) Talc emboli (IV drug users)
- 2. Inflammatory causes
 - a. Giant cell (temporal) arteritis
 - b. Other vasculitides
- 3. Hypercoagulation disorders
 - a. Oral contraceptives
 - b. Polycythemia
 - c. Pregnancy
 - d. Neoplasia
- 4. Sickling hemoglobinopathies
- 5. Infectious (with secondary vasculitis)
 - a. Syphilis

- b. Mucormycosis (diabetics)
- 6. Miscellaneous
 - a. Hemorrhage under an atherosclerotic plaque
 - b. Arterial spasm i.e. migraine
 - c. Idiopathic

B. Define the relevant aspects of epidemiology of the disease

- 1. Male predominance
- 2. Seventh decade most common
- 3. In younger patients (<30 years)
 - a. Atheromatous disease is much less likely
- 4. Retinal vascular occlusive disease
 - a. 38% branch artery occlusion
 - b. 58% central retinal artery occlusion
 - c. 5% cilioretinal artery occlusion

C. List the pertinent elements of the history

- 1. Painless, sudden, usually severe visual loss in one eye, usually to counting fingers or hand movements level, occurring over seconds
- 2. May have a history of amaurosis fugax

D. Describe pertinent clinical features

- 1. Opaque, edematous retina, particularly in posterior pole
- 2. Cherry red spot (orange reflex from intact choroidal vasculature beneath fovea)
- 3. Marked afferent pupillary defect
- 4. Narrowed retinal arterioles and "box car" or segmentation of the blood column in the arterioles
- 5. Retinal arteriolar emboli
- 6. Cilioretinal artery sparing of the foveola

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Ophthalmoscopy
- 2. Fluorescein angiography
- 3. Immediate erythrocyte sedimentation rate (ESR) and C-reactive protein in eyes without visible embolus if temporal arteritis is suspected
- 4. Blood pressure measurement
- 5. Other blood tests
 - a. Fasting blood glucose

- b. Complete blood count (CBC)
- c. Lipid profile
- d. Antinuclear antibodies
- e. Rheumatoid factor
- f. Hypercoagulation workup, if clinically indicated
- g. Specific treponemal assay (FTA-ABS, MHA-TP)
- 6. Carotid artery evaluation and cardiac echography (transesophageal echo has higher sensitivity than transthoracic echo)

II. Define the risk factors

- A. Smoking
- B. Oral contraceptive use
- C. IV drug abuse
- D. Trauma
- E. Systemic diseases
 - 1. Hypertension
 - 2. Cardiac valvular disease
 - 3. Diabetes mellitus
 - 4. Giant cell arteritis
 - 5. Long bone crushing trauma

III. List the differential diagnosis

- A. Acute ophthalmic artery occlusion
- B. Inadvertent recent intraocular injection of gentamicin
- C. Arteritic ischemic optic neuropathy
- D. Tay Sachs or other storage disease
- E. Severe trauma causing optic nerve disinsertion

IV. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcome, prognosis

- 1. Work in nonhuman primates suggests that the retina sustains irreversible ischemic damage when the arterial flow is obstructed for 90-100 minutes
- 2. 25% have a patent cilioretinal artery that supplies part or all of the papillomacular (PM) bundle

- 3. If only part of the PM bundle is spared, the resultant visual acuity is usually no better than 20/100
- 4. In about 10%, the cilioretinal artery spares the foveola; the vision improves to better than 20/50 in 80%
- 5. Presence of a retinal arterial embolus, whether in conjunction with an occlusion or not, is associated with increased mortality rate of 56% over 9 years from cardiac disease
- 6. Identification of any associated systemic disease is important for prognosis and management

B. Describe medical therapy options

- 1. If GCA is suspected, begin high-dose systemic corticosteroids while awaiting ESR and C-reactive protein results
- 2. Aspirin
- 3. Consider hospital admission if systemic symptoms warrant neurologic or additional urgent vascular workup (i.e., stroke in evolution).
- 4. Follow for signs of anterior segment neovascularization (iris, angle) with undilated pupil exam and gonioscopy monthly for 6 months following the event. If neovascularization is seen, treat with a full panretinal photocoagulation to avert neovascular glaucoma. May consider use of anti-VEGF agent as adjunct therapy
- 5. Workup usually is indicated to determine a cause
 - a. Appropriate treatment of systemic condition may decrease likelihood of another CRAO, stroke or myocardial infarction in the future
- 6. Immediate treatment may be attempted (often unsuccessfully) with goal of acutely lowering intraocular pressure (IOP)
 - a. Immediate ocular massage with finger or fundus contact lens
 - b. Lower IOP with topical or oral agents
 - c. Goal of above maneuvers is to help dislodge embolus to location downstream where less retina is involved

C. Describe surgical therapy options

- 1. Anterior chamber paracentesis
 - a. Additional maneuver to attempt to lower IOP (see above)
- 2. Panretinal photocoagulation laser (when anterior segment neovascularization is noted)
 - a. Decreases the stimulus for neovascular tissue growth and helps avert neovascular glaucoma

V. List the complications of treatment, their prevention and management

A. Anterior chamber paracentesis

- 1. Cataract in phakic persons if lens capsule violated
- 2. Hyphema

- 3. Endophthalmitis
 - a. Use topical povidone-iodine and a lid speculum to decrease risk

VI. Describe disease-related complications

- A. Anterior segment neovascularization (approx. 5%) usually occurs within 3 months of onset of occlusion. (mean= 5 weeks)
 - 1. Full scatter panretinal photocoagulation is recommended at earliest sign of neovascularization
 - 2. Failure to diagnose early neovascularization and treat with a complete PRP leads to neovascular glaucoma
- B. Visual prognosis usually poor

VII. Describe appropriate patient instructions

- A. Smoking cessation
- B. Maximize medical health by
 - 1. Controlling associated medical conditions
 - a. Hypertension
 - b. Diabetes mellitus
 - 2. Exercise
 - 3. Good primary care follow up
- C. Any change in vision in fellow eye should be reported promptly (within 60 minutes if possible) to an ophthalmologist
- D. Repeat eye examination every 4 weeks for first 3 months (per clinical judgment) to check for anterior segment neovascularization and to evaluate workup for underlying cause

Additional Resources

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Electrophysiologic Testing in Disorders of the Retina, Optic Nerve and Visual Pathway, 2nd ed., 2001, p.85-88, 162.
- 3. AAO, Focal Points: Retinal Arterial Obstruction, Module #1, 1994.
- 4. Atebara NH, Brown GC, Cater J. Efficacy of anterior chamber paracentesis and Carbogen in treating acute nonarteritic central retinal artery occlusion. *Ophthalmology*. 1995;102:2029-2034.
- 5. Brown GC. Arterial occlusive disease. In: Regillo CD, Brown GC, Flynn HW Jr, eds. *Vitreoretinal Disease: The Essentials.* New York: Thieme, 1999;97-115.

Sickle cell retinopathy

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Sickle-cell hemoglobinopathy results from a genetic mutation in the hemoglobin A (HbA) protein that polymerizes in low oxygen environments leading to 'sickling' of erythrocytes and retinal vascular occlusion
- 2. Evolutionary pressure for this mutation stems from a protective effect in malarial infections

B. Define the relevant aspects of epidemiology of the disease

- 1. Sickle mutations are highest in African-American populations
 - a. Hemoglobin AS (HbAS) = 8.5%
 - b. Hemoglobin AC (HbAC) = 2.5%
 - c. Hemoglobin SS (HbSS) = 0.14%
 - d. Hemoglobin CC (HbCC) = 0.016%
 - e. Hemoglobin SC (HbSC) = 0.2%
 - f. Hemoglobin S-thalassemia (HbSthal) = 0.03%
- 2. More severe retinopathy occurs in HbSC disease and HbSthal while more severe systemic manifestations occur with HbSS disease (the anemia related to SS is protective against severe retinopathy)

C. List the pertinent elements of the history

- 1. Known hemoglobinopathy (see above)
- 2. African heritage
- 3. History of sickle crisis with severe pain of
 - a. Long bones
 - b. Chest
 - c. Abdomen
 - d. Joints
- 4. Infarction related events inclusing stroke and heart attack
- 5. Symptoms
 - a. Blurry vision
 - b. New floaters
 - c. Photopsia
 - d. Scotoma (partial or complete)

e. Ocular pain

D. Describe pertinent clinical features

- 1. Signs
 - a. Non-proliferative
 - i. Conjunctival vasculature changes ('corkscrew or comma-shaped' vessels)
 - ii. Iris atrophy
 - iii. Fundus changes
 - i) Iridescent spots (hemoglobin-laden macrophages)
 - ii) Salmon patch retinal/pre-retinal hemorrhage
 - iii) Retinoschisis
 - iv) Black sunburst (retinal pigment epithelium (RPE) hyperplasia)
 - v) Retinal vascular tortuosity
 - vi) Artery occlusion (branch or central)
 - vii) Enlargement of the foveal avascular zone
 - viii) Retinal vascular sclerosis (whitening)
 - ix) Peripheral white without pressure
 - iv. Choroidal vascular occlusions
 - v. "Y-shaped" vascular changes at the optic nerve
 - vi. Angioid streaks
 - b. Proliferative sickle retinopathy: Goldberg Classification
 - i. Stage I
 - i) Peripheral arterial occlusion
 - ii) Sclerosed peripheral vessels "silver wire"
 - ii. Stage II
 - i) Arterial-venous peripheral anastomosis
 - ii) Vascular remodeling at avascular periphery
 - iii. Stage III
 - i) Peripheral neovascularization "sea-fan"
 - ii) Traction from adherent vitreous strands
 - iv. Stage IV
 - i) Vitreous hemorrhage
 - v. Stage V

- i) Most common in HbSC
- ii) Traction retinal detachment (RD)
- iii) Rhegmatogenous retinal detachment (RRD)
- iv) Combined tractional and rhegmatogenous RD
- 2. Extraocular symptoms
 - a. None
 - b. Abdominal pain
 - c. Chest pain
 - d. Long bone pain

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Sickle prep (rapid test)
- 2. Hemoglobin electrophoresis (identifies hemoglobin chains)
- 3. Increased reticulocyte count

II. Define the risk factors

- A. Family history
- B. African ancestry
- C. Mediterranean ancestry (less common)
- D. Increased risk for ocular involvement with HbSC and HbSthal
- E. Decreased risk for systemic involvement with HbSC and HbSthal
- F. Lower risk of retinopathy in HbAS and HbSS
- G. Hypoxia
- H. Dehydration
- I. Possibly smoking (increases risk of acute chest syndrome)

III. List the differential diagnosis

- A. Diabetic retinopathy and tractional retinal detachment
- B. Hypertensive retinopathy
- C. Central or branch retinal vein occlusion
- D. Hyperviscosity syndromes
- E. Eales disease
- F. Radiation retinopathy
- G. Chronic RD

- H. Leukemic retinopathy
- I. Familial exudative vitreoretinopathy (FEVR)
- J. Idiopathic occlusive retinal arteriolitis
- K. Incontinentia pigmenti

IV. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcome, and prognosis

- 1. Many peripheral neovascular fronds regress (60%)
- 2. Salmon patch resolves spontaneously
 - a. May leave hyperpigmented black sunburst
 - b. May create vitreoretinal traction or epiretinal membrane

B. Describe systemic therapy options

- 1. Maintain good oxygenation
- 2. Maintain good hydration
- 3. Desferrioxamine (systemic with potential RPE degeneration)
- 4. Pneumococcal vaccination
- 5. Hydroxyurea

C. Describe therapy for elevated intraocular pressure

- 1. Topical agents (multiple if necessary) to control IOP
- 2. Avoid acetazolamide (Diamox®)
 - a. Decreases serum bicarbonate
 - b. Metabolic acidosis
 - c. Increased sickling tendency
- 3. Methazolamide may be used for intraocular pressure (IOP) control
 - a. Less acidosis
 - b. May cause hemoconcentration
- 4. Hyperosmotic agents (Mannitol)

D. Surgical therapy options

- 1. Panretinal laser photocoagulation indications
 - a. Active proliferative disease or active fibrovascular neovascularization
 - b. Spontaneous hemorrhage
 - c. Large elevated sea-fans
 - d. Rapid growth of neovascularization

- 2. Avoid scleral buckle if possible
 - a. Increased risk of anterior segment ischemia
 - b. Increased risk of hyphema
 - c. Elevated IOP risk increases
- 3. Pars plana vitrectomy
 - a. Preferred method to address RD
 - b. Higher risk than with patients with normal hemoglobin
 - c. Peripheral dissections may be difficult
 - d. Hyphema management (consider washout if IOP > 25)

V. List the complications of treatment, their prevention and management

- A. Manage by avoiding intervention if possible
- B. Treat IOP elevation aggressively
- C. Monitor for side effects of systemic medications
- D. Hyphema management with washout if necessary to manage IOP and minimize optic nerve ischemia
- E. Keep patients well hydrated
- F. Transfuse if necessary

VI. Describe disease-related complications

- A. Ocular
 - 1. Vitreous hemorrhage
 - 2. Retinal detachment
 - 3. Tractional retinal detachment
 - 4. Retinal hemorrhage
 - 5. Vitreoretinal traction
 - 6. Epiretinal membranes
 - 7. Optic nerve ischemia
 - 8. Cataract
 - 9. Iris atrophy
 - 10. Peripheral retinal vascular ischemia
 - 11. Retinoschisis
 - 12. Macular ischemia

- 13. Choroidal infarctions
- 14. Angioid streaks

B. Systemic

- 1. Ischemia/infarction of multiple organ systems
- 2. Medication toxicity

VII. Describe appropriate patient instructions

- A. Maintain a lifestyle consistent with adequate oxygenation
- B. Maintain generous hydration
- C. Obtain emergency assistance immediately with systemic problems
- D. Obtain regular dilated fundus examination (at least annually)

Additional Resources

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. Hemoglobinopathies in Retina ed. Ryan SJ, Section 5 Chapter 79: Emerson GG, Harlan JB Jr., Fekrat S, Lutty GA, Goldberg MF. Mosby 2005.
- 3. Penman AD, Serjeant GR. Recent advances in the treatment of proliferative sickle cell retinopathy. *Curr Opin Ophthalmol* 1992;3:379-88.
- 4. Jacobson MS, Gagliano DA, Cohen SB, et al. A randomized clinical trial of feeder vessel photocoagulation of sickle cell retinopathy. A long-term follow-up. *Ophthalmology* 1991;98:581-5.
- 5. Farber MD, Jampol LM, Fox P, et al. A randomized clinical trial of scatter photocoagulation of proliferative sickle cell retinopathy. *Arch Ophthalmol* 1991;109:363-7.
- 6. Jampol LM, Farber M, Rabb MF, et al. An update on techniques of photocoagulation treatment of proliferative sickle cell retinopathy. *Eye* 1991;5 (pt 2):260-3.
- 7. AAO, Ophthalmology Monographs 11. Laser Photocoagulation of the Retina and Choroid, 1997.
- 8. AAO, Ophthalmology Monographs 2. Electrophysiologic Testing in Disorders of the Retina, Optic Nerve, and Visual Pathway, 2nd ed., 2001.

Retinopathy of prematurity

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Variable oxygenation
- 2. Ischemia leading to VEGF production

B. Define the relevant aspects of epidemiology of the disease

- 1. Low infant weight
- 2. Lung immaturity

C. List the pertinent elements of the history

- 1. Gestational age at birth
- 2. Birth weight (inversely associates with severity)

D. Describe pertinent clinical features (acute disease)

- 1. Classification
 - a. Zone 1: Circle with a radius 2x the distance between the optic nerve and the center of the fovea centered on the nerve
 - b. Zone II: Extends from edge of zone I to a circle whose radius is equal to the distance between optic disc and nasal ora serrata
 - c. Zone III: Temporal crescent of the retina anterior to zone II
- 2. Disease stage
 - a. Immature
 - b. Stage 1: Demarcation line (thin and flat)
 - c. Stage 2: Elevated ridge
 - d. Stage 3: Extraretinal fibrovascular proliferation
 - e. Stage 4A: Traction retinal detachment, macula on
 - f. Stage 4B: Traction retinal detachment, macula off
 - g. Stage 5: Total retinal detachment
 - i. Open anterior, open posterior funnel detachment
 - ii. Open anterior, closed posterior funnel detachment
 - iii. Closed anterior, closed posterior funnel detachment
- 3. Plus Disease: Vascular dilation or engorgement with arterial tortuosity
- 4. Rush Disease: Rapid progression with iris vessel dilation/engorgement

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Frequent dilated fundus exams in high-risk infants
- 2. B scan ultrasonography for advanced RD or media opacity

II. Define the risk factors

A. Young gestational age; usually less than 32 weeks

B. Low birth weight

- 1. Acute ROP incidence increases with decreased weight
 - a. 1000-1500 g: 7%
 - b. <1000 g: 32%
- C. Genetic predisposition
- D. Oxygen supplementation
- E. Congenital heart disease with right-left shunting

III. List the differential diagnosis

- A. Diseases that can produce similar fundus changes but none below are associated with prematurity
 - 1. Incontinentia pigmenti
 - 2. Norrie disease
 - 3. Familial exudative vitreoretinopathy
 - 4. X-linked retinoschisis
 - 5. Miscellaneous conditions simulating stage 5 disease
 - a. Coats disease
 - b. Retinoblastoma
 - c. Persistent fetal vasculature (persistent hyperplastic primary vitreous)

IV. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcome and prognosis

- 1. Mild cases (stage 2 or less)
- 2. Usually spontaneously regress with good outcome
- 3. "Threshold disease" as defined by CRYO-ROP study
 - a. Stage 3 (5 contiguous or 8 cumulative clock hours of EFVP)
 - b. Zone I or II

- c. Plus disease (any)
- d. Increased risk of progression to poor outcome if retinal detachment or macular traction
- 4. Most severe disease is zone I threshold
 - a. Highest risk for poor outcome
- 5. Myopia, amblyopia, and strabismus are common outcomes (with/without treatment)

B. Describe medical therapy and laser/cryotherapy/anti-VEGF options

- 1. Treatment indicated
 - a. "Threshold disease" as defined by CRYO-ROP study
 - i. Traditional indication for laser surgery
 - b. "Early treatment"- per ETROP study
 - i. Zone I, any stage ROP with plus
 - ii. Zone I, Stage 3 with or without plus
 - iii. Zone II, Stage 2 or 3 with plus
- 2. Better outcomes with earlier intervention
 - a. Screening infants at risk to detect disease <u>at pre-threshold</u> is critical to maximize good outcomes
 - i. All infants <1500 g or <32 weeks gestation at birth should be screened
 - ii. If the neonatologist requests screening due to associated illness
 - iii. Start screening exams at 4-6 weeks of chronological age
- 3. Treatment is directed at ablating peripheral avascular retina
 - a. Laser photocoagulation surgery (near-confluent)
 - b. Transscleral cryotherapy (option in cases with media opacity)
- 4. Emerging evidence that there may be a role for intravitreal anti-VEGF therapy (Bevacizumab) in treating this disease. However, this therapy is off label and not FDA approved

C. Describe surgical therapy options

- 1. Scleral buckling
 - a. Anterior RD
- 2. Lens-sparing vitrectomy
 - a. More posterior retinal detachment
- 3. Combined buckling and vitrectomy

V. List the complications of treatment, their prevention and management

A. Laser surgery

- 1. Hemorrhage (avoid laser to ridge) or foveal burn
- 2. Cataract and anterior segment burns (avoid tunica vasculosa lentis and red laser wavelength is preferred)

B. Cryotherapy

- 1. Hemorrhage (avoid cryotherapy to ridge)
- 2. Conjunctival scarring
- 3. Proliferative vitreoretinopathy

C. Anesthesia (either IV sedation or intubation as directed by neonatology)

- 1. Perform treatment with cardiopulmonary monitoring
- 2. Perform treatment in neonatal intensive care unit or operating room
- 3. Neonatologist or anesthesiologist back-up

D. Intravitreal injections

- 1. Endophthalmitis
- 2. Lens damage
- 3. Vitreous hemorrhage
- 4. Retinal tears or detachment

E. Vitrectomy

- 1. Cataract (if lens-sparing surgery)
- 2. Vitreous hemorrhage
- 3. Persistent or recurrent RD

VI. Describe disease-related complications

- A. Retinal detachment (traction-exudative early/rhegmatogenous late)
- B. Retinal dragging or folding
- C. Retrolental fibrovascular tissue
- D. Cataract
- E. Glaucoma
- F. Myopia
- G. Strabismus
- H. Amblyopia

VII. Describe appropriate patient instructions

A. Close monitoring of acute disease

- 1. Monitor any pre-threshold disease for progression every 1-2 weeks
- B. Close monitoring after treatment
- C. Lifelong monitoring/management of late complications (above)
 - 1. Adults with ROP history (with or without treatment of acute disease) are at increased risk for
 - a. RD
 - b. Glaucoma
 - c. Cataract
 - 2. Life-long retinal detachment precautions

Additional Resources

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Ophthalmology Monographs 11. Laser Photocoagulation of the Retina and Choroid, 1997.
- 3. AAO, Focal Points: Retinopathy of Prematurity, Module #11, 2001.
- 4. AAO, Focal Points: Current Management of Retinopathy of Prematurity, Module #3, 1993.
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- 18. Cryotherapy for Retinopathy of Prematurity Cooperative Group. Multicenter trial of cryotherapy for retinopathy of prematurity: ophthalmological outcomes at 10 years. *Arch Ophthalmol* 2001;119:1110-8.
- 19. Good WV and the Early Treatment for Retinopathy of Prematurity Cooperative Group. The Early Treatment for Retinopathy of Prematurity Study: structural findings at age 2 years. *Br J Ophthalmol* 2006;90:1378-82.
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Retinal telangiectasis

Coats Disease

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. The cause is unknown
 - a. A developmental or congenital vascular anomaly
 - b. Retinal telangiectasia
 - c. Ectatic arterioles
 - d. Microaneurysms
 - e. Venous dilation
 - f. Fusiform capillary dilation
 - g. Exudative retinal detachment
 - h. Capillary non-perfusion

B. Define the relevant aspects of epidemiology of the disease

- 1. Affects men more than women
- 2. Unilateral
- 3. Peak age of onset is during youth (peak 6-8 years old)
- 4. Macular subtype (Idiopathic Juxtafoveal retinal telangiectasis, type 1 [IJRT 1]) typically presents between the ages of 20 and 40 years

C. List the pertinent elements of the history

- 1. Young children may present with leukocoria and strabismus
- 2. Patients may report central visual loss and/or metamorphopsia
- 3. Some patients are asymptomatic if limited or peripheral exudation only
- 4. IJRT 1 more likely to present with central scotoma or metamorphopsia

D. Describe pertinent clinical features

- 1. Staging of typical childhood form
 - a. Stage 1: Telangiectasis only without evidence of exudation
 - b. Stage 2: Telangiectasis with exudation
 - i. With or without macular exudation involvement
 - c. Stage 3: Subtotal retinal detachment

- i. With or without macular involvement
- d. Stage 4: Total retinal detachment
 - i. Glaucoma common
- e. Stage 5: end stage disease with blind eye and possible phthisis
 - i. Mature cataract
- 2. Staging of IJRT 1
 - a. Early stage
 - i. Microaneurysms with predilection for the temporal half of macula
 - ii. Microvascular tortuosity in the area of microaneurysms
 - b. More advanced stage
 - i. Intraretinal edema
 - ii. Cystoid macular edema (CME)
 - iii. Subretinal fluid is often found in the center of the macula
 - iv. Lipid may accumulate in the macula
- 3. Describe appropriate testing and evaluation for establishing the diagnosis
 - a. Dilated fundus examination
 - b. Fluorescein angiography
 - i. Early filling and late leakage of the microaneurysms
 - ii. Vasculature is abnormal and cystoid edema may be seen
 - iii. Capillary non-perfusion may occur in the peripheral retina and can affect the fellow eye
 - c. Optical coherence tomography (OCT)
 - i. Cystoid edema in the macula
 - ii. Subretinal fluid is also possible

II. List the differential diagnosis

- A. Leukocoria
 - 1. Retinoblastoma
 - 2. Persistent fetal vasculature
 - 3. Other
- B. Familial exudative vitreoretinopathy
- C. Branch retinal vein occlusion
- D. Diabetic retinopathy

- E. Choroidal neovascularization (CNV)
- F. Radiation retinopathy
- G. Retinopathy of prematurity

III. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcome, and prognosis

- 1. Childhood Coats disease
 - a. Severity and rate of progression greatest in younger children (< 4 years old)
 - b. May develop lipid exudation in macula
 - c. Severe cases may develop retinal detachment
 - i. Potential glaucoma
 - d. Older individuals may develop lipid exudation peripherally or posteriorly
- 2. IJRT 1 macular subtype, usually adult onset
 - a. Patients may experience deterioration of vision due to the leakage of fluid in the area of microaneurysms
 - b. If no vision loss and/or limited exudation, careful observation is recommended

B. Describe medical therapy options

- 1. None proven
- 2. Anti-VEGF and corticosteroid intravitreal injections are controversial and off label

C. Describe surgical therapy options

- 1. Photocoagulation and/or cryotherapy to obliterate the vascular anomalies and halt progression
- 2. Vitrectomy surgery to repair retinal detachment
 - a. Limited success
- 3. For IJRT type 1, The standard treatment is light focal laser treatment to close the microaneurysms
 - a. This may require multiple sessions

IV. List the complications of treatment, their prevention and management

A. Laser may damage vision if applied near or in the center of the macula

- B. Risks of intravitreal injections include
 - 1. Cataract
 - 2. Retinal tear
 - 3. Vitreous hemorrhage
 - 4. Endophthalmitis

- 5. Retinal detachment
- C. Surgical repair of retinal detachment is of limited efficacy

V. Describe disease-related complications

- A. Peripheral telangiectasis may lead to posterior lipid deposition and vision loss
- B. Exudative retinal detachment with severe lipid exudation
- C. Glaucoma
- D. Phthisis
- E. In IJRT 1, loss of central vision by
 - 1. chronic macular edema
 - 2. central cystoid changes
 - 3. Lipid migration into the center of the macula

VI. Describe appropriate patient instructions

- A. Patients should monitor central vision with an Amsler grid
- B. Patients should regularly return for follow-up examinations

Macular telangiectasis (Mac Tel) or Gass' Juxtafoveal retinal telangiectasis Type 2 (non-exudative)

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. The cause is unknown
- 2. Mueller cell dysfunction has been proposed

B. Define the relevant aspects of epidemiology of the disease

- 1. This is a chronic and slowly progressive retinal vascular condition
- 2. Affects men and women equally
- 3. Onset typically in the fifth and sixth decade
- C. List the pertinent elements of the history
 - 1. Decreased visual acuity most common presenting complaint
 - 2. Patients report a central scotoma and metamorphopsia
 - 3. Some patients are asymptomatic in the early stages

D. Describe pertinent clinical features

1. Early stage

- a. A very subtle loss of the foveal reflex
- b. A slightly anomalous appearance to the blood vessels
- c. Abnormalities in the juxtafoveal region
- 2. Moderate stage
 - a. Area just temporal to the fovea has a grey and slightly thickened appearance
 - b. Venules in this area may be blunted and slightly tortuous
 - c. Retina may contain crystals
 - i. small, discrete refractile bodies in the superficial retina
 - d. Lipid exudates and CME are absent
- 3. Advanced stage
 - The grey, thickened retina can become oval in shape encircling the fovea and is typically
 1-2 disc diameters in size
 - b. In this zone, pigment can migrate into the retina and the retina itself can appear atrophic
 - c. In a minority of patients, subretinal new vessel membranes can grow (these appear in the subretinal space)
 - i. The neovascularization typically has retinal anastomoses

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Fluorescein angiography
 - a. Late staining in the area of the grey retina
 - b. Non-perfusion and cysts are absent
 - c. Subretinal neovascularization will leak late (if present)
- 2. OCT
 - a. Hyporeflective oval shaped space in the inner retina
 - b. Location in the macula (not apparent clinically)
 - c. Consistent with loss of tissue beneath the internal limiting membrane
 - d. Patients may develop thinning of the fovea over time

II. List the differential diagnosis

- A. Age-related macular degeneration
- B. Branch or central retinal vein occlusion
- C. Macular hole
- D. Diabetic retinopathy

III. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcome, and prognosis

- 1. The course of this condition is slow
- 2. Patients may retain good vision for several decades

B. Describe medical therapy options

1. No medical therapy has been tested in a clinical trial

C. Describe surgical therapy options

- 1. Grid laser treatment is ineffective for the edema
- 2. Focal laser photocoagulation and photodynamic therapy
 - a. Limited success in the treatment of associated subretinal neovascularization
- 3. Anti-VEGF intravitreal injections and corticosteroids have been used in treatment of associated edema and subretinal neovascularization
 - a. Case reports only off-label use

IV. List the complications of treatment, their prevention and management

- A. Grid laser surgery treatment may increase risk of atrophy in the macula
- B. Focal laser may cause central scotoma and progressive atrophy
- C. Intravitreal injections may cause
 - 1. Retinal tear
 - 2. Retinal detachment
 - 3. Cataract
 - 4. Vitreous hemorrhage
 - 5. Endophthalmitis

V. Describe disease-related complications

- A. Patients may develop central degeneration of the retinal pigment epithelium and photoreceptors
- B. Choroidal neovascularization

VI. Describe appropriate patient instructions

- A. Patients should monitor central vision with an Amsler grid
- B. Patients should return regularly for follow-up examinations

Additional Resources

Retina/Vitreous

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Ophthalmology Monographs 11. Laser Photocoagulation of the Retina and Choroid, 1997.
- 3. Yanuzzi LA, Bardal AM, Freund KB, Chen KJ, Eandi CM, Blodi BA. Idiopathic Macular Telangiectasia. Arch Ophthalmol ;124:450-460, 2006.
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Acquired retinal macroaneurysm

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Arteriosclerosis leads to a weakened arteriolar wall with subsequent aneurysmal outpouching
 - a. Systemic hypertension exacerbates vasculopathy
- 2. Histopathology
 - a. Gross arteriolar distension with surrounding blood, lipid, hemosiderin and fibroglial proliferation

B. Define the relevant aspects of epidemiology of the disease

- 1. Most are female
- 2. Sixth or seventh decade of life
- C. List the pertinent elements of the history
 - 1. May be asymptomatic
 - 2. May cause sudden painless visual loss

D. Describe pertinent clinical features

- 1. Round or fusiform dilations of the retinal arterioles
- 2. Located in the posterior pole within the first 3 orders of arteriolar bifurcation
- 3. Superotemporal artery is most commonly reported site
- 4. Multilayer hemorrhage common
 - a. Subretinal
 - b. Intraretinal
 - c. Subhyaloid/preretinal
 - d. Vitreous
- 5. Macular edema/exudate may be present
- 6. Most are unilateral (90%)
- E. Describe appropriate testing and evaluation for establishing the diagnosis
 - 1. Check blood pressure and lipid profile
 - 2. Ensure patient has follow up with medical professional
 - 3. Fluorescein angiography may not demonstrate the aneurysm when it is blocked by excessive hemorrhage, causing marked hypofluorescence
 - a. The macroaneurysm typically fills in the early arterial phase of the angiogram

b. In the late frames, the aneurysm wall may show staining or leakage

II. Define the risk factors

- A. Systemic hypertension
- B. Hyperlipidemia
- C. Cardiovascular disease

III. List the differential diagnosis

- A. Proliferative diabetic retinopathy
- B. Branch retinal vein occlusion
- C. Choroidal melanoma
- D. Retinal telangiectasia
- E. Age-related macular degeneration
 - 1. Hemorrhagic pigment epithelial detachment
 - 2. Choroidal neovascularization with hemorrhage

IV. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcome and prognosis

- 1. Macroaneurysm can thrombose
 - a. Spontaneous involution, fluid resorption, good visual recovery
 - b. Spontaneous arteriolar occlusion distal to macroaneurysm
 - i. Branch artery occlusion and visual loss
- 2. Macroaneurysm can leak chronically leading to visual loss
 - a. Macular edema
 - b. Lipid maculopathy

B. Describe surgical therapy options

- 1. Laser photocoagulation of macroaneurysm itself may be performed if there is secondary exudation that is affecting visual acuity
 - a. No clear indication for treatment has been established and the benefits have not been proven
 - b. When laser is performed, a large spot size (200 microns) and treatment to a light gray endpoint is usually employed to minimize risk of rupture or of creating artery occlusion distal to the macroaneurysm
 - c. Treatment may also be directed to surround the macroaneurysm rather than direct

treatment

2. Vitrectomy to clear vitreous hemorrhage

V. List the complications of treatment, their prevention and management

- A. Laser photocoagulation of the macroaneurysm can lead to inadvertent occlusion of the associated arteriole itself with a consequent branch retinal artery occlusion
 - 1. If the distal portion of the arteriole to be treated supplies the macula, laser photocoagulation must be carefully considered
 - 2. Laser can also rupture Bruch membrane with risk of subsequent choroidal neovascularization

B. Rupture of macroaneurysm possible

C. Complications of vitrectomy

VI. Describe disease-related complications

- A. Subfoveal hemorrhage
- B. Vitreous hemorrhage
- C. Macular edema
- D. Foveal lipid

VII. Describe appropriate patient instructions

- A. Work with internist to keep blood pressure under control
- B. Maintain normal lipid profile
- C. Avoid tobacco use

Additional Resources

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. Chew EY, Murphy RP. Acquired retinal macroaneurysms. In: Ryan SJ, Hinton DR, Schachat AP, Wilkinson CP. eds. *Retina*. 4th ed. Philadelphia: Elsevier/Mosby; 2006:1475-1478

Cystoid macular edema

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Intraretinal edema contained in cystoid spaces in the macula
 - a. due to abnormal permeability of retinal perifoveal capillaries as in diabetes mellitus, inflammation, and retinal dystrophies

B. Define the relevant aspects of epidemiology of the disease

- 1. May be associated with many conditions
 - a. Cataract surgery (most common)
 - b. Following any other intraocular surgery, retinal laser, cryotherapy
 - c. Anterior, intermediate or posterior uveitis
 - d. Diabetic retinopathy
 - e. Branch retinal vein occlusion (BRVO)
 - f. Central retinal vein occlusion (CRVO)
 - g. Choroidal neovascularization
 - h. Medications
 - i. Prostaglandin analogs
 - ii. Niacin
 - iii. Epinephrine
 - iv. Taxanes (paclitaxel, chemotherapeutic agent)
 - i. Epiretinal membrane/vitreomacular traction
 - j. Retinitis pigmentosa
 - k. Idiopathic CME

C. List the pertinent elements of the history

- 1. Central visual impairment
- 2. Blurred vision
- 3. Metamorphopsia
- 4. Past medical history
 - a. Past surgery
 - b. Systemic disease
 - c. Medications

D. Describe pertinent clinical features

- 1. Honeycomb-like cystoid spaces surrounding and involving the center of the fovea; may involve multiple layers
- 2. May appear as intraretinal striae radiating from center of fovea
 - a. Edema in Henle layer
- 3. May be evidence of vitreomacular traction or other associated disease
 - a. Diabetic retinopathy
 - b. Retinal vein occlusions
 - c. Other
- 4. Retinal pigment epithelium (RPE) hypertrophy, clumping
- 5. RPE atrophy when longstanding
- 6. Anterior segment vitreous adhesions

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Optical coherence tomography (OCT)
- 2. Fluorescein angiography

II. Define the risk factors

- A. Contralateral post-surgical cystoid macular edema (CME)
- B. Diabetic retinopathy
- C. Uveitis
- D. Vitreomacular interphase abnormalities
- E. Epiretinal membrane
- F. Inflammatory conditions

III. List the differential diagnosis

- A. Central serous retinopathy
- B. Epiretinal membrane
- C. Vitreomacular traction (without CME)
- D. Macular hole
- E. X-linked retinoschisis
- F. Goldmann-Favre disease
- G. Nicotinic acid/Niacin maculopathy

IV. Describe patient management in terms of treatment and follow -up

A. Drug Induced

1. Stop causative medication

B. May not need therapy

- 1. Many cases of post-operative CME resolve within 6 weeks
- C. Topical corticosteroids
- D. Topical non-steroidal anti-inflammatory drugs (NSAIDs)
- E. Anti-VEGF therapy for specific indications
 - 1. Diabetic macular edema
 - 2. Branch or Central retinal vein occlusion

F. Sub-Tenons corticosteroid injection

G. Oral corticosteroids

1. Particularly if CME is associated with uveitis

H. Intravitreal corticosteroid injection

I. Oral Acetazolamide or topical Dorzolamide

1. Particularly if CME is associated with retinitis pigmentosa

J. Laser surgery

- 1. If the macular edema is associated with diabetic retinopathy or BRVO
- 2. Early Treatment of Diabetic Retinopathy Study did not demonstrate benefit to grid/focal laser surgery in eyes with macular ischemia

K. Vitrectomy

- 1. Particularly if CME is associated with
 - a. Vitreomacular traction
 - b. Taut surface fibrosis
 - c. Vitreous traction to a surgical wound
 - d. Intraocular lens (IOL) subluxation
 - e. Dislocation or haptic chafe on iris root

V. List the complications of treatment, their prevention and management

A. Corticosteroid side effects

- 1. Cataract
- 2. Glaucoma
- 3. Systemic side effects

- 4. Ptosis
- B. Laser surgery or vitrectomy associated complications
- C. Complications and risks of intravitreal injections

VI. Describe disease-related complications

A. Permanent reduction of central vision if edema fails to resolve and the macular edema becomes chronic

Additional Resources

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Ophthalmology Monographs 11. Laser Photocoagulation of the Retina and Choroid, 1997.
- 3. AAO, Ophthalmology Monographs 2. Electrophysiologic Testing in Disorders of the Retina, Optic Nerve and Visual Pathway, 2nd ed., 2001.
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Selected white dot syndromes

Birdshot retinochoroidopathy (Vitiliginous chorioretinitis)

