Q

BRAO vs CRAO

- Which is the more common entity?

A

BRAO vs CRAO

- Which is the more common entity? CRAO

Q

BRAO vs CRAO

- Which is the more common entity? CRAO
- Which is more likely to be embolic?

A

BRAO vs CRAO

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Q

BRAO vs CRAO

- Which is the more common entity? CRAO
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What are the three main varieties of embolus?

A

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What are the three main varieties of embolus?
Calcific; platelet-fibrin; cholesterol

Q

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Emboli composed of cholesterol are known by what eponymous name?

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Hollenhorst plaque

BRAO vs CRAO

Hollenhorst plaque

Q

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For each statement, identify which variety is associated:
--Arise from diseased cardiac valves: ***?***

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--Associated with large-vessel arteriosclerosis: ***?***

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In general terms, where do emboli usually lodge?

Q/A

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In general terms, where do emboli usually lodge?
At a two words in the arterial tree

A

BRAO vs CRAO

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In general terms, where do emboli usually lodge?
At a branch point in the arterial tree

A

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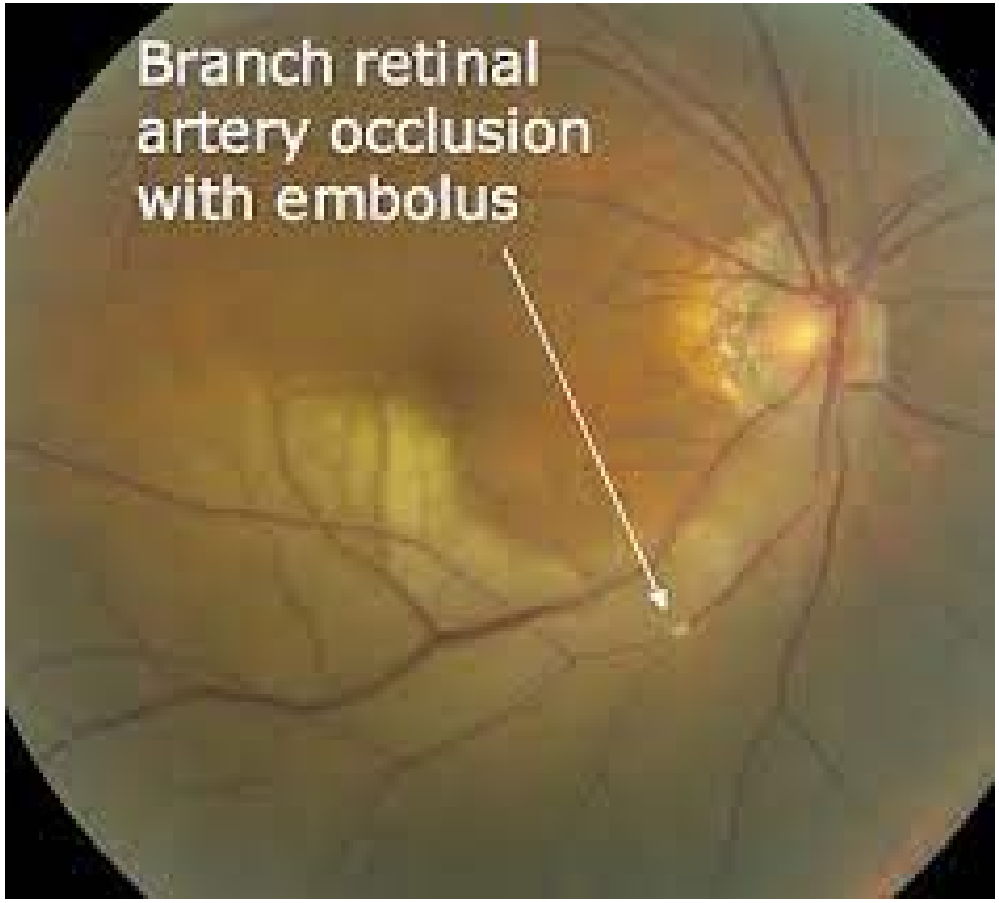
In general terms, where do emboli usually lodge?
At a branch point in the arterial tree. That is, an emboli will continue to float along in the bloodstream until it reaches a bifurcation for which it is too large to travel down either fork, and becomes lodged.

BRAO vs CRAO



BRAO with embolus visible at branch point

A

BRAO vs CRAO

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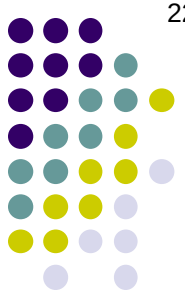
In general terms, where do emboli usually lodge?
At a branch point in the arterial tree. That is, an emboli will continue to float along in the bloodstream until it reaches a bifurcation for which it is too large to travel down either fork, and becomes lodged. In CRAO, the embolus usually lodges at the level of the lamina cribrosa; for this reason, an embolus isn't always visible on the ONH.

Q

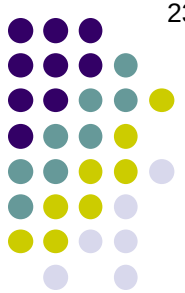
BRAO vs CRAO



- Which is the more common entity? CRAO
- Which is more likely to be embolic? BRAO
- For which is VA usually NLP?

A

BRAO vs CRAO



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Q

BRAO vs CRAO

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If vision is NLP after an arterial occlusion, which artery is implicated?

A

BRAO vs CRAO

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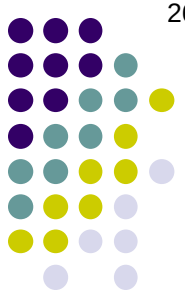
If vision is NLP after an arterial occlusion, which artery is implicated?
The **ophthalmic** artery

Q

BRAO vs CRAO



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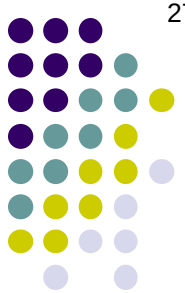
- Which can be associated with migraines?

A

BRAO vs CRAO



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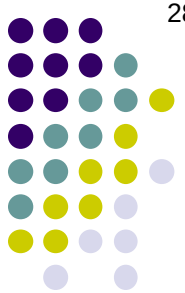

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- Which eventually recannulates, thus restoring blood flow to the affected area?

A

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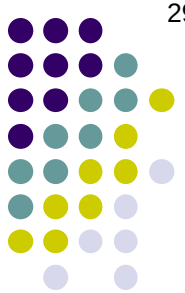

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Does restoration of blood flow reverse the damage wrought by the RAO?

A

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- For which is VA usually NLP? Neither
- Which can be associated with migraines? Both
- Which eventually recannulates, thus restoring blood flow to the affected area? Both

Does restoration of blood flow reverse the damage wrought by the RAO?
Nope—permanent damage is permanent

Q

Just BRAO

- Which of the following concerning BRAO are true?
  - The majority of cases are embolic

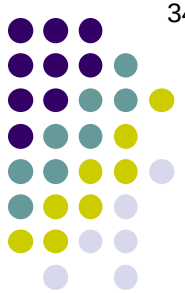
A

Just BRAO

- Which of the following concerning BRAO are true?
  - The majority of cases are embolic **T**

Q

Just BRAO



- Which of the following concerning BRAO are true?
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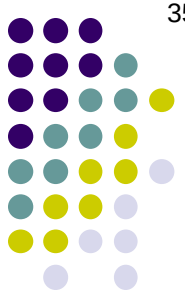
What are the common causes in **non**-*embolic cases?*
--***?***
--***?***
--***?***

A

Just BRAO



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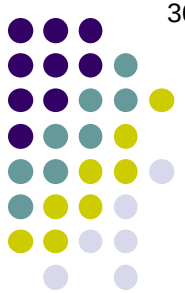
What are the common causes in **non**-*embolic cases?*
--Vasospasm
--?
--?

Q

Just BRAO



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What are the common causes in **non**-*embolic cases?*
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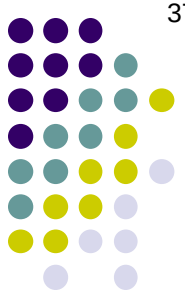
--?
--?

