

Journal Highlights

NEW FINDINGS FROM *OPHTHALMOLOGY*, *AJO*, AND *JAMA OPTHALMOLOGY*

Ophthalmology

Bupivacaine Injection for Comitant Strabismus

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Miller et al. evaluated the clinical effectiveness and anatomic changes resulting from bupivacaine injection into extraocular muscles to treat adults with comitant horizontal strabismus. They found that the anesthetic, when injected either by itself or in combination with botulinum toxin, improves eye alignment and corrects the strabismus by inducing changes in rectus muscle structure and length.

Of the 31 patients in this observational clinical series, 19 with esodeviations averaging 18.9 prism diopters (PD) received bupivacaine injections in the lateral rectus muscle, and 12 with exodeviations averaging 31.9 PD received bupivacaine in the medial rectus. Sixteen patients with large strabismus angles also received botulinum toxin type A injections in the antagonist muscle at the same treatment session. A second round of treatment was given to 13 patients who had residual strabismus after the initial round. Primary outcome measures included clinical measures of alignment

and muscle volume, maximum cross-sectional area, and shape derived from magnetic resonance imaging. Follow-up data were collected at the six-month and one-, two-, and three-year marks.

At an average of 15.3 months after the final treatment, original misalignments were reduced by 10.5 PD, with residual deviations of 10 PD or less in 53 percent of patients. In one-half of all patients, a single treatment of bupivacaine alone reduced misalignment at 11.3 months by 4.7 PD, with residual deviations of 10 PD or less. These corrections were stable for up to three years. Six months after treatment, muscle volume had increased by 6.6 percent in all patients, and maximum cross-sectional area had increased by 8.5 percent; these outcomes gradually relaxed toward pretreatment values. Computer modeling suggested that changes in agonist and antagonist

muscle lengths were responsible for the enduring changes in eye alignment.

These results support previous findings that treatment with bupivacaine alone improves eye alignment and that botulinum toxin in the antagonist muscle can correct larger deviations by allowing the bupivacaine-injected muscle to rebuild at reduced length. The authors have recently updated this protocol to combine bupivacaine with

epinephrine for patients with deviations of more than 20 PD; results of this treatment change will be provided in a subsequent report.

Subgroups of Angle-Closure Suspects Identified

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In the first use of an objective method to classify patients with angle-closure glaucoma, Nongpiur et al. investigated whether subgroups of patients could be classified based on anterior segment optical coherence tomography (AS-OCT) and biometric parameters. Although AS-OCT cannot image the ciliary body, the authors were able to identify three distinct subgroups of primary angle-closure suspects and characterized them as having either a large iris area or a large lens vault (LV) or elements of both.

For this cross-sectional study, the authors evaluated 243 primary angle-closure suspects as a primary group and 165 additional suspects as a validation group. All patients underwent gonioscopy and AS-OCT. The authors chose four parameters—iris area, anterior chamber depth, anterior chamber width, and LV length—and used hierarchical clustering to group these parameters on the basis of correlations. In addition, a Gaussian mixture model was employed to partition the patients into subgroups. All results were cor-



robored in the validation study population.

Subgroup 1 (n = 73) was characterized by a relatively greater iris area, and the researchers noted that this might result in angle crowding and angle closure in some patients. The predominant mechanism for subgroup 2 (n = 26) was a large LV and a shallow anterior chamber. Because the iris area in this grouping was smaller than that seen in subgroup 1, the authors suggested that a pushing mechanism was involved in angle-closure pathogenesis in these patients. Subgroup 3 (n = 144) had contributions from all four parameters in developing phenotypic angle closure.

The authors noted several study limitations, including the use of only static anatomic ocular parameters. In addition, because AS-OCT cannot image the ciliary body, eyes with a major ciliary body component might have been inappropriately categorized, and an additional subgroup might have been overlooked.

Resident Education and Preferred Practice Pattern Guidelines

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How well do residents in training follow the Academy's Preferred Practice Pattern (PPP) guidelines? Ong et al. examined this question with regard to care of primary open-angle glaucoma (POAG) patients and found that residents' compliance with POAG guidelines was high for most elements—with a few notable lapses.