I. Describe the approach to establishing the diagnosis

- A. Describe the etiology of this disease
 - 1. Etiology unknown
- B. Define the relevant aspects of the epidemiology of this disease
 - 1. Northern European ancestry
 - 2. Average age of 50 years
 - a. Bimodal i.e. may occur at younger or older ages
 - 3. Affects females more than males (2:1)

C. List the pertinent elements of the history

- 1. Floaters
- 2. Visual loss
- 3. Reduced dark adaptation

D. Describe pertinent clinical features

- 1. Cream to pale orange ovoid lesions
 - a. Approximately 200-400 microns in diameter
 - b. Located deep in the choroid
 - c. Most prominently detected nasal to the disc
 - d. Radiate from the disc
- 2. Minimal or no anterior chamber inflammation
- 3. Mild vitreous inflammation
- 4. Retinal vascular leakage from veins and disc
- 5. Cystoid macular edema
- 6. Optic nerve atrophy and retinovascular attenuation in late stages of disease

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. HLA-A29 testing
- 2. Fluorescein angiography to detect retinovascular leakage
- 3. Indocyanine green angiography (ICG) to confirm location of the birdshot lesions along the choroidal vessels
- 4. Visual field testing

5. Electroretinogram (ERG)

II. Define the risk factors

A. HLA-A29

III. List the differential diagnosis

- A. Sarcoidosis
- B. Lymphoma
- C. Syphilitic chorioretinitis
- D. Multifocal choroiditis
- E. Multiple evanescent white dot syndrome (MEWDS)

IV. Describe patient management in terms of treatment and follow-up

A. Describe medical therapy options

- 1. Corticosteroids
- 2. Cyclosporine
- 3. Combined corticosteroids and cyclosporine
- 4. Azathioprine
- 5. Other immunosuppressive medications
- 6. Uveitis referral

B. Describe follow-up options

- 1. Visual field testing
- 2. ERG

V. List the complications of treatment, their prevention and management

A. Oral corticosteroids

- 1. Complications
 - a. Cataract formation
 - b. Elevated intraocular pressure (IOP)
 - c. Weight gain and Cushingoid syndrome
 - d. Elevation of blood pressure
 - e. Elevation of blood glucose/worsening of diabetes mellitus

- f. Worsening of systemic infections
- g. Impaired wound healing and secondary infections
- h. Fluid retention
- i. Aseptic necrosis of the hip
- j. Osteoporosis
- k. Bone fractures
- I. Easy bruisability
- m. Possible worsening of peptic ulcer disease
- n. Elevation of serum lipid levels
- o. Exacerbation of psychiatric disease
- p. Thromboembolism
- 2. Prevention
 - a. Monitor for corticosteroid related complications
 - b. Limit duration of steroid use
 - c. Corticosteroid sparing agent
 - d. Referral to internal medicine or rheumatology
- 3. Inform patient of potential side effects
- 4. Management:
 - a. Use corticosteroids judiciously
 - b. Monitor for ocular side effects
- B. Other immunosuppressive agents and corticosteroid agents should be used in conjunction with a physician who is familiar with these side effects such as a uveitis specialist, a rheumatologist or internist familiar with careful monitoring of systemic complications

VI. Describe disease-related complications

- A. Chronic cystoid macular edema
- B. Loss of peripheral visual fields (need monitoring)
- C. Loss of visual acuity
- D. Optic atrophy
- E. Choroidal neovascularization
- F. Loss of night vision

VII. Describe appropriate patient instructions

- A. Careful monitoring for recurrences and active inflammation
- B. Treat medically when indicated by symptoms or testing (ERG)
- C. Disease may be chronic, recurrent, or spontaneously remit
- D. Risk of long-term visual disability and permanent visual field loss
- E. Familial cases are rare, despite HLA-A29 association

Punctate inner choroidopathy (PIC)

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Unknown
- B. Define the relevant aspects of epidemiology of the disease
 - 1. Young myopic females
 - 2. Average age is 30 years
 - 3. Usually Caucasian

C. List the pertinent elements of the history

- 1. Central or paracentral scotoma
- 2. Bilateral decreased visual acuity
- 3. Photopsias
- 4. Floaters
- 5. Photophobia
- 6. Metamorphopsia
- 7. 1-4 relapses per year are common
- 8. Autoimmune disease may be associated
- 9. Family history may occur, especially with autoimmune disorders

D. Describe pertinent clinical features

- 1. Multiple small (50-100 microns) round gray or yellow lesions
- 2. Occur at the level of the choroid and retinal pigment epithelium (RPE)
- 3. Pattern may be random or linear (in the periphery)
- 4. Scotoma corresponds to lesion location
- 5. Disc edema or hyperemia
- 6. No significant vitritis
- 7. Serous detachment may be present acutely

- 8. Evolution of the lesions
 - a. Yellow-white scars
 - b. Possible choroidal neovascularization
 - c. Subretinal fibrosis and/or RPE hyperplasia
 - d. Long-term risk of choroidal neovascularization
 - e. Enlarged blind spot

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Complete history and physical examination
- 2. Slit-lamp biomicroscopy
- 3. Visual field (enlarged blind spot, central/paracentral scotoma)
- 4. Fundus examination
- 5. Fluorescein angiography
- 6. Indocyanine green angiography
 - a. Choroidal hypofluorescence of acute lesions

II. Define the risk factors

A. Young, myopic females

III. List the differential diagnosis

- A. Multifocal choroiditis with panuveitis
- B. Acute posterior multifocal placoid pigment epitheliopathy (APMPPE)
- C. Multiple evanescent white dot syndrome (MEWDS)
- D. Birdshot retinochoroidopathy
- E. Acute zonal occult outer retinopathy (AZOOR)
- F. Serpiginous choroidopathy
- G. Syphilis
- H. Ocular histoplasmosis
- I. Herpetic chorioretinitis
- J. Sarcoidosis
- K. West Nile virus

IV. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcome and prognosis

- 1. Acute symptomatic phase
- 2. Convalescent period
- 3. Recurrences

B. Describe medical therapy options

- 1. Systemic corticosteroids
- 2. Periocular and/or intravitreal corticosteroids
- 3. Immunosuppressive therapy

C. Describe surgical therapy options

- 1. Treatment of CNV with:
 - a. Anti-VEGF
 - b. Photodynamic therapy (PDT)
 - c. Laser photocoagulation
- 2. Submacular surgery

V. List the complications of treatment, their prevention and management

A. Complications of systemic corticosteroids

- 1. Recommend internal medicine involvement or rheumatologist
- B. Complications of intravitreal or peri-ocular injections

VI. Describe disease-related complications

A. CNV is common

1. Usually occurs within the first year

B. Treatment as indicated

- 1. Anti-VEGF
- 2. PDT
- 3. Laser photocoagulation

VII. Describe appropriate patient instructions

- A. Patients should be advised of the high rate of recurrence
- B. Monocular visual acuity testing
- C. Amsler grid testing

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Etiology is unknown
- 2. Has been reported following viral syndromes
- 3. May be associated with cerebral vasculitis

B. Define the relevant aspects of epidemiology of the disease

- 1. Usually young, healthy adults
- 2. No sex predilection

C. List the pertinent elements of the history

- 1. Sudden onset of bilateral disturbance in vision
- 2. No photopsias
- 3. May be asymmetric with complaints involving only one eye
- 4. Review of systems
 - a. Patient should be queried for
 - i. Recent illnesses
 - ii. Neurologic symptoms or headache
 - i) To assess for systemic/CNS vasculitis

D. Describe pertinent clinical features

- 1. Creamy yellow to gray white, flat, subretinal lesions at the level of the retinal pigment epithelium (RPE)
- 2. Central or paracentral scotomas
- 3. Usually a normal blind spot
- 4. Rapid resolution of the lesions
- 5. Good return of visual acuity in most cases
 - a. May be associated with:
 - i. Episcleritis
 - ii. Retinal vein occlusion
 - iii. Optic nerve edema
 - iv. Mild vitreous reaction may be present
 - i) Iritis is rare
 - ii) Subretinal fluid may be present

E. Describe appropriate testing and evaluation to establish the diagnosis

- 1. Fundus photography
- 2. Fluorescein angiography
 - a. Acutely, visible lesions block early and stain late
 - b. Window defects in later stages (RPE atrophy)
- 3. Optical coherence tomography (OCT) variable findings:
 - a. Subretinal fluid
 - b. Increased outer retinal reflectivity
 - i. Outer nuclear layer and IS/OS disruption
 - c. Outer plexiform layer edema
 - d. Photoreceptor atrophy
 - e. Early preservation of the RPE
 - f. RPE atrophy following resolution

II. List the differential diagnosis

- A. Serpiginous choroidopathy
- B. Syphilitic chorioretinitis
- C. Punctate outer retinal toxoplasmosis if unilateral
- D. Multifocal choroiditis
- E. Punctate inner choroidopathy
- F. Multiple evanescent white dot syndrome
- G. Viral retinitis
- H. Diffuse unilateral subacute neuroretinitis
- I. Cerebral vasculitis with ocular manifestations
- J. Infectious choroiditis
- K. Mycobacterium tuberculosis
- L. Pneumocystis carinii

III. Describe patient management in terms of treatment and follow-up

A. Describe medical therapy options

- 1. No evidence that oral corticosteroids are of benefit
- 2. High dose corticosteroid treatment indicated with evidence or suspicion of cerebral vasculitis (potentially life-threatening).

3. Consider central imaging or neurology consultation

IV. List the complications of treatment, their prevention and management

A. No treatment typically prescribed

V. Describe disease-related complications

- A. Choroidal neovascularization
- B. Persistent scotomata
- C. Permanent reduction in vision due to
 - 1. RPE scarring or atrophy
 - 2. Complications of choroidal neovascularization

VI. Describe appropriate patient instructions

- A. Reassurance
- B. Symptom improvement occurs over a period of months
- C. Periodic ophthalmologic examinations are required
- D. Document fundus changes as disease resolves
- E. Monitor for complications
- F. Systemic corticosteroid treatment is optional and unproven
- G. Headache or neurologic symptoms
 - 1. Report promptly
 - 2. Consider neuroimaging and neurology consultation

Serpiginous choroidopathy

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Unknown
- 2. Pathology specimens reveal lymphocytic infiltrates in the choroid
- B. Define the relevant aspects of epidemiology of the disease
 - 1. Affects men and women
 - 2. Adult age ranges from 20-60 years old
 - 3. More common in Caucasians
- C. List the pertinent elements of the history

Retina/Vitreous

- 1. Blurred vision in one or both eyes
- 2. Photopsias
- 3. Scotomas, central or paracentral
- 4. Metamorphopsia
- 5. No distinct systemic symptoms
- 6. History of previous symptoms or episodes in either eye
- 7. Variable intervals between episodes

D. Describe pertinent clinical features

- 1. Mild anterior chamber or vitreous inflammatory reaction
- 2. Acute lesions
 - a. Appear yellowish or gray
 - b. Are located at the RPE and choroid
 - c. Appear around the nerve
 - d. Progress in a "serpentine" configuration
 - e. Have an active edge adjacent to a contiguous area of prior involvement
- 3. Older areas
 - a. Appear atrophic
 - b. Choroidal and RPE atrophy
- 4. Lesions are usually bilateral and asymmetric
- 5. CNV may occur and originate near scars or atrophy

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Fluorescein angiogram
 - a. Active lesions typically block early and leak late
 - b. Inactive lesions
 - i. May block early from blocking defects
 - ii. May have window defects from RPE loss
 - iii. Loss of choriocapillaris is demonstrated on early transit of FA

II. Define the risk factors

A. No known risk associations

III. List the differential diagnosis

- A. Acute posterior multifocal placoid pigment epitheliopathy (APMPPE)
- B. Sarcoidosis
- C. Tuberculosis
- D. Vogt-Koyanagi-Harada Disease
- E. Toxoplasmosis
- F. Age-related macular degeneration
- G. Presumed ocular histoplasmosis syndrome
- H. Multifocal choroiditis
- I. Peripapillary choroidal neovascularization

IV. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcome and prognosis

- 1. Intermittent remissions and recurrences
- 2. May be severe and recurrent
- 3. Variable vision loss dependent on extent of macular involvement
- 4. May maintain good visual acuity for years
- 5. Prognosis is variable
- 6. Interval between episodes are variable ranging from weeks to years

B. Describe medical therapy options

- 1. Acute lesions usually treated with corticosteroids
- 2. May be supplemented with periocular corticosteroid injections
- 3. Immunosuppressive therapy options
 - a. Cyclosporine
 - b. Azathioprine
 - c. Cyclophosphamide
 - d. Other cytotoxic agents
- 4. Anti-viral therapy has not been proven effective
- 5. Anti-VEGF for CNV
- C. Describe surgical therapy options
 - 1. Laser or PDT for CNV

V. List the complications of treatment, their prevention and management

A. Oral corticosteroids and immunosuppressive therapy (see above risks and cautions)

VI. Describe disease-related complications

- A. CNV
- B. Severe vision loss
- C. Scotomas

VII. Describe appropriate patient instructions

- A. Close follow-up required
- B. Consultation with a uveitis specialist, rheumatologist, and/or trained internist who are familiar with the systemic risk of immunosuppressive therapy and monitoring
- C. Vision loss may be variable dependent on severity and recurrences
- D. Episodes may occur at variable intervals
- E. New vision changes should be reported and promptly evaluated

Additional Resources

- 1. AAO, Basic and Clinical Science Course. Section 9: Intraocular Inflammation and Uveitis, 2013-2014.
- 2. AAO, Basic and Clinical Science Course Section 12: Retina and Vitreous, 2013-2014.
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- 12. Lim WK, Buggage RR, Nussenblatt RB. Serpiginous choroiditis. *Surv Ophthalmol* 2005;50:231-44.

Multiple evanescent white dot syndrome

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

1. Unknown

B. Define the relevant aspects of epidemiology of the disease

- 1. Most common in young, healthy women
- 2. May follow a viral syndrome

C. List the pertinent elements of the history

- 1. Sudden onset of blurred vision (typically unilateral)
- 2. Associated with photopsias and paracentral scotomata
- 3. May be aware of a shadow in the temporal field of vision (enlarged blind spot)
- 4. Viral prodrome in majority of patients

D. Describe pertinent clinical features

- 1. Ocular features depend on the time of examination following onset.
 - a. Early stage white spots
 - i. Gray-white, poorly demarcated, patchy outer retinal lesions
 - ii. Present along and outside the arcades
 - iii. Usually 200 to 500 microns in diameter
 - iv. May not be visible in all quadrants
 - v. Fade rapidly
 - b. Orange, granular pigmentation of the fovea
 - c. May have associated mild vitritis
 - d. May have a prominent sectoral field defect
 - i. Commonly in the area most involved with the white dots
- 2. Retinal lesions resolve with usual return to normal vision
 - a. Slower resolution of granular macular pigmentation
- 3. Retinal pigment epithelium (RPE) scarring rarely occurs but when it does may be associated with permanent field defects
- E. Describe appropriate testing and evaluation for establishing the diagnosis
 - 1. Fluorescein angiography
 - a. Wreath-like collections of punctate hyperfluorescence

- i. At the site of the white lesions
- ii. Also in areas where lesions are less apparent.
- iii. These areas demonstrate late staining
- b. Fellow asymptomatic eye may have subtle lesions
- 2. Visual fields may reveal enlarged blind spot
- 3. May have decreased a-wave amplitude asymmetry on ERG testing

II. Define the risk factors

- A. Female sex
- B. Young adult age

III. List the differential diagnosis

- A. Acute posterior multifocal placoid pigment epitheliopathy (APMPPE)
- B. Acute idiopathic enlarged blind spot syndrome
- C. Acute zonal occult outer retinopathy (AZOOR)
- D. Multifocal choroiditis
- E. Syphilitic retinitis
- F. Vogt-Koyanagi Harada (VKH) syndrome

IV. Describe patient management in terms of treatment and follow-up

- A. Describe medical therapy options
 - 1. None recommended (usual spontaneous resolution in 2-6 weeks)

V. Describe disease-related complications

- A. Permanent scotomata or sectoral field defects (rare)
- B. Choroidal or RPE hyperpigmentation
- C. Development of a more persistent posterior uveitis
- D. Rare recurrence or bilateral involvement
- E. Choroidal neovascularization

VI. Describe appropriate patient instructions

- A. Disorder is usually self-resolving within several weeks
- B. Return of vision is usually excellent

C. Follow-up is needed to document resolution

Additional Resources

- AAO, Basic and Clinical Science Course. Section 9: Intraocular Inflammation and Uveitis, Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Fluorescein and Indocyanine Green Angiography: Technique and Interpretation, 2nd ed. 1997, p.168-170.

Multifocal choroiditis with panuveitis

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Unknown
- B. Define the relevant aspects of epidemiology of the disease
 - 1. Onset is usually between the second and sixth decade

C. List the pertinent elements of the history

- 1. Visual disturbance
- 2. Vitreous floaters
- 3. Query regarding residence in regions where histoplasmosis is endemic

D. Describe pertinent clinical features

- 1. Small (200 to 1500 micron) well demarcated lesions at the level of the inner choroid
 - a. Active lesions are creamy white
 - b. Healed lesions have variable degrees of retinal pigment epithelium atrophy or hyperpigmentation, and can have a "punched out" appearance
- 2. Lesions usually are in different stages of evolution with several lesions of the same "age" or degree of pigmentation
- 3. Peripapillary predilection
- 4. Vitritis and some degree of anterior segment inflammation
- 5. Typically bilateral
- 6. May develop choroidal neovascularization
- 7. Variable subretinal fibrosis

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Diagnosis of exclusion since many other conditions can present with similar findings. Extent of work-up should be tailored by the history and physical findings
 - a. Always consider HIV in at risk individuals
- 2. Specific testing for
 - a. Sarcoidosis
 - b. Syphilis
 - c. Tuberculosis
- 3. Fluorescein angiography shows early hypofluorescence and late hyperfluorescence with staining of active lesions and subretinal fibrosis

II. List the differential diagnosis

- A. Ocular histoplasmosis syndrome (if no vitritis)
- B. Sarcoidosis involving the choroid
- C. Chorioretinal scarring from remote infection, such as
 - 1. Toxoplasmic chorioretinitis
 - 2. Panuveitis
 - a. Vogt-Koyanagi-Harada
 - b. Serpiginous
 - c. Acute posterior multifocal placoid pigment epitheliopathy (APMPPE)
- D. Diffuse unilateral subacute neuroretinitis (unilateral)
- E. Punctate inner choroidopathy (no vitritis, smaller spots)
- F. Birdshot retinochoroidopathy
- G. Multiple evanescent white dot syndrome (MEWDS) (unilateral, younger females)
- H. Syphilis
- I. Tuberculosis
- J. Other infectious causes (cryptococcus neoformans, pneumocystis carinii, etc)

III. Describe patient management in terms of treatment and follow-up

A. Describe medical therapy options

- 1. Oral, periocular, or intravitreal corticosteroids for acute inflammation (new lesions, vitritis, etc)
- 2. Periodic follow-up for recurrences and structural complications
- 3. Chronic systemic or local immunosuppression for chronic inflammation

B. Describe treatment options

- 1. For active inflammation
 - a. Oral prednisone
 - b. Corticosteroid-sparing immunomodulatory agents (methotrexate, cyclosporine, infliximab, etc)
 - c. Fluocinolone implant (Retisert ®)
 - d. Subtenon's injection of corticosteroid
 - e. Intravitreal corticosteroids
- 2. For choroidal neovascularization (CNV)
 - a. Anti-VEGF (off label)

- b. Photodynamic therapy (off label)
 - i. Risk of recurrence
- c. Vitrectomy with removal of subfoveal choroidal neovascularization (CNV) may be considered in select cases
 - i. High rate of recurrence
- d. Intravitreal corticosteroids (off-label)

IV. Describe disease-related complications

- A. Choroidal neovascularization (approx 20%)
 - 1. Depending on lesion location consider observation, steroids, anti-VEGF or photodynamic therapy
- B. Scotomata, visual impairment, or blindness
- C. Progressive subretinal fibrosis
- D. Epiretinal membranes
- E. Chronic cystoid macular edema

V. Describe appropriate patient instructions

- A. Report changes in vision
- B. Follow Amsler grid if lesions present in posterior pole to detect signs of choroidal neovascularization
- C. Regular eye examinations to detect progression of disease

Additional Resources

- AAO, Basic and Clinical Science Course. Section 9: Intraocular Inflammation and Uveitis, Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Fluorescein and Indocyanine Green Angiography: Technique and Interpretation, 2nd ed. 1997.
- 3. AAO, Focal Points: White Dot Syndrome, Module #4, 2007.

Sarcoidosis

I. Describe the approach to establishing the diagnosis

A. Define the relevant aspects of epidemiology of the disease

- 1. Occurs more frequently in African Americans than in Caucasians
- 2. Less severe form may be seen in older Caucasians of northern European descent
- 3. More common between ages 20 50 years
- 4. Ocular manifestations occur in 25 50% of patients with systemic sarcoid

B. Pathology

- 1. Multisystem disease characterized by granulomatous inflammation
- 2. Most common organ involved systemically is lungs (75%)
- 3. Other organs less commonly involved include
 - a. Skin (erythema nodosum)
 - b. Liver
 - c. Spleen
 - d. Central nervous system (CNS)
- 4. Hallmark is a noncaseating granuloma containing epithelioid cells, multinucleated giant cells and lymphocytes

C. List the pertinent elements of the history

- 1. Symptoms are variable from mild to severe
- 2. Pain, redness and photophobia
- 3. Decreased vision and floaters

D. Describe pertinent clinical features

- 1. Majority of patients have chronic anterior uveitis
- 2. Mutton fat keratic precipitates
- 3. Koeppe and Busacca iris nodules
- 4. Posterior synechiae
- 5. Vitreous opacities
- 6. Vitritis
- 7. Retinal and choroidal granulomas
- 8. Retinal periphlebitis (candlewax drippings, vascular sheathing)
- 9. Multifocal choroiditis

- 10. Macular edema
- 11. Retinal neovascularization
- 12. Disc edema
- 13. Optic nerve granuloma
- E. Describe appropriate testing and evaluation for establishing the diagnosis
 - 1. Most common tests
 - a. Chest X-ray
 - b. Serum angiotensin converting enzyme (ACE); levels may be suppressed by oral steroids and ACE inhibitors
 - 2. Other tests
 - a. Serum lysozyme
 - b. Liver function tests
 - c. Purified protein derivative controls (PPD) (for anergy)
 - d. Chest computed tomography (CT)
 - e. High resolution scan with contrast; more sensitive than chest x-ray
 - f. Limited gallium scan
 - g. Pulmonary function tests
 - h. Biopsy
 - i. Conjunctiva
 - ii. Lacrimal gland
 - iii. Mediastinal or other enlarged nodes

II. List the differential diagnosis

- A. Idiopathic uveitis
- B. Multiple sclerosis associated uveitis
- C. Herpes zoster associated uveitis
- D. Tuberculosis
- E. Syphilis
- F. Lyme disease
- G. Pars planitis
- H. Vogt-Koyanagi-Harada (VKH) syndrome
- I. Behçet disease
- J. Sympathetic ophthalmia
- K. Lymphoma
- L. Other infectious causes

III. Describe patient management in terms of treatment and follow-up

- A. Topical, periocular, intravitreal or systemic corticosteroids (or in any combination)
- B. Cycloplegia
- C. Immunosuppressive agents (methotrexate or cyclosporine most common) or the fluocinolone implant (Retisert®) may be used if oral corticosteroids are not tolerated or long term therapy is required

IV. List the complications of treatment, their prevention and management

A. Complications of corticosteroid therapy

- 1. Cataract
- 2. Glaucoma
- 3. Regular clinic visits to monitor for above

B. Complications of steroid-sparing immunosuppressive therapy

- 1. Bone marrow suppression
- 2. Liver toxicity
- 3. Renal toxicity
- 4. Monitor for above with blood cell count and comprehensive panel every 8 weeks

V. Describe disease-related complications

- A. Decreased vision due to cystoid macular edema, cataract, or vitreous opacity
- B. Optic neuropathy
- C. Pupillary block glaucoma (posterior synechiae)
- D. Inflammatory Glaucoma

Additional Resources

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Focal Points: Immune-Mediated Systemic Diseases Associated with Uveitis, Module #11, 2003, p. 6-7.
- 3. AAO, Focal Points: Laboratory Evaluation of the Uveitis Patient, Module #12, 2001, p. 3-4.

Intermediate uveitis/pars planitis

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Unknown, presumably autoimmune
 - a. If organized inflammatory cells on inferior pars plana present, referred to as pars planitis
 - b. If no organized inflammation inferiorly, referred to as intermediate uveitis

B. Define the relevant aspects of epidemiology of the disease

- 1. More common in children and young adults
- 2. Usually bilateral
- 3. May be associated with multiple sclerosis

C. List the pertinent elements of the history

- 1. May be asymptomatic in mild cases
- 2. Floaters are common
- 3. Decreased vision
 - a. Cystoid macular edema (CME)
 - b. Vitritis
 - c. Vitreous hemorrhage (more common in children)
- 4. Insidious onset, long duration (chronic)
- 5. Bilateral at presentation in 70 80%

D. Describe pertinent clinical features

- 1. Typically not associated with redness, pain, or photophobia
- 2. Anterior chamber inflammation usually mild
 - a. Posterior synechiae uncommon
- 3. Cataract (usually posterior subcapsular)
- 4. Vitreous cell always present in active disease
- 5. Vitreous opacities
 - a. White or yellowish aggregates of inflammatory cells
 - b. Most common inferiorly
- 6. Snowbanks (organized inflammatory cells on the inferior pars plana)
 - a. Pars plana/ora serrata
 - b. Usually inferior, usually 180°, yet may extend 360 degrees

- c. Coalesced exudates or fibroglial mass
- d. May become vascularized (thus leading to vitreous hemorrhage)
- 7. Periphlebitis is common
- 8. CME most common cause of decreased vision
- 9. Epiretinal membranes (ERM) are common
- 10. Optic disc edema may occur
- 11. Vitreous hemorrhage
- 12. Retinal detachment
 - a. Tractional
 - b. Rhegmatogenous
 - c. Exudative (Coats like reaction)
- 13. Neovascularization of the disc rare

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Intermediate uveitis is diagnosed primarily by clinical exam
- 2. Should be considered a diagnosis of exclusion
- 3. Tests that may be considered, depending on level of suspicion of diseases are listed below:
 - a. Multiple sclerosis
 - i. Neurologic exam
 - ii. Magnetic resonance imaging (MRI)
 - iii. Human leukocyte antigen (HLA) testing
- 4. Sarcoid
 - a. Chest x-ray
 - b. Angiotensin converting enzyme (ACE)
- 5. Syphilis
 - a. Serology
- 6. Lyme disease
 - a. Serology
- 7. Lymphoma
 - a. MRI of the brain
 - b. Lumbar puncture
 - c. Diagnostic vitrectomy

II. List the differential diagnosis

- A. Sarcoidosis
- B. Toxocariasis
- C. Lyme disease
- D. Whipple disease
- E. Intraocular lymphoma
- F. Syphilis
- G. Multiple sclerosis

III. Describe patient management in terms of treatment and follow-up

- A. May not need therapy if vitritis is incidental finding and patient has good vision with no structural complications (CME, ERM, etc)
- B. Topical corticosteroid
 - 1. Typically used as adjunctive treatment
- C. Periocular corticosteroid injection
- D. Oral corticosteroids
- E. Pars plana vitrectomy
- F. Laser surgical therapy to peripheral retina posterior to snow bank
- G. Corticosteroid sparing agents can be used if long term therapy required
 - 1. Methotrexate
 - 2. Azathioprine
 - 3. Cyclosporine A
 - 4. Mycophenolate
 - 5. Tumor necrosis factor (TNF) alpha antagonist therapy
- H. The fluocinolone implant (Retisert®) may be used if oral corticosteroids are not tolerated or long term therapy is required
- I. Cryotherapy to areas of snow banking

IV. Describe disease-related complications

- A. Decreased vision due to
 - 1. CME
 - 2. Epiretinal membrane
 - 3. Cataract
 - 4. Vitreous opacity

Additional Resources

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Laser Photocoagulation of the Retina and Choroid, 1997, p.144.
- 3. AAO, Retinal Detachment: Principles and Practice, 2nd ed., 1995, p.55, 59, 63.
- 4. AAO, Focal Points: Pars Planitis, Module #11, 1993.
- 5. Malinowski SM, Pulido JS, Folk JC. Long-term visual outcome and complications associated with pars planitis. *Ophthalmology*. 1993;100:818-824.

Endophthalmitis associated with filtering or inadvertent blebs

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of the disease

- 1. Presence of filtration bleb predisposes eye to late infection
- 2. Initial infection may involve bleb only (blebitis) and progress to bleb-associated endophthalmitis
- 3. History of conjunctivitis often precedes intraocular infection

B. Define the relevant aspects of epidemiology of the disease

- 1. Filtration blebs, either surgical or traumatic, are susceptible to infection
- 2. Risk of infection higher after mitomycin C and with inferior blebs
- 3. Leaking and non-leaking blebs are susceptible
- 4. Most common causative organisms include *Streptococcus* and *Haemophilus* species

C. List the pertinent elements of the history

- 1. Short period of red eye and irritation precedes more advanced symptoms
- 2. Decreased vision
- 3. Pain
- 4. Redness
- 5. Lid swelling
- 6. Discharge

D. Describe the pertinent clinical features

- 1. "White on red" describes bleb infiltrated with pus against the background of conjunctival hyperemia
- 2. Lid edema
- 3. Anterior chamber flare and cell
- 4. Hypopyon
- 5. Vitreous cellular infiltration provides differentiating feature from blebitis
- 6. Vitreous opacification

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Vitreous biopsy or tap to provide material for culture and sensitivity
- 2. Anterior chamber aspiration to provide material for gram stain and culture and sensitivity

II. Define the risk factors

- A. Preexisting filtration bleb
- B. External bacterial infection (e.g. blepharitis)
- C. Inferior location
- D. Use of mitomycin C during surgery

III. List the differential diagnosis

- A. Conjunctivitis
- B. Blebitis
- C. Uveitis
- D. Other forms of endophthalmitis

IV. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcome and prognosis

- 1. Visual outcome poorer for endophthalmitis and better for blebitis
- 2. Visual results are less satisfactory than after treatment of acute bacterial postoperative endophthalmitis

B. Describe medical therapy options

- 1. Intravitreal antibiotics for bacterial endophthalmitis
- 2. Aggressive topical fortified antibiotics for blebitis
- 3. Topical antibiotics
- 4. Subconjunctival antibiotics
- 5. Systemic oral antibiotics such as moxifloxacin
- 6. Topical corticosteroids
- 7. Systemic corticosteroids
- 8. Intravitreal corticosteroids (controversial)

C. Describe surgical therapy options

- 1. If vitreous involvement is demonstrated, intravitreal antimicrobials should be administered
- 2. When significant clinical infection is noted, early vitrectomy may be considered

V. List the complications of treatment, their prevention, and management

- A. Toxicity of injected antimicrobials
- B. Complications of systemic corticosteroids

Retina/Vitreous

- C. Complications of topical corticosteroids
- D. Complications of intravitreal steroids
- E. Complications of topical antimicrobials
- F. Complications of vitrectomy surgery

VI. Describe disease-related complications

- A. Scarring of bleb
- B. Loss of control of intraocular pressure (IOP)
- C. Vision loss
- D. Retinal detachment
- E. Vitreous opacification
- F. Epiretinal membrane
- G. Corneal decompensation
- H. Cystoid macular edema
- I. Anterior segment fibrosis
- J. Phthisis

VII. Describe appropriate patient instructions

- A. Patients with blebs should report any onset of redness or pain or discharge immediately
- B. Postoperative medications
- C. Advise of guarded visual prognosis
- D. Advise of potential for increased difficulty with control of IOP
- E. Advise to keep affected eye shielded at all times

Additional Resources

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. Brown RH, Yang LH, Walker SD, Lynch MG, Martinez LA, Wilson LA. Treatment of bleb infection after glaucoma surgery. *Arch Ophthalmol.* 1994;112:57-61.
- 3. Greenfield DS. Dysfunctional glaucoma filtration blebs. *Focal Points: Clinical Modules for Ophthalmologists.* San Francisco: American Academy of Ophthalmology; 2002, module 4.
- 4. Kangas TA, Greenfield DS, Flynn HW, Parrish RK, Palmberg P. Delayed-onset endophthalmitis associated with conjunctival filtering blebs. *Ophthalmology*. 1997;104:746-752.

Acute onset postoperative endophthalmitis

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of the disease

1. Bacteria enter the eye during the surgical procedure or through the wound in the postoperative period

B. Define the relevant aspects of epidemiology of the disease

- 1. Incidence after intraocular surgery is slightly less than one case per 1000 operations and depends on the indication for surgical intervention
- 2. In acute post-cataract endophthalmitis most cases are caused by gram- positive organisms, predominantly coagulase negative *Staphylococcus*, as well as *S. aureus*, *Streptococcus* spp, and also gram negative organisms
- 3. Studies have demonstrated that most cases are related to the patient's own bacterial flora
- 4. Occasional epidemics related to contaminated irrigating fluid have been described
- 5. Incidence increases in cases of complex or complicated surgery: capsular rupture, vitreous loss, and or wound leak

C. List the pertinent elements of the history

- 1. Onset usually within the first or second week postoperatively, but may be delayed
- 2. Foreign body sensation
- 3. Pain in approximately 75%
- 4. Redness
- 5. Vision loss
- 6. Lid swelling

D. Describe the pertinent clinical features

- 1. Decreased acuity
- 2. Increased conjunctival hyperemia and chemosis
- 3. Anterior chamber flare and cell
- 4. Hypopyon
- 5. Fibrin, particularly on lens surface
- 6. Vitreous cellular infiltration and opacification
- 7. Discharge
- 8. Lid edema
- 9. Corneal opacification

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Vitreous biopsy for culture and gram stain
- 2. Anterior chamber aspiration for culture and gram stain

II. Define the risk factors

- A. Diabetes mellitus
- B. Pre-existing conjunctival, lid or lacrimal infection
- C. Surgical complications, particularly capsular rupture or vitreous loss
- D. Externalized vitreous wick
- E. Wound dehiscence
- F. Immune compromised host

III. List the differential diagnosis

A. Toxic anterior segment syndrome

- 1. Acute noninfectious inflammatory reaction following anterior segment surgery (usually follows uneventful cataract surgery)
- 2. Results from inadvertent entry of toxic substance(s) into anterior chamber
- 3. Rapid onset (usually within 12-24 hours), but can be delayed (rare)
- 4. Findings
 - a. Corneal edema (if present, usually limbus to limbus)
 - b. Moderate to severe ac reaction +/- hypopyon and fibrin
 - c. Unreactive dilated pupil may be present
 - d. IOP elevation if trabecular meshwork is damaged
 - e. CME reported in a few cases
 - f. Vitritis and lid swelling usually absent
- 5. Etiology
 - a. Extraocular substances inadvertently entering ac intra- or postoperatively (e.g., talc from surgical glove)
 - b. Products intentionally introduced into ac intraoperatively
 - i. Contaminated anesthetic agents
 - ii. Preservatives (e.g., benzalkonium chloride)
 - iii. Mitomycin-C
 - iv. Contaminated intraocular lenses (including phakic IOL)

- v. Contaminated irrigating solutions
- vi. Contaminated surgical instruments
- 6. Often rapidly improves after topical steroids (distinguishing feature from infectious endophthalmitis)
- B. Rebound inflammation
- C. Lens induced uveitis
- D. Endogenous endophthalmitis

IV. Describe patient in terms of treatment and follow-up

A. Describe the natural history, outcome and prognosis

- 1. Visual loss is common even in treated patients
- 2. Approximately 50% of treated post-cataract patients achieve 20/40 or better vision
- 3. Outcome is dependent on the infecting organism: infections due to *Staphylococcus epidermidis* have better outcomes than gram-negative micrococci, *Staphylococcus aureus*, and Streptococcal infections
- 4. Time from presentation to treatment should be minimized for best prognosis

B. Describe medical therapy options

- 1. Intravitreal antibiotics are indicated in suspected cases, supplemented by
 - a. Systemic corticosteroids in many cases
 - b. Topical corticosteroids
 - c. Intravitreal steroids can be considered in eyes with severe inflammation (controversial)
 - d. Topical antibiotics
 - e. Oral antibiotics such as fourth generation fluoroquinolone could be considered, but not in lieu of intravitreal agents which should be administered urgently

C. Describe surgical therapy options

- 1. Intervention is indicated following the Endophthalmitis Vitrectomy Study guidelines (for post-cataract surgery endophthalmitis)
 - a. Applies to patients with acute onset endophthalmitis (presenting within 6 weeks of cataract surgery or secondary intraocular lens implantation)
 - b. Choice of initial procedure is guided by the presenting visual acuity:
 - c. For eyes with vision of light perception, pars plana vitrectomy and intraocular injection of antibiotics
 - d. For eyes with better than light perception, injection of intraocular antibiotics after tap for vitreous culture

V. List the complications of treatment, their prevention, and management

A. Surgical complications

- 1. Retinal detachment
- 2. Retinal tear
- 3. Vitreous hemorrhage
- 4. Anesthetic related complications
- 5. Corneal decompensation
- 6. Complications of anesthesia

B. Medical complications

- 1. Toxicity of injected antimicrobials
- 2. Complications of systemic corticosteroids
- 3. Complications of topical corticosteroids
- 4. Complications of topical antimicrobials

VI. Describe disease-related complications

- A. Vision loss
- B. Retinal detachment
- C. Vitreous opacification
- D. Epiretinal membrane
- E. Corneal decompensation
- F. Anterior segment fibrosis
- G. Cystoid macular edema
- H. Phthisis

VII. Describe appropriate patient instructions

- A. Postoperative medications
- B. Potential outcomes

Additional Resources

- 1. AAO, Basic and Clinical Science Course. Section 12:Retina and Vitreous, 2013-2014.
- 2. AAO, Focal Points: Evaluation of Impaired Visual Acuity Following Cataract Surgery, Module #6, 1996, p. 3-4.
- 3. Han DP. Endophthalmits. In: Albert DM, ed. *Ophthalmic Surgery: Principles and Techniques*.

