Q

Glaucoma After Intraocular Bleed

Glaucoma 2ndry to hyphema

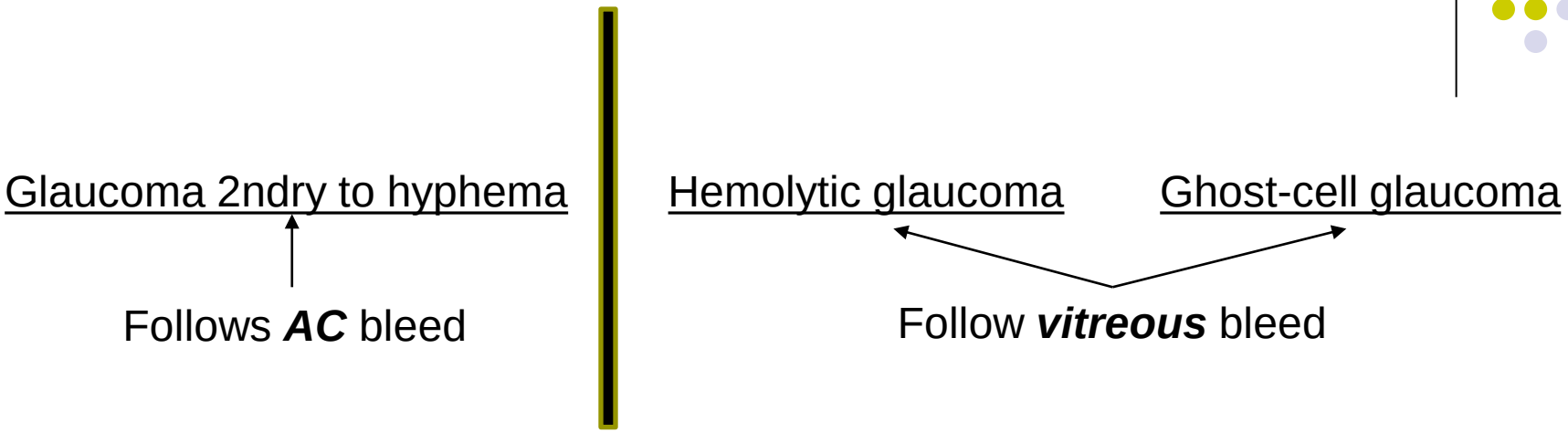
Hemolytic glaucoma

Ghost-cell glaucoma

One of these things is not like the others. Which two belong together, which one stands alone, and why?

A

Glaucoma After Intraocular Bleed



One of these things is not like the others. Which two belong together, which one stands alone, and why?

Glaucoma After Intraocular Bleed

Glaucoma 2ndry to hyphema

Follows ***AC*** bleed

Hyphema is covered in its own slide-set (FELT12)

Hemolytic glaucoma

Ghost-cell glaucoma

Follow ***vitreous*** bleed

Glaucoma After Intraocular Bleed

Glaucoma 2ndry to hyphema

Follows ***AC*** bleed

Hemolytic glaucoma **Ghost-cell glaucoma**

Follow ***vitreous*** bleed

The remainder of this set will focus on **hemolytic-** *and* **ghost-cell glaucoma**

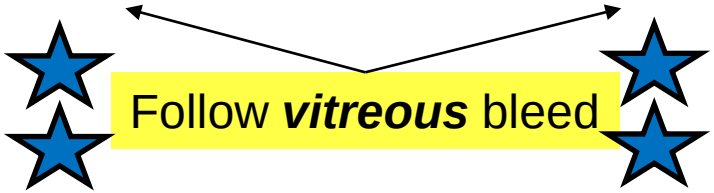
Glaucoma After Intraocular Bleed

Glaucoma 2ndry to hyphema

↑

Follows ***AC*** bleed

Hemolytic glaucoma **Ghost-cell glaucoma**



Follow ***vitreous*** bleed

THIS IS IMPORTANT! Take a moment to file a mental note before proceeding:
Hemolytic- and ghost-cell glaucoma follow a ***vitreous*** bleed, not an ***AC*** bleed!

Q

Glaucoma After Intraocular Bleed

Glaucoma 2ndry to hyphema

↑

Follows ***AC*** bleed

Hemolytic glaucoma **Ghost-cell glaucoma**

Follow ***vitreous*** bleed

What causes of vitreous hemorrhage are involved?