A

Just BRAO



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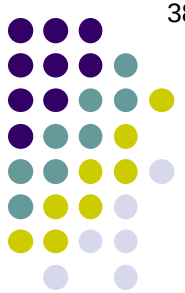
--?
--?

Q

Just BRAO



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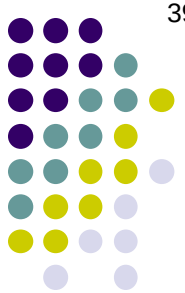
--*?*

A

Just BRAO



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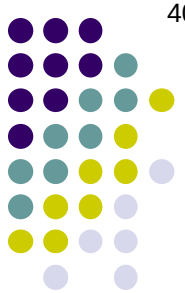
--Inflammation
--*?*

Q

Just BRAO



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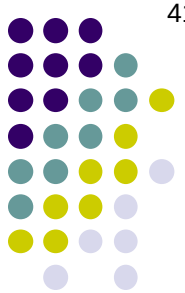
A

Just BRAO



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Just BRAO

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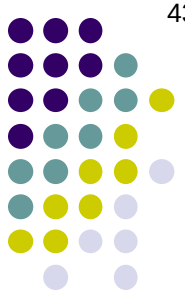
--Coagulopathy

Q

Just BRAO



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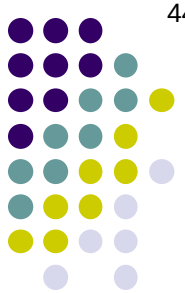
What are the common causes in **non***-embolic cases?*
--**Vasospasm** (eg, migraine)

Two recreational drugs are notorious-but-rare causes of vasospastic BRAO. What are they?
--?
--?

Hints forthcoming

Q

Just BRAO



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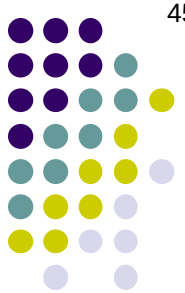
--? ← *Hint:* Illegal
--?

A

Just BRAO



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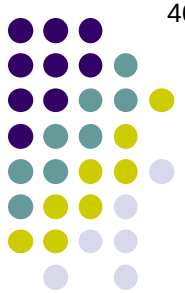
--Cocaine ← *Hint:* Illegal
--*?*

Q

Just BRAO



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A

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--Cocaine
--Sildenafil ← *Hint:* Legal

Q

Just BRAO

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What are the common causes in **non**-*embolic cases?*

Speaking of non-embolic cases…*A young-adult female presents with multiple bilateral BRAOs. This should bring to mind a specific condition—what is it?*

A

Just BRAO

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Susac syndrome

Just BRAO

Susac syndrome. Retinal whitening and cotton-wool spots along the proximal inferotemporal arcade vessels and within the inferotemporal macula suggestive of branch retinal artery occlusions

Q

Just BRAO

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What's weird about the BRAOs in Susac syndrome (other than that they're multiple and bilateral)?

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What's weird about the BRAOs in Susac syndrome (other than that they're multiple and bilateral)?
They occur at **non**-branch points

Just BRAO

Susac syndrome. Note the area of macular infarct doesn’t correspond to a branch-point blockage

Q

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In a nutshell, what is the underlying pathology in Susac?

Q/A

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It is an _____ condition involving anti-_____ cell antibodies

A

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It is an autoimmune condition involving anti- endothelial cell antibodies. The resulting endothelial cell damage attracts thrombotic material, which obliterates the lumen and thus produces (non-branch-point) occlusions.

Just BRAO

Susac syndrome. Note the multiple areas of arteriolar inflammation and blockage at non-branch points

Q

Just BRAO

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What are its two classic non-ocular signs/symptoms?
--***?***
--***?***

A

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What are its two classic non-ocular signs/symptoms?
--Sensorineural hearing loss
--Encephalopathy

Q

Just BRAO

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*What are the common causes in **non**-embolic cases?*

Vasospasm (eg, migraine)

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It is an autoimmune condition involving anti- endothelial cell antibodies. The resulting endothelial cell damage attracts thrombotic material, which obliterates the lumen and thus produces (non-branch-point) occlusions.

What are its two classic non-ocular signs/symptoms?
--Sensorineural hearing loss
--**Encephalopathy**

What does MRI brain reveal?

Q/A

Just BRAO

- Which of the following concerning BRAO are true?
  - The majority of cases are embolic **T**

*What are the common causes in **non**-embolic cases?*
Vasospasm (eg, migraine)

Speaking of non-embolic cases…*A young-adult female presents with multiple bilateral BRAOs. This should bring to mind a specific condition—what is it?*
Susac syndrome

What's weird about the BRAOs in Susac syndrome (other than that they're multiple and bilateral)?
They occur at **non**-branch points

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What does MRI brain reveal?
White matter lesions, esp. of the

two words

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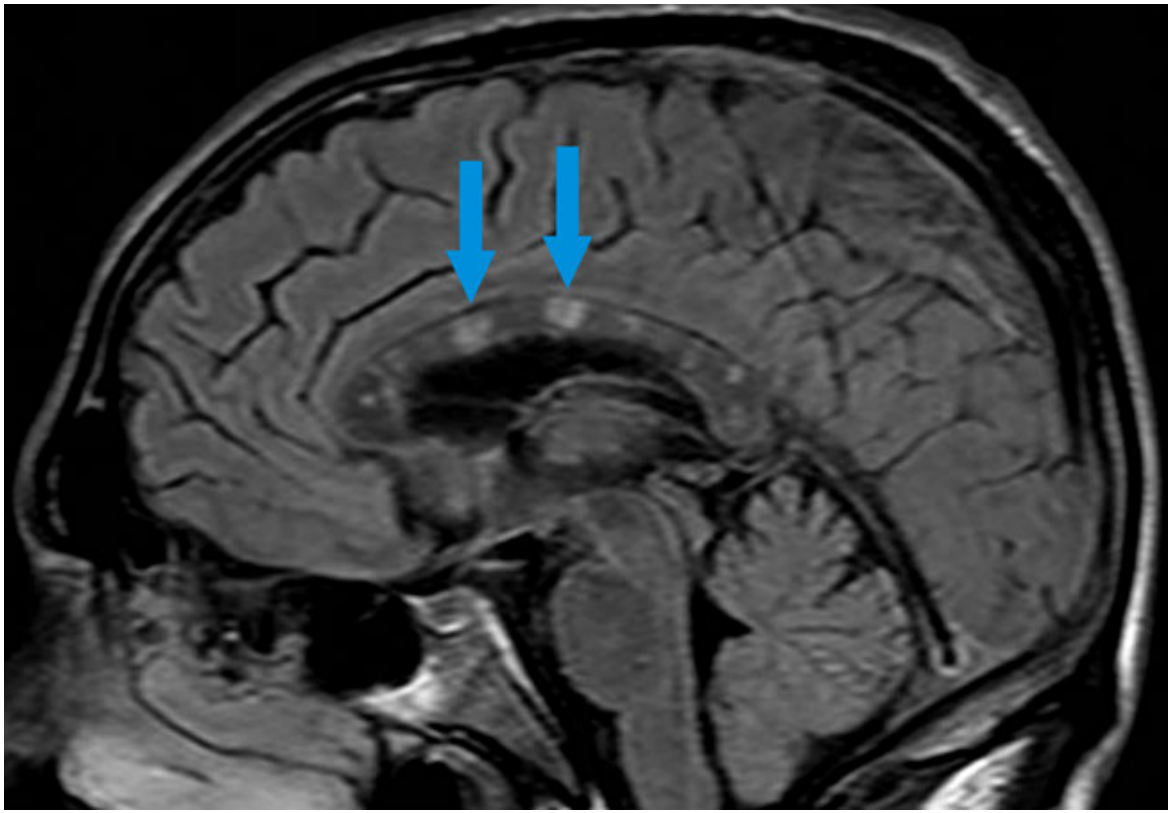
What does MRI brain reveal?
White matter lesions, esp. of the corpus callosum