For this retrospective chart review, researchers pulled 103 charts of POAG patients who underwent follow-up evaluations at the resident ophthalmology clinic of a Veterans Affairs Medical Center in North Carolina. The charts were evaluated for documentation of 19 elements as identified in the PPP guidelines. Compliance rates for the 19 elements were also averaged in all charts and compared among eight residents in either their first or second year of residency.

The overall compliance rate for

all elements was 82.6 percent for all charts, 78.8 percent for first-year residents, and 81.7 percent for second-year residents. These results were comparable to those found for residents' compliance with the cataract PPP (81 percent) and higher than that found for compliance with the diabetic retinopathy PPP (52.5 percent)—both of which were evaluated in earlier studies.

Documentation rates were high (greater than 90 percent) for all elements in the following categories: physical examination (visual acuity, slit-lamp, intraocular pressure, optic nerve, and visual field evaluations); follow-up (appropriate follow-up interval and interval adjustment after medication changes); and management (reconsideration of treatment regimen, use of alternative agent, discussion of compliance, reconsideration of current and target intraocular pressure, and gonioscopy, if needed). However, discussion of local or systemic problems with medications was documented in only 58.4 percent of all charts, and documentation of patient education was particularly poor, occurring in only 5.2 percent of all visits. Another area receiving minimal attention was referral for low-vision or social services, which was documented in only 16.1 percent of all charts.

The researchers suggested using the Academy's PPP guidelines as an objective and standardized way to evaluate resident performance across programs.

Imaging Ciliary Body and Choroidal Pseudomelanoma

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Shields et al. described a series of cataract patients who were suspected of having uveal melanoma but were subsequently found to have pseudomelanoma. Using ultrasound imaging, the authors offered several recommendations on how to differentiate the two conditions in patients with hypermature cataracts. Specifically, features such as an acoustically hollow center with a dense rim, a lack of contiguity with the uvea, a lack of

sentinel vessels, and a lack of a transillumination shadow were all suggestive of pseudomelanoma.

This case series included 20 patients who had unilateral hypermature cataracts and opaque media with no view of the fundus. All were referred with the presumptive diagnosis of melanoma; this diagnosis was based on ultrasonographic imaging, which gave the impression of a dome-shaped intraocular mass. In 17 of the patients, the mass appeared to be in the ciliary body; in the remaining three, it appeared to be in the choroid. In 18 of the patients, the cataractous lens was in an anatomic position; in two, it was subluxated. In every case, correct diagnosis of the pseudomelanoma was made using ultrasonography in A- and B-scan modes, ultrasound biomicroscopy, anterior segment optical coherence tomography, or a combination of these modalities. All diagnoses were confirmed after cataract surgery.

The authors concluded that oblique imaging of a hypermature cataract could produce a picture similar to that of a melanoma and noted that high-resolution ultrasonography or ultrasound biomicroscopy could help successfully diagnose the condition and limit unnecessary treatment. If confusion remains, they suggested that magnetic resonance imaging may also be helpful: Melanoma will enhance with gadolinium contrast, while the lens will not.

American Journal of Ophthalmology

Lifetime Risk of Blindness in Open-Angle Glaucoma

October *AJO*

Peters et al. determined the lifetime risk and duration of blindness in patients with manifest open-angle glaucoma. They found that approximately 1 out of 6 patients included in this retrospective chart review was bilaterally blind from glaucoma at the last follow-up visit. Of these bilaterally blind patients, 86 percent were aged 80 years or older when they became blind, and the median duration of bilateral

blindness was two years at death. The risk of blindness increased with time after initial diagnosis.

The authors reviewed the records of 592 deceased glaucoma patients and noted visual field status, visual acuity, and the presence of low vision or blindness at the time of diagnosis and during follow-up. Records of visual acuity and/or visual field examination during the three years prior to death were required for inclusion in the study. In these records, 367 patients (62.0 percent) were female, and 372 (62.8 percent) had glaucoma in both eyes. Median time between last visit and death was eight months, and median age at death was 87 years.

At the time of the final visit, 250 patients (42 percent) had at least one blind eye due to glaucoma, while 97 patients (16 percent) were bilaterally blind. Twelve patients (0.5 percent) had low vision. Median time with a glaucoma diagnosis was 12 years, median age when bilateral blindness first developed was 86 years, and median duration of bilateral blindness was two years. The cumulative incidences of blindness in at least one eye and bilateral blindness were 26 percent and 5 percent, respectively, after 10 years; these incidences increased to 38 percent and 13 percent, respectively, at 20 years.