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Malden MA: Blackwell Science; 1999:650-662.

4. Johnson MW, Doft BH, Kelsey SF, et al. The Endophthalmitis Vitrectomy Study. Relationship between clinical presentation and microbiologic spectrum. *Ophthalmology*. 1997;104:261-72.

Endogenous endophthalmitis

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

1. Bacterial or fungal organisms reach eye via bloodstream, enter internal ocular space by crossing blood-ocular barrier (blood-retina barrier)

B. Define the relevant aspects of epidemiology of the disease

- 1. Low incidence, commonly misdiagnosed, need high suspicion
- 2. Hematogenous spread usually means association with other foci of infection
- 3. Patients may present with systemic infection
- 4. Wide age range, with patients from neonates to patients in their tenth decade
- 5. Slight male preponderance
- 6. Bacterial
 - a. North America and Europe more gram-positive organisms
 - i. Staphylococcus aureus
 - ii. Group B Streptococcus
 - iii. Streptococcus pneumoniae
 - iv. Listeria sp.
 - v. *Nocardia* asteroides
 - b. East Asia predominantly gram negative organisms
 - i. Klebsiella sp.
 - ii. *E. coli*
 - iii. Pseudomonas sp.
 - iv. *N. meningitidis*
 - v. Serratia marcescens
- 7. Fungal
 - a. Candida albicans (yeast)
 - b. Aspergillus sp (mold)
 - c. Cryptococcus neoformans
 - d. Coccidioides immitis
- 8. Extraocular infection sites
 - a. Lung

- b. Liver
- c. Central nervous system
- d. Endocardium (Endocarditis)
- e. Sepsis
- f. Renal/ genitourinary tract

C. List the pertinent elements of the history

- 1. Detailed medical history key to diagnosis
- 2. Duration of symptoms
- 3. Underlying medical condition
 - a. Systemic infection
 - b. Recent minor procedure (colonoscopy, tattoo, hemorrhoidectomy, etc)
 - c. Immunocompromised
 - d. Intravenous drug abuse (IVDA)
 - e. Other medications
- 4. No recent intraocular surgery or trauma (to rule out exogenous endophthalmitis)

D. Describe pertinent ocular clinical features

- 1. Symptoms
 - a. Ocular pain
 - b. Blurred vision
 - c. Floaters
 - d. Photophobia
 - e. Scotoma
- 2. Signs
 - a. Swollen eyelids (uncommon)
 - b. Conjunctival chemosis and injection (may be absent)
 - c. Anterior chamber inflammation and hypopyon
 - d. Elevated intraocular pressure (IOP) with associated corneal edema
 - e. Vitritis
 - f. Reduced red reflex
 - g. Poor view of fundus due to secondary inflammation
 - h. Retinal infiltrates
 - i. Retinal hemorrhage with or without pale centers (Roth spots)

- j. Panophthalmitis (endophthalmitis plus orbital signs of proptosis, limited motility and possible optic nerve involvement)
- k. Candida
 - i. Multifocal, fluffy, yellow-white retinal or subretinal lesions extending into vitreous as "cotton balls"
 - ii. Vitreous infiltrates can present in "string of pearls" configuration
- I. Aspergillus
 - i. Yellow subretinal and retinal infiltrates, often in macula
 - ii. Inflammation generally more severe than Candida endophthalmitis
 - iii. Chorioretinal lesions usually larger and progress rapidly
 - iv. Inflammatory exudate may layer to form subretinal or subhyaloidal hypopyon
 - v. Propensity for vascular invasion thrombosis, necrosis
- 3. Extraocular symptoms
 - a. Systemic features may be absent , most commonly fever, chills and arthralgias

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Blood cultures
 - a. Regardless of symptoms
- 2. Intraocular
 - a. Anterior chamber sample
 - b. Vitreous sample for Gram stain, culture
 - i. Useful in absence of positive cultures from elsewhere
- 3. Culture indwelling catheters and IV lines
- 4. Extraocular
 - a. Wide range of sites
 - b. Consider urine, sputum, cerebrospinal fluid cultures dependent on symptoms and history
- 5. Polymerase chain reaction (PCR)
 - a. May be useful with unusual organisms or culture-negative samples

II. Define the risk factors

A. Underlying medical condition

- 1. Diabetes
- 2. IV drug abuse (IVDA)
- 3. Human immunodeficiency virus (HIV)/Acquired immunodeficiency syndrome (AIDS)

- 4. Autoimmune disease
- 5. Cardiac disease
- 6. Malignancy
- 7. Organ transplant

B. Systemic infection

- 1. Liver abscess
- 2. Pneumonia
- 3. Endocarditis
- 4. Soft tissue infection
- 5. Urinary tract infection
- 6. Meningitis
- 7. Septic arthritis

C. latrogenic

- 1. IV access
- 2. Indwelling catheter
- 3. Parenteral nutrition (TPN)
- 4. Abdominal surgery
- 5. Invasive procedures
- 6. Hemodialysis
- 7. Immunosuppression (long-term antibiotics or corticosteroids)

D. IVDA most common risk factor for Candida or Aspergillus endophthalmitis

E. Common associations

- 1. Klebsiella
 - a. Liver abscesses in diabetics
- 2. Pseudomonas aeruginosa
 - a. More common in neonates, younger patients
- 3. Neisseria meningitis
 - a. More common in children
- 4. Bacillus cereus
 - a. IV Drug abuse
- 5. Aspergillus
 - a. Chronic lung disease
 - b. Post liver transplant

- 6. Candida
 - a. Intraocular fungal infection in newborns, postpartum
 - b. History of malignancy, immunosuppression, TPN, indwelling catheters, recent abdominal surgery
- 7. Cryptococcus
 - a. Fungal meningitis (papilledema, headache)

III. List the differential diagnosis

A. Adults

- 1. Primary retinochoroidal infection
 - a. Toxoplasmosis
 - b. Toxocariasis
 - c. Tuberculosis
 - d. Syphilitic chorioretinitis
 - e. Cat-Scratch disease
 - f. Lyme disease
 - g. Diffuse unilateral subacute neuroretinitis (DUSN)
- 2. Non-infectious anterior or posterior uveitis (sarcoid, pars planitis)
- 3. Large cell lymphoma
- 4. Viral retinitis (cytomegalovirus (CMV) retinitis, acute retinal necrosis)
- 5. Angle-closure glaucoma (late, with elevated IOP & severe inflammation)
- 6. Mucormycosis / cavernous sinus thrombosis / orbital cellulitis (eyelid swelling, chemosis)
- 7. Sympathetic ophthalmia
- 8. Behçet disease
- 9. Intraocular tumor necrosis
- 10. Old vitreous hemorrhage (Terson syndrome)
- 11. Drug-induced hypopyon (rifabutin)

B. Children

- 1. Retinoblastoma (loss of red reflex)
- 2. Uveitis
- 3. Toxocariasis
- 4. Occult intraocular foreign body and exogenous endophthalmitis

IV. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcome, and prognosis

- 1. Bacterial
 - a. Prognosis poor
 - i. Majority of patients (69% in literature review of 271 eyes) count fingers or worse
 - i) 25% required evisceration or enucleation
 - ii) 5% mortality from direct result of extraocular infection
 - b. Gram-negative organism infection less likely to retain useful (counting fingers or better) vision than gram-positive organism infection; similar rate of evisceration/enucleation
 - c. Eyes undergoing vitrectomy more likely to retain useful vision, less likely to require evisceration or enucleation
 - d. Poor prognostic factors
 - i. Diagnosis delay
 - ii. Use of inappropriate antibiotics
 - iii. Panophthalmitis
 - iv. Virulent organisms
 - v. Gram-negative infection
- 2. Fungal
 - a. Variable prognosis in *Candida*
 - b. Poor prognosis in Aspergillus with secondary macular involvement and/or vascular involvement

B. Describe medical therapy options

- 1. Evaluation with medical workup by infectious disease specialist
- 2. Eye drops
 - a. Cycloplegic
 - b. Topical corticosteroid
- 3. Intravitreal injections
 - a. Bacterial
 - i. Vancomycin for gram positive
 - ii. Ceftazidime for gram negative
 - iii. Intravitreal corticosteroid (controversial)
 - b. Fungal

- i. Amphotericin B
- ii. Voriconazole
- 4. Systemic, broad-spectrum antibiotics per infectious disease consultant
 - a. Bacterial
 - i. Vancomycin
 - ii. Aminoglycoside
 - iii. Third-generation cephalosporin
 - iv. Fourth-generation-fluoroquinolone
 - v. Consider clindamycin in IVDA (suspect bacillus)
 - b. Fungal
 - i. Fluconazole or newer generation triazole (voriconazole)
 - ii. Amphotericin in resistant cases

C. Describe surgical therapy options

- 1. Vitrectomy
 - a. Remove organisms, endotoxins and exotoxins, vitreous opacities or membranes
 - b. Culture material
 - c. Perform if significant vitreous involvement or if high suspicion for fungal disease
 - i. In cases of fungal disease, early vitrectomy is better
- 2. Evisceration or enucleation if blind, painful; phthisical; unsalvageable

V. List the complications of treatment, their prevention and management

- A. Side effects and risks of systemic medications
- B. Risks of surgical intervention
 - 1. Retinal tear(s) and or retinal detachment
 - 2. Vitreous hemorrhage
 - 3. Risks of anesthesia

VI. Describe disease-related complications

- A. Ocular
 - 1. Cataract
 - 2. High IOP
 - 3. Hypotony

- 4. Retinal detachment
- 5. Secondary choroidal neovascular membrane
- 6. Chorioretinal scar
- 7. Phthisis
- 8. Loss of eye
- 9. Loss of vision

B. Systemic

1. Spread of infection outside eye

VII. Describe appropriate patient instructions

- A. Compliance upon discharge with ocular and systemic therapy
- B. Self-monitoring of symptoms (decrease in visual acuity, redness, pain)

Additional Resources

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. Jackson TL, Eykyn SJ, Graham EM, et al. Endogenous bacterial endophthalmitis: a 17-year prospective series and review of 267 reported cases. *Surv Ophthalmol* 2003;48:403-23.
- 3. Lee SY, Chee SP. Group B Streptococcus endogenous endophthalmitis: case reports and review of the literature. *Ophthalmology* 2002;109:1879-86.
- 4. Chee SP, Jap A. Endogenous endophthalmitis. *Curr Opin Ophthalmol* 2001;12:464-70.
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- Rao NA, Hidayat AA. Endogenous mycotic endophthalmitis: variations in clinical and histopathologic changes in candidiasis compared with aspergillosis. Am J Ophthalmol. 2001;132:244-251.

Chronic or delayed onset endophthalmitis following cataract surgery

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of the disease

1. Introduction of microbes into the eye during surgery or through the surgical incision in the postoperative period

B. Define the relevant aspects of epidemiology of the disease

- 1. Uncommon complication of cataract surgery
- 2. Most often due to Propionibacterium acnes
- 3. May be due to rare non virulent strain of *Staphylococcus* or other organism
- 4. Occasionally fungal in origin, sometimes as a part of epidemic caused by contamination of irrigating fluids or surgical instruments

C. List the pertinent elements of the history

- 1. Initial good visual results
- 2. Late onset of mild decreased vision
- 3. Late onset chronic irritation
- 4. Ocular pain (not always present)
- 5. Photophobia

D. Describe the pertinent clinical features

- 1. Mild to moderate conjunctival hyperemia
- 2. Mild to moderate anterior chamber flare and cell with keratitic precipitates (may become progressively more difficult to suppress with topical steroids)
- 3. Vitreous cellular infiltrate
- 4. Plaque of white infiltrate in capsule characteristic for *P. acnes*

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Anterior chamber tap for culture and sensitivity
- 2. Vitreous biopsy for culture and sensitivity
- 3. Fungal stains when suspicious
- 4. Anaerobic cultures for *P. acnes* must be held for 2 weeks
- 5. Gonioscopy to rule out retained lens fragments

II. Define the risk factors

A. Fungal cases more common in more equatorial latitudes

III. List the differential diagnosis

- A. Chronic sterile uveitis
- B. Retained lens material

IV. Describe patient in terms of treatment and follow-up

A. Describe the natural history, outcome and prognosis

- 1. Recurrent inflammation common in eyes which have not had total capsulectomy and removal of intraocular lens
- 2. Visual results of treatment similar to acute post-operative endophthalmitis, although fungal cases may have a worse prognosis

B. Describe medical therapy options

- 1. P. acnes
 - a. Intravitreal vancomycin, although antimicrobial therapy alone almost never cures disease
 - b. Role of intravitreal clindamycin for anaerobes (*P. acnes*)
- 2. Gram-positive organisms
 - a. Intravitreal vancomycin
- 3. Gram-positive and gram-negative organisms
 - a. Intravitreal ceftazidime
- 4. Fungal organisms
 - a. Intravitreal amphotericin
 - b. Intravitreal voriconazole
 - c. Consider oral fluconazole

C. Describe surgical therapy options

- 1. Most fungal infections require vitrectomy
- 2. *P. acnes* most effectively treated by vitrectomy and removal of plaque material
 - a. Capsule may sometimes be partially or entirely removed
 - b. Lens may sometimes be removed

V. List the complications of treatment, their prevention, and management

A. Surgical complications

- 1. Retinal detachment
- 2. Retinal tear
- 3. Vitreous hemorrhage
- 4. Corneal decompensation
- 5. Lens dislocation

B. Medical complications

- 1. Toxicity of injected antimicrobials
- 2. Complications of systemic corticosteroids
- 3. Complications of topical corticosteroids
- 4. Complications of topical antimicrobials

VI. Describe disease-related complications

- A. Visual loss
- B. Retinal detachment
- C. Vitreous opacification
- D. Epiretinal membrane
- E. Corneal decompensation
- F. Anterior segment fibrosis
- G. Cystoid macular edema
- H. Phthisis

VII. Describe appropriate patient instructions

- A. Postoperative topical antimicrobials
- B. Postoperative topical corticosteroids
- C. Advise patient to report any recurrent inflammation or visual loss

Additional Resources

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Focal Points: Evaluation of Impaired Visual Acuity Following Cataract Surgery, Module #6, 1996, p.4, 10-11.
- 3. Clark WL, Kaiser PK, Flynn HW, Belfort A, Miller D, Meisler DM. Treatment strategies and visual acuity outcomes in chronic postoperative *Proprionibacterium acnes* endophthalmitis. *Ophthalmology*. 1999;106:1665-1670.
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Necrotizing herpetic retinitis: acute retinal necrosis (ARN) and progressive outer retinal necrosis (PORN)

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. The most common organisms responsible for ARN and PORN are:
 - a. Varicella zoster virus (VZV) most common
 - b. Herpes simplex virus (HSV)
 - c. Can also be associated with Cytomegalovirus (CMV) and Epstein-Barr Virus (EBV)

B. Define the relevant aspects of epidemiology of the disease

- 1. Can occur at any age (usually in younger patients)
- 2. Usually begins as unilateral disease
- 3. One third develop involvement of fellow eye
- 4. May present as bilateral disease
- 5. PORN by definition occurs in severely immunocompromised patients
- 6. ARN occurs in immunocompetent patients
- 7. May be preceded by shingles (recent or remote) if VZV mediated

C. List the pertinent elements of the history

- 1. History of immunosuppression (PORN)
- 2. History of shingles or other herpetic infection
- 3. Vision loss
- 4. Floaters
- 5. Red eye
- 6. Light sensitivity
- 7. Pain

D. Describe pertinent clinical features

- 1. Acute retinal necrosis (ARN)
 - a. Usually otherwise healthy patient without immunocompromise
 - b. Peripheral retinal necrosis with discrete borders. Infiltrates usually start posterior to the equator

- c. Rapid progression in the absence of anti-viral therapy
- d. Circumferential spread
- e. Occlusive arteriolar vasculopathy
- f. Prominent inflammation in anterior chamber and vitreous
- g. Optic neuropathy common
- h. Can present initially as an optic neuropathy and subsequently develop retinitis
- 2. Progressive outer retinal necrosis (PORN)
 - a. Immunocompromised host
 - b. Multifocal areas of deep retinal opacification
 - c. Peripheral retinitis +/- macula
 - d. Lesions rapidly coalesce
 - e. Less prominent (or absent) vitritis
 - f. May have sparing of the retina around vessels
 - g. Extremely rapid progression to total retinal detachment (RD) and optic atrophy

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Diagnosis is primarily by clinical appearance, course
- 2. CD4 count
- 3. Human immunodeficiency virus (HIV)
- 4. Can consider vitreous polymerase chain reaction (PCR) for VZV or HSV

II. List the differential diagnosis

- A. Toxoplasmosis
- B. Cytomegalovirus retinitis
- C. Syphilitic retinitis
- D. Sarcoidosis

III. Describe patient management in terms of treatment and follow-up

A. Treatment options for ARN

- 1. IV acyclovir (1,500 mg/m2 IV in three divided doses) for 7-14 days followed by oral valacyclovir (1 g tid), oral famciclovir (500 mg tid), or oral acyclovir (800 mg 5 times daily) for up to 3 months to reduce risk for fellow eye
- 2. An alternative to IV acyclovir that may be considered is repeated intravitreal injections of ganciclovir or foscarnet in combination with oral valacyclovir

- 3. Oral prednisone in addition to above antivirals for ARN (controversial)
- 4. Role of aspirin unclear but sometimes recommended to inhibit vascular thrombosis
- 5. May consider prophylactic laser photocoagulation to prevent retinal detachment
- 6. Vitrectomy plus
 - a. Silicone oil due to potential late detachment from breaks in necrotic retina)
 - b. Gas tamponade for acute RD
 - c. In combination with oral valacyclovir or valganciclovir

IV. Describe patient management in terms of treatment and follow-up (treatment options for progressive outer retinal necrosis)

- A. Combination IV therapy with 2 agents (e.g., acyclovir plus foscarnet) may have better prognosis than IV acyclovir alone
- B. IV acyclovir: 50 90% no light perception
- C. Intravitreal therapy (ganciclovir and/or foscarnet) plus systemic ganciclovir or foscarnet may be the best treatment
- D. Long term maintenance therapy required

V. List the complications of treatment, their prevention and follow-up

- A. Acyclovir
 - 1. Renal impairment
- B. Ganciclovir (IV and oral) and valganciclovir
 - 1. Neutropenia
 - 2. Thrombocytopenia

C. Foscarnet

1. Renal impairment

VI. Describe disease-related complications

A. Retinal detachment

- 1. Incidence is high (>70%)
- 2. Most commonly occurs 8 to 12 weeks after onset of disease
- 3. May occur despite prophylactic laser retinopexy
- 4. Vitrectomy with silicone oil
- B. Optic neuropathy
- C. Cataract

Additional Resources

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Ophthalmology Monographs 11. Laser Photocoagulation of the Retina and Choroid, 1997.
- 3. AAO, Retinal Detachment: Principles and Practice, 2nd ed., 1995.
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- 7. Bonfioli AA, Eller AW. Acute retinal necrosis. *Semin Ophthalmol* 2005;20:155-60.
- 8. AAO, Focal Points: Infectious Posterior Uveitis, Module #3, 2005.

Toxoplasmosis

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease - *Toxoplasma gondii*

- 1. Protozoal infection of the retina and choroid
- 2. Latent infection has encysted organisms in host cells at borders of scars
- 3. May become actively replicating infection
- 4. Active infection produces inflammatory reaction
- 5. Infection and inflammation are tissue destructive

B. Define the relevant aspects of epidemiology of the disease

- 1. Usually unilateral
- 1. Accounts for 25% of cases of posterior uveitis in United States, probably most common cause worldwide
- 2. Regional differences in prevalence of toxoplasmosis infection
- 3. Definitive host is the cat
- 4. Infective forms are oocysts and bradycysts
 - a. Usually ingested in contaminated food or water or in undercooked meat
- 5. Vertical transmission (intrauterine infection) possible
 - a. 65-85% bilateral
 - b. 55-60% involve macula

C. List the pertinent elements of the history

- 1. Exposure to materials fecally contaminated by cats
 - a. Litter boxes
 - b. Garden soil
 - c. Improperly stored water (unsecured reservoirs)
 - d. Food (Contaminated)
- 2. Exposure to undercooked meats from infected animals
- 3. Animals were exposed to material fecally contaminated by cats
- 4. Exposure to uncooked vegetables grown in fecally contaminated soil
- 5. Maternal prenatal infection (vertical transmission)
- 6. Recent febrile illness or lymphadenopathy (acquired toxoplasmosis)

D. Describe pertinent clinical features

- 1. Unilateral focal chorioretinitis adjacent to healed chorioretinal scar
 - a. Active chorioretinitis is yellow-white, slightly elevated, with a relatively well-defined border
 - b. Healed scars may be multiple, but usually only one reactivates at a time
 - c. Atypical forms of extensive chorioretinitis may occur in immunocompromised individuals
- 2. Intraocular inflammation
 - a. Iritis
 - i. Often granulomatous
 - b. Vitritis
 - i. Often intensified over the lesion (headlight in the fog)
 - c. Vasculitis
 - i. Variably present
 - ii. Often arteritis, but also periphlebitis
 - iii. May be remote from the chorioretinitis
 - d. Neuroretinitis
 - e. Cystoid macular edema or macular star
 - f. Optic neuropathy
 - i. Secondary inflammation in nerve or infective neuroretinitis
- 3. Presentation and course are more aggressive in immunosuppressed host

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Mostly clinical diagnosis
- 2. Confirmation of exposure to toxoplasmosis by serum antibody titers
 - a. High sensitivity and low specificity because of high prevalence of positive antibody titers in general population
 - b. Immunoglobulin (Ig) M antibody determinations helpful in the diagnosis of acquired toxoplasmosis although seldom detected
 - i. Aqueous IgG or IgA
 - ii. Polymerase chain reaction (PCR) of aqueous or vitreous
 - i) Can be helpful in atypical cases

II. Define the risk factors

- A. Risk of congenital infection if pregnant woman develops toxoplasmosis infection
- B. Risk of acquired infection
 - 1. Residence in endemic area

- 2. Contact with cat litter or soil contaminated by cats
- 3. Consumption of undercooked meat
- 4. Consumption of uncooked vegetables from soil contaminated by cats
- 5. Consumption of contaminated water

C. Risk of recurrent infection

1. Increased if impairment of immune system or advanced age

III. List the differential diagnosis

A. Infections

- 1. Cat-scratch disease (Bartonella sp. infection)
- 2. Tuberculosis
- 3. Toxocariasis
- 4. Cytomegalovirus retinitis
- 5. Necrotizing herpetic retinitis
- 6. Syphilis
- 7. Focal fungal or bacterial infections
- 8. Endogenous endophthalmitis
- B. Posterior uveitis
- C. Masquerade syndromes
 - 1. Intraocular tumors
 - 2. Intraocular lymphoma

IV. Describe patient management in terms of treatment and follow-up

A. Decision to treat based on proximity to macula and optic nerve, amount of inflammation, and vision

- 1. Sight-threatening infections almost always treated
- 2. Small, peripheral lesions often observed
- 3. Infection is self-limited in most cases in healthy patients
- B. Antibiotic treatment- may be used for reactivation or for prophylaxis in preparation for ocular surgery
 - 1. Traditional triple therapy
 - a. Pyrimethamine
 - i. Can be combined with sulfadiazine or triple-sulfa, azithromycin, or clindamycin

- b. Folinic acid
- c. Sulfadiazine or trimethoprim-sulfamethoxazole
- 2. Monotherapy generally reserved for non-sight-threatening disease usually when intraocular inflammation severe enough to warrant oral corticosteroid use
 - a. Trimethoprim-sulfamethoxazole
 - b. Doxycycline or minocycline
 - c. Azithromycin
 - d. Atovaquone
 - e. Clindamycin

C. Anti-inflammatory treatment

- 1. Topical corticosteroids
- 2. Oral corticosteroids
 - a. Recommend not starting steroids prior to initiation of antibiotics

V. List the complications of treatment, their prevention and management

A. Pyrimethamine

- 1. Hematologic toxicity
 - a. Prevention with leucovorin (folinic acid) use
- 2. Periodic blood counts if high doses given

B. Clindamycin

1. Low risk of pseudomembranous colitis

C. Sulfa medications

- 1. Rash
- 2. Nausea
- 3. Stevens-Johnson syndrome
- 4. Aplastic anemia
- D. Tetracyclines
 - 1. Photosensitivity
 - 2. Discoloration of tooth enamel in children < 11 years or in babies of treated mothers
- E. Corticosteroids
 - 1. Possible increase in risk of recurrence

VI. Describe disease-related complications

- A. Loss of vision related to chorioretinal scars
- B. Nystagmus in children with congenital infection
- C. Chronic vitreous opacification
- D. Epiretinal membrane
- E. Choroidal neovascularization
- F. Retinal tear or detachment
- G. Cataract
- H. Vascular occlusion

VII. Describe appropriate patient instructions

A. Report redness, pain, blurred vision, new floaters, or sensitivity to light immediately

Additional Resources

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Focal Points: Ocular Toxoplasmosis: Clinical Presentations, Diagnosis, and Therapy, Module #10, 1999.
- 3. Cochereau-Massin I, LeHoang P, Lautier-Frau M, et al. Ocular toxoplasmosis in himan immunodeficiency virus-infected patients. *Am J Ophthalmol* 1992;114:130-135.
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- 8. Koo L, Young LH. Management of ocular toxoplasmosis. Int Ophthalmol Clin 2006;46:183-93.
- 9. Bonfioli AA, Orefice F. Toxoplasmosis. *Semin Ophthalmol* 2005;20:129-41.
- 10. Soheilian M, Sadoughi MM, Ghajarnia M, et al. Prospective randomized trial of trimethoprim/sulfamethoxazole versus pyrimethamine and sulfadiazine in the treatment of ocular toxoplasmosis. *Ophthalmology* 2005;112:1876-82.
- 11. AAO, Focal Points: Infectious Posterior Uveitis, Module #3, 2005.

Syphilitic panuveitis

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Sexually transmitted multi-systemic disease caused by the spirochete *Treponema pallidum*
- 2. Occurs in secondary stage of syphilis

B. Define the relevant aspects of epidemiology of the disease

- 1. It can affect individuals of any socioeconomic group
- 2. Increased risk among individuals engaging in high risk sexual behavior and those with acquired immune deficiency syndrome (AIDS)
 - a. May be sentinel infection that leads to diagnosis of human immunodeficiency virus (HIV) infection
- 3. 1%-2% of all uveitis cases
- 4. Geographically concentrated

C. List the pertinent elements of the ocular history

- 1. Sudden or insidious
- 2. Variable severity
- 3. Variable pain, redness and photophobia
- 4. Blurred vision or floaters

D. Describe pertinent ocular features

- 1. Uveitis most common ocular manifestation
 - a. Unilateral or bilateral
- 2. Cystoid macular edema
- 3. Vitritis
- 4. Hypopyon
- 5. Chorioretinitis may be focal or multifocal
- 6. Diffuse or localized choroiditis or chorioretinitis, posterior plaque of chorioretinitis or multiple yellow-gray subretinal lesions
- 7. Retinitis (focal or necrotizing); Retinitis with superficial retinal precipitates
- 8. Exudative retinal detachment
- 9. Retinal vasculitis or perivasculitis
- 10. Neuroretinitis
- 11. Isolated papillitis

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Serodiagnosis: nontreponemal tests
 - a. Venereal Disease Research Laboratory (VDRL) or rapid plasma reagin (RPR)
 - i. Positive VDRL or RPR indicates active disease and exposure to the bacteria
 - ii. Titers return to normal with effective therapy
 - iii. Titers may also return to normal without treatment in patients with late latent and tertiary syphilis
 - iv. Biological false positive results may result from cross reactive antibodies (ex. anticardiolipin, Lyme) and it occurs more commonly in HIV-infected patients and in the geriatric population
 - v. Other causes for false positive tests include
 - i) Recent viral infection
 - ii) Immunization
 - iii) Pregnancy
 - iv) Presence of lupus anticoagulant
 - v) Antiphospholipid antibodies
- 2. Serodiagnosis: treponemal tests
 - a. Fluorescent treponemal antibody absorption (FTA-Abs)
 - b. Microhemagglutination assay Treponema pallidum (MHA-TP)
 - c. More specific than non-treponemal tests
 - d. Turn positive earlier and remain positive longer than non-treponemal tests
 - e. Should always follow a positive non-treponemal test to confirm the diagnosis of syphilis
 - f. False positive results may occur due to antigenic cross-reactivity in individuals who may be positive for other spirochetal infections (Lyme disease, leptospirosis) and autoimmune disease (systemic lupus erythematosus (SLE))
- 3. Cerebrospinal fluid (CSF) analysis
 - a. In patients with uveitis and positive serology, asymptomatic neurosyphilis must be ruled out
- 4. HIV testing on all patients with syphilis given high rate of co-infection

II. List the differential diagnosis

- A. Syphilis is the "great masquerader", so consider the possibility of syphilis in any case of diffuse uveitis unresponsive to conventional anti-inflammatory therapy
- B. Retinitis pigmentosa
- C. Necrotizing herpetic retinopathies (acute retinal necrosis, progressive outer retinal necrosis)
- D. Cytomegalovirus retinitis
- E. Tuberculosis
- F. Lyme disease
- G. Sarcoidosis
- H. Toxoplasmosis (especially in acquired immunodeficiency syndrome (AIDS) patients)
- I. Neuroretinitis
- J. Intraocular lymphoma

III. Describe patient management in terms of treatment and follow-up

- A. Ocular inflammation secondary to syphilis should be treated as neurosyphilis
 - 1. Penicillin G, IV for 10-14 days
 - 2. Topical, regional or oral corticosteroids may be used to quiet anterior or posterior segment inflammation
- B. In patients allergic to penicillin
 - 1. Doxycycline or penicillin desensitization under careful observation
- C. For patients with positive CSF serology, repeat CSF exam every 6 months until cell count, protein and VDRL return to normal

IV. Describe appropriate patient instructions

- A. Importance of long term serologic monitoring
- B. Monitor patient for development of Jarisch-Herxheimer reaction during first 24 hours of treatment
 - 1. Massive systemic inflammatory/cytokine response to large antigenic load of inactivated or killed pathogen

- AAO, Basic and Clinical Science Course. Section 9: Intraocular Inflammation and Uveitis, Section 12: Retina and Vitreous, 2013-2014.
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- 3. Browning DJ. Posterior segment manifestations of active ocular syphilis, their response to a neurosyphilis regiment of penicillin therapy, and the influence of human immunodeficiency virus status on response. Ophthalmology 2000; 107:2015-2023.
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- 7. AAO, Focal Points: Laboratory Evaluation of Patients with Uveitis, Module #12, 2001.

8. AAO, Focal Points: Infectious Posterior Uveitis, Module #3, 2005.

Toxocariasis posterior uveitis

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Infestation of the retina/choroid with a second stage larva of *Toxocara canis* (most commonly) or *Toxocara cati*
- 2. Infestation is presumed to occur after ingestion or cutaneous infection with hematogenous spread to the eye

B. Define the more common aspects of the epidemiology of this disease

- 1. Usually occurs in children of lower economic settings
- 2. More common in sub-tropical or tropical climates because the ground does not freeze

C. List the pertinent elements of the history

- 1. Severe loss of vision in one eye in a child
- 2. Loss of red reflex in one eye of a child
- 3. Strabismus with vision loss in one eye in a child
- 4. History of a red eye
- 5. Play in soil contaminated by pets
- 6. Pica

D. Describe pertinent clinical features

- 1. Peripheral granuloma
 - a. Focal, elevated, white, peripheral nodule with variable degrees of surrounding peripheral membranes and pigmentary scarring
 - b. Falciform fold in retina from lesion to optic nerve
 - c. Possible retinal detachment
 - d. Vitreous opacities
 - e. Usually diagnosed in cicatricial phase when the inflammation is quiescent
- 2. Posterior granuloma
 - a. Focal, elevated, white nodule, usually < 1 disc diameter, with variable pigmentation
 - b. Vitreous opacities and membranes
 - c. Secondary inflammatory changes more mild than with peripheral granuloma
 - d. Prognosis depends on location
- 3. Endophthalmitis
 - a. Panuveitis with red, painful eye

- b. Often no view of fundus
- c. Ascribed to death of the parasite with a secondary exuberant inflammatory reaction

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Clinical features with supportive Toxocara serology is usually considered diagnostic
- 2. Antibody to toxocara may not be lifelong
- 3. Intraocular fluid can be assayed for specific anti-Toxocara antibodies, cytology for eosinophilic leukocytes
- 4. Polymerase chain reaction of intraocular fluids

II. Define the risk factors

- A. Contact with soil or food contaminated with feces from infected animals (dogs and cats)
- B. Cutaneous larva migrans
- C. Visceral larva migrans

III. List the differential diagnosis

- A. Toxoplasmosis
- B. Retinoblastoma
- C. Pars planitis (peripheral Toxocaral granuloma)
- D. Coats disease
- E. Other forms of uveitis
- F. Toxoplasmosis
- G. Persistent fetal vasculature

IV. Describe patient management in terms of treatment and follow-up

A. Describe medical therapy options

- 1. Parasite is assumed to be dead when the patient presents with either cicatricial or acute inflammatory changes
- 2. Treatment with albendazole or thiabendazole
 - a. Probably achieves intraocular levels
 - b. Should provide no benefit in cicatricial disease
 - c. Treatment rarely given
- 3. Corticosteroid therapy can reduce secondary damage from intraocular inflammation

B. Describe surgical therapy options

- 1. Vitrectomy indicated for significant vitreous inflammation, debris, or traction.
- 2. Diagnostic biopsy of vitreous (rare)
- 3. Repair of retinal detachment (RD) is possible with vitreoretinal procedures
- 4. Excision of granuloma may be necessary

V. Describe disease-related complications

- A. Severe vision loss with macular scar
- B. Retinal folds and RD
- C. Amblyopia
- D. Cataract

VI. Describe appropriate patient instructions

- A. Assess home environment for risks to other children
- B. Report changes in vision that may indicate retinal detachment

- AAO, Basic and Clinical Science Course. Section 9: Intraocular Inflammation and Uveitis, Section 9: Retina and Vitreous 2013-2014.
- 2. AAO, HIV: HIV/AIDS and the Eye: A Global Perspective, 2002.
- 3. AAO, Focal Points: Infectious Posterior Uveitis, Module #3, 2005.