A

Glaucoma After Intraocular Bleed

Glaucoma 2ndry to hyphema

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Follows ***AC*** bleed

Hemolytic glaucoma **Ghost-cell glaucoma**

Follow ***vitreous*** bleed

What causes of vitreous hemorrhage are involved?
The usual suspects—PDR, CRVO, etc, as well as trauma

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Glaucoma After Intraocular Bleed

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Follows ***AC*** bleed

Hemolytic glaucoma **Ghost-cell glaucoma**

Follow ***vitreous*** bleed

What causes of vitreous hemorrhage are involved?
The usual suspects—PDR, CRVO, etc, as well as trauma

How does the blood get from the vitreous cavity to the AC?

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Glaucoma After Intraocular Bleed

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Hemolytic glaucoma **Ghost-cell glaucoma**

Follow ***vitreous*** bleed

What causes of vitreous hemorrhage are involved?
The usual suspects—PDR, CRVO, etc, as well as trauma

How does the blood get from the vitreous cavity to the AC?
It can occur spontaneously, but more commonly there's a hx of anterior hyaloid face disruption from trauma or surgery (eg, cataract; PPV) that provides a ready pathway for cells to reach the AC

Q

Glaucoma After Intraocular Bleed

Glaucoma 2ndry to hyphema

↑

Follows ***AC*** bleed

Hemolytic glaucoma

↓

?

Ghost-cell glaucoma

↓

?

In a nutshell, what is the mechanism underlying both hemolytic and ghost-cell glaucomas?

A

Glaucoma After Intraocular Bleed

Glaucoma 2ndry to hyphema

↑

Follows ***AC*** bleed

Hemolytic glaucoma → TM clogged

Ghost-cell glaucoma → TM clogged

In a nutshell, what is the mechanism underlying both hemolytic and ghost-cell glaucomas?
TM clogging→impeded aqueous outflow→increased IOP

Q

Glaucoma After Intraocular Bleed

Glaucoma 2ndry to hyphema

↑

Follows ***AC*** bleed

Hemolytic glaucoma

↓

TM clogged with…

?

Ghost-cell glaucoma

↓

TM clogged with…

?

In each condition, what is clogging the TM?
--Hemolytic glaucoma: ***?***
--Ghost-cell glaucoma: ***?***