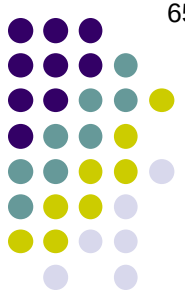
Just BRAO



Susac syndrome: Classic ‘snowball’ lesions of the corpus callosum

Q

Just BRAO



- Which of the following concerning BRAO are true?
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  - About half of cases involve the temporal retina, and half the nasal retina

A

Just BRAO

- Which of the following concerning BRAO are true?
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  - About ~~half~~ 98% of cases involve the temporal retina, and ~~half~~ only 2% the nasal retina **F**

Q

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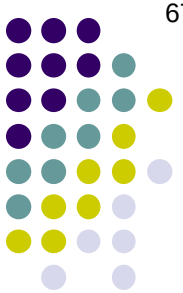

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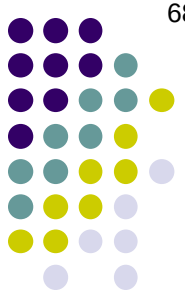

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Q

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Q/A

Just CRAO

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A

Just CRAO

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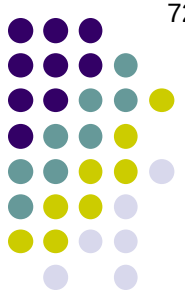
Q

Just CRAO



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What pathologic process is felt to underlie most thrombotic cases?

A

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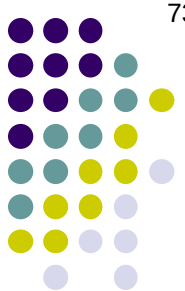

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Q

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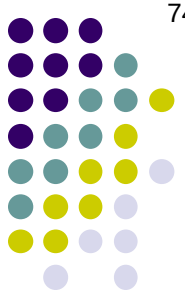

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In such cases, where does the thrombus usually form?

Q/A

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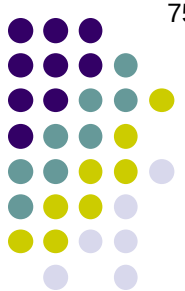

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At the level of the [two words] (same locale as embolic cases)

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Q

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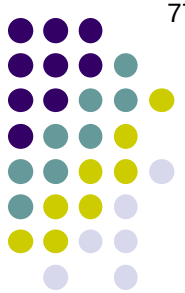

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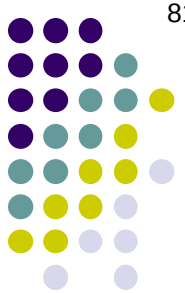
Final vision is 20/400 or so

Q

Just CRAO



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Q/A

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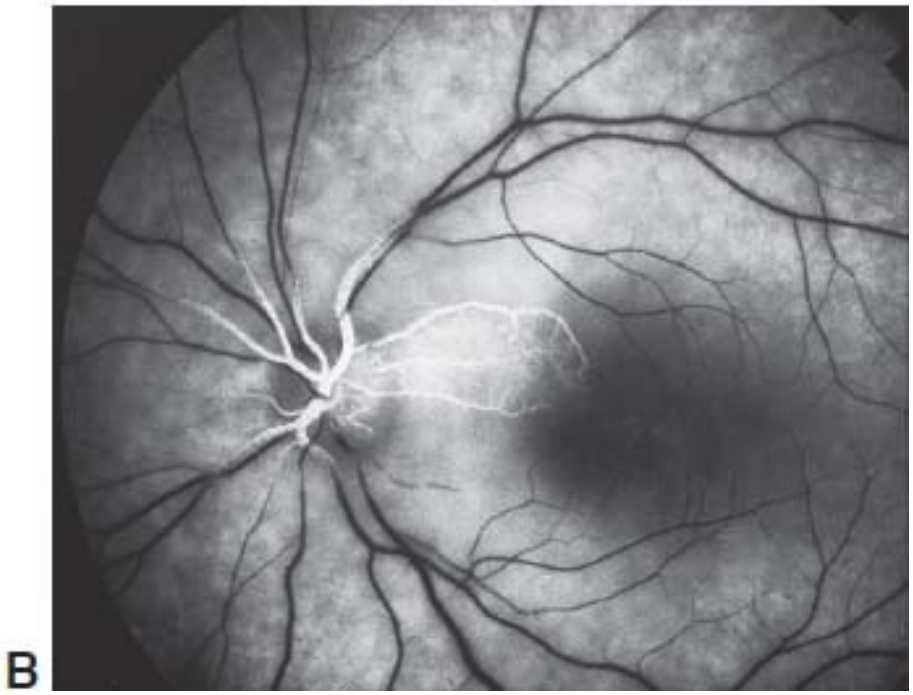

A, CRAO with cilioretinal artery. *B*, FA reveals preservation of a sector of superonasal macula related to cilioretinal vessels.

Q

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An artery that services the retina, but instead of arising from the abb.
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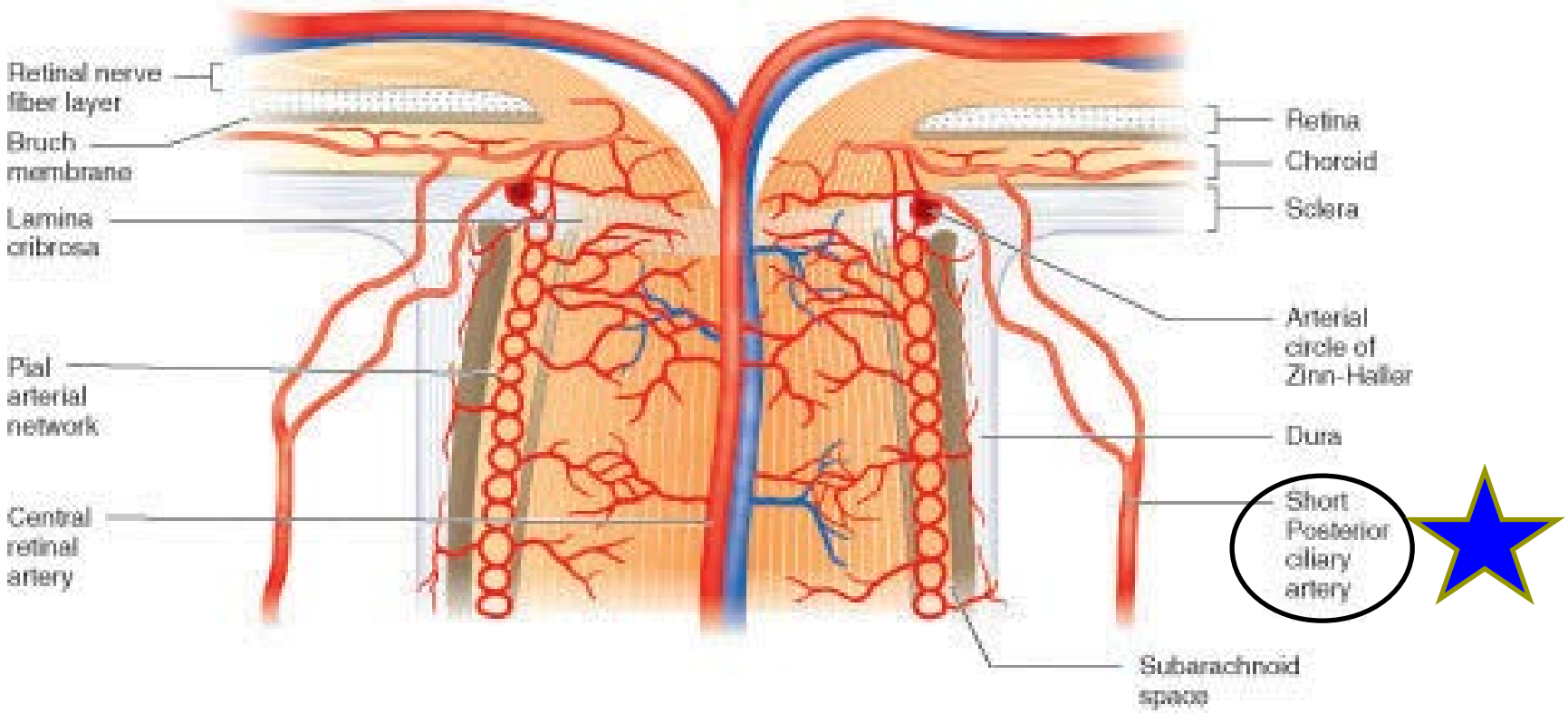