Cytomegalovirus retinitis

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Cytomegalovirus retinitis (CMV) is a herpes-class virus that is common in the human population
- 2. Transmission
 - a. Congenital infection via vertical transmission from a mother during pregnancy
 - b. Acquired infection from sexual contact, contact with other body fluids, including urine and respiratory transmission (rare)
- 3. Latency
 - a. CMV is a DNA virus that can establish latency in a variety of human cell types
 - b. Recurrence from latency can occur
- 4. Clinical manifestations of CMV infection
 - a. Congenital infection can have devastating neurologic and ocular effects, including blindness
 - b. Acquired infection in children or adults is usually inapparent or mildly symptomatic
 - c. Reactivation depends on body tissue affected
 - i. Reactivation of latent infection is due to loss of immunity
 - ii. Retinal involvement is the most common and clinically important disease associated with CMV
 - iii. Other organs that are commonly involved include mucosal lining of gastrointestinal tract and the lungs

B. Define the relevant aspects of epidemiology of this disease

- 1. CMV retinitis from reactivation of latent infection occurs in patients who are immunocompromised
 - a. Acquired immune deficiency syndrome (AIDS)
 - b. Organ-transplant patients and other iatrogenic immunosuppression
 - c. Elderly patients with loss of specific immunity
- 2. CMV retinitis in patients with AIDS is a major public health problem
 - a. Number of new cases is markedly reduced with the advent of highly active anti-retroviral therapy (HAART). However, although the incidence has decreased, CMV retinitis is still the most common opportunistic infection in HIV + patients
- 3. In AIDS, CMV retinitis usually occurs in patients with CD4+ T-lymphocyte counts < 50 cells/mm³ and a significant or high viral load
 - a. Risk increases with CD4 counts < 100

b. Only rarely does CMV occur at CD4 counts > 250

C. List the pertinent elements of the history

- 1. Ocular symptoms
 - a. Blurred vision and/or floaters are most common presenting symptoms
 - b. Patients may be asymptomatic
 - c. Patients often do not initially note visual field loss from peripheral disease
 - d. Presentation with moderate to severe vision loss in one eye may be present
- 2. CMV retinitis as the first manifestation of AIDS, leading to diagnosis, is less common (around 5%)
- 3. CMV retinitis may be associated with systemic CMV disease:
 - a. Active CMV may be detected in the blood or urine by polymerase chain reaction (PCR) or culture in approximately 60% of patients
- 4. Inquire about risk factors for HIV infection
- 5. If an organ transplant patient, inquire about CMV status of host and donor at time of transplantation, any CMV prophylaxis treatment, and immunosuppressive drugs

D. Describe pertinent clinical features

- 1. Necrotizing retinitis
 - a. Patches of infected retina tend to be wedge-shaped or arcuate
 - b. Infected retina is a characteristic yellow-white color
 - c. Intraretinal hemorrhage within the necrotizing retina is common, but not essential to diagnosis
 - d. Fulminant retinal necrosis with retinal hemorrhage is more often seen in the posterior pole
 - e. Granular/indolent retinitis is more commonly seen in the periphery
 - f. Patches heal from the inside out with an active border surrounding an atrophic central core
 - g. Circular or geographic lesions may also occur
 - h. Punctate satellite lesions at the edge of active retinitis are common
 - i. Frosted branch angiitis occurs in small percentage of untreated patients
- 2. Unilateral or bilateral disease may be present at time of diagnosis
- 3. Intraocular inflammation
 - a. Mild vitritis is common
 - b. Anterior segment inflammation can occur, but severe inflammation is uncommon. The eye is white and there are usually no posterior synechiae
- 4. Optic nerve involvement most commonly occurs secondary to spread from adjacent retinitis
- 5. Primary optic nerve involvement without accompanying retinitis can occur but is uncommon

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Characteristic clinical appearance is considered adequate for diagnosing CMV retinitis in patients with a high risk of disease
- 2. HIV antibody, viral load, and CD4+ T-lymphocyte count are pertinent to establishing likelihood of CMV retinitis
- 3. Active CMV may be detected in the blood or urine by PCR or culture in approximately 60% of patients
- 4. CMV serology not useful because of high rate of positivity in the population at risk
 - a. Titer of CMV antibody is not relevant to diagnosis

II. Define the risk factors

- A. HIV infection with CD4 <50 and high viral load; occurs less commonly with increasing CD4+ counts
- B. Organ transplant recipient on immunosuppressive medication, especially those who received transplant from a seropositive donor
- C. Immunosuppression following chemotherapy

III. List the differential diagnosis

- A. Necrotizing herpetic retinitis due to varicella zoster or herpes simplex
- B. Toxoplasma chorioretinitis
- C. Syphilitic chorioretinitis
- D. HIV retinopathy with hemorrhages and cotton wool spots
- E. Other bacterial and fungal infection of the retina

IV. Describe patient management in terms of treatment and follow-up

A. Describe medical therapy

- 1. HAART leads to sustained elevation of CD4+ levels and may eliminate need for anti-CMV treatment
- Induction therapy with either high dose intravenous antiviral medication for 2 to 3 weeks and/or weekly intravitreal injections of anti-viral agents. (Note: intravitreal injections fail to cover systemic CMV disease, important in immunosuppressed patients.)
 - a. Treatment with intravitreal injections alone for 2 to 3 weeks if systemic medications are contraindicated due to renal or bone marrow toxicity
 - b. Oral valganciclovir is a commonly used adjunct
 - c. Intravitreal ganciclovir or foscarnet is commonly used with macula or optic nervethreatening disease)
- 3. Maintenance therapy with lower doses of antiviral medication until there is improvement in the

immune system (Recommend to continue treatment until the CD4 is greater than 100 for 3 to 6 months)

- a. Oral valganciclovir is most commonly used
- b. Oral ganciclovir is rarely used for maintenance therapy due to poor bioavailability and poor intravitreal concentration
- 4. Relapse may occur depending upon immune status

B. Describe surgical therapy options

- 1. Intravitreal injection (ganciclovir or foscarnet)
- 2. Ganciclovir implant with concomitant oral ganciclovir
- 3. Vitrectomy for retinal detachment
- 4. Intraocular injection for relapsed disease

V. List the complications of treatment, their prevention and management

A. Ganciclovir

- 1. Neutropenia, anemia, and thrombocytopenia common
- 2. Anemia may occur with valganciclovir
- 3. Treatment with bone marrow stimulants or discontinuation of drug
 - a. Bone marrow stimulants
 - b. Withdrawal of other bone-marrow suppressive drugs

B. Foscarnet

- 1. Renal toxicity common
 - a. Incidence reduced with careful dose calculation based on creatinine clearance
 - b. Adequate hydration may also help prevent toxicity
- 2. May also result in anemia
 - a. Hydration before administration of drug is mandatory
 - b. Requires concomitant use of oral probenecid to protect kidney from drug uptake
 - c. Kidney function checked frequently during treatment
 - d. Use of smallest effective dose

C. Cidofovir

- 1. Intraocular inflammation
 - a. Treatment with topical steroids
- 2. Hypotony
 - a. Usually irreversible

- 3. Renal toxicity
 - a. Incidence reduced with careful dose calculation based on creatinine clearance
 - b. Adequate hydration may also help prevent toxicity

VI. Describe disease-related complications

- A. Retinal detachment
- B. Optic nerve atrophy
- C. Blindness
 - 1. Especially in zone 1 disease (posterior)
 - a. Macula
 - b. Optic nerve

D. Intraocular inflammation

- 1. Immune recovery uveitis reported as immune system recovers in HIV-positive patients with CMV retinitis
 - a. The risk of immune recovery uveitis is higher among patients treated with cidofovir for CMV retinitis.
 - b. Treat immune recovery uveitis with topical or systemic steroids
- 2. Macular edema
- 3. Epiretinal membrane
- E. Cataract

VII. Describe appropriate patient instructions

- A. Drug compliance
- B. Report changes in vision or new floaters promptly

- AAO, Basic and Clinical Science Course. Section 1: Update on General Medicine; Section 4: Ophthalmic Pathology and Intraocular Tumors; Section 5: Neuro-Ophthalmology; Section 9: Intraocular Inflammation and Uveitis; Section 12: Retina and Vitreous, 2013-2014.
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Retinitis pigmentosa

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Hereditary basis can be established in only about 50% of cases
- 2. May be autosomal dominant, autosomal recessive, X-linked recessive, or simplex (i.e., no family history of retinitis pigmentosa)

B. Define the relevant aspects of epidemiology of the disease

- 1. Incidence 1 in 4000
- 2. Most common hereditary chorioretinal dystrophy
- 3. 20% autosomal dominant, < 10% X-linked
- 4. Autosomal recessive most common hereditary mode

C. List the pertinent elements of the history

- 1. Nyctalopia
- 2. Constricted visual fields
- 3. Onset of symptoms commonly in first or second decade of life, but may present much later
 - a. Statistically, X-linked RP has the earliest onset of disease

D. Describe pertinent clinical features

- 1. Narrowed arterioles are typically the earliest feature of RP
- 2. Diffuse mottling and granularity of the RPE also occur early
- 3. Pigment migration into the retina in a spiculated pattern is typical but sine pigmento forms may occur
- 4. Waxy disc pallor occurs late and may be associated with disc drusen in certain forms of RP

E. Associated features and complications

- 1. Fine pigmented cells in vitreous
- 2. Cystoid macular edema (CME) with or without angiographic leakage
- 3. Posterior subcapsular cataracts (PSC)
- 4. Coats like exudative response
- 5. Rarely vasoproliferative tumor
- F. Describe appropriate testing and evaluation for establishing the diagnosis
 - 1. Electrophysiology
 - a. Electroretinography (ERG)

- i. Testing method
 - i) Corneal electrode is used to record retinal response to a light stimulus
 - ii) Scotopic ERG
 - (i) tested in dark-adapted state
 - (ii) dim flash of light (below cone threshold)
 - (iii) measures rod response only
 - (iv) Bright flash—measures both rod and cone response
 - iii) Photopic ERG
 - (i) tested in light-adapted state
 - (ii) measures cone function (rods are bleached)
 - iv) 30-Hz flicker response
 - (i) Measures cone response
- ii. Results
 - i) a-wave
 - (i) First waveform (negative direction) following light stimulus
 - (ii) Measures photoreceptor layer
 - ii) b-wave
 - (i) Second waveform (positive direction)
 - (ii) Measures bipolar and Muller cells
- iii. Interpretation
 - i) Rod-cone dystrophy: Scotopic responses are primarily diminished
 - ii) Cone-rod dystrophy: Photopic responses are primarily diminished
- 2. Psychophysiologic
 - a. Dark adaptometry
 - i. Performed by first light-adapting patient, then testing patient in dark conditions with series of dim lights projected 11 degrees below fixation. Lowest threshold of stimulus intensity that is perceived is plotted against time.
 - ii. Useful in evaluating night blindness
 - iii. Typical RP findings
 - i) Delayed cone-rod break
 - ii) Elevated final threshold
 - iii) Abnormally prolonged recovery to final threshold
 - b. Color vision testing

- i. Ishihara, Hardy-Rand-Ritter plates
 - i) Colored figures or numbers that stand out in a field of colored dots
 - ii) Adequate for screening, but not for classifying the deficiency
- ii. Farnsworth Panel D-15
 - i) 15 colored discs, patients asked to arrange
 - ii) May quickly screen for the nature of the color deficiency
 - iii) less sensitive, but more practical
- iii. Farnsworth-Munsell 100-hue test
 - i) Patients arrange 100 colors discs
 - ii) Very sensitive, but time consuming
- c. Contrast sensitivity
 - i. Pelli Robson contrast sensitivity chart
 - ii. Unlike Snellen chart, letters decrease in contrast instead of size
- 3. Other tests of value
 - a. Goldmann visual field testing or equivalent (e.g. Humphrey automated field testing)
 - i. Annular or ring scotoma or constriction of isopters may be observed
 - b. Fluorescein angiography
 - c. OCT
 - i. Diffuse disruption of the inner segment/outer segment (is/os) layer
 - ii. Diffuse thinning of the photoreceptor layer
 - iii. CME may be seen
 - d. Autofluorescence
 - i. Ring hyperfluorescence in a paramacular pattern
 - ii. Hypofluorescence corresponding to midperipheral spicules

II. Define the risk factors

- A. Parental consanguinity
- B. Positive family history

III. List the differential diagnosis

- A. Infection (such as syphilis, congenital rubella)
- B. Inflammation (uveitis)

- C. Choroidal vascular occlusion
- D. Toxicity (chloroquine or thioridazine)
- E. Systemic metabolic disorders (Refsum disease, abetalipoproteinemia)
- F. Blunt trauma
- G. Resolution of an exudative retinal detachment
- H. Gyrate atrophy (night blindness)
- I. Choroideremia (night blindness)
- J. Vitamin A deficiency (night blindness)
 - 1. Inquire about gastric bypass procedures
 - 2. Bitot spot
 - 3. Dry eye
- K. Congenital stationary night blindness

L. Paraneoplastic retinopathy

- 1. Cancer associated retinopathy or CAR
- 2. Melanoma associated retinopathy or MAR
- 3. Typically rapid late onset pan retinal degeneration
- 4. Minimal pigment spiculation
- 5. CAR includes small cell lung carcinoma

M. Acute zonal occult outer retinopathy (AZOOR)

- 1. Initially presents with photopsia
- 2. Patchy field loss with
- 3. Minimal funduscopic findings
- 4. May progress to a panretinal degeneration
- 5. Typically without pigment spiculation

N. Goldmann-Favre Syndrome (enhanced S-cone syndrome)

- 1. Autosomal recessive
- 2. Excessive S-cones ("S" for "short" or blue-wavelength cones)
- 3. Symptoms
 - a. Nyctalopia
 - b. Increased blue light sensitivity
 - c. Variable peripheral field loss
- 4. Signs
 - a. Pigmentary retinal degeneration

- b. Optically empty vitreous
- c. Yellowish pigmentary lesions along vascular arcades
- d. Macular schisis—does not leak on angiography

IV. Describe patient management in terms of treatment and follow-up

A. Describe natural history, outcomes, prognosis

- 1. Retinitis pigmentosa (RP) slowly progresses to visual loss over time
- 2. Late in the course, ERG becomes undetectable
- 3. Follow with serial visual field testing to provide patient with a reference for rate of progression

B. Describe medical therapy options

- 1. Nutritional supplementation options
 - a. Vitamin A palmitate
 - i. Large study suggested 15,000 IU/day may slow the progression but benefits considered marginal at best by various experts worldwide
 - ii. Marginal benefits must be balanced against possible risks of high-dose Vitamin A toxicity (teratogenicity, liver toxicity)
 - b. Docosahexaenoic acid (DHA) (omega-3 fatty acid found in cold water fish)
 - i. Two clinical trials failed to show clear treatment benefit, but patients in those trials with the highest levels of DHA in red blood cells had the lowest rates of degeneration
- 2. Associated CME may respond to oral carbonic anhydrase inhibitors (i.e., acetazolamide)
- 3. Diet with fish (1-3 servings per week) may slow progression

C. Describe surgical therapy options

- 1. Intravitreal triamcinolone for associated CME
- 2. Cataract extraction

V. List the complications of treatment, their prevention and management

- A. Vitamin A toxicity (particularly hepatotoxicity)
- B. Risks of intravitreal injection
- C. Risks of cataract surgery

VI. Describe disease-related complications

A. Systemic diseases with RP association (Syndromic RP)

1. Refsum disease (associated with neurological complications such as ataxia or neuropathy)

- a. Check serum phytanic acid level
- 2. Bassen-Kornzweig syndrome AKA a beta lipoproteinemia (malabsorption of fat soluble vitamins)
 - a. Check lipid profile and serum protein and lipoprotein electrophoresis and peripheral blood smear
- 3. Kearns-Sayre syndrome (RP with mitochondrial myopathy)
 - a. Chronic progressive external ophthalmoplegia (CPEO)
 - b. Cardiology consultation to rule out cardiac conduction defects
- 4. Usher syndrome (RP with congenital sensorineural hearing loss)
 - a. Otolaryngology consultation
- 5. Bardet Biedel Syndrome
 - a. Obesity
 - b. Polydactyly
 - c. Cognitive delay

VII. Describe appropriate patient instructions

- A. Genetic counseling
- B. Assess driving abilities in relationship to visual acuity and field
- C. Vision rehabilitation as needed

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Stargardt disease/fundus flavimaculatus

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Stargardt disease and fundus flavimaculatus are variable phenotypic expressions of the same genetic mutation in the ATP-binding cassette (ABC) transporter gene *ABCA4* located on chromosome 1p (i.e. allelic mutations and combinations leads to various phenotypes)
- 2. Abnormal *ABCA4* protein function leads to build-up of lipofuscin in retinal pigment epithelium (RPE) cells, limiting their function and viability

B. Describe the relevant aspects of epidemiology of the disease

- 1. Stargardt disease (STGD1) is the most common macular dystrophy
- 2. Spans all ethnic populations
- 3. Equal male and female incidence
- 4. Estimated prevalence of 1:10,000
- 5. Autosomal recessive inheritance for STGD1
- 6. Chance of affected parent having an affected child is less than 1% in STGD1
- Dominant forms of Stargardt disease have been identified and are much less common e.g. STGD
 3, ELOVL4 mutation,(elongation of very long chain fatty acid)

C. List the pertinent elements of the history

- 1. History of completely normal visual function in early childhood
- 2. Family history
 - a. Immediate relatives (typically siblings in the autosomal recessive form) with same or different macular dystrophy and/or degeneration (rare)
 - b. Phenotypes may vary dramatically
 - c. Consanguineous reproduction increases the likely expression of a recessively inherited disease

D. Describe pertinent clinical features

- 1. Symptoms
 - a. Gradual diminution of central visual function
 - b. Early to mid-teens is typical age of symptomatic central visual impairment
- 2. Signs
 - a. Central beaten-bronze bull's eye maculopathy (coalesced areas of RPE atrophy)
 - b. Pericentral pisciform yellow-white flecks
 - c. General symmetry of eyes regarding findings and function

Retina/Vitreous

d. May present with a near normal fundus initially

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Fluorescein angiography (FA)
 - a. RPE window defect in the macula in a bulls eye pattern
 - b. Characteristic dark choroid
 - i. Absence does NOT rule out STGD1
 - c. Late staining flecks
 - d. Fundus autofluorescence may be helpful
 - i. Peripapillary sparing of hyperfluorescent flecks
 - ii. Hypofluorescence corresponding to bulls eye
- 2. Optical coherence tomography
 - a. Paracentral or central RPE and photoreceptor atrophy
 - b. Hyperreflective deposits at the level of the RPE
- 3. Electrophysiology
 - a. Electroretinography (ERG)
 - i. ERG amplitudes are variable
 - i) May be normal early in disease
 - ii. Abnormalities more prevalent when diffuse flecks are evident suggesting more global involvement
 - b. Electrooculography (EOG)
 - i. Typically normal except with extensive RPE changes
- 4. Visual field
 - a. Typically normal but can progress to central scotoma and/or annular (ring) scotoma
- 5. Color testing
 - a. Generalized abnormal color discrimination
 - b. Should not be used as diagnostic criteria
 - c. Severe color abnormalities early in the clinical presentation would support a diagnosis of cone dystrophy

II. Define the risk factors

- A. Family history (recessive)
- B. Environmental uncertain

III. List the differential diagnosis

- A. Dominant Stargardt-like macular dystrophies (STGD2, STGD3, STGD4)
- B. Atrophic AMD
- C. Cone-rod dystrophy
- D. Pattern dystrophy
- E. Ceroid lipofuscinosis
- F. Pericentral retinitis pigmentosa
- G. Vitelliform dystrophy (Best disease)
- H. X-linked juvenile retinoschisis
- I. Dominant cystoid macular edema
- J. Solar retinopathy
- K. Central areolar choroidal dystrophy
- L. Fundus albipunctatus
- M. Functional visual loss

IV. Patient management in terms of treatment and follow-up

A. Describe the natural history, outcome, and prognosis

- 1. Most retain fair vision in at least one eye (e.g., 20/70 20/100)
- 2. Patients presenting with pericentral and diffuse flecks with or without a typical atrophic central lesion have a greater tendency to progress to more advanced stages
- 3. Rarely causes legal blindness in childhood years
- 4. Mobility is usually minimally affected

B. Medical therapy options

- 1. Minimize oxidative stress (i.e., avoid smoking and ultraviolet light)
- 2. Avoid medications with potential macular toxicity
- 3. Low vision aids and visual rehabilitation
- 4. Protective eyewear should be considered
- 5. Gene and cell-based therapies are being studied

V. Disease-related complications

- A. Ocular
 - 1. Epiretinal membrane
- B. Global

1. Increase risk of nighttime motor vehicle accidents

VI. Appropriate patient instructions

- A. Fundus examination (annually)
- B. Vision rehabilitation
- C. School issues (assign a teacher of the visually impaired)
- D. Polycarbonate safety glasses
- E. Low impact and minimal contact sports recommended
- F. DMV testing to ensure safe ability to drive

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- Stargardt Disease/Fundus Flavimaculatus in *Pediatric Retina* ed. Hartnett ME, Section 1 Chapter
 Sippy BD, Aaberg TM Sr. Lippincott Williams & Wilkins 2005.
- 3. Web-based support sites
 - a. http://www.nei.nih.gov (http://www.nei.nih.gov/)
 - b. http://www.blindness.org (http://www.blindness.org/)
 - c. http://www.maculardegeneration.org (http://www.maculardegeneration.org)

Best Disease (Vitelliform Dystrophy)

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Best 1 gene mutation
- 2. Bestrophin 1 protein resides in the calcium activated chloride channel of the RPE cells
- 3. Autosomal dominant inheritance with variable penetrance and expressivity
- 4. Various phenotypes in addition to classic Best disease including adult onset vitelliform maculopathy, autosomal recessive bestrophinopathy and autosomal dominant vitreoretinochoroidopathy (ADVIRC)

B. Define the relevant aspects of epidemiology of the disease

- 1. Rare disease
- 2. In most cases retention of good vision until adulthood
- 3. Refraction is usually hyperopic

C. List the pertinent elements of the history

- 1. Family history of central vision loss
- 2. Central visual loss in the patient

D. Describe pertinent clinical features

- 1. Carrier state
 - a. May appear normal except for abnormal electro-oculography (EOG), rare cases of genetically confirmed Best disease with normal retinal examination and normal EOG.
- 2. Early stage
 - a. May have normal retinal appearance initially (Stage 1)
 - b. Vitelliform lesions (uniform yellow "yolk-like" appearance), usually with minimal vision loss (Stage 2)
 - c. Vitelliform lesions have been observed as early as the first week of life
- 3. More advanced stages (variable appearance)
 - a. Pseudohypopyon (Stage 3)
 - b. Vitelliruptive or disrupted "scrambled egg" stage (Stage 4)
 - c. Atrophy (yellow pigment disappears) (Stage 5)
 - d. Multiple vitelliform lesions (rare)
 - e. Spontaneous disappearance of the lesion (rare)
 - f. CNV and cicatrization may ensue in the areas of retinal pigment epithelium (RPE) atrophy

(Stage 6)

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Genetic testing: BEST1 gene mutation
- 2. EOG: abnormal with Arden ratio (absent light rise) near 1
- 3. Electroretinogram (ERG): normal for both scotopic and photopic conditions
- 4. Fluorescein angiography
 - a. Vitelliform lesion typically blocks early and stains late
 - b. Late staining in the disrupted vitelliform stage
 - c. Window defect with RPE atrophy
 - d. Hyperfluorescence and leakage associated with CNV
- 5. Optical coherence tomography (OCT)
 - a. Corresponds to the staging of the vitelliform lesion, central dome shaped thickening of the RPE complex
 - b. Macular hole has been reported

II. List the differential diagnosis

- A. Adult-onset vitelliform macular dystrophy
- B. Basal laminar drusen with vitelliform detachment
- C. Pseudovitelliform age related macular degeneration (AMD) or other forms of AMD including retinal pigment epithelial detachment (PED)
- D. Acute exudative polymorphous vitelliform maculopathy and paraneoplastic vitelliform maculopathy
- E. Stargardt macular dystrophy
- F. Toxoplasma retinochoroiditis
- G. Macular coloboma

III. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcome, and prognosis

- 1. Although vision can deteriorate at any age, visual prognosis is generally good
- 2. Central visual loss is slow, usually occurring after age 30 to 40 but may decline due to the development of CNV
- 3. Most patients retain reading vision in at least one eye throughout life

B. Describe medical therapy options

1. No treatment for Best disease

2. If complication such as CNV occurs, antiVEGF therapy (bevacizumab, ranibizumab, or aflibercept) should be considered; photodynamic therapy may also be considered

IV. Describe disease-related complications

A. CNV may complicate the disease at any stage but more typically in the later stages of disease

V. Describe appropriate patient instructions

- A. Patients should check each eye individually for vision decrease
- B. Yearly follow-up examinations
- C. Family members should be examined

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Juvenile retinoschisis

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Inherited (x-linked recessive)
- 2. Defect is in the RS1 (retinoschisis 1) gene, which is located on the short arm of the X chromosome (Xp22.13). The RS1 gene encodes for an extracellular protein (retinoschisis) secreted by photoreceptors that is necessary for normal cellular organization and arrangement and governs cell to cell adhesion in the retina

B. Define the relevant aspects of epidemiology of the disease

- 1. Males
- 2. Female carriers are very rarely clinically identified
- 3. 50% of those with foveal radiating retinal folds also have peripheral retinoschisis
- 4. Vitreous hemorrhage may be the presenting abnormality
- 5. Retinal breaks may develop in inner lamina (75%) or outer lamina (13%)
- 6. Retinal detachment (RD) occurs in 5-20%

C. List the pertinent elements of the history

- 1. Decreased vision
- 2. May be asymptomatic
- 3. Family history consistent with x-linked recessive inheritance patterns

D. Describe pertinent clinical features

- 1. Visual acuity 20/40-20/400 by adulthood
- 2. Onset in early childhood
- 3. Always bilateral
- 4. Cystoid foveal changes with retinal striae which radiate from the center of the foveal configuration (foveal radiating folds) ("maculoschisis") in a spoke-wheel pattern
 - a. These cysts do not leak on fluorescein angiography
- 5. Peripheral schisis is most common in the inferotemporal quadrant
- 6. Absolute scotoma
- 7. Separation between the nerve fiber layer and ganglion cell layer
 - a. this differs from degenerative retinoschisis where the split typically occurs in the outer plexiform layer/nuclear layer
- 8. "Vitreous veils" may be seen peripherally

9. Retinoschisis does not extend to the ora serrata

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Detailed family history/ exam of family members
- 2. Dilated retinal examination with scleral depression to rule out an associated outer layer retinal break or RD
- 3. Optical coherence tomography to assess for macular schisis; cystoid abnormalities identified above the outer plexiform layer (OPL) unlike garden variety CME in which the cystic spaces are seen below the OPL in the Henle plexiform layer
- 4. Electroretinogram
 - a. Electronegative ERG
 - b. Normal a-wave
 - c. Subnormal b-wave
- 5. B-scan echography
 - a. Useful to look for schisis and differentiate from RD

II. List the differential diagnosis

- A. Rhegmatogenous RD
- B. Traction RD
- C. Exudative RD
- D. Choroidal detachment
- E. Senile degenerative retinoschisis
- F. Peripheral white without pressure
- G. Cystoid macular edema

III. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcomes, and prognosis

- 1. Amblyopia may develop
- 2. Progressive, pigment retinopathy and/or macular atrophy may develop
- 3. Vitreous hemorrhage or RD may develop
- B. Describe medical therapy options
 - 1. Treat superimposed amblyopia, strabismus, low vision

C. Describe surgical therapy options

- 1. Vitrectomy for associated vitreous hemorrhage
- 2. Vitrectomy +/- scleral buckle for associated RD

Retina/Vitreous

IV. List the complications of treatment, their prevention and management

A. Complications of vitrectomy and scleral buckling surgery

V. Describe disease-related complications

- A. Vitreous hemorrhage
- B. RD
- C. Macular atrophy

VI. Describe appropriate patient instructions

A. Genetic counseling

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Spontaneous vitreous hemorrhage

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Posterior vitreous separation occurs
 - a. Secondary traction at the stronger vitreoretinal interface sites
 - b. May result in avulsion of a retinal vessel
 - c. May result in a retinal tear
- 2. Vitreous traction may also occur in areas of retinal neovascularization
 - a. Proliferative diabetic retinopathy
 - i. Neovascularization of the disc
 - ii. Neovascularization elsewhere
 - b. Retinal Venous Occlusive Disease
 - c. Other causes for retinal neovascularization
 - i. Branch retinal vein occlusion
 - ii. Central retinal vein occlusion
 - iii. Sickle cell disease
 - iv. Eales disease
 - v. Familial Exudative Vitreoretinopathy (FEVR)
 - vi. Retinopathy of prematurity (ROP)
- 3. Vascular tumors of the retina may bleed spontaneously
- 4. Choroidal neovascularization
 - a. May break through the neurosensory retina into the vitreous
 - b. Common in neovascular age-related macular degeneration
 - c. Large submacular hemorrhages (i.e. anti-coagulated patients)
 - d. Tumors of the choroid (i.e. choroidal melanoma)
- 5. Other inflammatory disorders
 - a. Sarcoidosis with NV
 - b. Eales disease
- 6. Non-accidental trauma in children (i.e. Shaken Baby)
- 7. Trauma

- a. Vitreous traction
- b. Choroidal rupture
- c. Chorioretinal sclopetaria
- d. Terson syndrome (sub-ILM hemorrhage)
- 8. X-linked retinoschisis (young males)
- 9. Retinal macroaneurysm rupture with bleeding into vitreous

B. Define the relevant aspects of epidemiology of the disease

- 1. More common in patients with
 - a. Diabetes mellitus
 - b. Systemic arterial hypertension
 - c. High myopia
 - d. Blood dyscrasias
 - e. Systemic vascular disease

C. List the pertinent elements of the history

- 1. Unilateral decrease in visual acuity
- 2. Loss of depth perception
- 3. Sudden onset of new floaters
- 4. Photopsia
- 5. Visual field defect
- 6. Medical history with vascular risk factors (see above)

D. Describe pertinent clinical features

1. Hemorrhage in vitreous cavity

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Scleral depressed exam
- 2. Examination of fellow eye
- 3. Ultrasonography
 - a. When the hemorrhage obscures an adequate view of the retina
 - b. Caution in cases of trauma (possible open globe injuries)
- 4. Blood pressure assessment
- 5. Testing for diabetes mellitus when suspected
 - a. Primary care provider referral
 - b. Fasting glucose test
 - c. Hemoglobin A1c (HgbA1c) level

6. Hemoglobin electrophoresis when sickle cell suspected

II. List the differential diagnosis

- A. A careful assessment of the cellular involvement to ensure that the cells are red blood cells versus other possible causes that include:
 - 1. White blood cells in uveitis
 - 2. Inflammatory cells in endophthalmitis
 - 3. Asteroid hyalosis
 - 4. Neoplastic cells
 - a. Lymphoma
 - b. Other metastatic cells
 - 5. Amyloid infiltration of the vitreous (rare)
 - 6. Synchesis scintillans
 - a. Cholesterolosis
 - b. Repeated trauma and chronic hemorrhage
 - c. Coats disease
 - 7. Coagulopathy or bleeding disorder
 - 8. Post-injection deposits (i.e. intravitreal triamcinolone)

III. Describe patient management in terms of treatment and follow-up

- A. Observe for clearing
- B. Confirm that the retina is attached
- C. Confirm the absence of detectable retinal breaks
- D. Retinopexy for retinal break (Cryotherapy or laser)
- E. If retinal tear or detachment is detected on ultrasound
 - 1. Consider vitrectomy
- F. Repair retinal detachment
 - 1. Pars plana vitrectomy
 - 2. Scleral buckle
 - 3. Pneumatic retinopexy
 - 4. Combined procedure
- G. Panretinal photocoagulation or anti-VEGF injections for:
 - 1. Proliferative diabetic retinopathy

- 2. Central retinal vein occlusion
- 3. Ocular ischemic syndrome with proliferation
- H. Sectoral scatter laser photocoagulation surgery for proliferative BRVO Consider peripheral retinal photocoagulation surgery for sickle cell retinopathy
- I. Vitrectomy if the blood fails to clear in reasonable time (2-3 months)
- J. Head elevation, bedrest

IV. List the complications of treatment, their prevention and management

- A. Complications of laser surgery or cryopexy
- B. Complications of vitrectomy surgery
- C. Epiretinal membrane

V. Describe disease-related complications

- A. Progression to RD possible if untreated or lost to follow-up
- B. Corneal blood staining (with hyphema)
- C. Epiretinal membranes
- D. Proliferative vitreoretinopathy

VI. Describe appropriate patient instructions

A. Follow up is very important

- 1. May need repeat ultrasonography
 - a. Repeat until hemorrhage clears for retinal examination

B. Patient instructions

- 1. Monitor for and report new symptoms
 - a. Photopsia
 - b. Visual field defect
 - c. Further loss of vision

C. May require vitrectomy if no clearance or retinal detachment is diagnosed

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Focal Points: Diagnosis and Management of Vitreous Hemorrhage, Module #10, 2000, p.9.

Posterior vitreous detachment

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease (based on clinical observations)

- 1. Initial event
 - a. Syneresis of the central vitreous
- 2. Destabilization of the vitreous gel leads to liquefied vitreous and partial separation of vitreous from retina
- 3. Liquefied vitreous may pass into the subhyaloid space
- 4. The posterior hyaloid eventually separates from the retina
- 5. The end-stage of the separation process may represent an acute event with or without symptoms
- 6. Vitreous gel remains attached to vitreous base
- 7. Resulting vitreous traction on vitreous base or upon other visible or invisible vitreoretinal adhesions can result in a retinal break
- 8. Associated conditions
 - a. Aphakia, pseudophakia
 - b. Trauma
 - c. Myopia
 - d. Inflammatory/infectious disease
 - e. Preterm birth

B. Define the relevant aspects of epidemiology of the disease

- 1. Prevalence increases with increasing axial length and patient age
- 2. Prevalence of 10% in patients less than 50 years old (autopsy study)
- 3. Prevalence of 63% in patients over 70 years old (autopsy study)

C. List the pertinent elements of the history

- 1. Many patients are asymptomatic
- 2. Photopsias
- 3. Floaters
- 4. Cloudy/hazy vision
- 5. Symptoms increase risk of a retinal break

D. Describe pertinent clinical features

1. Glial floater overlying the optic disc: Weiss ring

2. Shafer sign (pigment in the anterior vitreous) and/or vitreous hemorrhage are highly associated with retinal break

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Slit-lamp biomicroscopy
- 2. Indirect ophthalmoscopy with scleral depression to detect any associated retinal breaks
- 3. B-scan echography if a vitreous hemorrhage precludes ophthalmoscopy
 - a. B-scan echography performed to assess for RD or retinal flap tear
 - b. Normal B-scan does not ensure absence of a retinal break

II. Define the risk factors

- A. Aphakia, pseudophakia
- B. Trauma
- C. Myopia
- D. Inflammatory/infectious disease
- E. Increased age

III. List the differential diagnosis

- A. Foreign body
- B. Infection
- C. Vitreous hemorrhage
- D. Vitreous inflammation
- E. Retinal tear
- F. Retinal detachment
- G. Migraine photopsias usually different
- H. Multiple evanescent white dot syndrome (MEWDS) photopsias differ
- I. Some retinal degenerations photopsias differ

IV. Describe patient management in terms of treatment and follow-up

- A. Describe the natural history, outcome, and prognosis
 - 1. Asymptomatic PVD up to 5% risk of break
 - 2. Symptomatic PVD up to 15% risk of break
 - 3. Symptomatic PVD with associated vitreous hemorrhage up to 70% risk of break
 - 4. An untreated retinal break can lead to a retinal detachment.

- a. Patients are at highest risk for development of a retinal tear in the first six weeks following an acute PVD
- b. Patients should be re-examined at 4-6 weeks after their initial symptoms

B. Describe medical therapy options

1. Cautious observation for clearing of vitreous hemorrhage

C. Describe surgical therapy options

- 1. Neodymium: yttrium-aluminum-garnet (Nd:YAG) laser disruption of the vitreous floaters is not recommended
- 2. Pars plana vitrectomy to remove the floaters is not encouraged (See Rhegmatogenous retinal detachment)
 - a. Should be considered when there is a dense hemorrhage and a retinal tear or detachment is suspected

V. Describe disease-related complications

- A. Vitreous hemorrhage without a retinal break
- B. Retinal break with or without vitreous hemorrhage
- C. Rhegmatogenous retinal detachment

VI. Describe appropriate patient instructions

- A. Natural history description
- B. If any of the following symptoms develop, the patient should return for an eye examination right away
 - 1. Photopsias or flashes
 - 2. Any new floaters or change in floaters
 - 3. A dark veil or curtain coming over the vision from any direction in the affected eye

C. The affected eye should be checked while the fellow eye is covered

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Retinal Detachment: Principles and Practice, 2nd ed., 1995, p.26-29.
- 3. AAO, Focal Points: Diagnosis and Management of Vitreous Hemorrhage, Module #10, 2000, p.5-6.
- 4. AAO, Focal Points: Retinal Complications Following Cataract Surgery, Module #12, 1992, p. 1-2.
- 5. Byer NE. Natural history of posterior vitreous detachment with early management as the premier line of defense against retinal detachment. *Ophthalmology*. 1994;101:1503-1514.

- 6. Foos RY. Posterior vitreous detachment. *Trans Am Acad Ophthalmol Otolaryngol*. 1972;76:480-497.
- 7. Foos RY, Wheeler NC. Vitreoretinal juncture: synchysis senilis and posterior vitreous detachment. *Ophthalmology*. 1982;89:1502-1512.
- Green WR. Vitreoretinal juncture. In: Ryan SJ, ed. *Retina*. 2nd ed. St Louis: Mosby;1994:1869-1930
- 9. AAO, Preferred Practice Patterns Committee, Retina Panel. Posterior Vitreous Detachment, Retinal Breaks and Lattice Degeneration Preferred Practice Pattern, 2008.

Traumatic breaks

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Blunt closed-globe trauma creates vitreoretinal traction that may result in various retinal breaks
 - a. Retinal dialysis
 - b. Retinal flap tear or giant retinal tear (tear posterior to the vitreous base insertion, >90°)
 - c. Operculated retinal tear
 - d. Macular hole
 - e. Avulsion of the vitreous base
- 2. Open-globe trauma can result in a retinal break by these mechanisms:
 - a. Direct trauma to the retina
 - b. Indirect trauma secondary to vitreoretinal traction
 - c. Vitreoretinal incarceration in the wound

B. Define the relevant aspects of epidemiology of this disease

- 1. Severe ocular trauma occurs at all ages
 - a. Children
 - i. Frequently sporting injuries and accidents
 - b. Young adults (male > female)
 - i. Occupational injuries
 - ii. Sporting injuries
 - iii. Accidents
 - iv. Assault
 - c. Older adults
 - i. Frequently accidents, particularly falls

C. List the pertinent elements of the history

- 1. History of trauma
 - a. Usually recent
 - b. One or both eyes involved
- 2. Floaters
- 3. Photopsias
- 4. Blurred vision
- 5. Loss of visual field or acuity
- 6. Mechanism of injury
 - a. Blunt
 - b. Penetrating
 - c. Perforating
- 7. Wearing of spectacles at that time

D. Describe pertinent clinical features

- 1. Blunt injury
 - a. Retinal breaks usually peripheral
 - b. Retinal dialysis most common inferotemporally and superonasally
- 2. Penetrating injury
 - a. Retinal break at the site of an entrance or exit scleral wound
 - b. Retinal break at the impact site of an intraocular foreign body (IOFB)
- 3. Vitreous hemorrhage
- 4. Other signs of trauma to any portion of the eye or periocular structure
- 5. Loss of vision due to
 - a. Vitreous hemorrhage or hyphema
 - b. Traumatic maculopathy
 - c. Retinal detachment (RD)
 - d. Concurrent injury to the cornea, lens or optic nerve
 - e. Retinitis sclopetaria involving the macula
 - f. Commotio retinae (Berlin's edema)
 - g. Choroidal rupture
 - h. Macular holes

E. Describe appropriate testing and evaluation to establish the diagnosis

- 1. B-scan echography to detect traumatic retina break and RD in the presence of
 - a. Vitreous hemorrhage
 - b. Other media opacity secondary to anterior segment injury

II. Define the risk factors

A. Penetrating, perforating or severe blunt ocular trauma

B. Lack of appropriate eye protection

III. List the differential diagnosis

- A. Non-traumatic retinal break
- B. Sclopetaria
- C. Outer or inner retinal break associated with retinoschisis
- D. Non-traumatic giant retinal tear

IV. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcome and prognosis

- 1. Traumatic retinal breaks with vitreoretinal traction: high risk of progressing to RD without treatment
- 2. Penetrating trauma, giant retinal tears, vitreous hemorrhage, ocular inflammation and younger age: increased risk of proliferative vitreoretinopathy (PVR) and secondary complex RD
- 3. Retinal dialysis: may progress slowly, over years, to symptomatic RD and the location of the retinal break beneath the vitreous base
- 4. Chronic asymptomatic cases may remain stable without treatment
- 5. Observation for sclopetaria

B. Describe surgical therapy options

- 1. Laser retinopexy (or cryopexy if view obscured by opacity such as vitreous hemorrhage)
- 2. Scleral buckling surgery and/or vitrectomy for RD
- 3. Surgical repair of simultaneous ocular injuries or removal of IOFB

V. List the complications of treatment, their prevention and management

- A. Risks of vitrectomy and scleral buckling surgery
- B. Risks of local or general anesthesia

VI. Describe disease-related complications

- A. RD with or without PVR
- B. Vitreous hemorrhage

VII. Describe appropriate patient instructions

- A. Natural history description
- B. Risk of sympathetic ophthalmia secondary to penetrating trauma
- C. Benefits, risks and alternatives of surgical management

D. Use of protective eyewear

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Retinal Detachment: Principles and Practice, 2nd ed., 1995, p.16-17.
- 3. AAO, Preferred Practice Patterns Committee, Retinal Panel. Posterior Vitreous Detachment, Retinal Breaks and Lattice Degeneration Preferred Practice Pattern, 2008.