A

Glaucoma After Intraocular Bleed

Glaucoma 2ndry to hyphema

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Follows ***AC*** bleed

Hemolytic glaucoma

↓

TM clogged with…

Hgb-laden macrophages

Ghost-cell glaucoma

↓

TM clogged with…

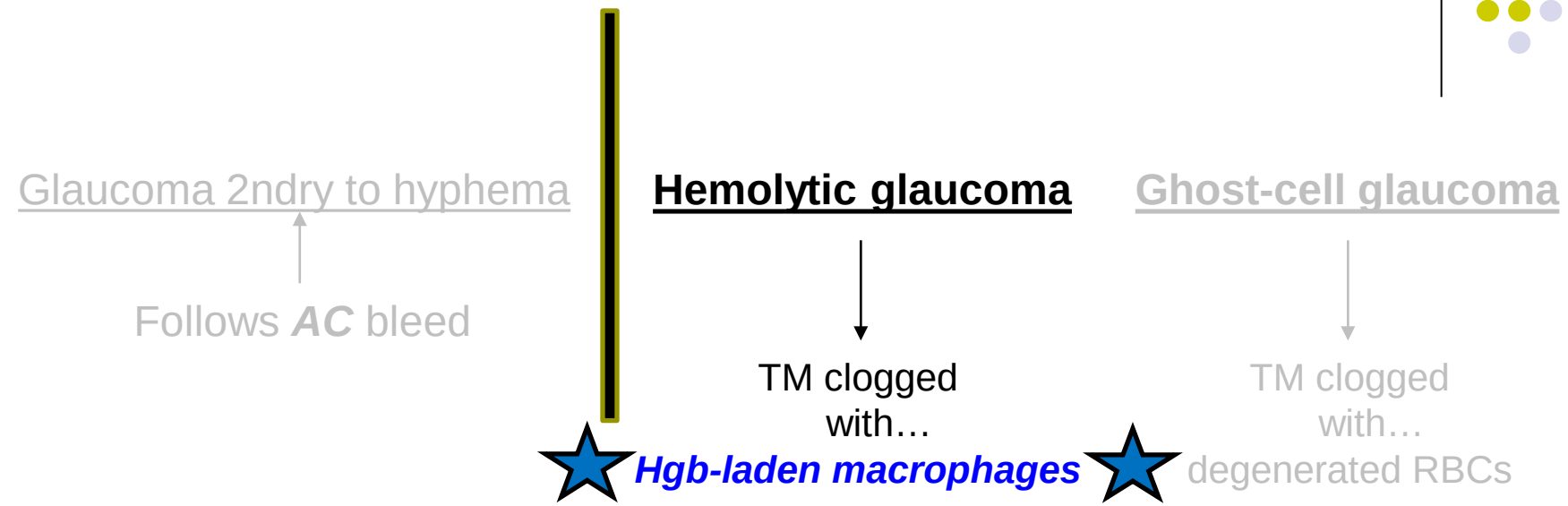
degenerated RBCs

In each condition, what is clogging the TM?

--Hemolytic glaucoma: Hgb-laden macrophages

--Ghost-cell glaucoma: Degenerated RBCs

Glaucoma After Intraocular Bleed



Make another mental note: While ghost-cell glaucoma involves RBCs as would be expected in a hemorrhage-related condition, in hemolytic glaucoma the culprit is **not** RBCs—it's ***macrophages***

Q

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What's up with the macrophages? How do they figure in all this?