Short posterior ciliary artery

Q

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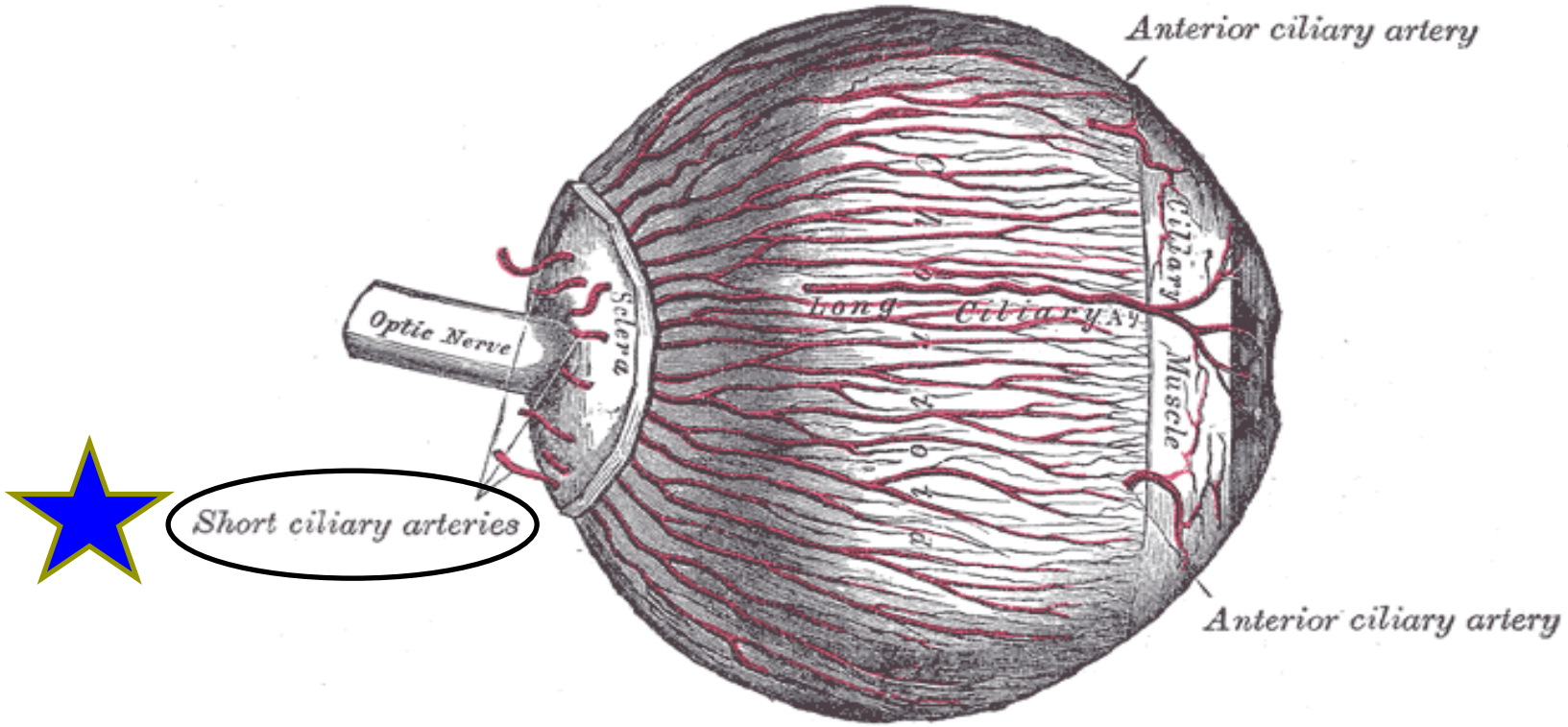

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(giant cell arteritis)

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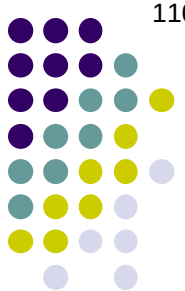
Q

Just CRAO



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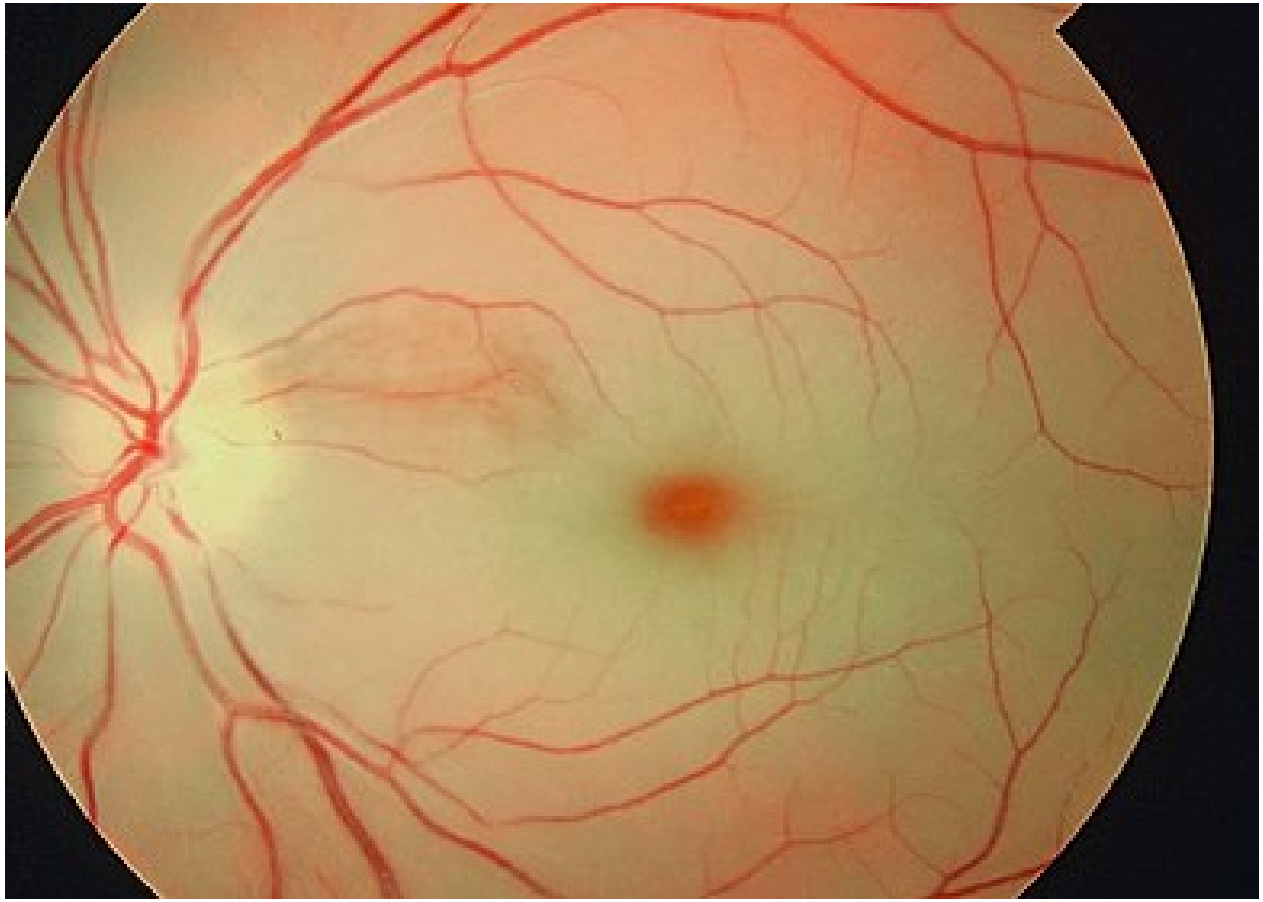
Just CRAO



CRAO: Cherry red spot

Q

Just CRAO

- V
  a
  -
  -
  -
  -
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What causes the foveola to be extra red in a CRAO?