Horseshoe tears

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Posterior vitreous detachment (PVD) or blunt ocular trauma causes dynamic vitreoretinal traction yielding tears at sites of increased vitreoretinal adhesion
- 2. Anomalous vitreoretinal adhesion may occur at:
 - a. Posterior extension of the vitreous base
 - b. Cystic retinal tuft
 - c. Zone of lattice degeneration
 - d. Chorioretinal scar
- 3. The nature of the vitreoretinal adhesion and the retinal weakness determines the defect
 - a. Horseshoe tear (adhesion at the apex of the tear)
 - b. Vitreous releases from the margins of the hole after a PVD
 - c. Operculated hole (avulsed retina adherent to detached posterior hyaloid)

B. Define the relevant aspects of epidemiology of this disease

- 1. PVD
 - a. Asymptomatic PVD up to 5% risk of break
 - b. Symptomatic PVD up to 15% risk of break
 - c. Symptomatic PVD with associated vitreouse hemorrhage up to 70% risk of break
- 2. Horseshoe retinal tear
 - a. If symptomatic: 25-50% risk of retinal detachment (RD), higher with aphakia, pseudophakia, vitreous hemorrhage
 - b. If asymptomatic: RD is much less common
- 3. Atrophic retinal hole
 - a. If symptomatic: risk of RD is low
 - b. If asymptomatic: RD is rare

C. List the pertinent elements of the history

- 1. Symptoms of acute posterior vitreous detachment
 - a. Floaters
 - b. Photopsias
- 2. Symptoms of retinal detachment

- a. Shadow in the field of vision
- b. Photopsias

D. Describe pertinent clinical features

- 1. Shafer sign: red blood cells or pigment granules in the anterior vitreous (tobacco dust)
- 2. Retinal tear: Full-thickness retinal break with horseshoe configuration
- 3. Atrophic retinal hole: round or oval full-thickness retinal break
- 4. Retinal tear with avulsed retinal operculum
- 5. Subretinal fluid: may be present around the retinal tear or retinal hole
- 6. Pigmentary changes around retinal tear or retinal hole: evidence of chronicity (>3 months)
- 7. Retinal vessels sometimes bridging a tear: can be a source of vitreous hemorrhage

E. Describe appropriate testing or evaluation for establishing the diagnosis

- 1. Indirect ophthalmoscopic examination with scleral depression
- 2. B-scan echography: to visualize a retinal tear or associated retinal detachment if a media opacity is present

II. Define the risk factors

- A. Increasing age
- B. History of retinal tear and/or detachment in contralateral eye
- C. Family history of retinal tear and/or detachment
- D. Ocular trauma
- E. Axial myopia
- F. Aphakia, pseudophakia
- G. Recent neodymium yttrium-aluminum-garnet (Nd:YAG) posterior capsulotomy
- H. Lattice degeneration

III. List the differential diagnosis

- A. Cystic retinal tuft
- B. Atrophic retinal hole
- C. Enclosed ora bay
- D. Lattice retinal degeneration
- E. Toxoplasmosis scars
- F. White without pressure
- G. Retinoschisis
- H. Choroidal melanoma

IV. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcome and follow-up

- 1. Most symptomatic retinal tears resulting in retinal detachment do so within 6 weeks of the onset of symptoms
- 2. Retinal detachment rarely occurs more than 3 months after development of the tear

B. Describe surgical therapy options

- 1. Symptomatic horseshoe flap-tears should usually be promptly treated with photocoagulation or cryotherapy
- 2. Asymptomatic flap-horseshoe tears, especially if pigmentary demarcation is present, may be followed without treatment
- 3. Symptomatic operculated tears sometimes do not require treatment, especially if there is no subretinal fluid, not highly myopic, or the fellow eye has not detached. "Treatment may not be necessary"
- 4. Asymptomatic operculated tears, especially if pigmentary demarcation is present, rarely require treatment
- 5. Asymptomatic round holes rarely require treatment
- 6. Asymptomatic lattice degeneration without holes does not require treatment (unless PVD causes a horseshoe tear)
- 7. Asymptomatic lattice degeneration with hole usually does not require treatment
- 8. History of prior retinal detachment in fellow eye, high myopia, aphakia, pseudophakia, or cataract surgery planned in the near future, weigh in favor of treatment, even in cases of asymptomatic flap-horseshoe tears and symptomatic retinal tears
- 9. Retinopexy methods include cryopexy, laser photocoagulation with a slit-lamp biomicroscopic delivery system or with an indirect ophthalmoscope delivery system
- 10. If treatment is elected, examination one to two weeks later ensures there is an adequate treatment effect (pigment reaction may not be evident for 2 3 weeks)
- C. Careful follow-up is often indicated if there is evidence that the retinal break might be of recent onset
 - 1. Associated RD often requires scleral buckling surgery and/or vitrectomy

V. List the complications of treatment, their prevention and management

- A. Failure to prevent retinal detachment
- B. latrogenic vitreous hemorrhage or choroidal neovascularization
- C. Inadvertent photocoagulation of the macula
- D. Posterior cryotherapy application in the macula
- E. Complications of periocular or retrobulbar anesthesia if required

Retina/Vitreous

- F. Cryotherapy may promote release of underlying RPE which can stimulate proliferative vitreoretinopathy
- G. Laser retinopexy and cryotherapy may increase the risk of epiretinal membrane formation

VI. Describe disease-related complications

- A. Progression to retinal detachment
- B. Epiretinal membrane formation
- C. Vitreous hemorrhage, possibly recurrent, from bridging retinal vessel

VII. Describe appropriate patient instructions

- A. Natural history description
- B. Benefits, risks and alternatives of retinopexy
- C. Importance of prompt consultation if sudden increase in floaters, photopsia or development of a shadow in the field of vision
- D. Restriction of vigorous activity after treatment until laser or cryotherapy scar matures

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Laser Photocoagulation of the Retina and Choroid, 1997, p.211-212.
- 3. AAO, Retinal Detachment: Principles and Practice, 2nd ed., 1995, p.12-14, 17-18.
- 4. AAO, Focal Points: Retinal Breaks, Holes and Tears, Module #3, 1996, p.7-8.
- 5. AAO, Preferred Practice Pattern Committee, Retina Panel. Posterior Vitreous Detachment, Retinal Breaks and Lattice Detachment Preferred Practice Pattern, 2008.

Giant retinal tear

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Idiopathic
- 2. Traumatic

B. Define the relevant aspects of epidemiology of this disease

- 1. Giant retinal breaks generally occur posterior to the edge of the vitreous base insertion or the posterior edge of lattice degeneration
- 2. Male predominance
- 3. Over half occur in individuals under age 40 years
- 4. May be associated with trauma
- 5. About 30% have ocular or systemic congenital abnormalities (includes Marfan syndrome, Stickler syndrome, lens coloboma, and cleft palate)

C. List the pertinent elements of the history

- 1. Floaters
- 2. Photopsias
- 3. Blurred vision
- 4. Loss of visual field
- 5. May have history of ocular trauma

D. Describe pertinent clinical features

- 1. Large retinal break visible with anterior flap
- 2. By definition, circumferential retinal break extending for greater than 90 degrees (3 clock hours)
- 3. The posterior edge of the tear may be folded over itself because vitreous is adherent only to the posterior edge of the tear (unlike retinal dialysis)
- 4. Marked vitreous pigment ("tobacco dust") is common

II. List the differential diagnosis

- A. Retinal detachment with peripheral retinal atrophy
- B. Large retinal break due to trauma or retinal necrosis (if 90° or more, it is by definition a giant tear)
- C. Retinoschisis with large inner or outer lamellar break
- D. Large chorioretinal scar
- E. Retinal break secondary to chorioretinitis sclopetaria

F. Retinal dialysis (vitreous is adherent to both the anterior and posterior edges of the tear)

III. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcome and prognosis

- 1. Prognosis is generally very poor without vitreoretinal surgery
- 2. High risk of proliferative vitreoretinopathy, sometimes within weeks of the retinal detachment
- 3. Giant retinal breaks in the fellow eye develop in over 10% of patients

B. Describe surgical therapy options

- 1. Vitrectomy with or without a scleral buckle procedure is frequently required
- 2. Liquid perfluorocarbon and long-term gas or silicone tamponade is often required during the vitrectomy procedure
- 3. While controversial, some consider prophylactic 360-degree peripheral laser photocoagulation or scleral buckle in the fellow eye

IV. List the complications of treatment, their prevention and management

- A. Complications of vitrectomy and scleral buckling surgery
- B. Retinal folds may be prevented with use of perfluorocarbon liquid and careful drainage of subretinal fluid during fluid/gas or fluid/silicone exchange)

V. Describe disease-related complications

- A. Retinal re-detachment due to proliferative vitreoretinopathy
- B. Hypotony and phthisis
- C. Cataract
- D. Epiretinal membrane

VI. Describe appropriate patient instructions

- A. Natural history description
- B. Review signs and symptoms of retinal tear and retinal detachment.
- C. Risk of contralateral eye involvement
- D. Benefits, risks and alternatives of surgical management

Additional Resources

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Retinal Detachment: Principles and Practice, 2nd ed., 1995, p.125-126,162-163.

Retina/Vitreous

- 3. AAO, Focal Points: Retinal Breaks, Holes and Tears, Module #3, 1996, p.1.
- 4. AAO, Focal Points: Posterior Segment Vitrectomy: An Overview of Indications, Module #4, 1991, p.1.
- 5. AAO, Preferred Practice Patterns Committee, Retina Panel. Posterior Vitreous Detachment, Retinal Breaks and Lattice Degeneration Preferred Practice Pattern, 2008.
- 6. Batman C, Cekic O. Vitrectomy with silicone oil or long-acting gas in eyes with giant retinal tear long-term follow-up of a randomized clinical trial. *Retina*. 1999;19:188-92.

Atrophic holes

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Progressive atrophy and thinning of the neurosensory retina resulting in a full-thickness retinal defect
- 2. Frequently seen in the thinned retina within lattice degeneration
- 3. Vitreous-traction is not a pathogenic mechanism

B. Define the relevant aspects of epidemiology of this disease

- 1. Most common in the third decade
- 2. New holes may continue to develop at a slow rate,
- 3. Often bilateral
- 4. About 18-29% of patients with lattice degeneration have concomitant atrophic retinal holes
- 5. Less than 0.3% of patients with atrophic holes develop a clinical retinal detachment
- 6. Higher risk of RD in young myopic patients

C. List the pertinent elements of the history

- 1. Atrophic retinal holes usually are asymptomatic and found incidentally
- 2. Visual field defects, new floaters or photopsia should raise consideration of an associated retinal detachment

D. Describe pertinent clinical features

- 1. Round or oval full-thickness retinal break without an overlying operculum
- 2. Often found within a zone of lattice degeneration
- 3. Often surrounded by a cuff of subretinal fluid
- 4. Sometimes associated with retinal pigment epithelium clumping and atrophy secondary to chronicity
- 5. Retinal detachments associated with atrophic holes are commonly found in the inferior half of the fundus with the highest prevalence involving the inferotemporal quadrant

II. Define the risk factors

- A. Increasing age
- B. Lattice degeneration
- C. Axial myopia
- D. Family history of atrophic holes or lattice degeneration

Retina/Vitreous

III. List the differential diagnosis

- A. Cystic retinal tuft
- B. Operculated retinal tear
- C. Lattice degeneration without hole
- D. Paving-stone retinal degeneration
- E. Enclosed ora bay

IV. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcome and prognosis

- 1. With time, atrophic holes can enlarge and become more numerous
- 2. A small percentage may progressively accumulate subretinal fluid, leading to a subclinical retinal detachment
- 3. Subclinical retinal detachments rarely progress or do so very slowly
- 4. Demarcation lines often occur

B. Describe surgical therapy options

- 1. The majority of atrophic retinal holes do not require treatment
- 2. Retinopexy may be considered
- 3. Surgery is indicated for clinical RD with signs of progression

V. List the complications of treatment, their prevention and management (See Lasers)

- A. latrogenic vitreous hemorrhage or choroidal neovascularization from laser photocoagulation
- B. Inadvertent photocoagulation of the macula

VI. Describe appropriate patient instructions

- A. Natural history description
- B. Benefits, risks and alternatives of retinopexy or cryotherapy
- C. Importance of prompt consultation for a sudden onset of floaters, photopsia or new onset of a shadow in the field of vision
- D. For most asymptomatic atrophic retinal holes, recommended observation is every 1 to 2 years
- E. Those associated with subclinical retinal detachments need closer follow up to monitor for potential progression

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Retinal Detachment: Principles and Practice, 2nd ed., 1995, p.14-15,18.
- 3. AAO, Focal Points: Retinal Breaks, Holes and Tears, Module #3, 1996, p.2, 7-8.
- 4. AAO, Focal Points: Lattice Degeneration of the Retina, Module #5, 1989, p.2-3.
- 5. AAO, Preferred Practice Pattern Committee, Retina Panel. Posterior Vitreous Detachment, Retinal Breaks and Lattice Detachment Preferred Practice Pattern, 2008.

Lattice degeneration

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Peripheral retinal condition characterized by
 - a. Local thinning of the inner retina
 - b. Strong vitreous adherence at its margins
 - c. Overlying vitreous liquefaction

B. Define the relevant aspects of epidemiology of the disease

- 1. 6-10% of general population
 - a. Bilateral in up to 1/2 of these patients
- 2. More common in myopes
- 3. Familial in some reports
- 4. Lattice degeneration is associated with 1/3 of all retinal detachments (RD)

C. List the pertinent elements of the history

1. Usually asymptomatic

D. Describe pertinent clinical features

- 1. Elliptically shaped, parallel to the ora, multiple, tendency to cluster in superior and inferior retina (can run obliquely or at right angles to ora)
- 2. Usually located anterior to the equator
- 3. 'Lattice' derives from the hyalinized-appearing crisscrossing retinal vessels within the lattice patch
- 4. May contain round atrophic holes
- 5. Radial or meridional variant
 - a. Straddles peripheral retinal blood vessels, perpendicular to ora
 - b. Consider hereditary hyaloideoretinopathies (Stickler syndrome, Wagner disease)
- 6. Associated pigment migration may have multiple circumferential rows, and may only be visible in regions
- E. Describe appropriate testing and evaluation for establishing the diagnosis
 - 1. Examination with scleral depression to view retinal thinning

II. Define the risk factors

A. Positive family history

- B. Myopia
- C. Wagner disease
- D. Stickler syndrome

III. List the differential diagnosis

- A. White without or with pressure
- B. Peripheral chorioretinal scarring
- C. Cobblestone
- D. Hereditary hyaloideoretinopathies
 - 1. Stickler syndrome (ocular and systemic findings)
 - a. Optically empty vitreous with radial/perivascular lattice
 - b. Autosomal dominant inheritance
 - c. Genetic mutation in type II procollagen
 - d. Ocular (myopia, glaucoma, cataract) and skeletal abnormalities (craniofacial abnormalities, arthritis, joint hypermobility)
 - e. High incidence of retinal detachment
 - 2. Wagner disease (has ocular findings without systemic disease)
 - a. Optically empty vitreous with radial/perivascular lattice
 - b. Autosomal dominant inheritance
 - c. Ocular abnormalities (myopia, glaucoma, cataract) without associated skeletal abnormalities
 - d. Wagner disease is less likely to be associated with retinal detachment

IV. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcome and prognosis

- 1. Lattice predisposes to retinal break formation
 - a. Small atrophic holes
 - i. Within lattice
 - ii. Rarely lead to RD
 - iii. Young patients
 - iv. Resulting detachment progresses slowly
 - b. Horseshoe tears
 - i. Usually occur at posterior or lateral edge of lattice

- ii. Usually lead to RD
- iii. Older patients

B. Describe surgical therapy options

- 1. Treatment of lattice degeneration without a retinal break or with small atrophic holes without RD is not usually recommended
 - a. May be considered in patients with a fellow eye retinal detachment, especially if there was a poor visual outcome in that eye
- 2. Associated RD should be treated as appropriate

V. Describe disease-related complications

A. Retinal break with or without RD

VI. Describe appropriate patient instructions

- A. Warning signs of RD include photopsias, floaters, or a curtain/veil in the visual field
- B. Discussion of natural history and outcomes
- C. If no associated retinal breaks, follow-up yearly

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Laser Photocoagulation of the Retina and Choroid, 1997, p.212-214.
- 3. AAO, Retinal Detachment: Principles and Practice, 2nd ed., 1995, p.9, 14, 23-26, 92.
- 4. AAO, Focal Points: Retinal Breaks, Holes and Tears, Module #3, 1996, p.3-4.
- 5. Byer NE. Long-term natural history of lattice degeneration of the retina. *Ophthalmology* 1989;96:1396-1402.
- 6. AAO, Preferred Practice Patterns Committee, Retina Panel. Posterior Vitreous Detachment, Retinal Breaks and Lattice Degeneration Preferred Practice Pattern, 2008.
- 7. Wilkinson C. Interventions for asymptomatic retinal breaks and lattice degeneration for preventing retina detachment. Cochrane Database Syst Rev 2005:CD003170.

Rhegmatogenous retinal detachment

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Vitreous liquefaction
- 2. Posterior vitreous detachment
- 3. Vitreous traction
- 4. Retinal break
- 5. Retinal detachment (RD) when liquified vitreous passes through the retinal break into the potential space between the sensory retina and retinal pigment epithelium (RPE)

B. Define the relevant aspects of epidemiology of the disease

- 1. Incidence in general population is 1 in 10,000 persons per year
- 2. 50% of persons with RD have symptoms of photopsias or floaters
- 3. In up to 97%, a definite retinal break can be found

C. List the pertinent elements of the history

- 1. Photopsias
- 2. Floaters
- 3. Curtain or shadow moving over the field of vision
- 4. Peripheral followed by central visual loss
- 5. Previous ocular trauma
- 6. Previous ocular surgery, especially phakic status
- 7. Family history
- 8. History of axial myopia
- 9. Surgical and non-surgical trauma

D. Describe pertinent clinical features

- 1. Elevation of retina along with a flap tear or break in the retina, or retinal dialysis
- 2. Pigmented cells (a.k.a. tobacco dust) in the anterior vitreous (Shafer sign)
- 3. May have a vitreous hemorrhage due to the retinal tear
- 4. Clear subretinal fluid that does not usually shift with body position
- 5. Signs of acute detachment
 - a. Low (or normal) intraocular pressure
 - b. Bullous retinal elevation, corrugated retinal surface due to outer retinal edema with an intact

internal limiting membrane

- c. Movement of detached retina with and after eye movements
- d. Flap tear usually able to be seen
- 6. Signs of chronic detachment
 - a. Elevated (or normal) intraocular pressure possible
 - b. Degenerated photoreceptors may be visible in the anterior chamber and may mimic the appearance of anterior chamber cells (Shafer sign)
 - c. Fixed folds possible due to proliferative vitreoretinopathy (PVR).
 - d. Minimal retinal movement with eye movements
 - e. Flap tear may exhibit a rolled edge (PVR)
 - f. Intraretinal cysts
 - g. White dots on retinal surface
 - h. Pigmented demarcation line at posterior border of detachment

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Indirect ophthalmoscopy with scleral depression
- 2. B-scan echography if media opacity is present

II. Define the risk factors

- A. Vitreoretinal traction in acute posterior vitreous detachment
- B. Prior RD in the fellow eye
- C. Axial myopia
- D. Lattice degeneration
- E. Prior intraocular surgery
- F. Eye trauma or head trauma
- G. Aphakia/pseudophakia
- H. Retinal breaks, especially superior breaks
- I. Family history
- J. Necrotizing retinitis

III. List the differential diagnosis

- A. Degenerative retinoschisis
- B. Juvenile retinoschisis
- C. Choroidal detachment

- D. Traction RD
- E. Exudative RD
- F. Tumors
- G. Peripheral white without pressure

IV. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcome, and prognosis

- 1. Macular sparing RD should be treated promptly to avoid macular detachment
- 2. Asymptomatic, usually inferior, RD may sometimes be observed and remain stable without treatment
- 3. If a demarcation line is present, RD likely chronic and may remain stable without treatment unless the RD has progressed beyond the demarcation line or has become symptomatic.
 - a. Laser retinopexy may be considered to augment the demarcation line to reduce the risk of progression
- 4. Eyes with untreated, progressive RD lose vision and ultimately become phthisical (natural history).

B. Describe surgical therapy options

- 1. Pneumatic retinopexy
- 2. Scleral buckle with cryotherapy or laser surgery with or without subretinal fluid drainage
- 3. Pars plana vitrectomy
- 4. Scleral buckle plus vitrectomy
- 5. Laser demarcation

V. List the complications of treatment, their prevention and management

A. Standard complications of pneumatic retinopexy, scleral buckling, vitrectomies

- 1. Cataract formation (pneumatic, vitrectomy)
- 2. Endophthalmitis
- 3. Choroidal or vitreous hemorrhage
- 4. High intraocular pressure (IOP)
- 5. Failure to achieve reattachment, or re-detachment of the retina
- 6. PVR formation
- 7. Ptosis
- 8. Diplopia (most common with scleral buckle)

VI. Describe disease-related complications

- A. Proliferative vitreoretinopathy
- B. Hypotony
- C. Phthisis
- D. Glaucoma
- E. Visual field defect

VII. Describe appropriate patient instructions

- A. Discuss warning signs of floaters, photopsias, visual field defect
- B. Stress importance of prompt consultation with an ophthalmologist if these warning signs develop
- C. Describe natural history
- D. Discuss benefits, risks, alternatives of surgical management

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Retinal Detachment: Principles and Practice, 2nd ed., 1995.
- 3. AAO, Focal Points: Retinal Detachment, Module #5, 1998.
- 4. Lean JS. Proliferative vitreoretinopathy. In: Albert DM, Jakobiec FA, eds. *Principles and Practice of Ophthalmology*. Philadelphia: Saunders; 1994:1110-1121.
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- Hilton GF, Brinton DA. Pneumatic retinopexy and alternative techniques. In: Ryan SJ, ed. *Retina*.
 2nd ed. St Louis: Mosby; 1994:2093-2112.
- 7. Tewari HK, Kedar S, Kumar A, et al. Comparison of scleral buckling with combined scleral buckling and pars plana vitrectomy in the management of rhegmatogenous retinal detachment with unseen retinal breaks. *Clin Experiment Ophthalmol* 2003;31:403-7.
- 8. Saw SM, Gazzard G, Wagle AM, et al. An evidence-based analysis of surgical interventions for uncomplicated rhegmatogenous retinal detachment. Acta Ophthalmol Scand 2006;84:606-12.

Traction retinal detachment

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Fibrocellular membranes on the retina and posterior vitreous contract, exert circumferential or anteroposterior traction on the retina and detach the retina from the retinal pigment epithelium (RPE)
- 2. Associated conditions can be categorized into
 - a. Neovascular (e.g., proliferative diabetic retinopathy (PDR), other vascular occlusive disease)
 - b. Hereditary (e.g., familial exudative vitreoretinopathy, Norrie)
 - c. Congenital (e.g., persistent fetal vasculature, retinopathy of prematurity)
 - d. Inflammatory (e.g., pars planitis, *Toxocara canis*)
 - e. Idiopathic (e.g., vitreomacular traction syndrome)
 - f. Trauma/postoperative (e.g., proliferative vitreoretinopathy (PVR))

B. Define the relevant aspects of epidemiology of the disease

- 1. Most common in patients with PDR
- 2. Postoperatively after retinal detachment repair (PVR)

C. List the pertinent elements of the history

- 1. Visual loss or visual field defect
 - a. May be asymptomatic
- 2. Floaters
- 3. Photopsias
- 4. Metamorphopsia

D. Describe pertinent clinical features

- 1. Detached retina appears concave in shape with a smooth surface
- 2. Fibrous or fibrovascular membranes are white and contracted, exerting traction on detached retina
- 3. Retina usually immobile
- 4. May have a secondary retinal break (combined traction-rhegmatogenous)
 - a. May give the retina a convex instead of tractional, concave configuration
- 5. Tractional detachments usually do not extend to the ora serrata

E. Describe appropriate testing and evaluation for establishing the diagnosis

1. Patient history of diabetes, sickle cell, retinopathy of prematurity

- 2. Slit-lamp biomicroscopic and indirect ophthalmoscopy
- 3. Ultrasound if coexisting vitreous hemorrhage/media opacity
- 4. Optical coherence tomography (OCT) to look at macular status

II. Define the risk factors

- A. Diabetic retinopathy
- B. Sickle cell retinopathy
- C. Retinopathy of prematurity
- D. Retinal reattachment surgery
- E. PVR
- F. Retinal vein occlusion
- G. Old penetrating injury

III. List the differential diagnosis

- A. Rhegmatogenous retinal detachment (RRD)
- B. Retinoschisis
- C. Myelinated nerve fiber layer

IV. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcome, and prognosis

- 1. Without treatment, the traction RD may remain stable or may progress to involve the foveal center
- 2. Vision will progressively decline when the macula is involved.

B. Describe medical therapy options

- 1. Prevention by optimal medical care for associated systemic diseases
- 2. Regular ophthalmology examinations by an ophthalmologist

C. Describe surgical therapy options

1. Pars plana vitrectomy with membrane peeling, endolaser and retinal reattachment with or without tamponade

V. List the complications of treatment, their prevention and management

A. Complications of vitrectomy

- 1. Cataract formation
- 2. Endophthalmitis

Retina/Vitreous

- 3. Choroidal or vitreous hemorrhage
- 4. High intraocular pressure (IOP)
- 5. Failure to achieve reattachment, or re-detachment of the retina
- 6. PVR formation

VI. Describe disease-related complications

- A. Anterior segment neovascularization and neovascular glaucoma
- B. Vitreous, preretinal, intraretinal or subretinal hemorrhage
- C. Combined traction-rhegmatogenous retinal detachment (RRD)

VII. Describe appropriate patient instructions

- A. Treat associated systemic medical conditions
- B. Obtain regular eye examinations
- C. Report any visual changes to an ophthalmologist immediately
- D. Natural history description
- E. Benefits, risks, alternatives of surgical management

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Laser Photocoagulation of the Retina and Choroid, 1997, p.91-94.
- 3. AAO, Diabetes and Ocular Disease: Past, Present and Future Therapies, 2000, p.160-162, 164, 170-171.
- 4. AAO, Retinal Detachment: Principles and Practice, 2nd ed., 1995, p.8, 77-79.
- 5. AAO, Focal Points: Retinal Detachment, Module #5, 1998, p.7.

Exudative retinal detachment

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

1. Accumulation of subretinal fluid due to exudation from a malignant, inflammatory, or vascular process

B. Define the relevant aspects of epidemiology of the disease

- 1. Wide variety of conditions may produce exudative retinal detachment. Common etiologies
 - a. Malignancy
 - i. Melanoma
 - ii. Metastatic tumor
 - iii. Intraocular lymphoma
 - iv. Retinoblastoma
 - b. Inflammatory
 - i. Vogt-Koyanagi-Harada syndrome
 - ii. Posterior scleritis
 - iii. Severe retinal vasculitis (infectious or primary)
 - c. Idiopathic
 - i. Central serous chorioretinopathy
 - ii. Uveal effusion syndrome
 - iii. Choroidal detachment
 - d. Vascular
 - i. Choroidal neovascularization (most common)
 - ii. Toxemia of pregnancy
 - iii. Malignant hypertension
 - e. Macular degeneration
 - f. Coats disease
 - g. Choroidal hemangioma
 - h. Extraocular venous compression secondary to scleral buckle
 - i. Disseminated intravascular coagulation (DIC)

C. List the pertinent elements of the history

1. Decreased visual acuity

- 2. Symptoms consistent with any of above diagnoses
- 3. Loss of visual field
- 4. Photopsias

D. Describe pertinent clinical features

- 1. Retinal detachment with smooth convex surface
- 2. Shifting subretinal fluid that changes with patient 's head position
- 3. Vitreous cells in some inflammatory conditions
- 4. Possible tumor of choroid or retina
- 5. Pigment epithelial changes
- 6. Retinal vascular disease
- E. Describe appropriate testing and evaluation for establishing the diagnosis
 - 1. Dilated fundus exam with scleral depression
 - 2. Ultrasonography
 - 3. Fluorescein angiography
 - 4. Referral to oncologist for metastatic work-up if indicated

II. List the differential diagnosis

- A. Rhegmatogenous retinal detachment
- B. Retinoschisis
- C. Choroidal detachment

III. Describe patient management in terms of treatment and follow -up

- A. Determine underlying cause with fluorescein angiography/history/ exam/ultrasound
- B. Examine fellow eye for clues as to etiology
- C. Treat underlying condition as indicated
- D. Management is rarely surgical

IV. Describe disease-related complications

A. Loss of vision usually associated with underlying disorder or its complications

Additional Resources

1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.

- 2. AAO, Retinal Detachment: Principles and Practice, 2nd ed., 1995, p.8, 79.
- 3. AAO, Focal Points: Retinal Detachment, Module #5, 1998, p.7-8.
- 4. Regillo CD, Benson WE. *Retinal Detachment: Diagnosis and Management*. 3rd ed. Philadelphia: Lippincott; 1998:60-66.

Degenerative retinoschisis

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Two forms described
 - a. "Typical" degenerative retinoschisis—most common form
 - i. Extension of typical peripheral cystoid degeneration
 - ii. Splitting of retina in the outer plexiform layer, usually inferotemporally
 - b. "Reticular" degenerative retinoschisis—less common form
 - i. Extension of reticular peripheral cystoid degeneration
 - ii. Splitting of the retina in the nerve fiber layer
 - iii. This form more likely to progress posteriorly and cause retinal detachment

B. Define the relevant aspects of epidemiology of the disease

- 1. In 1-2% of adults
- 2. Bilateral in 50%-80%

C. List the pertinent elements of the history

- 1. Usually asymptomatic
- 2. May have decreased vision
 - a. Peripheral scotoma
 - b. Loss of peripheral vision

D. Describe pertinent clinical features

- 1. Bilateral in up to 80%
- 2. Absolute scotoma
- 3. Sheathing of retinal vessels within area of schisis
- 4. Snowflakes or frosting on the elevated inner wall of the schisis cavity
- 5. Dome-shaped with a smooth surface
- 6. Usually located temporally, particularly inferotemporally
- 7. "Swiss cheese" outer retinal holes common
- 8. Inner holes also common but may be difficult to see clinically
- E. Describe appropriate testing and evaluation for establishing the diagnosis
 - 1. Indirect ophthalmoscopy with scleral depression
 - a. Schisis cavity moves with the motion of the depressor.

- b. Effect may be replicated with ultrasound testing.
- 2. Goldmann visual field testing
- 3. Optical coherence tomography (OCT)
- 4. Laser surgery application to retinoschisis area
 - a. Visible laser burn will appear on outer retina and RPE in retinoschisis, but not in a retinal detachment)
- 5. B-scan echography to identify subtle areas of schisis in the affected or fellow eye
- 6. Demarcation line (hyperpigmentation at level of the retinal pigment epithelium) at posterior edge of the elevated retina suggests chronic retinal detachment

II. Define the risk factors

- A. Hyperopia
- B. Reticular peripheral cystoid degeneration

III. List the differential diagnosis

A. Rhegmatogenous retinal detachment

- 1. Clinical differentiation
- B. Exudative retinal detachment
- C. Juvenile retinoschisis

IV. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcomes, prognosis

- 1. Majority remain stable without progression
- 2. Progression (macular involvement is very rare)
- 3. Retinal detachment (rare, only if inner and outer layer holes are present)

B. Describe surgical therapy options

- 1. None for primary condition, i.e., prophylactic laser retinopexy to demarcate schisis cavity is not recommended
- 2. If a retinal detachment develops, repair with scleral buckle and/or vitrectomy techniques

V. Describe disease-related complications

- A. Progression of schisis cavity
- B. Progression to retinal detachment

C. Development of an outer layer break

VI. Describe appropriate patient instructions

- A. Natural history description
- B. Warning signs of retinal detachment (photopsias, floaters, visual field defect) should lead to prompt consultation

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Laser Photocoagulation of the Retina and Choroid, 1997, p. 213.
- 3. AAO, Electrophysiologic Testing in Disorders of the Retina, Optic Nerve and Visual Pathway, 2nd ed., 2001, p. 69-72, 208.
- 4. AAO, Retinal Detachment: Principles and Practice, 2nd ed., 1995, p. 14, 20-3, 45, 64-5, 92, 126.
- 5. AAO, Focal Points: Peripheral Lesions of the Fundus, Module #8, 2000, p. 7.
- 6. AAO, Focal Points: Retinal Detachment, Module #5, 1998, p. 9.

Commotio retinae

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of the disorder

- 1. Blunt, closed-globe trauma to the globe produces commotio retinae at the impact site (coup), or
- 2. Opposite to the site of impact (contrecoup)
- 3. Shearing and disorganization of photoreceptor outer segments and damage to the RPE

B. Define the relevant aspects of epidemiology of this disorder

- 1. Generally, young males
- 2. Sports or recreational activities

C. List the pertinent elements of the history

- 1. Mechanism of sudden blunt trauma
- 2. Timing of visual decrease (usually acute)
- 3. Visual problems concerning color perception, brightness
- 4. Inquire about work related/safety eyeglasses (were they worn, were they available)

D. Describe pertinent clinical features

- 1. Thickened opaque retinal whitening
- 2. Occasional retinal hemorrhages
 - a. May have cherry-red-spot macular appearance
- 3. May also include late findings such as
 - a. hyperplasia of the retinal pigment epithelium

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. OCT to assess extent of photoreceptor injury
- 2. Fluorescein angiography to assess extent of injury
- 3. Either study is optional and mostly prognostic
- 4. Thorough dilated funduscopic exam to rule out retinal tear, scleral or choroidal rupture, and retinal detachment

II. Define the risk factors

- A. Participation in activities that may result in blunt trauma to the eye, especially if no eyewear protection is used
 - 1. Bungee cords, airbags, surfing, paintballs, slingshots

2. Increased severity with Stargardt disease

III. List the differential diagnosis

- A. Traumatic retinal pigment epitheliopathy (extensive dye leakage on fluorescein angiography)
- B. Branch or central retinal artery occlusion
- C. Chorioretinitis sclopetaria
- D. Cotton wool spots
- E. Myelination of the nerve fiber layer

IV. Describe the patient management in terms of treatment and follow-up; natural history

- A. Observation, the visual prognosis is frequently good without treatment
- B. Suspicion of a ruptured globe requires surgical exploration
- C. Examine for other trauma related ocular injuries
- D. Follow for elevated (IOP) due to angle recession

V. Describe disease-related complications

A. Permanent damage to the photoreceptor RPE-complex

B. Other trauma related injuries

- 1. Ruptured globe
- 2. Traumatic optic neuropathy
- 3. Traumatic macular hole
- 4. Retinal break or dialysis
- 5. Angle recession
- 6. Dislocated lens
- 7. Choroidal rupture
- 8. Scleral rupture

VI. Describe appropriate patient instructions

- A. Retinal detachment precautions
- B. Annual exams for possible glaucoma
- C. Protective eyewear

Additional Resources

1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.

Choroidal rupture

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Blunt, closed-globe trauma may lead to choroidal rupture
- 2. Direct ruptures of choroid from a blunt impact
- 3. Indirect concussive injury to the posterior pole (Contrecoup)
- 4. Either mechanism may lead to contusion necrosis of the choroid

B. Define the relevant aspects of epidemiology of the disease

- 1. Young males
- 2. Closed globe trauma

C. List the pertinent elements of the history

- 1. History of a violent altercation
- 2. Motor vehicle accident
- 3. Sports injuries

D. Describe pertinent clinical features

- 1. Posterior curvilinear (usually with optic nerve as epicenter) or linear rent in the retinal pigment epithelium (RPE) Bruch membrane complex; may also be peripheral
- 2. Often associated with subretinal or sub-RPE hemorrhage in the acute phase
- 3. Subretinal hemorrhage may obscure the choroidal rupture
- 4. May be multiple and concentric
- 5. Acute visual loss may be caused by
 - a. Rupture involving the fovea
 - b. Subretinal blood
 - c. Vitreous hemorrhage
 - d. Commotio retinae
 - e. Anterior segment or optic nerve injury
- 6. Chronic visual changes depend upon
 - a. Healing response
 - b. Choroidal neovascularization (CNV)
 - c. Gliosis
 - d. Subretinal fibrosis

- e. RPE disturbance
- f. Proximity to fovea
- g. associated trauma such as traumatic optic neuropathy

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Fluorescein angiography reveals:
 - a. Choroidal/RPE defects
 - b. CNV
- 2. OCT to evaluate
 - a. Extent of the rupture
 - b. Presence of sub or intra-retinal fluid
- 3. Neither angiography or OCT may be useful in the presence of blood that obscures the fundus

II. Define the risk factors

A. Angioid streaks (See Angioid streaks)

III. List the differential diagnosis

- A. Angioid streaks
- B. Lacquer cracks in myopic degeneration
- C. Traumatic pigment epitheliopathy
- D. Commotio retinae
- E. Chorioretinitis sclopetaria

IV. Describe the patient management in terms of treatment and follow-up

- A. Choroidal ruptures without associated complications may be observed
- B. Peripheral retina and iridocorneal angle need to be evaluated
- C. CNV may be associated with rupture and may be treated with off-label use of anti-vascular endothelial growth factor (VEGF) therapy, photodynamic therapy, or thermal laser photocoagulation
- D. Possible surgical removal or displacement of associated subretinal blood

V. List complications of treatment

- A. Complications of intraocular injections
- B. Complications of photodynamic therapy
- C. Complications of thermal laser

VI. Describe disease-related complications

- A. CNV that frequently occurs in the foveal region
- B. Other trauma related injuries
 - 1. Ruptured globe
 - 2. Traumatic optic neuropathy
 - 3. Traumatic macular hole
 - 4. Retinal break or dialysis
 - 5. Angle recession
 - 6. Dislocated lens
 - 7. Scleral rupture

VII. Describe appropriate patient instructions

- A. Amsler grid if near the macula
- B. Report new distortion or blurring
- C. Followup periodically to evaluate for CNV or annually for glaucoma
- D. Education on symptoms of retinal detachment
- E. Protective eyewear

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Laser Photocoagulation of the Retina and Choroid, 1997, p.233-234.
- 3. AAO, Focal Points: Open-Globe Injuries, Module #7, 2001.
- 4. Williams DF, Mieler WF, Williams GA. Posterior segment manifestations of ocular trauma. Retina 1990;10 Suppl 1:S35-44.