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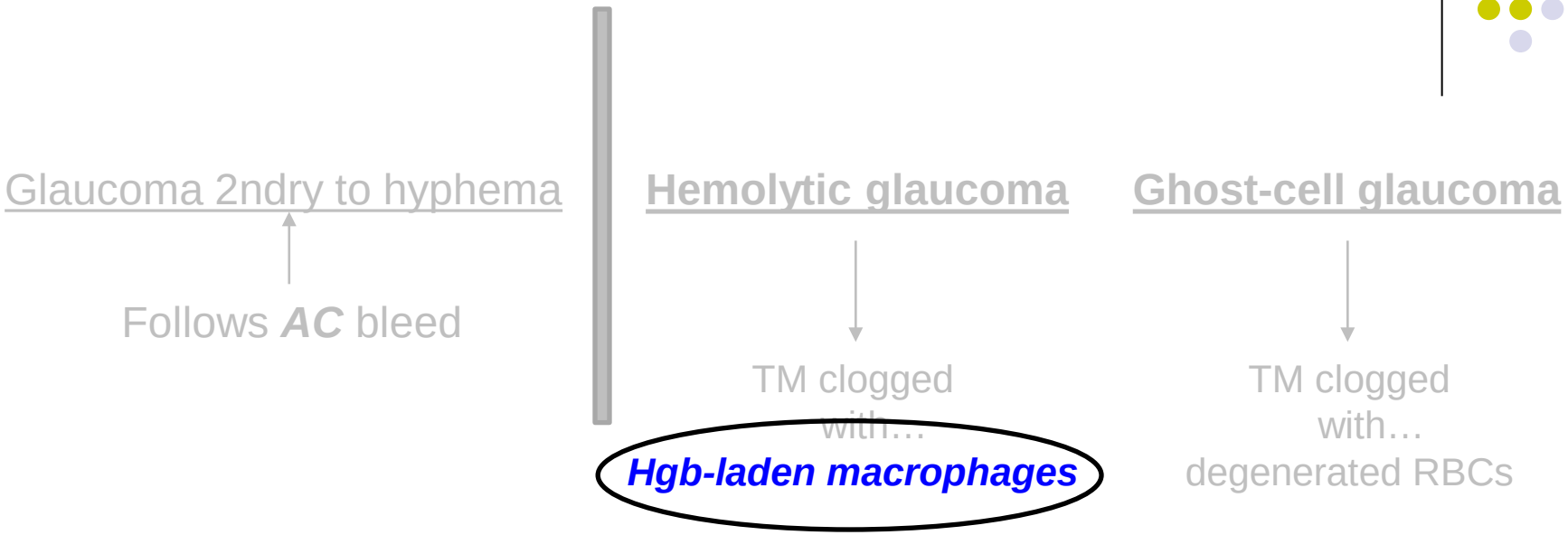
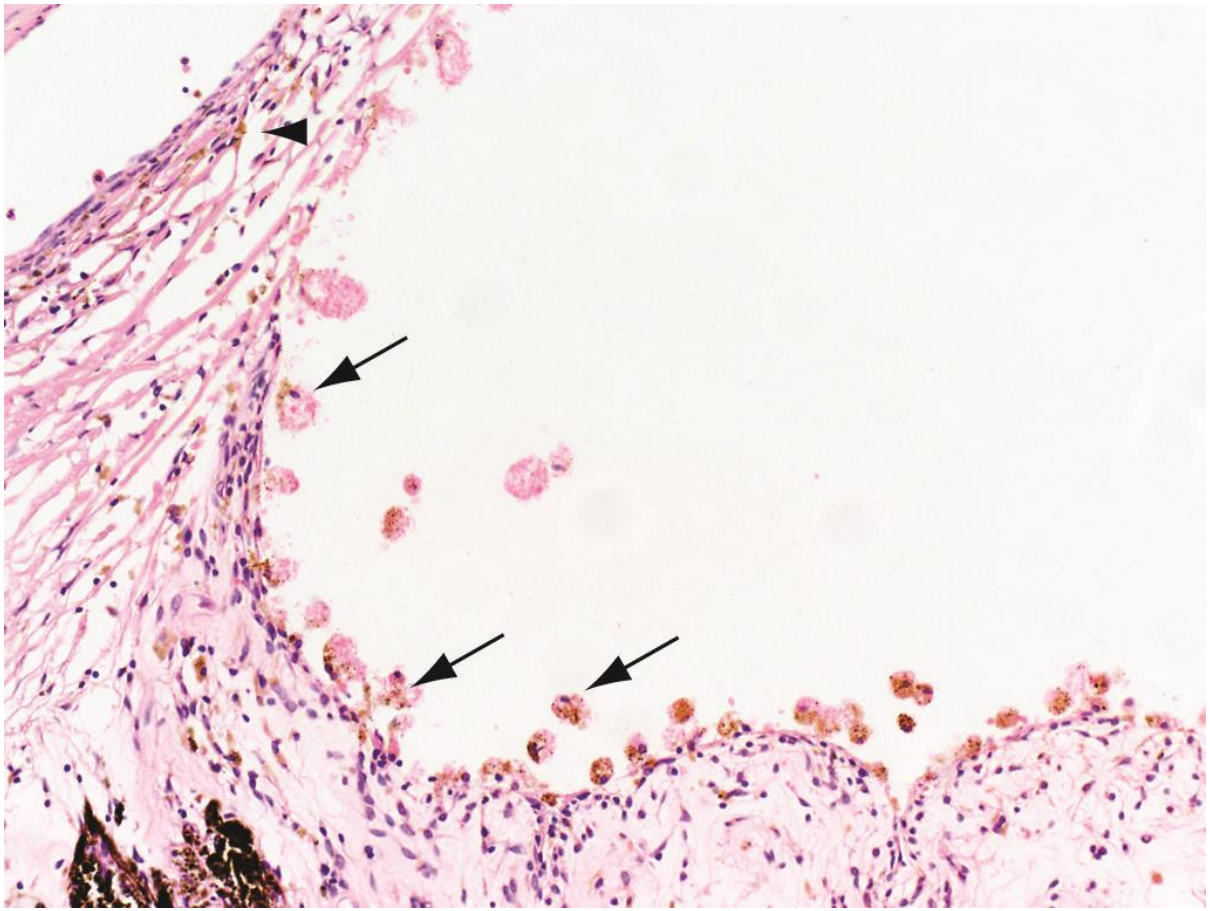


What's up with the macrophages? How do they figure in all this?

RBCs in a vitreous hemorrhage start to break down after a week or two. The degeneration of these cells attracts macrophages, which consume both the effete RBCs as well as the hemoglobin-related material they release. Heavy-laden with globules of degenerated Hgb and other RBC detritus, these macrophages end up in the AC, and ultimately the angle.