'cherry red spot'

A

Just CRAO

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    Huh? Then what accounts for the cherry red spot appearance?
    The acute hypoxia induced by the CRAO causes the retina to become opaque and edematous—especially in the posterior pole, where the nerve fiber and ganglion cell layers are thickest.
  - The classic description of [illegible] appearance on ophthalmoscopy is ~~*blood and thunder*~~ **F**

'cherry red spot'

A

Just CRAO

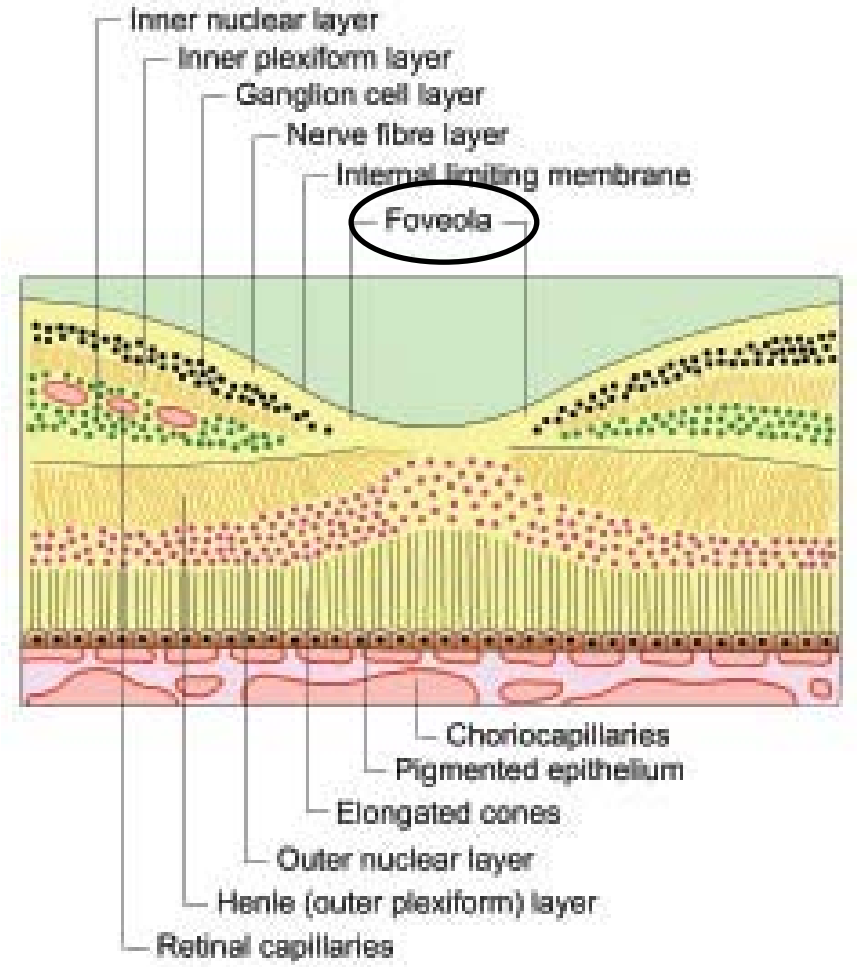
- V
  a
  - The classic description of this appearance on ophthalmoscopy is ~~*blood curdling thunder*~~ **F**

What causes the foveola to be extra red in a CRAO?
Nothing—that is to say, the color of the foveola is **unchanged** in CRAO

Huh? Then what accounts for the cherry red spot appearance?
The acute hypoxia induced by the CRAO causes the retina to become opaque and edematous—especially in the posterior pole, where the nerve fiber and ganglion cell layers are thickest. But recall that the foveola lacks several of the inner retinal layers.

'cherry red spot'

Just CRAO



Foveola

A

Just CRAO

- V
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  - The classic description of this appearance on ophthalmoscopy is ~~*blood and thunder*~~ **F**

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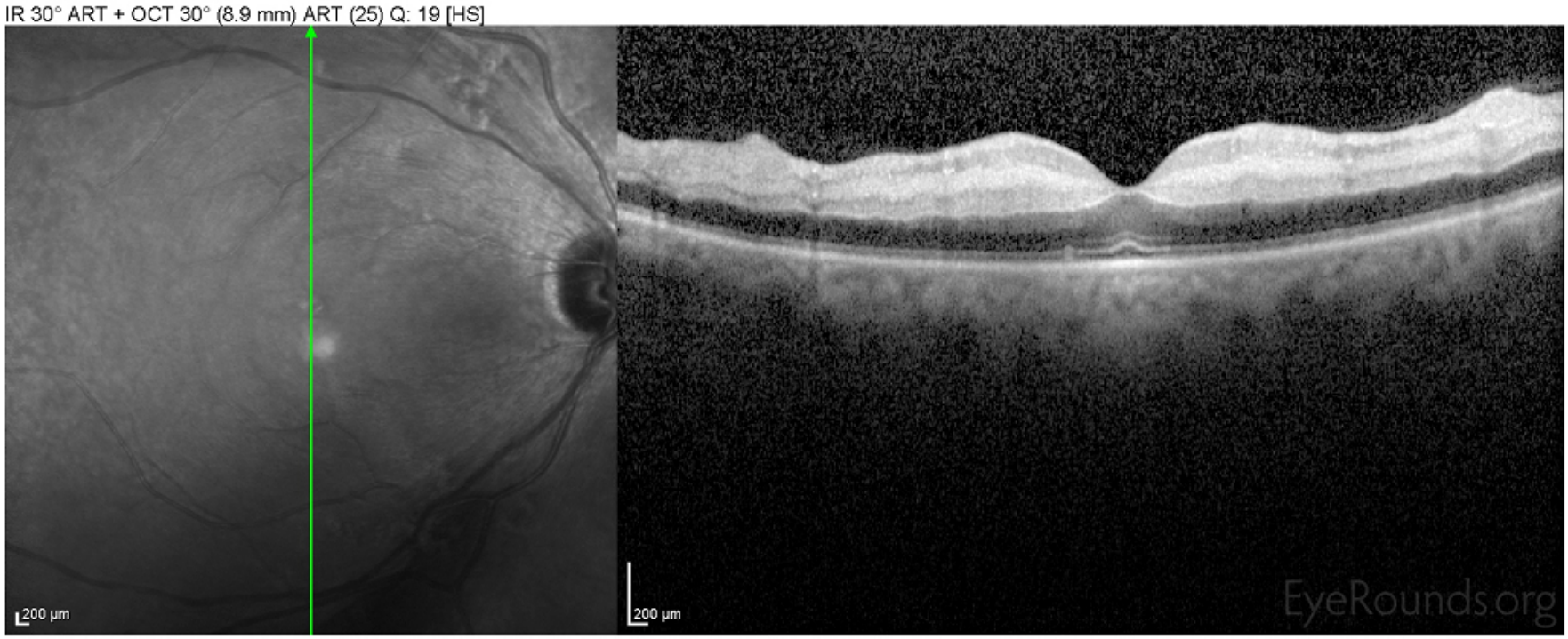
'cherry red spot'

Just CRAO



OCT of a CRAO. Note the severe retinal edema that largely spares the foveolar region

A

Just CRAO

- V
  a
  - *What causes the foveola to be extra red in a CRAO?*
    Nothing—that is to say, the color of the foveola is **unchanged** in CRAO
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'cherry red spot'

Q

Just CRAO

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    Huh? Then what accounts for the cherry red spot appearance?
    The acute hypoxia induced by the CRAO causes the retina to become opaque and
  - edemato on cell
    layers ar layers.
  - This mea foveola,
    and thus
  - So, it's n **whiter**,
    and this
  - The classic description of its appearance on ophthalmoscopy is ~~*blood and thunder*~~ **F**

An important aside: Are all retinal layers equally affected by a CRAO?