Sclopetaria

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

1. Full-thickness rupture of the choroid and retina resulting from kinetic energy transferred from an orbital projectile without rupture of the scleral

B. Define the relevant aspects of epidemiology of the disease

- 1. Usually a bullet, BB, or pellet gun injury
- 2. Industrial heavy equipment injury
- 3. Air bag injury

C. Describe pertinent clinical features

- 1. Vitreous, retinal and/or choroidal hemorrhage
- 2. Choroidal rupture with overlying retinal discontinuity
- 3. Bare sclera is often visible acutely or after the hemorrhage clears
- 4. Contrecoup mechanism of injury may occur

D. Describe the complications of this disease

- 1. Massive fibroglial or fibrovascular proliferation
- 2. Retinal pigment epithelial hyperplasia
- 3. Optic nerve damage (common)
- 4. Retinal detachment (relatively uncommon)

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Consider computed tomography (CT) scan to rule out
 - a. Intraocular foreign body
 - b. Intraorbital/intracranial foreign body
 - c. Fracture

II. Define the risk factors

- A. Engaging in high risk behavior involving BB/guns
- B. Military personnel engaged in combat

III. List the differential diagnosis

A. Giant retinal tear
- B. Retinal detachment (RD)
- C. Choroidal rupture
- D. Blunt trauma
- E. Large colobomas (no recent or remote trauma)

IV. Describe patient management in terms of treatment and follow-up

- A. Observation initially
 - 1. Treatment usually not required for sclopetaria site
- B. Retinal detachment surgery (i.e. scleral buckle) is not usually necessary
- C. Management of associated central nervous system (CNS) injuries

V. List the complications of treatment, their prevention and management

- A. Observation
- B. Complications of RD surgery if required

VI. Describe disease-related complications

A. CNS injury associated with high speed projectile passing through orbit

VII. Describe appropriate patient instructions

- A. Report loss of peripheral vision, suggesting retinal detachment
- B. Report neurologic symptoms

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. Martin et al. Treatment and pathogenesis of traumatic chorioretinal rupture (sclopetaria). Am J Ophthalmol 117:2:190-200, 1994.

Scleral ruptures and lacerations

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

1. Open-globe injury from either blunt (rupture) or sharp (laceration) object

B. Define the relevant aspects of epidemiology of the disease

- 1. Significant trauma to the eye
- 2. Major motor-vehicle accident
 - a. Suspect associated facial fracture

C. List the pertinent elements of the history

- 1. High-risk activities resulting in eye trauma
- 2. Mechanism of injury
- 3. Suspect and inquire about intraocular foreign body
- 4. Inquire and document whether the injury was work related.
- 5. Were safety glasses worn? Provided?

D. Describe pertinent clinical features (the following clinical signs may not be present in all cases)

- 1. Visual acuity is the most important determinant of final visual outcome
- 2. Afferent pupillary defect is strong predictor of outcome
- 3. Hemorrhagic chemosis
- 4. Low intraocular pressure (IOP)
- 5. Positive Seidel test
- 6. Normal IOP does not preclude rupture
- 7. Hyphema
- 8. Vitreous hemorrhage
- 9. Rupture most common at limbus or parallel to and under the insertion of the rectus muscles, or previous scleral incision
- 10. Deepened anterior chamber
- 11. Uveal prolapse
- 12. Retinal incarceration
- 13. Retinal detachment (RD)
- 14. Giant retinal tear
- 15. Rule out associated traumatic endophthalmitis

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Gentle ultrasound in eyes without signs of obvious globe rupture
 - a. Helpful in occult rupture
- 2. Computed tomography (CT) scan or radiography, to rule out associated fracture or intraocular foreign body
- 3. Magnetic resonance imaging (MRI) scan only after metallic intraocular foreign body has been ruled out
- 4. Globe exploration when rupture suspected
 - a. Hemorrhagic chemosis
 - b. Hypotony
 - c. Deep anterior chamber (AC)
 - d. Intraocular air on imaging

II. Define the risk factors

- A. Any ocular trauma, blunt (rupture) or sharp (laceration) injuries
- B. Motor vehicle accidents with severe facial trauma
- C. Alcohol-related injuries
- D. Falls with facial trauma in elderly
- E. Previous cataract or corneal transplant surgery

III. List the differential diagnosis

- A. Penetrating or perforating injury
- B. Retained intraocular foreign body
- C. Conjunctival laceration without rupture

IV. Describe patient management in terms of treatment and follow-up

- A. Surgical exploration for any eye with suspected rupture
- B. Scleral and/or corneal wounds closed primarily
 - 1. Reposit extruded uveal and retinal tissue if possible
- C. Secondary intraocular surgery
 - 1. May need serial ultrasound examinations if view is obscured
 - 2. Typically planned 7-14 days following primary repair
- D. Primary enucleation performed only with severe globe destruction
- E. Corneal lacerations that cross the limbus must be explored to posterior extent

- F. Consider systemic antibiotics prophylactically and/or intravitreal antibiotics if infection is seen or suspected
- G. Tetanus prophylaxis if required
- H. Discussion of sympathetic ophthalmia

V. List the complications of treatment, their prevention and management

- A. Uveal and retinal prolapse
- B. Complications of corneoscleral laceration repair (e.g., wound leak, tissue incarceration, irregular astigmatism)

VI. Describe disease-related complications

- A. Rhegmatogenous RD
- B. Traction RD (with or without proliferative vitreoretinopathy)
- C. Retinal incarceration
- D. Vitreous hemorrhage
- E. Hyphema
- F. Uveal prolapse
- G. Hypotony
- H. Phthisis bulbi
- I. Expulsive choroidal hemorrhage
- J. Sympathetic ophthalmia

Additional Resources

1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.

Ocular penetrating and perforating injury

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Perforating globe injury = 2 full thickness scleral defects
 - a. Usually an entrance plus exit wound
 - b. Usually a missile-like injury
- 2. Penetrating globe injury involves
 - a. Entrance wound, no exit wound
 - b. Usually a sharp lacerating trauma
- 3. One may not be able to distinguish penetrating from perforating injury until intraocular surgery is performed

B. Define the relevant aspects of epidemiology of the disease

- 1. Most common in young males
- 2. May be work-related or recreational accident

C. List the pertinent elements of the history

- 1. Work-related injuries where metallic foreign body may hit eye
 - a. Metal-on-metal
- 2. Altercation using sharp objects: knives, nail guns, etc.
- 3. Inappropriate gun play
- 4. Sports injuries

D. Describe pertinent clinical features

- 1. Pain and decreased vision
- 2. Examination
 - a. Decreased visual acuity
 - b. Decreased intraocular pressure (IOP)
 - c. Scleral or corneal laceration usually visible
 - d. Shallow anterior chamber (if cornea violated)
 - e. Abnormally deep anterior chamber may suggest scleral injury
 - f. Hyphema
 - g. Cataract and/or dislocated lens
 - h. Vitreous hemorrhage

- i. Retinal detachment (RD) and/or choroidal detachment
- j. Possible intraocular or intraorbital foreign bodies (IOFB)
- k. Possible signs of endophthalmitis at time of presentation

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Computed tomography (CT) scan
 - a. Check for intraocular or intraorbital foreign bodies
- 2. Plain x-ray (rarely useful)
- 3. Gentle ultrasound
 - a. Some risk of extrusion of intraocular contents
 - b. Should consider the globe ruptured until shown otherwise
- 4. Avoid an MRI if metallic foreign body is suspected

II. Define the risk factors

- A. Selected voluntary activities of high risk: e.g., metal-on-metal work
- B. Personal (involuntary injury) e.g., gunshot wound
- C. Lack of protective eyewear at time of activity
- D. Soldier in modern warfare

III. List the differential diagnosis

- A. Blunt (closed-globe) injury
- B. Possibility of IOFB
- C. Scleral and/or choroidal rupture
- D. Partial thickness ocular laceration

IV. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcome and prognosis

- 1. All open globes are at risk for infection and (rarely) sympathetic ophthalmia
- 2. Risk factors for poor outcome
 - a. Presenting visual acuity <20/200
 - b. Afferent pupillary defect
 - c. Laceration (entry site) extending posterior to the plane of rectus muscle insertion
 - d. Exit site in macula or affecting optic nerve

- e. Large lacerations (>10 mm)
- f. Size, type of missile, IOFB
- g. Presence of retinal detachment
- h. Presence of endophthalmitis

B. Describe medical therapy options (adjunctive role)

- 1. Preoperative systemic antibiotics (and tetanus shot if not up to date)
- 2. Postoperative topical and systemic (prophylactic) antibiotics
- 3. Postoperative topical corticosteroids and cycloplegia
- 4. Intraoperative (intravitreal) antibiotics in selected cases that are at high-risk for infection such as vegetable matter injuries or rural injuries

C. Describe surgical therapy options

- 1. Emergency globe exploration and globe closure
 - a. Suture corneal and scleral lacerations
 - b. Excise vitreous from corneal wounds and re-form the anterior chamber
 - c. Reposit viable prolapsed/extruded tissue if not contaminated
 - d. Remove unviable prolapsed/extruded tissue
 - e. Avoid undue globe pressure during closure
 - f. Aggressive attempts to repair posterior exit sites should be avoided to prevent extruding retina and vitreous through a posterior wound
- 2. Intraocular surgery (e.g., vitrectomy/lensectomy) as primary procedure if IOFB and/or endophthalmitis are present
- 3. Secondary reconstruction (e.g., vitrectomy)
 - a. Typically within 7-14 days following primary repair
 - b. Address associated problems such as cataract, intraocular hemorrhage, choroidal hemorrhage or RD
 - c. Delay of vitrectomy
 - i. May allow cornea to clear
 - ii. Decreases risk of intraoperative hemorrhage in acutely inflamed eyes
 - iii. May allow spontaneous separation of the vitreous from the retina
 - iv. In perforating injuries, may allow posterior wounds to heal
- 4. For perforating injuries, vitrectomy surgery can also be considered for the following reasons:
 - a. Presence of moderate to severe vitreous hemorrhage
 - b. Ancillary damage during initial repair
 - c. Signs of progressive transvitreal traction

V. List the complications of treatment, their prevention and management

- A. Complications of vitrectomy
- B. Risks of general anesthesia
- C. Risks of corneoscleral laceration repair
 - 1. Tissue incarceration, wound leak, irregular astigmatism
 - 2. Prevented by meticulous surgical repair

VI. Describe disease-related complications

- A. Endophthalmitis
- B. Retinal tear(s)
- C. Tractional or rhegmatogenous retinal detachment
- D. Cyclitic membrane formation
- E. Hypotony
- F. Aphakia if lens extruded or removed
- G. Sympathetic ophthalmia
- H. Toxicity of IOFB
- I. Phthisis bulbi

VII. Describe appropriate patient instructions

- A. Traumatized eyes are at risk for late problems such as retinal detachment, glaucoma, and rarely sympathetic ophthalmia (patients should be educated regarding the symptoms of these conditions)
- B. Protective eyewear may be reasonable for all high risk activities to protect both eyes

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Focal Points: Open-Globe Injuries, Module #7, 2001.
- 3. Mieler WF, Mittra RA. The role and timing of pars plana vitrectomy in penetrating ocular trauma. *Arch Ophthalmol*. 1997;115:1191-1192.

Intraocular foreign body

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

1. Object penetrates globe and portions of object or projectile remain within eye

B. Define the relevant aspects of epidemiology of the disease

- 1. High risk work/home environments that would include exploding particles or "metal on metal" contact
- 2. Shooting BB guns, pellet guns
- 3. Inadequate or lack of eye protection with high risk activities

C. List the pertinent elements of the history

- 1. Eye pain and blurring after "metal on metal" contact with a hammer or other tool
- 2. Explosions, trauma from elsewhere, etc.
- 3. Establish if foreign body is metallic if possible
- 4. Likelihood of organic material

D. Describe pertinent clinical features (variable)

- 1. Subconjunctival hemorrhage, chemosis
- 2. Blurred vision
- 3. Corneoscleral or conjunctival/ scleral laceration
- 4. Lens trauma (check for sectoral cataract and or phacodonesis)
- 5. Trauma to iris (check for iridodonesis or iris defects)
- 6. Hyphema
- 7. Vitreous hemorrhage
- 8. Retinal tear or detachment
- 9. Subretinal hemorrhage
- 10. Intraocular inflammation
- 11. Visible foreign matter within globe (anterior or posterior segment)
- 12. Fibrous encapsulation of intraocular foreign body (IOFB) (late)
- 13. Endophthalmitis
- E. Describe appropriate testing and evaluation for establishing the diagnosis
 - 1. Frontal and lateral X-rays (especially if CT is unavailable) help determine presence but not exact location of IOFB(s)

- 2. Computed tomography (CT) scans (X-ray if CT not available)
- 3. Ultrasonography (use with caution if globe is ruptured)-better for non-radiopaque foreign bodies
- 4. Magnetic resonance imaging (MRI) contraindicated if metallic foreign body is suspected

II. Define the risk factors

- A. Unsafe use of pellet guns and BB guns
- B. Failure to use safety goggles in metal-on-metal hammering

III. List the differential diagnosis

- A. Perforating injuries (with or without intraorbital foreign body)
- B. Occult scleral rupture
- C. Blunt trauma
- D. Closed globe injury with periocular foreign body

IV. Describe patient management in terms of treatment and follow-up

A. Prognosis

- 1. Related to type and extent of injury
- 2. Related to location of impact
- 3. Presence/development of endophthalmitis or retinal detachment (RD)
- 4. Type/composition of projectile
- 5. Related to presenting vision and presence or absence of an APD

B. Surgical therapy

- 1. Prompt vitrectomy may reduce incidence of endophthalmitis
- 2. IOFB removed through sclerotomy, limbus, or original wound depending on size
- 3. Lens removal may be necessary when the lens capsule is ruptured
- 4. Ferrous objects may be removed with a magnet
- 5. Antibiotics
 - a. Topical and systemic (intraocular for suspected or established endophthalmitis)
- 6. Tetanus prophylaxis if required

V. List the complications of treatment, their prevention and management

A. Risk of RD and proliferative vitreoretinopathy

1. Ophthalmoscopy to detect and treat any retinal tear and detachment

B. Infection

1. Intraocular antibiotics necessary for treatment of suspected or established endophthalmitis

VI. Describe disease-related complications

A. Siderosis (iron)

- 1. Deposited in epithelial tissues such as retina, lens epithelium, RPE, etc
- 2. Oxidation and dissemination of ferric ions generates powerful oxidants (Fenton reaction)
 - a. Leads to cell membrane damage and enzyme inactivation
- 3. May lead to unilateral depression of ERG amplitudes

B. Chalcosis (copper)

- 1. Pure copper: especially toxic; leads to severe inflammation
- 2. Late removal may not cure chalcosis
 - a. May increase after surgery due to dissemination of the metal
- 3. Less than 85% copper content (brass, bronze): chronic chalcosis
 - a. Affinity for limiting membranes
 - Deposits in Descemet's membrane, greenish aqueous particles, green discoloration of iris,
 "sunflower" cataract, brownish red vitreous opacities and strand formation, metallic flecks on retinal vessels and macula
- C. Retinal tear and RD
- D. Endophthalmitis
- E. Cataract
- F. Glaucoma (angle trauma)

VII. Describe appropriate patient instructions

- A. Usual post-vitrectomy instructions
- B. Safety glasses for any high risk activity

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Focal Points: Open-Globe Injuries, Module #7, 2001.
- 3. AAO, Focal Points: Posterior Segment Vitrectomy: An Overview of Indications, Module #4, 1991, p.5.
- 4. Joseph DP, Pieramici DJ, Beauchamp NJ Jr. Computed tomography in the diagnosis and

prognosis of open-globe injuries. *Ophthalmology* 2000;107:1899-906.

Hemorrhagic choroidal detachment

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Rupture or shearing of suprachoroidal vessel
- 2. Serous effusion may lead to shearing force on these vessels (i.e. scleral buckling surgery)
- 3. Sudden or prolonged hypotony causing serous effusion leading to shearing of vessels
 - a. Penetrating keratoplasty
 - b. Cataract surgery
 - c. Glaucoma) surgery
 - d. Laceration due to trauma
 - e. Indirect mechanism
 - f. Suture penetration during scleral buckle or strabismus surgery

B. Define the relevant aspects of epidemiology of the disease

- 1. May occur spontaneously
 - a. More severe if patient is anticoagulated
- 2. Valsalva maneuver
- 3. Intraocular surgery associated with hypotony
- 4. Advanced age
- 5. Systemic hypertension
- 6. Open globe injury
- 7. Elevated intraocular pressure (IOP) prior to intraocular surgical incision

C. List the pertinent elements of the history

- 1. Acute pain
- 2. Profound visual loss with obstruction of the visual axis
- 3. History of glaucoma surgery

D. Describe pertinent clinical features

- 1. Narrowed or collapsed anterior chamber
- 2. Elevated IOP
- 3. Corneal edema
- 4. Hyphema
- 5. Subretinal hemorrhage

- 6. Vitreous hemorrhage
- 7. Centrally appositional (kissing) choroidal detachment
- 8. Loss of red reflex

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Ultrasound is helpful for:
 - a. Diagnosis and determining the extent of the choroidal (e.g. if macula is involved)
 - b. Useful for following trend
 - c. Determining when clot has liquefied
 - d. Differentiate from serous choroidal detachment

II. Define the risk factors

- A. Advanced age
- B. High myopia
- C. Aphakia
- D. Systemic Hypertension
- E. Intraoperative tachycardia
- F. Anticoagulation
- G. Atherosclerosis
- H. Scleral buckling with vortex vein compression
- I. Valsalva maneuver
- J. Hypotony
- K. Open globe injury
- L. Glaucoma especially with incisional surgery
- M. Sturge-Weber associated choroidal hemangiomas
- N. Suprachoroidal hemorrhage in the fellow eye

III. List the differential diagnosis

- A. Serous choroidal detachment
- B. Tumors
- C. Retinal detachment (RD) especially exudative
- D. Retinoschisis
- E. Large subretinal hemorrhage

IV. Describe patient management in terms of treatment and follow-up

Retina/Vitreous

A. Natural history

- 1. Choroidal hemorrhage resolves over weeks to months
- 2. Associated with subretinal fibrosis and/or tractional RD
- 3. Visual prognosis guarded

B. Surgical intervention

- 1. Immediate closure of ocular surgical incision(s) and removal of vitreous prolapse into the wound (if possible)
- 2. Drainage of suprachoroidal hemorrhage
 - a. Allow time for clot liquefaction (7-14 days)
 - b. Indications: RD or severe pain
 - c. Ultrasound for intra-operative or pre-operative guidance
 - d. Infusion into anterior chamber (or anterior vitreous with long infusion line)
 - e. Equatorial sclerotomy at site of maximum accumulation of blood to drain fluid and clots
 - f. After drainage of suprachoroidal blood, pars plana vitrectomy may be performed
- 3. Vitrectomy indicated for
 - a. Vitreous incarceration
 - b. Vitreous hemorrhage
 - c. Retinal tears, rhegmatogenous retinal detachment or retinal incarceration
 - d. Tractional RD
 - e. Epiretinal membrane(s)

V. List the complications of treatment, their prevention and management

- A. Attempting to drain formed clot may limit efficacy
- B. Aggressive manipulation may result in choroidal injury
- C. Re-bleeding from the choroid
- D. Incarceration of retinal tissue
- E. Extrusion of intraocular contents

VI. Describe disease-related complications

- A. Markedly elevated IOP
- B. Phthisis bulbi
- C. Proliferative vitreoretinopathy
- D. Vitreous hemorrhage

- E. Retinal pigment epithelium (RPE) and retinal atrophy
- F. Expulsion of intraocular contents
- G. Retinal detachment

VII. Describe appropriate patient instructions

A. Careful follow-up to determine need for, and optimal timing of, surgical intervention

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. Wirostko et al. Suprachoroidal hemorrhage: outcome of surgical management according to hemorrhage severity. Ophthalmology 105:12:2271-5, 1998.
- 3. Scott et al, Visual acuity outcomes among patients with appositional suprachoroidal hemorrhage. Ophthalmology 104:12:2039-46, 1997.

Serous choroidal detachment

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Accumulation of fluid in the suprachoroidal space
 - a. Detachment of the choroid
 - b. Detachment of the ciliary body
 - c. Resulting from factors that cause leakage from the choroidal vessels
 - i. Obstruction of the vortex veins by encircling scleral buckle
 - ii. Any intraoperative hypotony (e.g. related to glaucoma filtering procedure or penetrating keratoplasty)
 - iii. Any postoperative hypotony due to wound leak
 - iv. Inflammation i.e. scleritis, uveitis
 - v. Neoplastic
 - vi. Anatomic
 - i) Uveal effusion syndrome with choroidal congestion
- 2. Choroidal detachment may occur in situations resulting in osmotic pressure related differences between the choroidal vasculature and its surrounding environment

B. Define the relevant aspects of epidemiology of the disease

- 1. Patients undergoing intraocular surgery
- 2. Systemic inflammatory conditions
- 3. Neoplasms
- 4. Small globes and thick sclera (uveal effusion)

C. List the pertinent elements of the history

- 1. Recent ocular surgery
- 2. Less painful than hemorrhagic choroidal detachment, frequently painless
- 3. Recent ocular inflammation
- 4. Recent decrease in vision
- 5. Visual field defects

D. Describe pertinent clinical features

- 1. May occur during the early postoperative period following:
 - a. Retinal reattachment surgery

- b. Glaucoma surgery
- c. Any surgery associated with transient or prolonged hypotony
- 2. Appearance of yellow/orange elevated ciliary body and choroid
- 3. Shallowing of anterior chamber may result in:
 - a. Intraocular pressure (IOP) spike
 - b. Peripheral anterior synechiae
 - c. Corneal edema
- 4. May be present within a day of scleral buckling
- 5. The ora serrata may be visible without scleral indentation
- 6. Size may fluctuate
- 7. May have associated subretinal fluid
- E. Describe appropriate testing and evaluation for establishing the diagnosis
 - 1. Clinical examination and ultrasound to help differentiate between serous detachment, hemorrhagic detachment, and neoplasm

II. Define the risk factors

- A. Patients undergoing intraocular surgery
- B. Hypertension
- C. High myopia with advanced age
- D. Glaucoma surgery is particularly prone
- E. Systemic inflammatory disease
- F. Hypotony
- G. Hyperopia
- H. Nanophthalmos
- I. Scleritis
- J. Uveitis
- K. Congenital or acquired scleral abnormality

III. List the differential diagnosis

- A. Hemorrhagic choroidal detachment
- B. Retinal detachment (rhegmatogenous or exudative)
- C. Choroidal tumor
- D. Retinoschisis
- E. Idiopathic chorioretinal folds

Retina/Vitreous

IV. Describe patient management in terms of treatment and follow-up

A. Observation

- B. Treat hypotony (e.g. close any leaking wounds)
- C. Treatment of choroidal detachment depends on the amount of choroidal elevation present
- D. Surgical drainage is often performed in eyes with centrally appositional choroidal detachment ("kissing choroidals") in order to avoid permanent retina-to-retina adhesions
- E. Drainage of suprachoroidal fluid is performed through a sclerotomy posterior to the scleral spur
- F. Simultaneous or intermittent infusion of fluid into the anterior chamber maintains the pressure gradient and minimizes the risk of recurrence
- G. A viscoelastic may also be used to minimize postoperative hypotony
- H. Consider treatment with corticosteroids
- I. Scleral windows for the uveal effusion syndrome

V. List the complications of treatment

- A. Hemorrhagic choroidal detachment
- B. Retinal detachment
- C. Subretinal hemorrhage
- D. Recurrence of serous choroidal detachment
- E. Systemic complications of corticosteroids

VI. Describe disease-related complications

- A. Peripheral tractional retinal detachment
- B. Retina-to-retina adherence
- C. Elevated IOP
- D. RPE abnormalities
- E. Hypotony

VII. Describe appropriate patient instructions

- A. Report pain, loss of visual field, or loss of vision
- B. In cases of hypotony
 - 1. Advise patient to wear eye shield over affected eye at all times

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. AAO, Retinal Detachment: Principles and Practice, 2nd ed., 1995, p.80-81, 87-88, 145, 151-152.
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- 4. Law et al. Retinal complications after aqueous shunt surgical procedures for glaucoma. Arch Ophthalmol 114:12:1473-80, 1996.

Post-traumatic endophthalmitis

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of the disease

- 1. Penetrating or perforating injury of the globe
- 2. Introduction of microbes by the object causing injury
- 3. Introduction of microbes of the patient's own flora

B. Define the relevant aspects of epidemiology of the disease

- 1. Incidence of infection varies from 2% to 7% depending on the location and circumstances of the injury
 - a. Incidence higher
 - i. In presence of IOFB
 - ii. In rural settings
 - iii. With lens trauma
 - iv. With delay in wound closure
 - v. With vegetative matter
- 2. Eyes with retained intraocular foreign bodies are more likely to become infected
- 3. *Bacillus cereus* organisms are more common causative agents than in other forms of endophthalmitis in several series
 - a. Accounts for almost 25% of post-traumatic endophthalmitis
 - b. Most commonly associated with soil-contaminated injuries (especially those involving foreign bodies)
- 4. Gram positive organisms
 - a. The second most common causative agents
- 5. Gram negative organisms and mixed infections
 - a. More common with trauma than in postoperative endophthalmitis

C. List the pertinent elements of the history

- 1. Type of injury
- 2. Time from injury to onset of infection (or change in symptoms)
- 3. Type of repair of injury
- 4. Antimicrobial prophylaxis (don't assume that systemic or topical antibiotics will treat the infection; it may mask the signs)
- 5. Pain

- 6. Redness
- 7. Visual loss
- 8. Setting of injury

D. Describe the pertinent clinical features

- 1. Wound repair
- 2. Decreased acuity
- 3. Conjunctival hyperemia
- 4. Anterior chamber flare and cell
- 5. Hypopyon
- 6. Fibrin, particularly on lens surface
- 7. Vitreous cellular infiltration and opacification
- 8. Lid edema
- 9. Corneal opacification
- 10. Retinal detachment (RD)
- 11. Intraocular foreign body (IOFB)
- 12. Vitreous hemorrhage
- 13. Rapidity of change in signs

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Anterior chamber sample for culture, sensitivity and gram stain
- 2. Vitreous biopsy for culture, sensitivity, and gram stain

II. Define the risk factors

- A. IOFB
- B. Soil contaminated injuries
- C. Vegetable matter contaminated injury
- D. Delayed wound closure

III. List the differential diagnosis

A. Severe postoperative inflammation

IV. Describe patient in terms of treatment and follow-up

A. Describe the natural history, outcome and prognosis

- 1. Visual outcomes
 - a. Often poor compared to post-cataract surgery endophthalmitis
- 2. *Bacillus* cereus infections
 - a. Commonly result in phthisis and/or loss of the eye
- 3. Effects of the injury may also contribute to reduced vision

B. Describe medical therapy options

- 1. Intraocular antibiotic injection in all cases, supplemented by
 - a. Systemic corticosteroids (select cases)
 - b. Topical corticosteroids
 - c. Topical antibiotics
 - d. Systemic antimicrobial therapy
 - i. Fourth generation fluoroquinolones may be considered

C. Describe surgical therapy options

- 1. Pars plana vitrectomy
- 2. Intraocular antibiotic injection should be considered strongly
- 3. Removal of retained IOFB when present

V. List the complications of treatment, their prevention, and management

A. Surgical complications

- 1. RD
- 2. Cataract
- 3. Anesthetic related complications
- 4. Corneal decompensation
- 5. Complications of anesthesia

B. Medical complications

- 1. Toxicity of injected antimicrobials
- 2. Systemic side effects of antibiotics
- 3. Complications of systemic corticosteroids
- 4. Complications of topical corticosteroids
- 5. Complications of topical antimicrobials

VI. Describe disease-related complications

- A. Visual loss
- B. RD
- C. Vitreous opacification
- D. Epiretinal membrane
- E. Corneal decompensation
- F. Anterior segment fibrosis
- G. Cataract formation
- H. Glaucoma
- I. Phthisis

VII. Describe appropriate patient instructions

- A. Postoperative medications
- B. Potential outcomes
 - 1. Advise of guarded visual prognosis, potential for eye loss
 - 2. Advise to keep other eye protected at all times (e.g. with polycarbonate spectacles)

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
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Sympathetic ophthalmia

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

1. Autoimmune response to previously sequestered antigens in the setting of ocular injury

B. Define the relevant aspects of epidemiology of the disease

- 1. Very rare, bilateral, non-necrotizing, granulomatous panuveitis
- 2. Occurs after injury to fellow eye (exciting eye)
- 3. Latent period followed by development of uveitis in the uninjured globe (sympathizing eye)
- 4. Incidence has decreased with improved wound closure and early enucleation of severely traumatized eyes

C. Describe the pathologic features

- 1. Diffuse granulomatous uveal involvement with lymphocytes, epithelioid cells and occasional eosinophils
- 2. Relative lack of retinal inflammation
- 3. Absence of granulomatous inflammation in choriocapillaris (unlike VKH)
- 4. Eosinophils are present in the choroid early in the course of disease
- 5. Phagocytosis of pigment by epithelioid cells
- 6. Dalen Fuchs nodules (yellow inflammatory drusen like deposits at the level of the inner choroid)
- 7. Granulomatous process may extend to scleral canals and optic nerve

D. List the pertinent elements of the history

1. Insidious onset with mild photophobia, redness and blurring of vision in the sympathizing eye weeks to years after injury

E. Describe pertinent clinical features

- 1. Bilateral
 - a. Severe panuveitis in the injured or operated eye
 - b. Sympathizing eye
 - i. Thickening of the uveal tract on B-scan ultrasonography
 - ii. Panuveitis
 - iii. Dalen-Fuchs nodules
 - iv. Exudative retinal detachment
 - v. Large mutton fat keratic precipitates
 - vi. Infiltration of the iris

- vii. Extensive peripheral anterior synechiae
- viii. Loss of accommodation
- ix. Vitritis
- x. Papillitis

II. Define the risk factors

A. Suspect sympathetic ophthalmia (SO) in patients with following risk factors

- 1. Scleral rupture
- 2. Perforating or penetrating injury with or without uveal prolapse
- 3. Previous intraocular surgery
- 4. Perforating ulcers
- 5. History of evisceration

III. List the differential diagnosis

- A. Vogt-Koyanagi-Harada syndrome
- B. Phacoanaphylactic endophthalmitis
- C. Ocular sarcoidosis
- D. Lymphoma
- E. Syphilis

IV. Describe patient management in terms of treatment and follow-up

- A. High-dose oral corticosteroids and immunomodulatory therapy are standard of care
- B. Although not proven, enucleation within one to two weeks is sometimes recommended in an effort to prevent SO
- C. Once SO is established, enucleation may not change outcome

V. Complications of treatment

A. Complications typical for long term corticosteroids or immunosuppressive therapy

VI. Disease related complications

- A. Peripheral anterior and posterior synechiae
- B. Glaucoma
- C. Cataracts

- D. Rubeosis iridis
- E. Pupillary membrane
- F. Cystoid macular edema
- G. Exudative retinal detachment
- H. Choroidal neovascularization
- I. Vision loss

VII. Describe appropriate patient instructions

- A. Report changes in vision promptly, including difficulty with accommodation
- B. Medication instructions
- C. Follow-up instructions

- AAO, Basic and Clinical Science Course. Section 9: Intraocular Inflammation and Uveitis, Section 12: Retina and Vitreous, 2013-2014.
- 2. Chan CC, Roberge RG, Whitcup SM, et al. 32 Cases of sympathetic ophthalmia: a retrospective study at the National Eye Institute, Bethesda, Md., from 1982 to 1992. *Arch Ophthalmol* 1995;113:597-600.
- 3. Lam S, Tessler HH, Lam BL, et al. High incidence of sympathetic ophthalmia after contact and noncontact neodymium:YAG cyclotherapy. *Ophthalmology* 1992;99:1818-1822.
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Shaken baby syndrome

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Vigorous, back and forth shaking of an infant
- 2. Multiple etiologies of head trauma
- 3. Some have advocated the use of the terminology "Abusive Head Trauma" or "Non Accidental Head Injury" to emphasize that forceful shaking is not the only possible etiology of this form of child abuse

B. Define the relevant aspects of epidemiology of the disease

- 1. A form of child abuse
- 2. Children less than 2-years-old, typically less than 12 months of age

C. List the pertinent elements of the history

- 1. Lack of known (accidental) trauma
- 2. No history of systemic medical problems
- 3. Abuse history (often difficult to ascertain)
- 4. Ophthalmic findings inconsistent with reported history

D. Describe pertinent clinical features

- 1. Ophthalmic
 - a. Bilateral, multi-layered intraocular hemorrhages
 - i. Intraretinal and preretinal most common and concentrated in the posterior pole
 - ii. Subretinal and vitreous hemorrhage less common
 - b. Papilledema
 - c. Retinoschisis (may be hemorrhagic acutely)
 - d. Cotton wool spots
 - e. Macular edema
 - f. Retinal folds
 - g. White centered hemorrhages possible
- 2. Systemic
 - a. Associated intracranial hemorrhage (subdural or subarachnoid)
 - b. Cerebral edema may be present (bulging fontanelles)
 - c. A broad spectrum of neurologic changes can manifest

d. Bruises or fractures of trunk or limbs sometimes present

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. X-Ray: chest, skull, long bone
- 2. Magnetic resonance imaging (MRI) or computed tomography (CT) of head
- 3. Spinal fluid analysis (sometimes)
- 4. Photos for documentation (if available)
- 5. Engage social services

II. Define the risk factors

A. Age less than 2 years

III. List the differential diagnosis

- A. Terson syndrome (accidental or non-accidental head injury)
- B. Cardiopulmonary resuscitation (chest compression)
- C. Birth trauma (neonates only)
- D. Systemic conditions (e.g., sepsis, blood dyscrasias, vasculitis)
- E. Strangulation
- F. X-linked retinoschisis (vitreous hemorrhage)
- G. Persistent hyaloid artery (vitreous hemorrhage)

IV. Describe patient management in terms of treatment and follow-up

A. Describe medical therapy options

1. Patching if amblyopia develops

B. Describe surgical therapy options

- 1. Vitrectomy for vitreous hemorrhage in visual axis
- 2. Repair of RD (can be tractional from neovascularization)
- C. Protect the child
 - 1. Social service involvement is urgent and mandatory
 - 2. Affected child may need to be separated from suspected perpetrator
 - 3. Appropriate documentation of ocular findings.