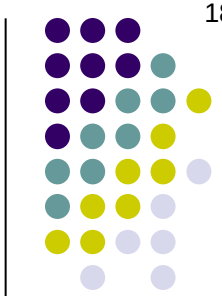
Glaucoma After Intraocular Bleed



Hemolytic glaucoma. The anterior chamber angle contains macrophages with erythrocytic debris and rust-colored intracytoplasmic material (arrows).

Q

Glaucoma After Intraocular Bleed



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'Globules of degenerated Hgb' are known by what eponymous name?

globules of degenerated Hgb

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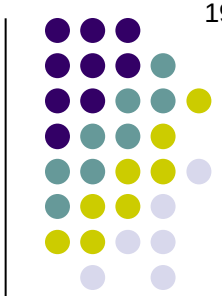
Glaucoma After Intraocular Bleed



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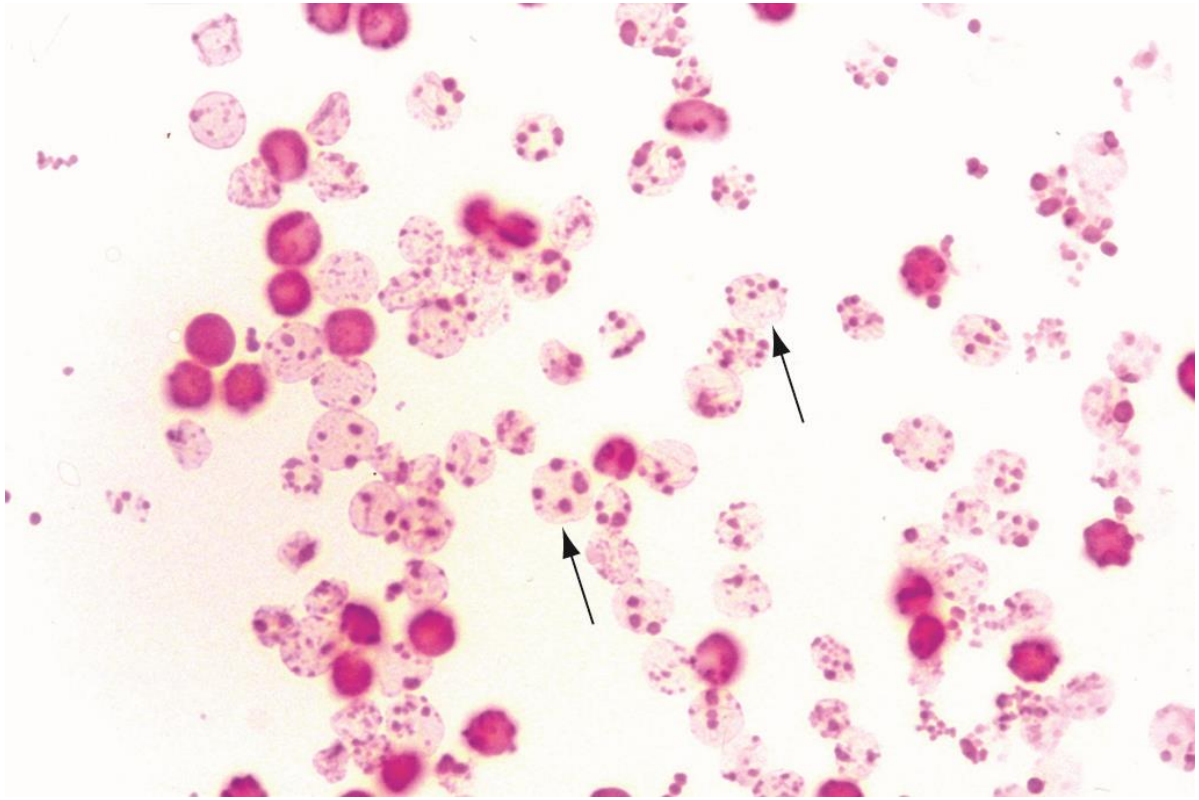
Heinz bodies

globules of degenerated Hgb

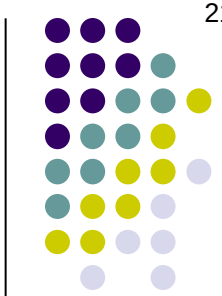
Glaucoma After Intraocular Bleed



Hemolytic glaucoma. The degenerating hemoglobin is present as small globules known as Heinz bodies (arrows).