'cherry red spot'

Q/A

Just CRAO

- V
  a
  - The acute hypoxia induced by the CRAO causes the retina to become opaque and edemato… on cell layers ar… layers.
  - This mea… foveola, and thus…
  - So, it's n… **whiter**, and this…
  - The classic description of it… earance on ophthalmoscopy is ~~*blood and thunder*~~ **F**

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An important aside: Are all retinal layers equally affected by a CRAO?
No, the inner vs outer layers are much more affected than are the inner vs outer

'cherry red spot'

A

Just CRAO

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on cell
layers.
foveola,
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'cherry red spot'

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No, the inner layers are much more affected than are the outer

Why is this?

'cherry red spot'

A

Just CRAO

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No, the inner layers are much more affected than are the outer

Why is this?
Because of the nature of retinal blood supply

on cell
layers.
foveola,
whiter,

'cherry red spot'

Q

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No, the inner layers are much more affected than are the outer

Why is this?
Because of the nature of retinal blood supply

What does that mean?

'cherry red spot'

A

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An important aside: Are all retinal layers equally affected by a CRAO?
No, the inner layers are much more affected than are the outer

Why is this?
Because of the nature of retinal blood supply

What does that mean?
It means we need a short derail to review the vascular supply of the retina…

'cherry red spot'

Q

Just CRAO

Blood supply

Blood supply

Blood supply

Blood supply

Blood supply

How many blood supplies does the retina receive?

Blood supply

Blood supply

Blood supply

Blood supply

Blood supply

Blood supply

Blood supply

A

Just CRAO

Blood supply

How many blood supplies does the retina receive? Two

Blood supply

Q

Just CRAO

Blood supply:

?

What are the sources of the retina's two blood supplies?

Blood supply:

?

A

Just CRAO

Blood supply:
Central retinal artery

What are the sources of the retina's two blood supplies?

Blood supply:
Choriocapillaris

Q

Just CRAO

- **Retinal Layers**
  - Internal limiting membrane
  - two words layer
  - two words layer
  - two words layer
  - two words layer
  - two words layer (aka…(one word) layer)
  - two words layer
  - External limiting membrane
  - two/words inner and outer segments
- **RPE**
- **Bruch's membrane**

Blood supply:
Central retinal artery

What are the layers of the retina?

Blood supply:
Choriocapillaris

A

Just CRAO

- **Retinal Layers**
  - Internal limiting membrane
  - Nerve fiber layer
  - Ganglion cell layer
  - Inner plexiform layer
  - Inner nuclear layer
  - Outer plexiform layer (Henle's layer)
  - Outer nuclear layer
  - External limiting membrane
  - Rod/cone inner and outer segments
- **RPE**
- **Bruch's membrane**

Blood supply:
Central retinal artery

What are the layers of the retina?

Blood supply:
Choriocapillaris

Q

Just CRAO

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  - Rod/cone inner and outer segments
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- **Bruch's membrane**

Blood supply:
Central retinal artery

Which layers are supplied by each blood supply?

Blood supply:
Choriocapillaris

A

Just CRAO

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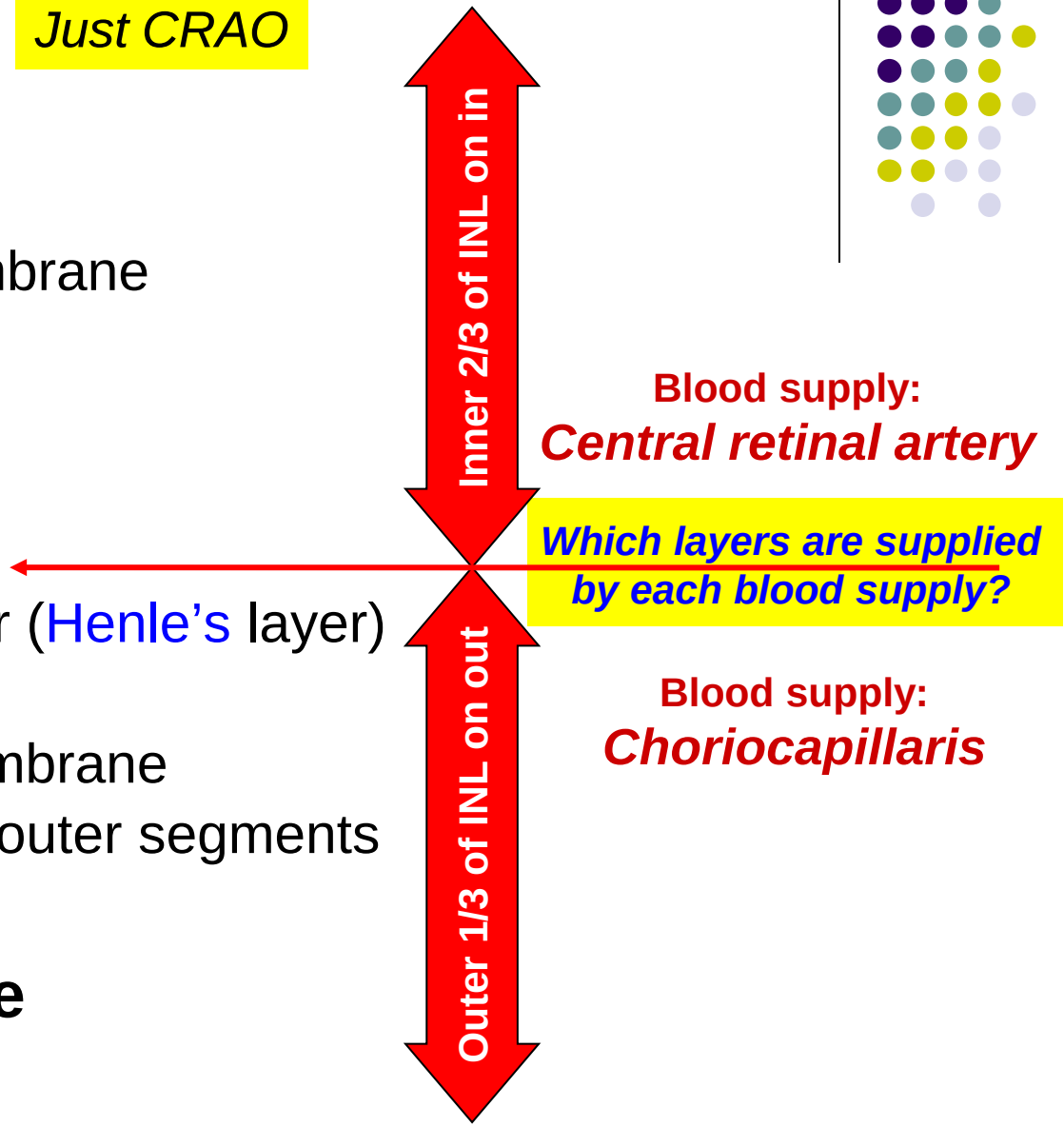

Just CRAO

- **Retinal Layers**
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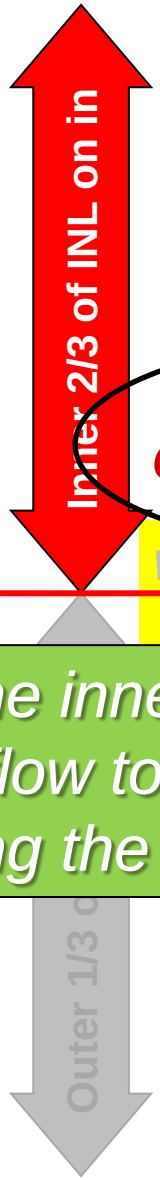
  - [illegible]
  - [illegible]
  - [illegible]
- RPE
- Bruch's membrane



Blood supply:
Central retinal artery

Which layers are supplied by each blood supply?

supply:
capillaris

***This** is why CRAO devastates the inner retina, but not the outer—blood flow to the outer remains largely intact during the event*

Q

Just CRAO

- W[...]
  a[...]

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So, it's not that the foveola is **redder**; rather, it's that the surrounding retina is **whiter**, and this makes the (normal) foveolar reflex *appear* redder by comparison.

- The classic description of its appearance on ophthalmoscopy is *bl*[...]*er* F

'cherry red spot'

A less-important aside: Will a cherry-red spot be present in an **ophthalmic** *artery occlusion?*

A

Just CRAO

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Q

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Why not?