V. List the complications of treatment

A. Complications of vitrectomy or scleral buckle procedures (See Vitrectomy for selected macular

diseases)

VI. Describe disease-related complications

- A. Macular and/or optic nerve dysfunction common (with variable vision loss)
- B. Specific late manifestations
 - 1. Retinal folds
 - 2. Chorioretinal atrophy/scarring
 - 3. Optic atrophy
 - 4. Retinal detachment (RD)
 - 5. Retinoschisis

C. General

1. Permanent cerebral dysfunction common; mild to profound

D. Specific problems

- 1. Seizures
- 2. Paresis or paralysis
- 3. Cerebral blindness
- 4. Coma
- 5. Death

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Drug toxicity (posterior segment)

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Chloroquine derivatives:
 - a. Chronic administration of **chloroquine (Aralen®)** or **hydroxychloroquine (Plaquenil®)** for malaria prophylaxis or collagen-vascular disease (CVD) (rheumatoid arthritis or systemic lupus erythematosus)
 - b. Mechanism of toxicity is unclear
 - i. Both agents bind to melanin in the retinal pigment epithelium (RPE),
 - ii. This may prolong the adverse effects
- 2. Phenothiazines:
 - a. Chronic administration or acute overdosing of several phenothiazines (thioridazine (Mellaril®), chlorpromazine (Thorazine®), trifluoperazine (Stelazine®)) for treatment of psychiatric disorders
 - b. Also associated with RPE toxicity, and late atrophy of the RPE
- Numerous other drugs have been implicated with toxicity of the posterior segment (See Section VII)

B. Define the relevant aspects of the epidemiology of the disease

- 1. Chloroquine derivatives
 - a. More common in females
 - i. Likely because of the distribution of collagen vascular disease (CVD) is higher in females
 - b. Higher risk in older patients (>60 years) or those with macular degeneration or retinal dystrophy
 - c. Cumulative continuous years of exposure increases risk, (especially if longer than 5 years) as well as higher daily doses relative to lean body mass
 - d. Liver or renal failure increases risk because chloroquine derivatives are cleared by the liver and kidney
 - e. No racial predilection
- 2. Phenothiazines:
 - a. Relatively rare toxicity
 - b. Males and females equally affected
 - c. Most commonly seen with thioridazine (Mellaril®)

i. Less often with other agents

C. List the pertinent elements of the history

- 1. Chloroquine derivatives:
 - a. Use of a chloroquine derivative for treatment of
 - i. CVD
 - ii. Malaria prophylaxis
 - b. Symptoms
 - i. Blurred vision
 - ii. Reading difficulties
 - iii. Paracentral scotomas
 - iv. Photophobia
 - v. Central photopsia
 - vi. Color vision disturbance with advanced toxicity
 - vii. Plaquenil maculopathy and toxicity may develop insidiously without patient symptoms underlining the importance of screening tools
 - c. History of concomitant macular disease (AMD or dystrophy)
 - d. Weight (obese patients at greater risk of toxicity--agents are not stored in fat, so if patient is given a weight-adjusted dose instead of what is appropriate for their lean body mass, toxicity is more likely)
 - e. Short stature, greater risk of toxicity when Plaquenil dosage exceeds 6.5 mg/kg of ideal body weight, i.e. height much more important than weight in calculating safe therapeutic index
 - f. Age over 60 years
 - g. History of renal or liver failure
- 2. Phenothiazines:
 - a. History of phenothiazine use
 - b. Dyschromatopsia
 - c. Blurred vision
 - d. Nyctalopia

D. Describe pertinent clinical features

- 1. Chloroquine derivatives:
 - a. Macular pigment abnormality (funduscopic abnormalities are usually detected as a late manifestation of Plaquenil toxicity)
 - i. Initial parafoveal pigmentary changes

- ii. Later, a more typical bull's-eye pattern of depigmentation or atrophy
- b. Corneal verticillata may be present and should prompt careful macular screening. (May be an early sign of toxicity)
- 2. Phenothiazines:
 - a. Early findings include pigment stippling in the macula and periphery
 - b. In thioridazine toxicity, large nummular areas of atrophy of the RPE develop from the posterior pole to the midperiphery and enlarge over time even after the drug is stopped

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Chloroquine derivatives:
 - a. Automated visual field testing (Humphrey 10-2 with **white** target) to find paracentral loss of sensitivity
 - b. Spectral domain OCT has become an indispensable tool to detect early toxicity and may demonstrate parafoveal loss of the inner-segment/outer-segment (IS/OS) line referred to as the "flying saucer" sign.
 - c. Fundus photography with autofluorescence showing a hyperfluorescent ring
 - d. Multifocal ERG testing may be considered for early toxicity detection
 - e. Tests **NOT** currently recommended by the AAO for chloroquine/hydroxychloroquine toxicity screening
 - i. Fluorescein angiography--not more sensitive than tests for functional loss
 - ii. Amsler grid--not felt to be consistently reliable
 - iii. Full-field ERG--global test, not macula-specific
 - iv. Color vision testing--may be used as a supplemental test if baseline is obtained
 - v. Electro-oculogram (EOG)--non-specific
- 2. Phenothiazines:
 - a. Fluorescein angiography in the intermediate and late stages demonstrates patchy loss of the RPE and choriocapillaris with characteristic nummular pattern of involvement
 - b. Visual fields may demonstrate
 - i. Mild constriction
 - ii. Paracentral scotomas, or ring scotomas even in the early stage
 - c. Electrophysiologic testing demonstrates markedly abnormal scotopic and photopic functions in late disease which may be partially reversible in earlier stages

II. Define the risk factors

A. Chloroquine derivatives:

1. Hydroxychloroquine has less potential ocular toxicity than chloroquine

2. Duration

- a. Toxicity usually dependent upon total dose
- b. Rarely occurs after only a few months of treatment
- c. Risk increases with longer duration of use of drug (even with doses in the "safe' range.)
- d. Greatest risk after 5 years of treatment at standard doses.

3. Dose

- a. Toxicity
 - i. Important to assess underlying risk
 - ii. Higher dose = higher risk
 - i) Chloroquine <u>> 250 mg/day or 1000 g total</u> (cumulative dose)
 - ii) Hydroxychloroquine <u>> 6.5 mg/kg of IBW or 460 g total</u> (cumulative dose)
- 4. Consider other risk factors
 - a. Total dosage (above)
 - b. Duration (>5 years)
 - c. Body habitus (obese patients on weight-adjusted high dose are at greater risk, or small patients getting "standard" dose)
 - d. Renal/hepatic disease (increased risk)
 - e. Concomitant macular disease
 - f. Age (>60)

B. Phenothiazines:

- 1. For thioridazine, toxicity rare with doses less than 800 mg/day
 - a. Cumulative dose may be important

III. List the differential diagnosis

A. Chloroquine derivatives:

- 1. Bulls-eye maculopathy differential
 - a. Stargardt disease
 - b. Cone dystrophy
 - c. Atrophic age-related macular degeneration
 - d. Pattern macular dystrophy
 - e. Chronic macular hole
 - f. Retinitis pigmentosa (syndromic and non syndromic)

- 2. Phenothiazines:
 - a. Thioridazine toxicity fundus picture bears some resemblance to:
 - i. Gyrate atrophy
 - ii. Choroidal atrophy
 - iii. Choroideremia
 - iv. Bietti crystalline dystrophy

IV. Describe patient management in terms of treatment and follow-up

A. Chloroquine derivatives:

- 1. Describe the natural history, outcome and prognosis
 - a. Progressive loss of visual acuity, visual field and color vision if drug continued
- 2. Describe medical therapy options
 - a. Baseline examination within the first year of starting the drug to document any complicating ocular conditions and to establish a record of the fundus appearance and functional status, early screening with HVF 10-2 and SD OCT, fundus autofluorescence and MF ERG may be additional screening tools in higher risk patients.
 - b. Prompt discontinuation of the chloroquine derivative at the first sign of toxicity
 - c. When it is difficult to determine if early toxicity is present, consider switching to other reasonable drug alternatives for control of underlying disease (discuss with prescribing physician)
 - d. Toxic effects may progress even after drug cessation
 - e. Rarely considered reversible if drug is stopped early
 - f. If patients are thought to have "possible" toxicity
 - i. Consider cessation of drug if possible
 - ii. Shorten follow-up to every 3-6 months
 - g. If patients are thought to have "probable" or definite toxicity
 - i. Stop drug immediately if at all possible
 - ii. Consider full-field ERG to evaluate degree of damage beyond macula
 - iii. If drug is not stopped
 - i) Close (every 3 month) follow-up to assess progression
 - ii) Document that the patient and prescribing physician are aware of the potential risk of vision loss

B. Phenothiazines:

1. Describe the natural history, outcome and prognosis

- a. Pigmentary atrophy continues to increase with breakdown of bridges between zones of atrophy even after the drug is discontinued
- b. Large clumps of hyperpigmentation are a feature of very late thioridazine toxicity
- 2. Describe medical therapy options
 - a. Medication should be stopped at earliest sign of toxicity

V. Describe disease-related complications

A. Chloroquine derivatives:

1. Visual loss, visual field changes, scotomas

B. Phenothiazines:

1. Visual loss, visual field changes, nyctalopia

VI. Describe appropriate patient instructions

A. Chloroquine derivatives:

- 1. Ensure patients understand potential for toxicity
- 2. When duration less than 5 years and there are no risk factors, follow-up should be at least at AAO-recommended intervals for routine adult exams (annual)
- 3. Follow-up exams at 6-12 month intervals when
 - a. A higher than standard dose is used
 - b. Duration of treatment longer than 5 years
 - c. Renal or liver insufficiency is present
- 4. Ophthalmoscopic changes and measurable loss of visual function may precede visual symptoms
- 5. Patients should understand that screening exams help to identify toxicity earlier, but cannot prevent toxicity or guarantee that there will be no visual loss
- 6. Patient compliance with follow-up exams should be emphasized, and that they must return immediately if there are any new symptoms (visual loss, reading difficulty, blind spots), or changes to their systemic status (kidney/liver disease, etc.)

B. Phenothiazines:

- 1. Discontinue drug to prevent worsening condition
- 2. Pigmentary loss may continue after drug is stopped
- 3. Discuss alternative medications with psychiatrist

VII. Other notable drug toxicities to the posterior segment, by clinical finding

A. Pigmentary Retinopathy
- 1. Chloroquine derivatives (as outlined above)-- antimalarial
 - a. Chloroquine (Aralen®)
 - b. Hydroxychloroquine (Plaquenil®)
- 2. Phenothiazines (as outlined above)--antipsychotics
 - a. Thioridazine (Mellaril®)
 - b. Chlorpromazine (Thorazine®)
 - c. Trifluoperazine (Stelazine®)
- 3. Deferoxamine (Desferal®)-- Iron chelating agent used in iron overload, can cause pigmentary or vitelliform maculopathy with visual loss usually about a week after treatment, with nyctalopia, ring scotoma, and reduced ERG
- 4. Dideoxyinosine (DDI)- Nucleoside reverse transcriptase inhibitor (NRTI) used for the treatment of HIV and AIDS that can be associated with a peripheral pigmentary retinopathy

B. Choroidal Toxicity

1. Topiramate (Topamax[®])--anticonvulsant and for migraine prophylaxis, associated with choroidal effusions or macular edema and possible elevation of IOP via secondary angle narrowing

C. Cystoid Macular Edema

- 1. Latanoprost (Xalatan®)--prostaglandin agonist, used in glaucoma
- 2. Epinephrine
- 3. Niacin (Vitamin B3)--lipid-lowering agent, can cause a mac CME that does not leak on fluorescein angiography (FA)
- 4. Taxanes (Taxol, Taxotere, Abraxane)- antimicrotubule chemotherapeutics for malignancies such as breast cancer that can be associated with CME on SD OCT but no leakage with FA
- 5. Fingolimod- new therapy for multiple sclerosis associated with CME with FA leakage
- 6. Rosiglitazone (Avandia®)--antidiabetic that may independently increase endothelial cell permeability and upregulate VEGF, causing macular edema

D. Crystalline Retinopathy

- Tamoxifen -- Antineoplastic, estrogen receptor antagonist used in breast cancer treatment. Usually seen in patients receiving high-dose therapy (>200mg day or over 100g cumulatively). Clinically, decreased vision with crystalline deposits and macular edema may be seen. Central loss of the IS/OS band with SD OCT has been more recently reported with lower daily dosages (20 mg)
- 2. Canthaxanthin -- carotinoid, available in health food stores, used for tanning. Striking perimacular crystalline deposition is possible
- 3. Talc--can cause an intravascular crystalline retinopathy in IV drug abusers
- 4. Methoxyflurane--inhalational anesthetic that can cause secondary oxalate crystal deposition
- 5. Ethylene glycol--agent in commercial antifreeze that can cause secondary oxalate crystal deposition, also may cause methanol related toxic optic atrophy

E. Miscellaneous associations

- 1. Digoxin (Lanoxin®)--Cardiac glycoside, causes xanthopsia, pericentral scotomata, defective color vision--cone dysfunction is reversible upon drug cessation
- 2. Sildenafil (Viagra®)--Phosphodiesterase-5 inhibitor, used for erectile dysfunction; can cause transient ERG abnormalities and blue tinting of vision as well as choroidal thickening and central serous retinopathy, no permanent dysfunction has been reported
- 3. Interferon (Betaseron®)--Immunomodulator, can cause severe retinopathy (retinal hemorrhages, cotton-wool spots) that is usually reversible upon discontinuation of drug, but rarely permanent visual loss can occur
- 4. Quinine- antimalarial agent also used for muscle cramping that in toxic dosages can cause nerve fibre layer toxicity and cherry red spot acutely and long-term inner retinal atrophy and optic atrophy
- 5. Rifabutin (Mycobutin[®])--Antitubercular agent, rare cause of anterior/posterior uveitis with or without hypopyon
- 6. Isotretinoin (Accutane®)--anti-acne agent, causes abnormal dark-adaptation curves and ERG responses

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Phototoxicity of the posterior segment

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Solar retinopathy
 - a. Photochemical injury
 - i. Retinal tissue destruction without elevation of tissue temperature
 - b. Direct or indirect viewing of the sun
 - i. Solar eclipse viewing most commonly
 - ii. Prolonged sun gazing while under influence of psychoactive drugs
 - c. Visible blue light, ultraviolet A, near-UV radiation
 - d. Retinal and retinal pigment epithelial (RPE) injury
 - i. Photoreceptors most sensitive
- 2. Photic injury from ophthalmic instruments
 - a. Prolonged or focal exposure to ophthalmic instrumentation lighting causing photochemical reaction
 - i. Surgical microscope
 - ii. Endoillumination
 - b. Ultraviolet light exposure
 - c. RPE destruction and photoreceptor outer segment damage
- 3. Occupational light toxicity
 - a. Arc welding without protective goggles
 - i. Photochemical injury due to blue light
 - b. Inadvertent exposure to laser
 - i. Photochemical injury
- 4. Photodisruptive
 - a. YAG laser injury
 - b. Microexplosion
- B. Define the relevant aspects of epidemiology of the disease
 - 1. Solar retinopathy
 - a. Most common after solar eclipse
 - b. Younger patients

- c. Psychiatric illness
- 2. Photic Damage from Ophthalmic instruments
 - a. Prevalence after cataract surgery estimated 3 7%
 - i. Prevalence greater with prolonged surgical times
 - b. Vitreoretinal surgical endoillumination: probe held very close to retina during membrane peel or macular hole surgery
 - i. Photoactive dye (e.g. ICG dye) may enhance phototoxicity
- 3. Occupational light toxicity
 - a. Arc welding exposure
 - b. Research or industrial laser exposure
- 4. Photodisruptive
 - a. Industrial
 - b. Lab accidents
 - c. YAG vitreolysis

C. List the pertinent elements of the history

- 1. Solar retinopathy
 - a. History of sun gazing
 - b. Symptoms
 - i. Decreased vision one or both eyes (bilateral most common)
 - ii. Central scotoma
 - iii. Dyschromatopsia
 - iv. Micropsia
 - v. Symptoms usually improve over weeks to months
- 2. Photic damage from ophthalmic instrumentation
 - a. Post-operative visual or ophthalmoscopic changes
 - b. Symptoms
 - i. Many asymptomatic
 - ii. Paracentral scotoma
 - iii. Visual acuity usually improves over weeks to months

D. Describe pertinent clinical features

- 1. Solar retinopathy
 - a. Visual acuity 20/25 20/100
 - i. May recover with residual metamorphopsia or small scotoma

- b. Fundus findings
 - i. Acute: deep, yellow-white spot within fovea
 - ii. 3 6 days: reddish spot at level of RPE with pigmented halo
 - iii. Later: 100 200 micron outer lamellar hole permanent
- 2. Photic damage from ophthalmic instrumentation
 - a. Fundus findings
 - i. Acute: deep, irregular yellow-white lesion of RPE and deep retina often oval shaped
 - ii. Later: mottled RPE

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Should always begin with visual acuity testing
- 2. Solar retinopathy
 - a. OCT
 - i. Acute changes: outer retinal "edema" of photoreceptor level and cell bodies
 - ii. Late: outer lamellar hole
 - b. Fluorescein angiography:
 - i. Acute: hyperfluorescent staining of central lesion
 - ii. Late: Window defect centrally
- 3. Photic injury from ophthalmic instruments
 - a. Fluorescein angiography: window defect develops in area corresponding to RPE mottling

II. Define the risk factors

- A. Solar retinopathy
 - 1. Youth
 - 2. Use of photosensitizing meds
 - a. Tetracycline
 - b. Accutane
 - 3. Psychiatric disease
 - 4. High refractive error and darkly pigmented fundi may reduce risk

B. Photic damage due to ophthalmic instrumentation

1. Prolonged surgical times

III. List the differential diagnosis

A. Solar retinopathy

- 1. Drusen
- 2. Macular pigmentary changes
- 3. Histo spot or PIC lesion
- 4. Whiplash maculopathy
- 5. Pattern dystrophy (e.g. foveomacular dystrophy)

B. Photic injury due to ophthalmic instrumentation

- 1. Age related macular degeneration
- 2. Cystoid macular edema
- 3. Solar retinopathy
- 4. Traumatic maculopathy

IV. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcome and prognosis

- 1. Solar and photic damage:
 - a. Symptoms and visual acuity usually improve in weeks to months
 - b. Permanent scotoma may result
 - c. Length of exposure may worsen long term damage and symptoms

B. Describe medical therapy options

1. None

C. Describe surgical therapy options

1. None

V. List the complications of treatment, their prevention and management

- A. Solar retinopathy
 - 1. None
- B. Photic damage due to ophthalmic instrumentation
 - 1. Minimize light exposure
 - 2. Oblique lighting
 - 3. Filter blue light and UV light from illumination sources
 - 4. Light shields

VI. Describe disease-related complications

- A. RPE atrophy
- B. Outer retinal damage

VII. Describe appropriate patient instructions

- A. Solar retinopathy
 - 1. Avoid exposure / sun gazing

Additional Resources

1. AAO, Basic and Clinical Science Course, Section 12: Retina and Vitreous, 2013-2014.

Nevus of the choroid

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of the disease

- 1. Congenital
- B. Define the relevant aspects of epidemiology of the disease
 - 1. Affects 7% of the population
- C. List the pertinent elements of the history
 - 1. Asymptomatic usually
 - 2. Recognized on routine exam
 - 3. New visual symptoms suggestive of malignant transformation
 - 4. Change in clinical appearance is concerning for malignant transformation

D. Describe the pertinent clinical features

- 1. Flat or minimally elevated choroidal lesion
- 2. Brown to grey in coloration usually
- 3. Amelanotic in 25% of cases
- 4. Overlying drusen or retinal pigment epithelium (RPE) changes suggest chronicity
- 5. Suggests transition to choroidal melanoma:
 - a. Orange pigmentation
 - b. Associated subretinal fluid
 - c. Increased thickness
 - d. Increased basal dimension
 - e. New subjective symptoms (atypical for nevus)
 - i. Photopsias
 - ii. Metamorphopsia
 - iii. Blurry vision
 - iv. Visual field defects
 - f. Juxtapapillary location has a higher risk of malignant transformation

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Fundus photography to document clinical characteristics
- 2. A- and B-scan ultrasound to document basal dimensions, thickness, and internal reflectivity
- 3. Fluorescein angiography to evaluate circulation and extent of the lesion

II. Define the risk factors

- A. Congenital lesion without known risk factors
- B. Small group of genetic nevus syndromes

III. List the differential diagnosis

- A. Choroidal melanoma
- B. Metastatic carcinoma
- C. Atypical or eccentric disciform scar associated with ARMD
- D. Melanocytoma
- E. Congenital hypertrophy of the RPE
- F. Combined hamartoma of the retina and RPE
- G. Choroidal osteoma
- H. Choroidal hemangioma
- I. Suprachoroidal hemorrhage
- J. Granuloma of the choroid
- K. Adenoma of the retinal pigment epithelium
- L. Prominent vortex ampulla

IV. Describe patient in terms of treatment and follow-up

A. Describe the natural history, outcome and prognosis

- 1. Choroidal nevi are distinguished from choroidal melanoma by relatively small size/ thickness and by a natural history without documented change in clinical appearance
- 2. Majority of choroidal nevi are benign
- 3. Some choroidal nevi develop a choroidal neovascular membrane, drusen, or overlying RPE changes; these do not suggest malignant transformation
- 4. A small number of choroidal nevi undergo malignant transformation

B. Describe medical therapy options

- 1. Typical choroidal nevi should be drawn or photographed, with clinical estimates of basal dimension and height documented
- 2. Fundus photography is useful for serial comparison
- 3. Patients with atypical choroidal nevi should have A- and B-scan ultrasound to document basal dimensions and thickness and to exclude sonographic features which are more typical for choroidal melanoma

V. Describe appropriate patient instructions

A. Patient should return periodically for assessment of nevus stability

Additional Resources

1. AAO, Basic and Clinical Science Course. Section 4: Ophthalmic Pathology and Intraocular Tumors, 2013-2014.

Melanoma of the ciliary body and choroid

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of the disease

- 1. Unknown
- 2. Melanoma may result from malignant transformation of a nevus

B. Define the relevant aspects of the epidemiology of the disease

- 1. Most common primary (non-metastatic) intraocular tumor in adults
- 2. Incidence in the United States is 6 to 7 cases per million population

C. List the pertinent elements of the history

- 1. Recent history of visual symptoms
- 2. Recent history of systemic symptoms (unusual at presentation)
 - a. Weight loss
 - b. Cachexia
 - c. Malaise
 - d. Jaundice
 - e. Respiratory difficulties

D. Describe pertinent clinical features

- 1. Ciliary body melanoma
 - a. Asymptomatic initially
 - b. Visible erosion through iris root, presenting as new iris mass
 - c. Sectoral cataract
 - d. Lens displacement
 - i. Induced astigmatism
 - ii. Angle closure glaucoma, (especially observed with ring configuration)
 - e. Sentinel episcleral vessel
- 2. Choroidal melanoma
 - a. Macula tumors are usually symptomatic
 - b. Peripapillary tumors may be symptomatic
 - c. Peripheral tumors are usually asymptomatic and detected on routine indirect ophthalmoscopy

E. Describe the appropriate testing and evaluation for establishing the diagnosis

- 1. A- and B-scan ultrasound:
 - a. Evaluate for features characteristic of melanoma
 - i. Dome shaped
 - ii. Mushroom or collar button shaped
 - iii. Acoustically hollow with low internal reflectivity
 - b. Establish basal dimensions and thickness
 - c. Eliminate other etiologies for choroidal mass lesion
- 2. Chest and liver evaluations to exclude metastatic disease
- 3. Fluorescein angiography may demonstrate hot spots and tumor circulation
- 4. Fine needle aspiration biopsy (FNAB)
 - a. Histological confirmation
 - b. Ancillary genetic testing

II. Describe relevant aspects of the pathology

A. Tumors are classified as:

- 1. Spindle cell nevus
- 2. Spindle cell melanoma
- 3. Epithelioid melanoma
- 4. Mixed cell type (mixture of spindle and epithelioid cells)

III. Define the risk factors

- A. Risk factors have not been conclusively determined but may include
 - 1. Dysplastic nevus syndrome
 - a. Predisposing to both cutaneous and uveal melanoma
 - 2. Oculodermal melanocytosis or melanosis oculi
 - 3. Caucasian race, light irides
 - 4. Sun exposure
 - 5. Cigarette smoking

IV. List the differential diagnosis

- A. Choroidal nevus
- B. Melanocytoma

- C. Metastatic carcinoma
- D. Atypical or eccentric disciform scar associated with ARMD
- E. Congenital hypertrophy of the retinal pigment epithelium (CHRPE)
- F. Choroidal osteoma
- G. Choroidal hemangioma
- H. Suprachoroidal hemorrhage
- I. Adenoma of the retinal pigment epithelium
- J. Prominent vortex ampulla

V. Describe the patient management in terms of treatment and follow-up

A. Describe the natural history, outcome, and prognosis

- 1. Untreated uveal melanoma will eventually metastasize
- 2. Most common metastatic sites for uveal melanoma are liver and lung

B. Collaborative Ocular Melanoma Study (COMS)

- 1. Defined tumor size classification
 - a. Small: <2.5mm thick and/or <8mm basal diameter
 - b. Medium: 2.5-10mm thick and/or <16mm basal diameter
 - c. Large: >10mm thick and/or >16mm basal diameter
- 2. Small tumors have low metastatic risk but can be treated if showing signs of progression (1% mortality at 5 yrs)
- 3. Medium tumors treated with brachytherapy vs. enucleation showed no difference in patient survival (10% mortality at 5 yrs)
- 4. Large tumor outcomes did not benefit from pre-enucleation external beam radiation (50% mortality at 5 yrs)
- C. Gene expression assay results may influence surveillance for metastasis

D. Describe surgical therapy options

- 1. Radiotherapy
 - a. Brachytherapy
 - b. Charged particle radiation
- 2. Eye wall resection
- 3. Enucleation
- 4. Transpupillary thermotherapy (TTT)

VI. List the complications of treatment, their prevention and management

- A. Radiation retinopathy, papillopathy and neovascular glaucoma
- B. Cataract
- C. Panretinal photocoagulation may be effective in producing regression of neovascularization
- D. Inadequate tumor treatment with radiation or laser therapy

VII. Describe appropriate patient instructions

- A. Patient should return periodically to retina specialist for assessment of post-treatment stability
- B. Chest and liver assessment should be performed periodically to monitor for the development of metastatic disease

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Retinoblastoma

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of the disease

1. Mutation in the retinoblastoma gene (*RB1*)

B. Define the relevant aspects of epidemiology of the disease

- 1. Affects 1 in 20,000 live births
- 2. No racial or gender predilection
- 3. Bilateral disease: mean age for diagnosis is 1 yr
- 4. Unilateral disease: mean age for diagnosis is 2 yr

C. List the pertinent elements of the history

- 1. Family history
 - a. Retinoblastoma
 - b. Sarcoma
 - c. Eye loss
- 2. Strabismus
- 3. Vision loss

D. Describe the pertinent clinical features

- 1. Growth characteristics of tumor
 - a. Exophytic growth into subretinal space
 - b. Endophytic growth and seeding into the vitreous
- 2. Leukocoria is the most common presenting sign
- 3. Strabismus is the second most prevalent clinical feature

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Presence of calcium is supportive of a diagnosis of retinoblastoma
- 2. Ultrasound of mass to find evidence of intrinsic calcification
- 3. Computed tomography (CT) is less commonly used to avoid radiation exposure in children, but is helpful in identifying calcific changes
- 4. Magnetic resonance imaging (MRI) scan to evaluate for concomitant midline brain tumor

F. Describe the pathology

- 1. Tumors are composed of cells with large hyperchromatic nuclei and scanty cytoplasm
- 2. Rosette formation is characteristic

II. Define the risk factors

A. Germline (bilateral disease) or somatic (unilateral disease) mutation in the retinoblastoma gene (*RB1* tumor suppressor gene)

1. Examination of parents (if possible) should be part of workup to identify familial form of the disease

III. List the differential diagnosis

- A. Coats disease
- B. Persistent fetal vasculature (persistent hyperplastic primary vitreous)
- C. Ocular toxocariasis
- D. Advanced retinopathy of prematurity
- E. Retinal dysplasia
- F. Retinal detachment
- G. Endophthalmitis
- H. Congenital cataract

IV. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcome and prognosis

- 1. Bilateral disease may develop despite unilateral presentation
- 2. Serial examinations under anesthesia (EUAs) are important
 - a. Always be aware that bilateral involvement is possible
 - b. Novel lesions may occur in either eye
 - c. Recurrences, especially near previously treated tumors is common

B. Describe medical/surgical therapy options

- 1. Chemo reduction with local therapy
 - a. Laser ablation
 - b. Cryotherapy
 - c. Brachytherapy
- 2. Enucleation
- 3. Radiation therapy

V. List the complications of treatment, their prevention and management

A. Chemotherapy

- 1. Neutropenia
- 2. Opportunistic infection
- 3. Hearing loss (due to carboplatin)

B. Radiation therapy

- 1. Radiation retinopathy
- 2. Midface hypoplasia
- 3. Increased rate of orbital sarcoma

VI. Describe disease-related complications

A. Second tumors in patients with heritable disease

- B. Midline brain tumors "trilateral retinoblastoma:
 - 1. Primary neuroendocrine tumors
 - 2. Seen in patients with heritable disease

VII. Describe appropriate patient instructions

- A. Offspring are at risk for disease and should be examined shortly after birth
- B. Follow-up EUA schedule is individualized based on patient's stage of disease

- 1. AAO, Basic and Clinical Science Course. Section 4: Ophthalmic Pathology and Intraocular Tumors, Section 12: Retina and Vitreous, 2013-2014.
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Melanocytoma or magnocellular nevus

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Variant of melanocytic nevus
- 2. Most likely arises postnatally

B. Define the relevant aspects of epidemiology of the disease

- 1. Occurs with equal frequency in African-American and Caucasian populations
- 2. More common than uveal melanoma in African-American patients

C. List the pertinent elements of the history

- 1. Document whether a pigmented lesion has been previously noted on ophthalmic examination
- 2. Obtain and review previous clinical photographs or retinal drawings
- 3. Discuss visual symptoms if present and any progression in symptoms

D. Describe pertinent clinical features

- 1. Dark brown to jet black epipapillary lesion
- 2. Usually located eccentrically over the optic disc
- 3. May occur anywhere in the uveal tract
- 4. Fibrillar margins due to extension into the nerve fiber layer
- 5. May be elevated, usually less than 2 mm

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Retinal drawing or photography to document size and clinical appearance for baseline comparison if growth is suspected
- 2. A- and B- scan echography if melanoma is considered highly in the differential diagnosis
- 3. Pathologically, melanocytoma cells are distinct with a characteristic large, polyhedral shape, small nuclei, and cytoplasm filled with melanin granules

II. Define the risk factors

A. Heavily pigmented races

III. List the differential diagnosis

- A. Uveal melanoma
- B. Peripapillary or choroidal nevus

- 1. Approximately one third of optic disc melanocytomas have a peripapillary nevus component)
- C. Congenital hypertrophy of the retinal pigment epithelium (CHRPE)
- D. Atypical disciform scar associated with age-related macular degeneration
- E. Retinal pigment epithelial (RPE) hyperplasia
- F. Combined hamartoma of the retina and the RPE

IV. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcome, and prognosis

- 1. Follow every 3-6 months following initial diagnosis, then annually once lesion is established as stable
- 2. Minimal, but definite growth is observed in 10% of melanocytomas over 5 years of observation
- 3. May produce a relative afferent pupillary defect
- 4. May be associated with a spectrum of visual field defects
 - a. Enlarged blind spot
 - b. Extensive nerve fiber layer defects
- 5. Malignant potential is low
- 6. Malignant transformation may rarely occur

B. Describe medical therapy options

1. Observation to exclude malignant transformation

C. Surgical therapy options

1. If growth is observed, transformation into uveal melanoma should be considered and treatment discussed (See Melanoma of the ciliary body or choroid)

V. List the complications of treatment, their prevention and management

A. Treatment is rarely indicated, but when necessary, the complications, prevention and management are identical to those for uveal melanoma (See Melanoma of the ciliary body or choroid)

VI. Describe disease-related complications

- A. Development of afferent pupillary defect
- B. Visual field defects
- C. Very rare malignant progression

VII. Describe appropriate patient instructions

A. Following confirmation of diagnosis, return for routine follow up

- 1. AAO, Basic and Clinical Science Course. Section 4: Ophthalmic Pathology and Intraocular Tumors, 2013-2014.
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Choroidal osteoma

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Etiology not fully defined
- 2. Chronic, low-grade choroidal inflammation
 - a. Hypothesized to contribute to development of osteoma

B. Define the relevant aspects of epidemiology of the disease

- 1. More common in women
- 2. Frequently diagnosed in adolescence to young adulthood

C. List the pertinent elements of the history

- 1. Previous history of lesion on dilated examination
- 2. History of new or progressive visual symptoms
- 3. Frequently asymptomatic

D. Describe pertinent clinical features

- 1. Yellow-white to orange juxtapapillary choroidal tumor
- 2. Well-defined pseudopod-like margins
- 3. Flat to minimally elevated
- 4. Bilateral in 20-25% of patients
- E. Describe appropriate testing and evaluation for establishing the diagnosis
 - 1. Retinal drawing and/or photography
 - a. Useful to document baseline appearance
 - 2. A- and B- scan echography
 - a. Demonstrates high intralesional lesion reflectivity
 - b. Corresponds to choroidal calcification and bone formation
 - c. An acoustical quiet zone with loss of normal orbital echoes is seen posterior to the osteoma
 - 3. OCT
 - a. High reflectivity of anterior surface of osteoma with transmission shadowing posterior to osteoma
 - b. May also be used to detect signs of CNV (if present)
 - c. Monitor response to treatment
 - 4. Fluorescein angiography

- a. Typically reveals early patchy hyperfluorescence and diffuse late staining
- b. May demonstrate location and extent of choroidal neovascularization (CNV) if present

II. Define the risk factors

A. Higher risk for disease in Caucasian women in their teens to young adulthood

III. List the differential diagnosis

- A. Amelanotic uveal melanoma
- B. Choroidal hemangioma
- C. Treated retinoblastoma
- D. Retinocytoma or retinoma (also calcific lesions)
- E. Choroidal metastases
- F. Idiopathic sclerochoroidal calcification

IV. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcome, and prognosis

- 1. Many patients are asymptomatic and require only follow-up
- 2. Lesions typically enlarge slowly over many years
- 3. Lesions may also decalcify over time
- 4. Macular involvement correlates with reduced visual acuity
- 5. Choroidal neovascularization is a frequent complication

B. Surgical therapy options

- 1. Treatment is primarily for CNV with associated metamorphopsia and/or loss of visual acuity
 - a. Laser for extrafoveal involvement
 - b. Anti-VEGF (off-label)
 - c. Photodynamic therapy (off-label)

V. List the complications of treatment, their prevention and management

A. Treatment of choroidal osteoma lesions and/or accompanying CNV in the fovea has been associated with poor visual outcome regardless of therapeutic approach

VI. Describe disease-related complications

A. Vision reduction from macular involvement by tumor or from subretinal neovascularization

VII. Describe appropriate patient instructions

- A. Regular follow-up visits to assess potential tumor growth
- B. Monitor for CNV development
- C. Monitor for lesion growth
- D. Advise patient to self-monitor with Amsler grid for macular lesions

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Vascular tumors of the choroid and retina

I. Circumscribed choroidal hemangioma

A. Describe the pertinent clinical features

- 1. No associated systemic disorder
- 2. Red-orange tumor
- 3. Present in the post-equatorial choroid
- 4. Typically occurs within the macular region
- 5. Symptoms include
 - a. Metamorphopsia
 - b. Micropsia
 - c. Blurry vision from the presence of subretinal fluid

B. Describe the natural history, outcome and prognosis

- 1. May affect the overlying retinal pigment epithelium (RPE)
- 2. Cystoid degeneration of outer retinal layers
- 3. Hyperopic shift with macular involvement
- C. Describe the patient management in terms of treatment and follow up
 - 1. Subretinal fluid may subside after
 - a. Photocoagulation
 - b. Radiation therapy
 - c. Photodynamic therapy
 - 2. Manage refractive error changes

II. Congenital choroidal hemangioma

A. Describe the pertinent clinical features

- 1. Associated with Sturge-Weber Syndrome (encephalofacial angiomatosis)
- 2. Facial nevus flammeus (port wine stain) may be present as part of Sturge-Weber syndrome
- 3. Diffuse choroidal redness and thickening with increased tortuosity of retinal vessels "tomato catsup fundus"

B. Describe the natural history, outcome and prognosis

- 1. Associated with glaucoma, retinal detachment and amblyopia
- 2. Complex or recurrent retinal detachment (RD) is common

3. Long-term visual prognosis is guarded

C. Describe the patient management in terms of treatment and follow-up

1. Treat glaucoma, RD and amblyopia

III. Retinal angioma (angiomatosis retinae)

A. Describe the pertinent clinical features

- 1. Associated with an unusual autosomal dominant condition
 - a. von Hippel Disease: retinal hemangioblastoma only
 - b. von Hippel-Lindau syndrome: retinal angioma associated with
 - i. Cerebellar hemangioblastoma
 - ii. Renal cell carcinoma
 - iii. Pheochromocytoma
- 2. Red-orange retinal tumor with large, tortuous afferent and efferent feeder vessels

B. Describe the natural history, outcome and prognosis

- 1. Retinal and subretinal exudates may involve the fovea
- 2. Exudative RD frequently develops
- C. Describe the patient management in terms of treatment and follow-up
 - 1. Photocoagulation for smaller tumors
 - 2. Cryotherapy for larger and more peripheral lesions
 - 3. Scleral buckling with cryotherapy
 - 4. Penetrating diathermy for largest lesions
 - 5. Early treatment may reduce the risk of a total exudative RD
 - 6. Refer all patients with characteristic retinal angioma for screening to exclude the systemic tumors associated with von-Hippel Lindau Syndrome

IV. Cavernous retinal hemangioma

A. Describe pertinent clinical features

- 1. Associated with similar lesions in the skin and central nervous system
 - a. Intracranial lesions may cause seizures
- 2. Multiple, small vascular saccules with associated fibroglial tissue
 - a. Plasma-erythrocyte separation may occur within the vascular spaces (sometimes evident on FA)

B. Describe the natural history, outcome and prognosis

- 1. Small retinal hemorrhages commonly develop on the surface of cavernous hemangioma
- 2. Vitreous hemorrhage may occur

C. Describe patient management in terms of treatment and follow-up

1. Treatment is rarely indicated

V. Arteriovenous malformation (racemose hemangioma)

A. Describe pertinent clinical features

- 1. Wyburn-Mason Syndrome
 - a. Mid-brain arteriovenous malformation may be associated
 - b. Vascular malformations may be present in the orbit and mandible (caution with dental procedures)
- 2. A clinical spectrum ranging from small, localized vascular communication near the disc or in the retinal periphery to a tangle of prominent, tortuous anastomotic blood vessels involving the majority of the fundus

B. Describe the natural history, outcome and prognosis

- 1. Most small lesions remain asymptomatic
- 2. Larger lesions may be associated with subretinal fluid and exudates

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Choroidal metastasis

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. Hematogenous spread of primary cancer (CA) to the choroid
- 2. Women
 - a. Breast CA is most common
 - b. Lung CA
- 3. Men
 - a. Lung CA is most common

B. Define the relevant aspects of epidemiology of the disease

- 1. Choroid is the most common site for intraocular metastasis
- 2. Choroidal <u>metastasis</u> is the most common intraocular neoplasm
- 3. Choroidal <u>melanoma</u> is the most common primary (non-metastatic) intraocular neoplasm

C. List the pertinent elements of the history

1. History of known primary including type, date of diagnosis, stage/extent and treatments

D. Describe pertinent clinical features

- 1. Decreased vision
- 2. Visual field defects
- 3. Pain common in breast CA
- 4. Multifocal (20%) and bilateral (25%)
- 5. Usually involves posterior pole
- 6. Serous RD is often associated

E. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Ultrasound (U/S)
 - a. B-scan
 - i. Assesses/measures the mass size/thickness
 - ii. Detects associated serous RD
 - iii. Identifies intra-lesional calcification (e.g. osteoma)
 - iv. Delineates mass shape (e.g. domed or collar button).
 - v. Enables the clinician to follow tumor progression or regression (e.g. therapeutic response)