Q

Glaucoma After Intraocular Bleed



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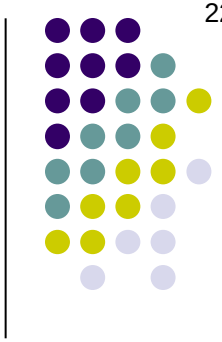
Heinz bodies

'Heinz bodies'? *Bruh, the BCSC* Glaucoma *book does* **not** *mention Heinz bodies. Why are you including details we don't need to know?*

A

Glaucoma After Intraocular Bleed



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I wouldn't do you like that bruh—the *Pathology* book mentions Heinz bodies in *its* discussion of hemolytic- and ghost-cell glaucoma, so it's fair game for the OKAP

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'Macrophages clogging the TM' should bring to mind another form of 2ndry OAG—what is it?

The degeneration
Cs as well as the
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Phacolytic glaucoma

In phacolytic glaucoma, the macrophages are not heavy-laden with Hgb. Instead, with what substance are they laden?

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Denatured lens protein ***-laden macrophages***

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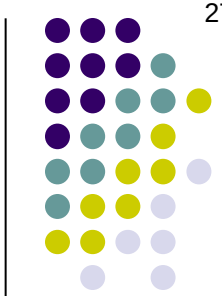

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What is the basic pathologic process in phacolytic glaucoma?

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Ghost-cell glaucoma

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TM clogged with…

degenerated RBCs

What is the basic pathologic process in phacolytic glaucoma?
A mature or (more commonly) hypermature cataract leaches denatured lens proteins through its lens capsule. The proteins attract macrophages, which attempt to clear the protein from the AC. The protein-laden macrophages (and the protein) are swept into the angle, where they clog the TM and cause an IOP spike.

What's up with the m

'Macrophages clogging t

2ndry OAG—what is it?

Phacolytic glaucoma

In phacolytic glaucoma, Instead, with what substance are they laden?
Denatured lens proteins

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Follows ***AC*** bleed	TM clogged with…	TM clogged with…
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Denatured lens proteins

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Phaco

*'Lens proteins inducing a 2ndry OAG'—isn't that phaco***antigenic** *glaucoma?*

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Glaucoma After Intraocular Bleed

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Follows ***AC*** bleed	TM clogged with…	TM clogged with…
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Instead, with what substance are they laden?

Denatured lens proteins

*'Lens proteins inducing a 2ndry OAG'—isn't that phaco***antigenic** *glaucoma?*
No. Phacoantigenic glaucoma is a rare condition in which the appearance of *normal* (ie, not denatured) lens proteins in the AC after a breach in the anterior capsule (either traumatic or surgical) provokes a granulomatous immune response.

neration

as the

ated Hgb

ngle.

I wouldn't do you like that brah—the *Pathology* book mentions Heinz bodies in *its* discussion of hemolytic- and ghost-cell glaucoma, so it's fair game for the OKAP

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Denatured lens proteins

What is the basic pathologic process in phacolytic glaucoma?

*'Lens proteins inducing a 2ndry OAG'—isn't that phaco***antigenic** *glaucoma?*

Take note of these characteristics, as they are key to differentiating between phacolytic- and phacoantigenic glaucoma! To reiterate:
--Phacoantigenic glaucoma is a *granulomatous* condition, whereas phacolytic is *not*; and

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Glaucoma After Intraocular Bleed

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Denatured lens proteins

Hemolytic glaucoma

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--Phacoantigenic glaucoma is a *granulomatous* condition, whereas phacolytic is *not*; and
--the capsule is *violated* in phacoantigenic glaucoma, whereas it is *intact* in phacolytic

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Glaucoma After Intraocular Bleed

Glaucoma 2ndry to hyphema

Hemolytic glaucom

ell glaucoma

TM clogged with…

Hgb-laden macrophage

l clogged with…

erated RBCs

Phacolytic through intact capsule

Phacoantigenic not intact capsule

*This is how I remember that the capsule is intact in phacolytic glaucoma, but **not** in phacoantigenic glaucoma*

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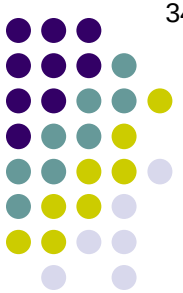

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Degenerated RBCs pose a special problem for the TM--why?