A

Just CRAO

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'cherry red spot'

A less-important aside: Will a cherry-red spot be present in an **ophthalmic** *artery occlusion?*
No

Why not?
Because an ophthalmic artery occlusion also bags the choroidal circulation, which is responsible for the foveolar reflex

Just CRAO

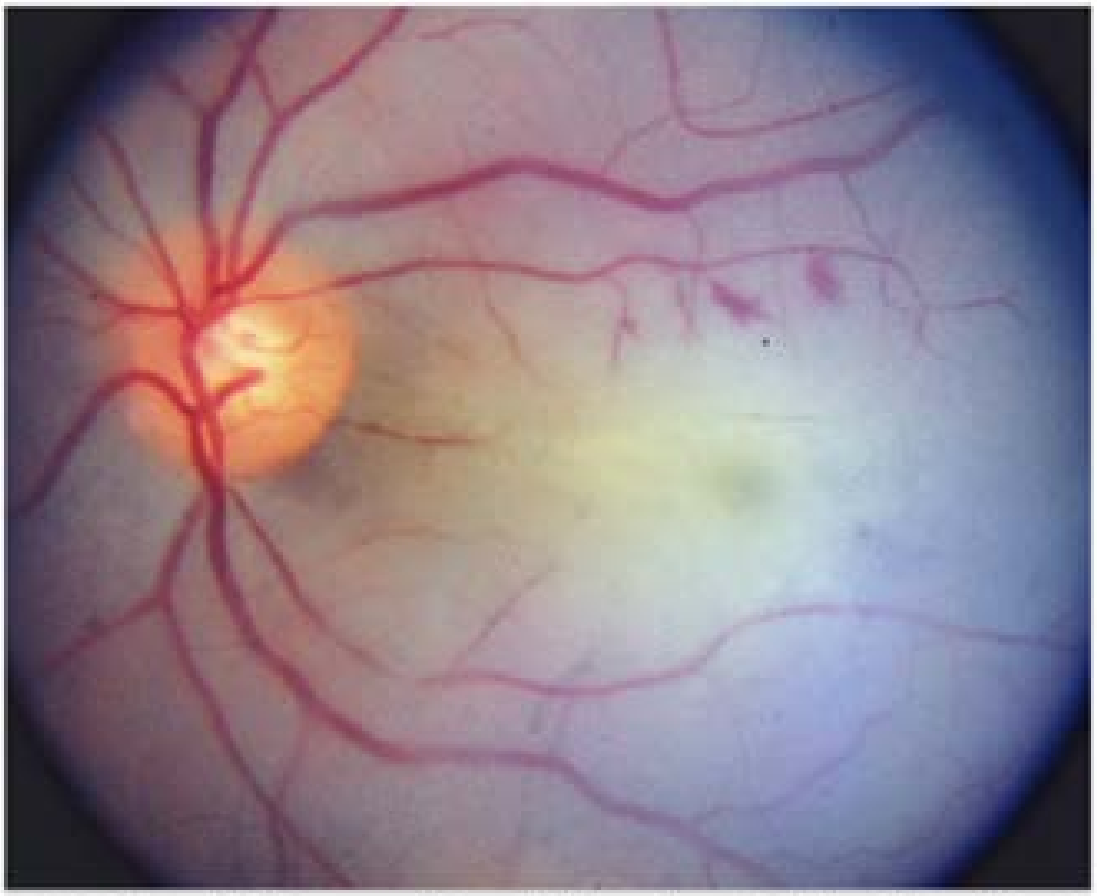

Fig. 7.6 Acute ophthalmic artery occlusion in the left eye. The retina is diffusely pale, and there is no cherry red spot because the choroid is also ischemic. The arteries are very attenuated, and there are a few hemorrhages superiorly.

Acute ophthalmic-artery occlusion

Q

Just CRAO

- Which of the following concerning CRAO are true?
  - The majority of cases are ~~embolic~~ thrombotic (only 20% are embolic) **F**
  - Vision is 20/40+ in ~20% of cases **T**
  - GCA accounts for ~2% of cases **T**
  - NVI develops in ~20% of cases **T**
  - The classic description of its appearance on ophthalmoscopy is *blood and thunder* 'cherry red spot' **F**

An even less-important aside: The appearance of what condition is described with the term blood and thunder*?*

A

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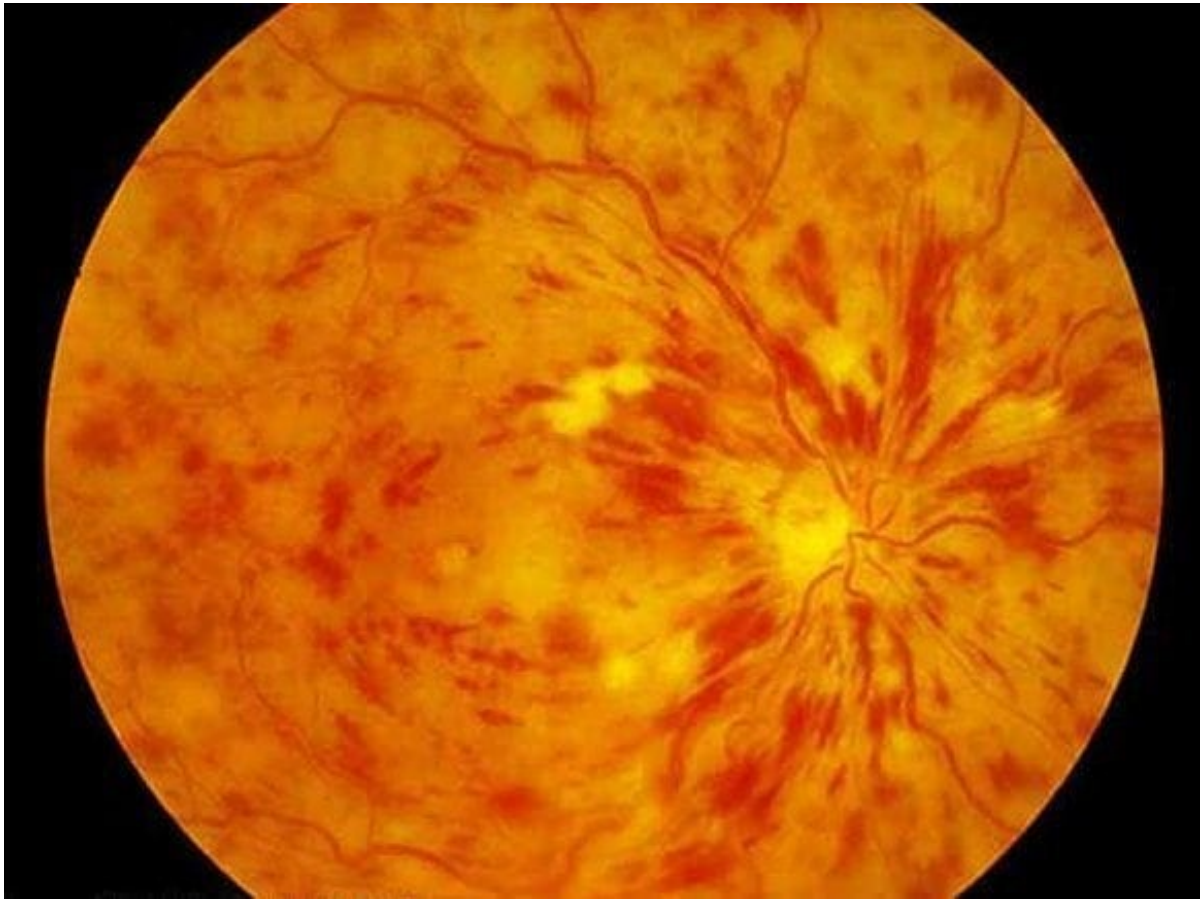
CR**V**O

Just CRAO



CRVO: ‘Blood and thunder’

Q

Just CRAO

CRAO management involves a single overarching goal:

A

Just CRAO

CRAO management involves a single overarching goal: *Cause an embolus (if present) to pass downstream*.

Just CRAO

CRAO management involves a single overarching goal: *Cause an embolus **(if present)** to pass downstream*.