The authors noted that because of longer life expectancies, glaucoma patients will have the disease for a longer period of time, and it is therefore possible that the lifetime risk of glaucoma blindness may increase even further.

Predictive Factors for the Progression of Diabetic Macular Ischemia

October *AJO*

Sim et al. investigated the predictive factors for progression of diabetic macular ischemia by analyzing fluorescein angiography. They found that the annual rate of foveal avascular zone (FAZ) enlargement ranged from 5 percent to 10 percent in eyes with established ischemia. They also noted that while a worse macular ischemia grade was independently pre-

dictive for progression, diabetic macular ischemia progression itself was predictive of the loss of visual function.

For this retrospective, longitudinal study, the authors collected data from 79 patients with type 2 diabetes who had mild, moderate, or severe ischemia grades and who had undergone macula-centered fluorescein angiography imaging at least twice in the previous six months. Severity of macular ischemia was assessed using Early Treatment Diabetic Retinopathy Study protocols, and custom software was used to quantify FAZ area.

The median FAZ areas at baseline for mild, moderate, and severe grades were 0.28, 0.37, and 0.73 mm², respectively, and significantly increased at the final fluorescein angiography. The authors found that FAZ enlargement rates were greater in more severe grades of ischemia, ranging from an increase per year from baseline of approximately 5 percent in mild grades to 7 percent and 10 percent in moderate and severe grades, respectively. Enlargement rates were at least threefold higher in eyes that showed a deterioration of visual acuity (19 percent) than in eyes that did not (5.6 percent). A loss of more than 0.05 logMAR or one line of Snellen visual acuity per year was associated with eyes that had an increase in FAZ area of more than 10 percent per year.

The authors concluded that although no treatment currently exists for visual loss attributable to macular ischemia, understanding its natural history might be of particular importance in the management of patients undergoing treatment for concurrent macular edema.

Liquid Culture Media in the Diagnosis of Microbial Keratitis

October *AJO*

In a retrospective case series, **Bhandange et al.** evaluated the role of liquid culture media in the diagnosis of microbial keratitis and found that the media increased the chance of isolating bacteria in pure bacterial and/or mixed infection; however, their role in

isolating fungus was limited.

The authors evaluated corneal scraping samples from 114 infectious keratitis patients. Samples were processed by corneal smear microscopy (using potassium hydroxide with calcofluor white and Gram stains) and a liquid culture examination (using 5 percent sheep blood agar, sheep blood chocolate agar, Sabouraud dextrose agar, brain heart infusion, thioglycolate broth, and Robertson's cooked meat broth). For inclusion in the study, all cases were required to have significant growth in the liquid culture.

Of the 114 cases, 44 were bacterial, 62 were fungal, and eight were mixed infection. Thirty-eight cases of bacterial keratitis were diagnosed by solid media alone; six of the 44 cases required liquid media for diagnosis. In fungal keratitis, all but one of the cases were diagnosed using solid media alone, while a single case required liquid media for diagnosis. In mixed infection, none of the cases required liquid media for diagnosis of the fungal component; however, all eight cases required liquid media for establishing the bacterial component.

Owing to overlap in clinical diagnosis of bacterial and fungal keratitis, the authors recommended inclusion of both solid and liquid culture media in the laboratory diagnosis of microbial keratitis.

Neurosensory Recovery Following Anti-VEGF Therapy for AMD

October *AJO*

In this interventional cohort study, **Munk et al.** evaluated neurosensory recovery in patients with wet age-related macular degeneration (AMD) receiving monthly intravitreal anti-VEGF therapy. Although the authors identified significant gains over one year in distance visual acuity and retinal sensitivity, there was no improvement in reading acuity and reading speed.

Sixty-four treatment-naïve neovascular AMD patients with subfoveal lesions were treated and examined monthly for distance visual acuity,

reading acuity, maximum reading speed, and contrast sensitivity. Using microperimetry, the authors evaluated the percentage of absolute and relative scotoma and mean central retinal sensitivity weighted by area. Improvements were determined by a random-slope and random-intercept model, and the recovery pattern of parameters was compared by correlating the individual slopes of each variable.