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Degenerated RBCs pose a special problem for the TM--why?
Healthy RBCs are very pliable, and gloop through the TM fairly easily. In contrast, degenerated RBCs become spherical and stiff, and do not pass easily through it; instead, they pile up in and clog the angle, preventing aqueous egress.

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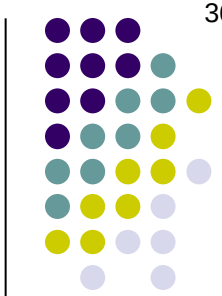
Glaucoma After Intraocular Bleed



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'RBCs that do not pass easily through the TM'—what other clinical scenario does that sound like?

Q/A

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Hyphema in a sickle-cell pt. Recall that the relatively basic v acidic nature of aqueous promotes RBC sickling. Sickled RBCs are significantly stiffer, and thus unable to pass easily through the TM.

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TM clogged with…

Hgb-laden macrophages

↓

(Classic clinical description)

Ghost-cell glaucoma

↓

TM clogged with…

degenerated RBCs

↓

(Classic clinical description)

What does examination of the AC reveal?

Q/A

Glaucoma After Intraocular Bleed

Glaucoma 2ndry to hyphema

↑

Follows ***AC*** bleed

Hemolytic glaucoma

↓

TM clogged with…

Hgb-laden macrophages

↓

color ***cells in AC***

Ghost-cell glaucoma

↓

TM clogged with…

degenerated RBCs

↓

color ***cells in AC***

What does examination of the AC reveal?

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Glaucoma After Intraocular Bleed

Glaucoma 2ndry to hyphema

↑

Follows ***AC*** bleed

Hemolytic glaucoma

↓

TM clogged with…

Hgb-laden macrophages

↓

***Red-tinged* cells in AC**

Ghost-cell glaucoma

↓

TM clogged with…

degenerated RBCs

↓

***Tan-colored* cells in AC**

What does examination of the AC reveal?

Q

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↓

TM clogged with…
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↓

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↓

TM clogged with…
degenerated RBCs

↓

Tan-colored cells in AC

Would these 'red-tinged cells' be Hgb-laden macrophages?

A

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Hemolytic glaucoma

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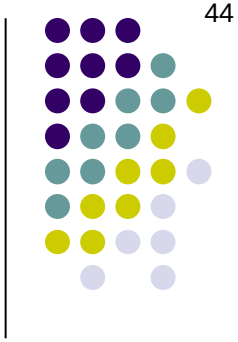
Tan-colored cells in AC

Would these 'red-tinged cells' be Hgb-laden macrophages?
Indeed they would

Q

Glaucoma After Intraocular Bleed



Glaucoma 2ndry to hyphema

↑

Follows ***AC*** bleed

Hemolytic glaucoma

↓

TM clogged with…
Hgb-laden macrophages

↓

Red-tinged cells in AC

Ghost-cell glaucoma

↓

TM clogged with…
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***Tan-colored* cells in AC**

Would these 'tan-colored cells' be the ghost cells after which the condition was named?