- b. A-scan
 - i. Defines internal acoustic properties (typically medium to high internal reflectivity)
 - ii. Confirms axial size/thickness
- 2. Fundus photography
- 3. Fluorescein angiography may help
 - a. Determine size/extent of flat lesion
 - b. Identify circulation status of the lesion
- 4. Magnetic resonance imaging (MRI) of brain/orbits to assess intracranial involvement
- 5. Fine needle aspiration biopsy (FNAB) when the primary diagnosis is elusive
- 6. Refer to oncologist for further systemic evaluation

F. Describe the pathology

1. Dependent on primary tumor type

II. Define the risk factors

- A. History of primary cancer
- B. Behavior that increases risk of cancer (e.g., smoking)

III. List the differential diagnosis

- A. Choroidal melanoma (amelanotic or partially-pigmented)
- B. Choroidal osteoma
- C. Choroidal hemangioma
- D. Choroidal neovascularization
- E. Coats disease
- F. Atypical or eccentric disciform scar
 - 1. May be associated with age-related macular degeneration (AMD)
 - 2. May have accompanying hypertrophic subretinal fibrosis
- G. Posterior scleritis with associated serous RD

IV. Describe patient management in terms of treatment and follow-up

- A. Describe the natural history, outcome and prognosis
 - 1. Globe retention is high
 - 2. Tumor flattening and fundus pigmentation expected after therapy is complete
 - 3. Mortality is high despite local ocular control

Retina/Vitreous

B. Describe medical therapy options

- 1. Systemic chemotherapy as directed by oncologist
- 2. External beam radiotherapy (XRT) as directed by radiation oncologist

C. Describe surgical therapy option

1. Enucleation only indicated for definitive pathology or pain control

V. List the complications of treatment, their prevention and management

- A. Serous RD may increase initially in response to therapy
- B. XRT related cataract acceleration
- C. XRT-related radiation retinopathy (worse with associated retinopathies such as diabetic or anemia-related)
- D. Visual field loss

VI. Describe disease-related complications

- A. Death
- B. Decreased visual function

VII. Describe appropriate patient instructions

A. Close follow-up with oncologist and ophthalmologist

- 1. AAO, Basic Clinical and Science Course, Section 4: Ophthalmic Pathology and Intraocular Tumors, 2013-2014.
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Ocular and central nervous system lymphoma

I. Describe the approach to establishing the diagnosis

A. Describe the etiology of this disease

- 1. B cell lymphoma (typically diffuse large cell type)
- 2. Ocular involvement frequently occurs in conjunction with central nervous system (CNS) lymphoma
 - a. 50% have concomitant CNS involvement at presentation

B. Define the relevant aspects of epidemiology of the disease

- 1. Disease affects seniors with a mean age of 64 years
- 2. No racial or gender predilection
- 3. List the pertinent elements of the history
- 4. Painless vision loss and floaters are the most frequent presenting ocular symptoms
- 5. CNS symptoms may also be described

C. Describe the pertinent clinical features

- 1. Bilateral ocular involvement in 80%
- 2. Vitritis that fails to respond to conventional management
- 3. Mild anterior uveitis
- 4. Deep, subretinal yellow-white infiltrates
- 5. Exudative retinal detachment
- 6. Retinal pigment epithelium (RPE) detachment
- 7. Atrophic "punched out lesions"
- 8. Macular edema
- 9. Optic neuropathy
- 10. Retinal vasculitis
- 11. Vascular occlusions may also be observed

D. Describe appropriate testing and evaluation for establishing the diagnosis

- 1. Pathologist should be available for prompt tissue handling and processing
- 2. Cytopathology analysis of vitrectomy specimen is standard for diagnosis
- 3. Additional studies include:
 - a. Immunohistochemistry

- b. Flow cytometry for cell surface markers
- c. Polymerase chain reaction (PCR) analysis for gene rearrangements
- 4. Magnetic resonance imaging (MRI) of brain necessary to exclude concomitant CNS involvement
- 5. Referral to oncologist for consideration of lumbar puncture, bone marrow, brain biopsy to help with establishment of diagnosis if vitrectomy specimen is not definitive

II. Define the risk factors

- A. Advanced age
- B. Compromised immune system (e.g. AIDS)

III. List the differential diagnosis

- A. Pars planitis/intermediate uveitis
- B. Sarcoidosis
- C. Syphilis
- D. Sympathetic ophthalmia
- E. Viral retinitis
- F. Tuberculosis

IV. Describe patient management in terms of treatment and follow-up

A. Describe the natural history, outcome and prognosis

- 1. Without treatment, median survival is 1.5 months after onset of neurologic symptoms
- 2. Vision may be mildly to severely impaired in the affected eye
- 3. Chemotherapy for CNS disease may also treat intraocular lesions

B. Describe medical therapy options

- 1. Ocular disease which presents concomitantly with CNS disease
 - a. Intrathecal chemotherapy
 - b. Intravenous chemotherapy with CNS penetrating agents
- 2. Isolated ocular disease
 - a. Intraocular chemotherapy is showing promise
 - b. Fractionated external beam radiation as salvage therapy

C. Describe surgical therapy options

- 1. Vitrectomy is usually required for definitive diagnosis
- 2. Helps to clear visual axis

3. Processing of specimen should be discussed with experienced pathologist preoperatively (see above)

V. List the complications of treatment

A. Radiation therapy

- 1. Radiation retinopathy
- 2. Radiation papillopathy
- 3. Accelerated cataract formation

B. Chemotherapy

- 1. Neutropenia
- 2. Opportunistic infection

C. Combined radiation and chemotherapy

1. Cognitive deficits

VI. Describe disease-related complications

- A. Ocular
 - 1. Persistent, progressive or recurrent vision loss
- B. CNS
 - 1. Cognitive and neurologic deficits

VII. Describe appropriate patient directions

A. Follow-up is indicated with both a retina specialist and an experienced oncologist

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- 3. Choi JY, Kafkala C, Foster CS. Primary intraocular lymphoma: A review. *Semin Ophthalmol* 2006;21:125-33.
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Lasers

I. List the (common) indications

A. Retinal tears and related pathology (e.g., lattice degeneration)

B. Macular edema

- 1. Diabetic clinically significant macular edema
- 2. Branch retinal vein occlusions
- 3. Retinal arterial macroaneurysms

C. Retina and optic disc neovascularization

- 1. Diabetic retinopathy
- 2. Branch and central retinal vein occlusions
- 3. Proliferative sickle cell retinopathy
- 4. Retinopathy of prematurity (ROP)
- 5. Inflammatory retinopathies
- D. Iris neovascularization/neovascular glaucoma
- E. Choroidal neovascularization (CNV) (not subfoveal)
- F. Miscellaneous retinopathies (e.g., Coats disease)
- G. Miscellaneous choroidopathies (e.g., central serous chorioretinopathy)
- H. Intraoperative treatment endolaser and laser indirect ophthalmoscopy

II. Describe the pre-procedure/therapy evaluation

- A. Visual acuity
- B. Duration and magnitude of symptoms
- C. Fluorescein angiography for selected diseases
- D. Optical coherence tomography (OCT) for selected diseases
- E. Assessment of media clarity (for laser wavelength and settings)
- F. Exact location and extent of disease process (for delivery type and lens use)

III. List the alternatives to this procedure/therapy

- A. Observation for selected, nonprogressive conditions
- B. Cryotherapy
- C. Photodynamic therapy or anti-vascular endothelial growth factor (VEGF) agents for selected CNV

- D. Intravitreal corticosteroids or anti-VEGF agents for selected macular edema cases
- E. Vitrectomy for vitreoretinal tractional states or progressive retinal neovascularization

IV. Describe the instrumentation, anesthesia and technique

A. Laser technology type

- 1. Tube-based (liquid cooled)
- 2. Solid-state diode

B. Laser wavelength choices (most common)

- 1. Green
- 2. Red
- 3. Yellow
- 4. Infrared

C. Delivery system types

- 1. Slit-lamp biomicroscope
- 2. Binocular indirect ophthalmoscope

D. Lenses

- 1. Contact (direct and indirect views)
- 2. Noncontact (e.g., 20 or 28 D lens for indirect delivery)

E. Anesthesia

- 1. Topical (e.g., proparacaine)
- 2. Retrobulbar or peribulbar
- 3. Sedation or general (rare) for children (e.g., ROP)

F. Style of treatment

- 1. Focal macular (e.g., targeted, grid, ablative, etc.)
- 2. Panretinal (peripheral scatter)
- 3. Delimiting-demarcating (e.g., retinal breaks and detachments)

V. List the complications of the procedure/therapy, their prevention and management

A. Complications

- 1. Visual acuity or field loss
- 2. Macular edema
- 3. Scotoma
- 4. Hemorrhage

Retina/Vitreous

- 5. Pain
- 6. Cataract
- 7. Pupil-accommodation alterations
- 8. CNV and chorioretinal scarring
- 9. Delayed dark adaptation
- 10. Serous retinal/choroidal detachment (heavy panretinal photocoagulation)
- 11. Rhegmatogenous/traction retinal detachment (usually secondary to intense treatment or to contraction of preexisting fibrovascular tissue)
- 12. Angle closure/increased intraocular pressure
- 13. Corneal abrasion

B. Prevention

- 1. Calibrate the intensity of the burns at an extramacular area
- 2. Maximize distance of laser spot to fovea (insure patient fixation with macular treatments)
- 3. Minimize spot number and intensity
- 4. Start placing the laser burns to the periphery during panretinal scatter photocoagulation
- 5. Avoid long posterior ciliary nerves (when possible)

C. Management

- 1. Analgesics for post-procedure pain
- 2. Retrobulbar anesthesia for pain during procedure

VI. Describe the follow-up care (indication dependent)

A. First follow-up visit

- 1. Retinal tear or detachment: 1-2 weeks
- 2. CNV: 3-4 weeks
- 3. Proliferative diabetic retinopathy (PDR)/ diabetic macular edema (DME): 2-4 months

B. Subsequent follow-up visits

- 1. Retinal tear: 3-6 months
- 2. CNV: monthly until leakage is stable
- 3. PDR/DME every 3-6 months

VII. Describe appropriate patient instructions

- A. Expect decreased vision immediately after treatment
- B. Possible mild to moderate ocular ache or foreign body sensation the day of treatment

Retina/Vitreous
- 1. Use analgesics (e.g., acetaminophen) as needed
- 2. Artificial tears for foreign body sensation
- C. Vision should steadily improve back towards pre-treatment baseline within 1 week in most cases
- D. Patient should call immediately with any visual worsening or persistent pain
- E. Possible activity or positional restrictions depending on specific condition treated (e.g., head of bed elevated with vitreous hemorrhage)

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- 2. AAO, Focal Points: Update on Management of Diabetic Retinopathy, 2011
- 3. AAO, Focal Points: Laser Management of Choroidal Neovascularization, Module #5, 1993.
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Intravitreal injections

I. List the indications/contraindications

A. Indications

- 1. Anti-vascular endothelial growth factor (VEGF) agents (pegaptanib, ranibizumab, bevacizumab, aflibercept)
 - a. Choroidal neovascularization
 - b. Macular edema
 - c. Proliferative retinopathies
- 2. Anti-virals (ganciclovir, foscarnet off-label use, fomivirsen off market)
 - a. Cytomegalovirus (CMV) retinitis
 - b. Acute retinal necrosis (ARN)
 - c. Progressive outer retinal necrosis
- 3. Corticosteroids (e.g., triamcinolone acetonide, dexamethasone, fluocinolone)
 - a. Macular edema (diabetic, retinal vein occlusion)
 - b. Uveitis
 - c. Choroidal neovascularization (CNV)
 - d. Adjunct to photodynamic therapy (PDT)
- 4. Antibiotics (e.g., vancomycin, ceftazidime)
 - a. Endophthalmitis
- 5. Gas (e.g., perfluoropropane, sulfurhexafluoride)
 - a. Retinal detachment
 - b. Submacular hemorrhage
- 6. Methotrexate (off-label use)
 - a. Ocular large cell lymphoma
 - b. Some forms of uveitis

B. Relative contraindications

- 1. Allergy to agent
- 2. Glaucoma or known steroid response (corticosteroids)
- 3. Conjunctivitis, external lid/lacrimal infection, blepharitis

II. Describe the pre-procedure evaluation

Retina/Vitreous

- A. History of glaucoma or allergy
- B. Dilated ophthalmic examination, particularly for peripheral retinal pathology
- C. Evaluate for ocular adnexal infections

III. List the alternatives to this procedure

A. Anti-VEGF agents

- 1. PDT
- 2. Laser photocoagulation
- 3. Systemic anti-VEGF therapy or periocular steroid injections (off-label)

B. Anti-virals

- 1. Oral or intravenous therapy
- 2. Ganciclovir implant

C. Corticosteroids

- 1. Sub-Tenons injection (off-label)
- 2. Systemic delivery
- 3. Steroid implant

D. Gas

- 1. Scleral buckle for retinal detachment
- 2. Pars plana vitrectomy

E. Methotrexate

- 1. Systemic chemotherapy
- 2. Local radiation

IV. Describe the instrumentation, anesthesia and technique

- A. Consider wearing a mask or minimize talking during procedure
- B. Apply topical anesthetic or inject subconjunctival lidocaine
- C. Apply 5 10% povidone iodine to ocular surface
- D. Use a lid speculum
- E. Injection 3.5 4.0 mm posterior to limbus not in horizontal meridian,
 - 1. Avoid touching lashes
 - 2. Measure from the limbus (e.g. calipers or blunt end of a TB syringe)
- F. Cotton tip to injection site may be applied to site after removing needle to prevent reflux
- G. Assess visual function after the injection

1. If no light perception, wait until the patient re-gains vision or treat accordingly

V. Describe the complications of this therapy, their prevention and management

A. Endophthalmitis

- 1. Prevention
 - a. Proper technique
 - b. Pre-injection povidone iodine solution
- 2. Management
 - a. Vitreous tap
 - b. Intravitreal antibiotics
 - c. Pars plana vitrectomy
- B. Retinal tear or detachment

C. Cataract

- 1. Corticosteroids
- 2. Lens trauma

D. Ocular hypertension/glaucoma

- 1. Prevention
 - a. Avoid corticosteroids in glaucoma or corticosteroid-responders
- 2. Management
 - a. Topical/systemic therapy
 - b. Surgery
- E. Intraocular hemorrhage

VI. Describe the follow-up care

- A. Consider application of topical antibiotic postoperatively
- B. Return for follow up care per treatment plan

VII. Describe appropriate patient instructions

- A. Counsel patient/caregiver on symptoms of endophthalmitis (e.g., redness, pain, light-sensitivity, loss of vision)
- B. Instruction regarding positioning, air travel restrictions for intraocular gas injection

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. Jager RD, Aiello LP, Patel SC, Cunningham ET Jr. Risks of intravitreous injection: a comprehensive review. *Retina* 2004;24:676-98.
- 3. Isenberg SJ, Apt L, Yoshimori R. Khwarg S. Chemical preparation of the eye in ophthalmic surgery. IV. Comparison of povidone-iodine on the conjunctiva with a prophylactic antibiotic. *Arch Ophthalmol* 1985;103:1340-2.
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Pars plana vitrectomy

I. List the indications/contraindications

A. Indications

- 1. Non-clearing vitreous hemorrhage
- 2. Endophthalmitis
- 3. Tractional macular pathologies
- 4. Retinal detachment repair
- 5. Vitreous biopsy
- 6. Malignant glaucoma
- 7. Dislocated/subluxed intraocular implant
- 8. Intraocular foreign body
- 9. Vitreous complications of anterior segment surgery (See Vitrectomy for posterior segment complications of anterior segment surgery)
 - a. Vitreous wick to wound with associated
 - i. Cystoid macular edema
 - ii. Peaked pupil
 - iii. Wound leak
 - b. Retained lens fragments

B. Relative contraindications

- 1. Active periocular infection
- 2. Bleeding diathesis
- 3. Unstable medical condition
- 4. Acute trauma with posterior rupture
- 5. Severe corneal opacification (may require keratoprosthesis)

II. Describe the pre-procedure evaluation

- A. Medical history
- B. Anterior segment evaluation
- C. Lens evaluation
- D. B-scan ultrasound as indicated
- E. Careful fundus examination

III. List the alternatives to this procedure

A. Repair for rhegmatogenous retinal detachment

- 1. Scleral buckle
- 2. Pneumatic retinopexy
- 3. Laser demarcation
- B. Vitreous tap and injection for endophthalmitis
- C. Pharmacologic vitreolysis (e.g., Ocriplasmin for macular holes and vitreomacular traction syndromes; hyaluronidase for vitreous hemorrhage)
- D. Observation

IV. Describe the instrumentation, anesthesia and technique

A. Instrumentation

- 1. Vitrectomy machine with fragmentation capability
- 2. Light source
- 3. Microscope with contact/non-contact lens viewing system
- 4. Scissors, microvitreoretinal (MVR) blade
- 5. Sutures to close sclerotomy, conjunctiva
- 6. Vitreous instruments (e.g., micro forceps, automated scissors)
- 7. Laser (endoprobe, indirect delivery)
- 8. 20, 23, or 25 gauge instrument options

B. Anesthesia

- 1. Retrobulbar
- 2. Peribulbar
- 3. General

C. Technique

- 1. Informed consent
- 2. Anesthesia of choice
- 3. Sterile prep
- 4. Conjunctival openings over sclerotomy sites (for 20 gauge vitrectomy)
- 5. Pars plana sclerotomies
- 6. Place infusion cannula (optional illuminated 'chandelier')
- 7. Core vitrectomy

- 8. Lensectomy or removal of lens fragments, if necessary
- 9. Membrane peeling as needed
- 10. Reattach retina if necessary
- 11. Laser retina, as needed
- 12. Gas exchange, as needed
- 13. Silicone oil as needed
- 14. Perfluorocarbon-silicone oil exchange
- 15. Removal of instruments and infusion cannula
- 16. Close sclerotomies, conjunctiva
- 17. May administer intravitreal or periocular antibiotics and/or other therapeutic agents such as anti-VEGF agents

V. Describe the complications of this procedure, their prevention and management

- A. Cataract formation (removal elective; surgical)
- B. Acute endophthalmitis
 - 1. Especially with an intraocular foreign body
 - 2. Inject intraocular antibiotics
 - 3. Consider repeat vitrectomy
- C. Retinal tear or detachment
 - 1. Consider laser retinopexy, scleral buckle and/or vitrectomy
- D. Secondary glaucoma
 - 1. Medical or surgical management
- E. Vitreous hemorrhage
 - 1. Observation
 - 2. Repeat vitrectomy

VI. Describe the follow-up care

A. Monitor and treat appropriately for elevated IOP, infection and/or RD

VII. Describe appropriate patient instructions

- A. Postoperative drops
- B. Postoperative positioning, such as face down, as needed
- C. Follow up visits, typically next day, next week, etc.

D. Gas bubble precautions:

- 1. Avoid high altitudes and airplane travel
- 2. Avoid nitrous oxide

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- 2. AAO, Diabetes and Ocular Disease: Past, Present and Future Therapies, 2000, p.88-89, 155-179, 207-210, 286, 290-291.
- 3. AAO, Focal Points: Evaluation and Management of Diabetic Retinopathy, Module #1, 2003, p.6-7.
- 4. Yanyali A, Horozoglu F, Celik E, Ercalik Y, Nohutcu AF. Pars plana vitrectomy and removal of the internal limiting membrane in diabetic macular edema unresponsive to grid laser photocoagulation. *Eur J Ophthalmol* 2006;16:573-81.
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- 6. Brazitikos PD, Androudi S, Christen WG, et al. Primary pars plana vitrectomy versus scleral buckle surgery for the treatment of pseudophakic retinal detachment: a randomized clinical trial. *Retina* 2005;25:957-64.
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- 8. Thomas D, Bunce C, Moorman C, et al. A randomised controlled feasibility trial of vitrectomy versus laser for diabetic macular oedema. *Br J Ophthalmol* 2005;89:81-6.

Vitrectomy for selected macular diseases

I. List the indications/contraindications

A. Indications

- 1. Symptomatic macular pucker
- 2. Vitreomacular traction syndrome
- 3. Stage 2-4 full thickness macular hole
- 4. Worsening or chronic cystoid macular edema (CME)

B. Contraindications

- 1. Active periocular infection
- 2. Bleeding diathesis
- 3. Unstable medical condition
- 4. Severe corneal opacification (may require keratoprosthesis)

II. Describe the pre-procedure evaluation

- A. Medical history
- B. Visual acuity
- C. Anterior segment/lens evaluation (media clarity)
- D. Stereoscopic dilated fundus examination
- E. Fundus photography
- F. Macular ocular coherence tomography (OCT)
- G. Fluorescein angiography as indicated

III. List the alternatives to this procedure

- A. Observation
- B. Medical therapy for CME

IV. Describe the instrumentation, anesthesia and technique

- A. Instrumentation (See Pars plana vitrectomy section for complete list)
 - 1. Special instrumentation for ILM removal if indicated
 - 2. High magnification contact/non-contact macular viewing lens (optional)
 - 3. Special instrumentation for lens fragment removal, as indicted

Retina/Vitreous

4. Facilitate visualization

- a. Triamcinolone acetonide (off-label)
- b. Vital dyes (off-label)
- 5. Vitreous substitute, as indicated (air, gas, silicone oil)

B. Anesthesia

- 1. Retrobulbar (local) with IV sedation
- 2. General

C. Technique (See Pars plana vitrectomy section for complete list)

- 1. Thorough membrane peeling to relieve traction, remove epiretinal membrane and/or internal limiting membrane (ILM)
- 2. Remove vitreous strands from anterior chamber for chronic CME
- 3. Perform gas/fluid exchange for tamponade of macular holes
- 4. Examine peripheral fundus to screen for retinal tears or detachment and treat as appropriate

V. Describe the complications of this therapy, their prevention and management

- A. Cataract formation
- B. Endophthalmitis
- C. Retinal tear or detachment
- D. Proliferative vitreoretinopathy (PVR)
- E. Persistent CME
- F. Persistent or recurrent macular hole
- G. Secondary glaucoma
- H. Choroidal or vitreous hemorrhage
- I. Vital dye may be toxic to retina and/or pigment epithelial cells

VI. Describe the follow-up care

A. Monitor and treat appropriately for elevated intraocular pressure, infection, CME or retinal detachment

VII. Describe appropriate patient instructions

- A. Postoperative drops
- B. Positioning, as indicated
- C. Follow up visits, typically next day, next week, etc.
- D. Visual recovery typically 4-6 weeks, up to a year

E. Altitude/air travel precautions with intraocular gas

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. Sjaarda RN and Thompson JT. Macular hole. In *Retina 3rd Edition*. Ed. Ryan SJ.
- 3. Vol 3. Surgical Retina Ed. Wilkinson CP. 2001, Chpt. 152, pp. 2547-2561.
- 4. AAO, Laser Photocoagulation of the Retina and Choroid, 1997, p. 55-58.
- 5. AAO, Focal Points: Posterior Segment Vitrectomy: An Overview of Indications, Module #4, 1991.

Vitrectomy for posterior segment complications of anterior segment surgery

I. List the indications/contraindications

A. Indications

- 1. Acute endophthalmitis
- 2. Retained lens fragments
- 3. Dislocated/subluxed intraocular lens (IOL)
- 4. Vitreous incarceration in incisions
- 5. Chronic cystoid macular edema (See Vitrectomy for selected macular diseases
- 6. Inadvertent globe penetration or perforation with retrobulbar needle

B. Contraindications

- 1. Active periocular infection
- 2. Bleeding diathesis
- 3. Unstable medical condition
- 4. Severe corneal opacification (may require keratoprosthesis)

II. Describe the pre-procedure evaluation

- A. Medical history
- B. Anterior segment evaluation
- C. Lens or IOL evaluation
- D. Meticulous dilated fundus examination, if possible
- E. Fundus photography, as indicated
- F. B-scan ultrasound, as indicated

III. List the alternatives to this procedure

- A. Medical treatment to stabilize eye and/or optimize visual acuity
- B. Contact lens (if dislocated or subluxed IOL)
- C. Temporary keratoprosthesis combined with pars plana vitrectomy (indication-dependent)
- D. YAG vitreolysis to relieve tractional strands
- E. Observation

IV. Describe the instrumentation, anesthesia and technique

A. Instrumentation (See Pars plana vitrectomy section for complete list)

- 1. Special instrumentation for lens fragment removal, as indicted
- 1. Vitreous substitute, as indicated (air, gas, oil)

B. Anesthesia

- 1. Retrobulbar (local) with IV sedation
- 2. General
- C. Technique (See Pars plana vitrectomy section for complete list)
 - 1. Re-enforce anterior wounds, as indicated
 - 2. Pars plana lensectomy or removal of lens fragments, if necessary
 - 3. Remove anterior vitreous strands and reconstruct anterior segment
 - 4. Thorough membrane peeling to relieve traction, as needed
 - 5. Treat retinal pathology, as indicated

V. Describe the complications of this therapy, their prevention and management

- A. Endophthalmitis
- B. Recurrent retinal detachment secondary to proliferative vitreoretinopathy (PVR)
- C. Cystoid macular edema (CME)
- D. Secondary glaucoma
- E. Choroidal or vitreous hemorrhage

VI. Describe the follow-up care

A. Monitor and treat appropriately for corneal edema, elevated intraocular pressure, infection, CME or retinal detachment

VII. Describe appropriate patient instructions

- A. Postoperative drops
- B. Positioning, as indicated
- C. Follow up visits, typically next day, next week, etc.
- D. Maximal visual recovery typically 4-6 weeks, up to a year
- E. Altitude/air travel precautions with intraocular gas

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. Scott IU, Flynn HW Jr., Smiddy WE et al. Clinical features and outcomes of pars plana vitrectomy inpatients with retained lens fragments. *Ophthalmology*. 2003, 110:1567-72.
- 3. Meredith TA. Vitrectomy for Infectious Endophthalmitis. In *Retina 3rd Edition*. Ed. Ryan SJ. Vol 3 *Surgical Retina*. Ed. Wilkinson CP. 2001, Chpt 135, pp. 2242-2263.
- Results of the Endophthalmitis Vitrectomy Study. A randomized trial of immediate vitrectomy and of intravenous antibiotics for the treatment of postoperative bacterial endophthalmitis. Endophthalmitis Study Group. *Arch Opthalmol.* 1995, 113:1479-96.

Pneumatic retinopexy

I. List the indications/contraindications

A. Indications

- 1. Rhegmatogenous retinal detachment (RD)
 - a. Located in the superior 8 clock hours of the retina
 - i. Single superior break
 - ii. A group of superior breaks within one clock hour

B. Relative contraindications

- 1. RD with breaks in the inferior 4 clock hours of the retina
- 2. Complex RD, including
 - a. Proliferative vitreoretinopathy
 - b. Giant retinal tear
 - c. Traction-rhegmatogenous retinal detachment
- 3. Media opacity, such as vitreous hemorrhage, interfering with thorough retinal examination
- 4. Traction or breaks/holes in other areas of attached retina (avoid secondary breaks)
- 5. Inferior lattice degeneration
- 6. Advanced glaucoma
- 7. Anticipated air travel
- 8. Non-compliant patient or a patient who has physical and/or mental disabilities that limit their ability to position properly

II. Describe the pre-procedure evaluation

- A. Anterior segment evaluation
- B. Lens evaluation
- C. Intraocular pressure (IOP) evaluation
- D. Dilated retinal examination with depression
- E. Assessment of willingness and ability to maintain post procedure positioning

III. List the alternatives to this procedure

- A. Cryo or laser retinopexy without internal gas tamponade
- B. Temporary balloon buckle

- C. Scleral buckle
- D. Pars plana vitrectomy
- E. Combined scleral buckle and vitrectomy

IV. Describe the instrumentation, anesthesia and technique

A. Instrumentation

- 1. Indirect ophthalmoscope and condensing lens
- 2. Lid speculum
- 3. Forceps
- 4. Caliper
- 5. Syringe and needle
- 6. Cryotherapy unit or laser photocoagulator
- 7. Sterile gas or air

B. Anesthesia

- 1. Topical
- 2. Subconjunctival
- 3. Retrobulbar

C. Technique

- 1. Informed consent
- 2. Betadine to conjunctival cul-de-sac
- 3. Application of cryotherapy or laser
- 4. Stabilize eye
- 5. Injection of 0.3 to 0.4 cc of gas 3.5-4.0 mm posterior to limbus superiorly, nasally or temporally
- 6. Tamponade injection site with cotton swab as needle withdrawn
- 7. Monitor postoperative pressure and retinal artery perfusion
- 8. Paracentesis to reduce IOP when needed
- 9. Head positioning for the gas bubble to tamponade the retinal break
- 10. Avoid subretinal gas
- 11. Perioperative antibiotics
- 12. Postoperative head positioning to close break(s)
- 13. Avoid steamrolling a superior retinal detachment through the macula

V. Describe the complications of this procedure, their prevention and management

A. Elevated IOP

- 1. Paracentesis
- 2. IOP lowering agents

B. Cataract

- 1. Secondary to intraocular gas
- 2. Secondary to lens violation
- C. New retinal breaks
- D. Retinal fold through macula

E. Subretinal gas

1. May require vitrectomy

F. Endophthalmitis

- 1. Tap and injection of intraocular antibiotics, or
- 2. Vitrectomy and injection of intraocular antibiotics

VI. Describe the follow-up care

- A. Topical antibiotics
- B. Topical corticosteroids
- C. Pupil dilatation
- D. Regular monitoring of IOP
- E. Regular monitoring of retinal apposition, retinal break closure and development of new retinal breaks

VII. Describe appropriate patient instructions

- A. Topical drop instructions
- B. Head position instructions
- C. Return visit instruction
- D. Expectation of potential secondary procedure
- E. Expectations of visual recovery
- F. Altitude restrictions
- G. Nitrous oxide warnings

Additional Resources

1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.

- 2. Purohit SS, Matthews GP, Zakov ZN. Pneumatic buckle for the repair of primary rhegmatogenous retinal detachment. *Ophthalmic Surg Lasers* 1999;30:509-12.
- 3. Assi AC, Charteris DG, Pearson RV, et al. Pneumatic retinopexy in the treatment of primary rhegmatogenous retinal detachment. *Eye* 1999;13(pt 6):725-8.
- 4. Tornambe PE, Hilton GF, Brinton DA, et al. Pneumatic retinopexy. A two-year follow-up study of the multicenter clinical trial comparing pneumatic retinopexy with scleral buckling. *Ophthalmology* 1991;98:1115-23.
- Brinton DA and Hilton GF. Pneumatic Retinopexy and Alternative Retinal Reattachment Techniques. 2001 In *Retina 3rd Edition* Ed. Ryan SJ, Vol 3 Surgical Retina Ed. Wilkinson CP, Chpt 123, pp. 2047-2062.
- 6. Yanyali A, Horozoglu F, Bayrak YI, et al. Steamroller versus basic technique in pneumatic retinopexy for primary rhegmatogenous retinal detachment. *Retina* 2007;27:74-82.
- 7. Saw SM, Gazzard G, Wagle AM, et al. An evidence-based analysis of surgical interventions for uncomplicated rhegmatogenous retinal detachment. *Acta Ophthalmol Scand* 2006;84:606-12.

Scleral buckle surgery

I. List the indications/contraindications

A. Indications

- 1. Scleral buckle alone
 - a. Rhegmatogenous retinal detachment (RD)
 - b. Prophylaxis in selected fellow eyes of giant retinal tear patients
- 2. In combination with pars plana vitrectomy
 - a. Complex retinal detachment
 - b. Trauma
 - c. Proliferative vitreoretinopathy
 - d. Larger or multiple breaks, especially inferiorly

B. Contraindications

- 1. Unstable medical condition
- 2. Sickle cell disease
 - a. Scleral buckle induced ischemia
 - b. Encirclement should be avoided

II. Describe the pre-procedure evaluation

- A. Medical history
- B. Anterior segment evaluation
- C. Lens evaluation
- D. Vitreous examination
- E. Dilated retinal examination with depression whenever possible
- F. Planning of the type and configuration of the buckle (e.g., segmental, circular, radial, sponge vs. hard silicone)

III. List the alternatives to the procedure

- A. Cryo or laser retinopexy
- B. Pneumatic retinopexy
- C. Pars plana vitrectomy
- D. Combined scleral buckle and vitrectomy

- E. Temporary balloon buckle
- F. Observation

IV. Describe the instrumentation, anesthesia and technique

A. Instrumentation

- 1. Forceps
- 2. Scissors
- 3. Muscle hooks and stay sutures
- 4. Conjunctival retractors
- 5. Needle holders
- 6. Indirect ophthalmoscope and condensing lens
- 7. Scleral depressor
- 8. Cryotherapy unit with probes, diathermy unit with needles, or laser photocoagulator
- 9. Buckling elements
- 10. Gas as indicated

B. Anesthesia

- 1. Retrobulbar anesthesia with IV sedation
- 2. General anesthesia

C. Technique

- 1. Conjunctival peritomy
- 2. Isolation of rectus muscles on retraction sutures
- 3. Inspection of the sclera for abnormalities such as anomalous vortex veins or scleral thinning
- 4. Identification by indirect ophthalmoscopy and marking on sclera of retinal breaks
- 5. Treatment of retinal breaks with cryotherapy, diathermy or laser
- 6. Fixation of exoplant or implant materials to sclera to support retinal breaks
- 7. Drainage of subretinal fluid (optional)
- 8. Gas injection (optional)
- 9. Visual confirmation of retinal break support and optic nerve perfusion
- 10. Conjunctival closure with sutures
- 11. Peribulbar anesthetics for postoperative analgesia (optional)

V. Describe the complications of this procedure, their prevention, and management

A. Complications of drainage of subretinal fluid

- 1. Retinal incarceration
 - a. Lower intraocular pressure (IOP) before drainage
- 2. Retinal perforation
 - a. Drainage in areas of highly elevated retina
- 3. Subretinal and/or choroidal hemorrhage
- B. Proliferative vitreoretinopathy (PVR)
- C. Increased IOP
- D. Choroidal detachment (serous or hemorrhagic)
- E. Anterior segment ischemia
- F. Secondary glaucoma
- G. Ptosis
- H. Diplopia
- I. Buckle extrusion or intrusion
- J. Buckle infection

VI. Describe the follow-up care

- A. Topical antibiotics
- B. Topical corticosteroids
- C. Cycloplegia
- D. Pain medication as needed
- E. Positioning instructions
- F. Periodic examination for vision, IOP, evidence of infection and status of retinal reattachment

VII. Describe the appropriate patient instructions

- A. Reduced activity in the early postoperative period (emphasize positioning)
- B. Importance of topical drops
- C. Expectations of visual recovery
- D. Time delay for visual recovery
- E. Gas bubble altitude/air travel restrictions as indicated

Additional Resources

- 1. AAO, Basic and Clinical Science Course. Section 12: Retina and Vitreous, 2013-2014.
- 2. Schepens CL, Hartnett ME, Hirose T: Schepens' Retinal Detachment and Allied Diseases, 2nd

Retina/Vitreous

edition. 2000 Butterworth-Heinemann, Boston, MA.

- 3. Wilkinson CP, Rice TA: Michels Retinal Detachment, 2nd edition. 1997 Mosby-Year Book, Inc. St. Louis, Mo.
- 4. Brazitikos PD, Androudi S, Christen WG, et al. Primary pars plana vitrectomy versus scleral buckle surgery for the treatment of pseudophakic retinal detachment: a randomized clinical trial. *Retina* 2005;25:957-64.
- 5. Ahmadieh H, Moradian S, Faghihi H, and the Pseudophakic and Aphakic Retinal Detachment (PARD) Study Group. Anatomic and visual outcomes of scleral buckling versus primary vitrectomy in pseudophakic and aphakic retinal detachment: six-month follow-up results of a single operation--report no. 1. *Ophthalmology* 2005;112:1421-9.

Vitrectomy for complex retinal detachment

I. List the indications/contraindications

A. Indications

- 1. Traction retinal detachment (TRD)
- 2. Proliferative vitreoretinopathy (PVR) with RD
- 3. Aphakic/pseudophakic RD
- 4. Combined tractional/rhegmatogenous retinal detachment
- 5. RD associated with ocular trauma and ruptured globe
- 6. RD with posterior breaks
- 7. RD with retinoschisis

B. Contraindications

- 1. Active periocular infection
- 2. Bleeding diathesis
- 3. Unstable medical condition
- 4. Severe corneal opacification (may require keratoprosthesis)

II. Describe the pre-procedure evaluation

- A. Medical history
- B. Anterior segment evaluation
- C. Lens evaluation
- D. Meticulous dilated fundus exam
- E. Fundus photography
- F. B-scan ultrasound as indicated
- G. CT Scan in case of ocular trauma and suspicion of intraocular foreign body

III. List the alternatives to this procedure

- A. Cryotherapy or laser retinopexy
- B. Pneumatic retinopexy
- C. Scleral buckle surgery

IV. Describe the instrumentation, anesthesia and technique

A. Instrumentation (See Pars plana vitrectomy section for complete list)

- 1. Special instrumentation for membrane removal, as indicted
- 2. Vitreous substitute, as indicated (air, gas, heavy liquid, oil)

B. Anesthesia

- 1. Retrobulbar (local) with IV sedation
- 2. General

C. Technique (See Pars plana vitrectomy section for complete list)

- 1. Lensectomy or removal of lens fragments, if necessary
- 2. Membrane peeling to relieve traction, as needed
- 3. Retinectomy in case of incarceration or retinal shortening
- 4. Flatten retina by air or perfluorocarbon liquid
- 5. Laser or cryoretinopexy
- 6. Gas or silicone oil

V. List the complications of this procedure, their prevention and management

- A. Cataract formation
- B. Endophthalmitis
- C. Recurrent RD secondary to PVR or untreated retinal breaks
- D. Secondary glaucoma
- E. Choroidal or vitreous hemorrhage

VI. Describe the follow up care

A. Monitor and treat appropriately for elevated intraocular pressure (IOP) infection, RD and/or cataract formation

VII. Describe appropriate patient instructions

- A. Postoperative drops
- B. Positioning, as indicated
- C. Follow up visits, typically next day, next week, etc.
- D. Visual recovery typically 4-6 weeks, up to a year
- E. Altitude/air travel precautions with intraocular gas

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