Initially, the authors identified a rapid short-term effect of anti-VEGF treatment across all functional variables. Progressive functional gain over one year was observed for distance visual acuity, contrast sensitivity, and mean central retinal sensitivity, but not for reading acuity and maximum reading speed. Decrease of absolute scotoma area did not reach statistical significance over this one-year period, nor did fixation stability improve. However, lesion size influenced the course of absolute scotoma area. Lesion type had no effect on any evaluated variable of visual function. They also noted that the individual slopes of reading acuity and distance visual acuity showed a moderate correlation, though all other variables lacked a significant correlation.

The authors concluded that visual recovery in anti-VEGF therapy is reflected in a characteristic pattern of functional changes over time, whereas distance visual acuity does not seem to comprehensively reflect overall visual function gain. Therefore, standard distance visual acuity tests may not completely reflect visual improvement in daily life.

JAMA Ophthalmology

Optimizing Descemet Membrane Endothelial Keratoplasty Using Intraoperative OCT

September *JAMA Ophthalmology*

Descemet membrane endothelial keratoplasty (DMEK) can be a challenging procedure for a surgeon, particularly because of poor visibility of the tissue due to the natural en face view through the operating mi-

croscope. In this retrospective study, Steven et al. analyzed imaging and video data to evaluate the use of intraoperative optical coherence tomography (iOCT) for improving the efficacy of DMEK. They found that iOCT technology enhanced visibility of graft orientation, rolling, and unfolding as well as monitoring of the graft attachment, thereby potentially improving the safety of the procedure.

The surgeons used iOCT in 26 eyes of 26 patients aged 39 to 93 years with corneal endothelial dysfunction undergoing DMEK. Fifteen patients with pseudophakic eyes and nine patients with phakic eyes underwent DMEK in combination with conventional phacoemulsification and posterior chamber lens implantation. In one case, DMEK was combined with pars plana vitrectomy and membrane peeling for treatment of macular hole.

The authors reported that iOCT enabled reliable visualization of all steps of the DMEK procedure. Graft-rolling behavior could be monitored without the necessity of restraining the graft with trypan blue, and iOCT allowed for exact imaging of the entire graft, even when recipient corneas had reduced transparency.

This technology also enabled the surgeons to control the entire attachment of the graft and allowed for more exact determination of time necessary for complete anterior chamber intraoperative air fill. Overall mean duration of the DMEK procedure was 25.7 minutes when using iOCT. Overall mean time for intraoperative anterior chamber air filling performed under iOCT was 236 seconds, compared with previously published air-filling times of 60 to 90 minutes.

Socioeconomic Disparity in the Use of Eye Care Services

September *JAMA Ophthalmology*

Individuals with age-related eye disease require eye care services for detection, assessment, and care at regular intervals. Zhang et al. explored the association between socioeconomic status and use of these eye care services

among U.S. adults with self-reported age-related eye disease and found that significant differences persist.

The study sample included 6,690 participants in the 2002 (n = 3,586) and 2008 (n = 3,104) National Health Interview Survey who were at least 40 years old and reported age-related macular degeneration, cataract, diabetic retinopathy, or glaucoma. The authors used multiple logistic regression to examine the association of income-to-poverty ratio (IPR) and educational attainment with the use of eye care services after controlling for age, sex, race/ethnicity, and health insurance status. IPR compares family income with the poverty threshold established by the Census Bureau; a score of 1 is the federal poverty threshold, and a score below 1 is categorized as below that threshold.

In 2002 and 2008, survey respondents with a higher IPR were more likely than those with a lower IPR to visit an eye care provider. And in 2002, respondents with less education were less likely than their more-educated counterparts to visit an eye care provider or undergo a dilated eye examination; however, the authors did not find statistically significant trends for eye care visits or dilated eye examinations by education level in 2008. Among respondents with an IPR between 3 and 5, prevalence of eye care visits and dilated eye examinations was lower in 2008 than in 2002. And among those respondents with less than a high school education, the age-adjusted prevalence for eye care visits decreased from 57 percent in 2002 to 44 percent in 2008.

The authors concluded that appropriate and timely public health interventions targeted at adults with low education and income levels might effectively reduce this continuing disparity in eye care.

Ophthalmology summaries are written by Jean Shaw and edited by John Kerrison, MD. American Journal of Ophthalmology summaries are edited by Thomas J. Liesegang, MD. JAMA Ophthalmology summaries are written by the lead authors.