Even though only 20% of CRAO are embolic, these are the only ones for which definitive tx is possible. Thus, for management purposes, it is best to treat all CRAOs as if they're embolic.

Q

Just CRAO

CRAO management involves a single overarching goal: *Cause an embolus (if present) to pass downstream*. Methods for achieving this goal work via one of two mechanisms: _____ or _____

word + abb. ← *Two approaches to getting an embolus to pass:* → **four words**

A

Just CRAO

CRAO management involves a single overarching goal: *Cause an embolus (if present) to pass downstream*. Methods for achieving this goal work via one of two mechanisms: Lowering IOP or dilating the retinal vasculature.

Lower IOP ← *Two approaches to getting an embolus to pass:* → *Dilate the retinal vasculature*

Q

Just CRAO

CRAO management involves a single overarching goal: *Cause an embolus (if present) to pass downstream*. Methods for achieving this goal work via one of two mechanisms: Lowering IOP or dilating the retinal vasculature. Six specific treatments are commonly employed—what are they?

Lower IOP ← *Two approaches to getting an embolus to pass:* → *Dilate the retinal vasculature*

?

?

?

?

?

?

A

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Lower IOP ← *Two approaches to getting an embolus to pass:* → *Dilate the retinal vasculature*

Carbogen

Anterior chamber paracentesis

Diamox

Sublingual nitro

Ocular massage

Glaucoma drops

Q

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CRAO management involves a single overarching goal: *Cause an embolus (if present) to pass downstream*. Methods for achieving this goal work via one of two mechanisms: Lowering IOP or dilating the retinal vasculature. Six specific treatments are commonly employed—what are they? Finally, **divide the treatments into their respective 'prongs.'**

Lower IOP ← *Two approaches to getting an embolus to pass:* → *Dilate the retinal vasculature*

? ← **Carbogen** → ?

(Start with carbogen *and work down the list)*

Anterior chamber paracentesis

Diamox

Sublingual nitro

Ocular massage

Glaucoma drops

A

Just CRAO

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Carbogen

Anterior chamber paracentesis

Diamox

Sublingual nitro

Ocular massage

Glaucoma drops

What is carbogen*?*

A

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Carbogen

Anterior chamber paracentesis

Diamox

Sublingual nitro

Ocular massage

Glaucoma drops

What is carbogen?
An admixture of 95% O_2 and 5% CO_2

Q

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Sublingual nitro

Ocular massage

Glaucoma drops

What is carbogen?
An admixture of 95% O_2 and 5% CO_2

How does it dilate the retinal vasculature?

A

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Carbogen

Anterior chamber paracentesis

Diamox

Sublingual nitro

Ocular massage

Glaucoma drops

What is carbogen?
An admixture of 95% O_2 and 5% CO_2

How does it dilate the retinal vasculature?
Retinal arterioles are CNS vessels—they dilate in response to increased $PaCO_2$

Q

Just CRAO

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Lower IOP ← *Two approaches to getting an embolus to pass:* → *Dilate the retinal vasculature*

Carbogen

/hat is carbogen?

n a

I'm fresh out of carbogen. Is there a way to MacGyver some?

ow

etinal arterioles are CNS vessels—they dilate
response to increased $PaCO_2$

Glaucoma drops

A

Just CRAO

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Carbogen

/hat is carbogen?

n a

I'm fresh out of carbogen. Is there a way to MacGyver some?

ow

Have the patient breathe into a paper bag

etinal arterioles are CNS vessels—they dilate
response to increased $PaCO_2$

Glaucoma drops

Q

Just CRAO

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Lower IOP ← *Two approaches to getting an embolus to pass:* → *Dilate the retinal vasculature*

Carbogen

? ← **Anterior chamber paracentesis** → ?

Diamox

Sublingual nitro

Ocular massage

Glaucoma drops

Q/A

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Carbogen

Anterior chamber paracentesis

? ← **Diamox** → ?

Sublingual nitro

Ocular massage

Glaucoma drops

Q/A

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Lower IOP ← *Two approaches to getting an embolus to pass:* → *Dilate the retinal vasculature*

Carbogen

Anterior chamber paracentesis

Diamox

? ← **Sublingual nitro** → ***?***

Ocular massage

Glaucoma drops

Q/A

Just CRAO

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Lower IOP ← *Two approaches to getting an embolus to pass:* → *Dilate the retinal vasculature*

Carbogen

Anterior chamber paracentesis

Diamox

Sublingual nitro

? ← **Ocular massage** → **?**

Glaucoma drops

Q/A

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Diamox

Sublingual nitro

Ocular massage

? ← **Glaucoma drops** → ?

A

Just CRAO

CRAO management involves a single overarching goal: *Cause an embolus (if present) to pass downstream*. Methods for achieving this goal work via one of two mechanisms: Lowering IOP or dilating the retinal vasculature. Six specific treatments are commonly employed—what are they? Finally, **divide the treatments into their respective 'prongs.'**

Lower IOP ← *Two approaches to getting an embolus to pass:* → *Dilate the retinal vasculature*

Carbogen

Anterior chamber paracentesis

Diamox

Sublingual nitro

Ocular massage

Glaucoma drops

Q

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?

Carbogen

Anterior chamber paracentesis

Diamox

Hol up—this section fails to mention the tx modality of [redacted]

Oc
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Glaucoma drops

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Thrombolysis

Carbogen

Anterior chamber paracentesis

Diamox

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Oc
mas

Glaucoma drops

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Anterior chamber paracentesis

Diamox

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Glaucoma drops

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Hol up—this section fails to mention the tx modality of thrombolysis, with its three specific treatments of ? , ? , and ? .

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Thrombolysis

Carbogen

Anterior chamber paracentesis

--tPA
--Intra-arterial thrombolysis
--Transvitreal thrombolysis

Diamox

Hol up—this section fails to mention the tx modality of thrombolysis, with its three specific treatments of tPA, intra-arterial thrombolysis, and trans-vitreal thrombolysis.

Oc
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Hol up—this section fails to mention the tx modality of thrombolysis, with its three specific treatments of tPA, intra-arterial thrombolysis, and trans-vitreal thrombolysis. Why aren't these covered here?
Because at present they are not recommended by the AAO in its *Preferred Practice Guidelines*

Q

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What is the timeframe of CRAO treatment?

Anterior
parac

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Carbogen

Sublingual nitro

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Carbogen

Anterior chamber paracentesis

Dia

Sublingual nitro

Ocular massage

Glaucoma drops

What is the timeframe of CRAO treatment?

Primate studies indicate that retinal cells undergo irreversible ischemic damage within 90 minutes of CRA ligature—a dauntingly small window of opportunity for treatment.

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Sublingual nitro

Ocular massage

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Primate studies indicate that retinal cells undergo irreversible ischemic damage within 90 minutes of CRA ligature—a dauntingly small window of opportunity for treatment. However, as many CRAO are felt to be incomplete, and as hope springs eternal in the human breast, most clinicians will treat up to 24^{o} after onset.

Q

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Anterior paracentesis

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Glaucoma drops

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What other management step must be taken?

Q/A

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What other management step must be taken?
The pt should be referred immediately to a stroke center if the event is acute, ie, if s/he has been symptomatic for amount of time

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Is this true for BRAO as well?

A

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Dia

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Anterior chamber paracentesis

Diamox

Ocular massage

Glaucoma drops

Carbogen

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C
h

What other management step must be taken?
The pt should be referred immediately to a stroke center if the event is acute, ie, if s/he has been symptomatic for >24 hrs

Is this true for BRAO as well?
Yes

What if it's been longer than 24 hrs?

Q/A

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Anterior
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Glaucoma
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Is this true for BRAO as well?
Yes

What if it's been longer than 24 hrs?
They should be referred urgently, ie, they need to be stroke-evaluated within amount of time

A

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C
h

What other management step must be taken?
The pt should be referred immediately to a stroke center if the event is acute, ie, if s/he has been symptomatic for >24 hrs

Is this true for BRAO as well?
Yes

What if it's been longer than 24 hrs?
They should be referred urgently, ie, they need to be stroke-evaluated within 1 week