ROUNDUP OF OTHER JOURNALS

Virtual Teaching Module Proves Effective

Eye

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Succar et al. investigated the impact of a Web-based teaching module known as the Virtual Ophthalmology Clinic (VOC) on medical student education. The authors found that use of the VOC boosted students' performance on testing immediately after their ophthalmology rotation and 12 months later.

The VOC is an interactive program that provides a computer-based simulation of the doctor-patient relationship in a virtual consulting room. Ten cases—all of which were recorded from actual patient interviews—are included, and the program places particular emphasis on history taking and clinical reasoning skills.

In this prospective controlled trial, the researchers randomly assigned 93 medical students to a traditional hospital-based ophthalmology rotation and 95 students to the VOC program. All students attended one of four clinical schools at the University of Sydney in Australia. The length of the training ranged from three to 10 days, depending on the individual school, and student subgroups were matched according to the length of their rotations.

All students were administered knowledge tests before and after their rotations, which covered history taking, interpretation of examinations, management of eye disorders, and clinical reasoning. Those in the VOC group outscored their traditionally trained peers both immediately following the rotation and 12 months later. Overall, those in the VOC group reported that the program was easy to navigate, and they rated it as more effective than traditional teaching methods.

The authors concluded that this teaching module presents a potential solution to a number of issues in

medical education, including time constraints, patient availability, and exposure to a representative selection of ophthalmic cases.

Ocular Inflammation After Femtosecond Cataract Surgery

Journal of Cataract and Refractive Surgery

Published online July 10, 2013

Abell et al. set out to assess the degree of surgical trauma induced by femtosecond laser-assisted cataract surgery. They measured the levels of postoperative ocular inflammation and found that the surgery resulted in less aqueous flare than did manual cataract surgery one day and four weeks after surgery.

For this prospective, consecutive, nonrandomized parallel cohort study, the authors evaluated 176 patients. All were treated by the same surgeon in a single center. Of these patients, 100 were assigned to the laser-assisted group; the remainder underwent conventional manual phacoemulsification.

At postoperative day 1, mean aqueous flare was 16.6 ± 8.9 photons per millisecond (ph/ms) in the laser group and 21.8 ± 12.0 ph/ms in the manual group. At four weeks, mean aqueous flare was 1.1 ± 8.1 ph/ms in the laser group and 14.6 ± 10.7 ph/ms in the manual group.

In terms of secondary endpoints, mean increase in measures of inflammation seen on optical coherence tomography was greater in the manual group, particularly with regard to outer zone retinal thickness. However, no statistically significant differences between the two groups were found during slit-lamp examinations and funduscopy.

Although both groups were treated with the same drugs for the same duration and frequency, the researchers noted that they could not rule out differences in compliance between groups, which might have produced confounding results.

Femtosecond Laser for Cataract Surgery in Infants

Journal of Cataract and Refractive Surgery

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In the first published report of the femtosecond laser's use in pediatric eyes, Dick et al. described a technique for performing laser-assisted cataract surgery in infants and found that the technique has the potential to increase the predictability, accuracy, and safety of surgery for congenital cataracts.

The authors reported on their experiences performing the procedure in four infants, aged 2 to 9 months of age. Three of the infants had congenital nuclear sclerotic cataracts; the fourth had a unilateral congenital calcified cataract. The off-label use of the femtosecond laser was performed according to a clinical protocol developed by an institutional ethics committee.

The authors noted that because the pediatric capsular bag is more elastic than its adult counterpart, a standard capsulotomy is difficult to perform and often leads to capsular tears or a large continuous curvilinear capsulorhexis; however, in three of the four cases described in this study, the anterior and posterior capsule discs were easy to remove, and no tears occurred. In the fourth case, which involved the calcified cataract, laser treatment and cataract removal were possible after a Malyugin ring was inserted. Total treatment time in these cases ranged from 24 to 50 minutes.

The researchers pointed out that because the current interface for the femtosecond laser is not intended for infants, a lateral canthotomy may be required. In addition, the substantial elasticity of the infants' lens capsules led to final anterior and posterior capsulotomy diameters that were slightly larger than intended.

Roundup of Other Journals is written by Jean Shaw and edited by Deepak P. Edward, MD.