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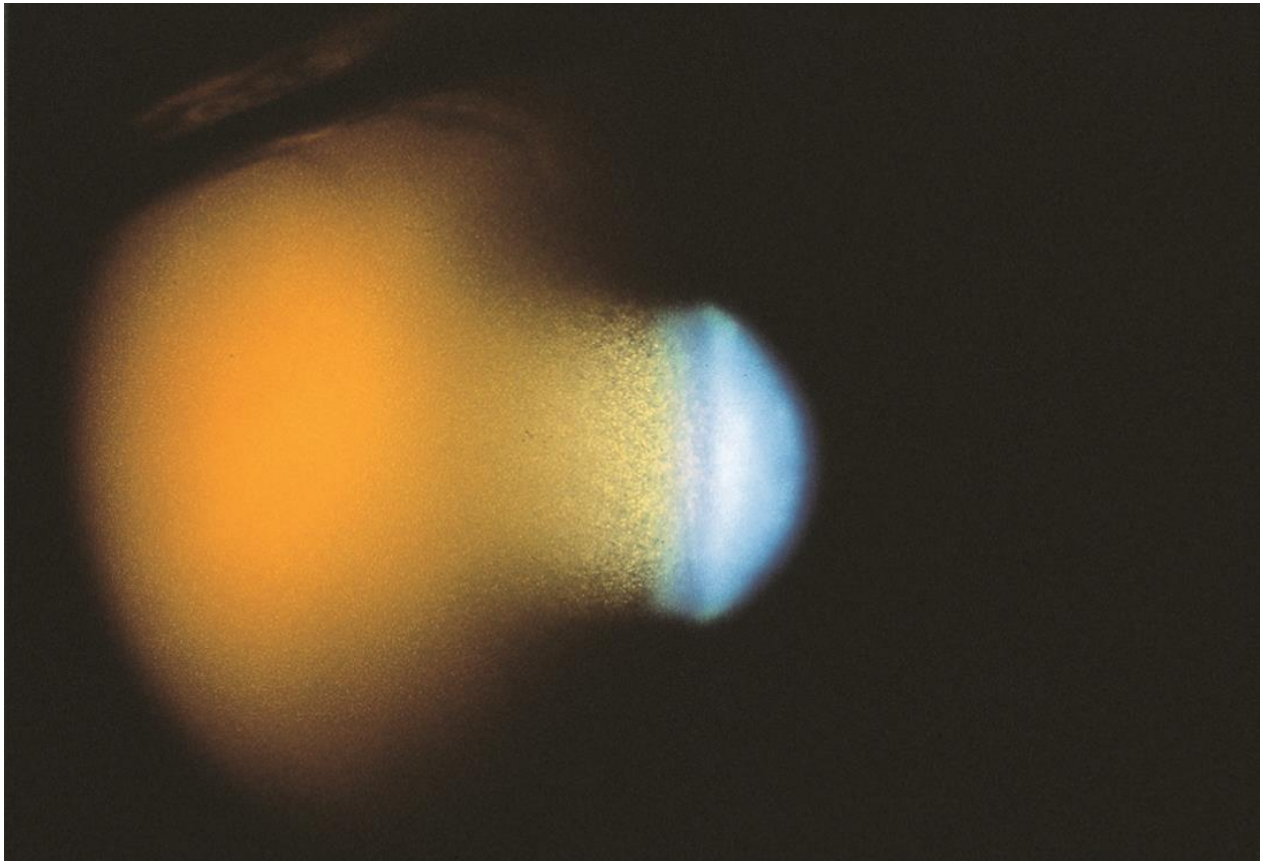
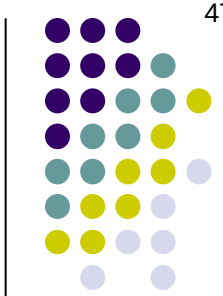


Ghost-cell glaucoma. Copious tan-colored cells in the AC.

Q

Glaucoma After Intraocular Bleed



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What's the origin story of the ghost cells?
They are RBCs from the vitreous bleed that have lost their hemoglobin

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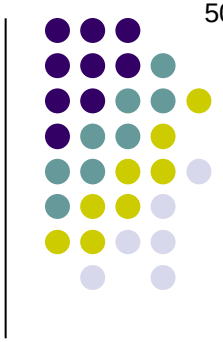

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Would these 'tan-colored cells' be the ghost cells after which the condition was named?
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How long does it take for RBCs to turn into ghost cells?
1-3 months

What's the origin story of the ghost cells?
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(Classic clinical description)

What does examination of the vitreous cavity reveal?

Q/A

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color ***hemorrhage in the vitreous***

What does examination of the vitreous cavity reveal?

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***Khaki-colored* hemorrhage in the vitreous**

What does examination of the vitreous cavity reveal?

Q

Glaucoma After Intraocular Bleed

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Hemolytic glaucoma

Ghost-cell glaucoma

Do hemolytic- and ghost-cell glaucoma resolve spontaneously?

Khaki-colored hemorrhage in the vitreous

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Usually, once the instigating vitreous hemorrhage has cleared

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With aqueous suppressants if possible

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AC washout

And if the AC washout fails?

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In the interim, how should the IOP be managed?
With aqueous suppressants if possible

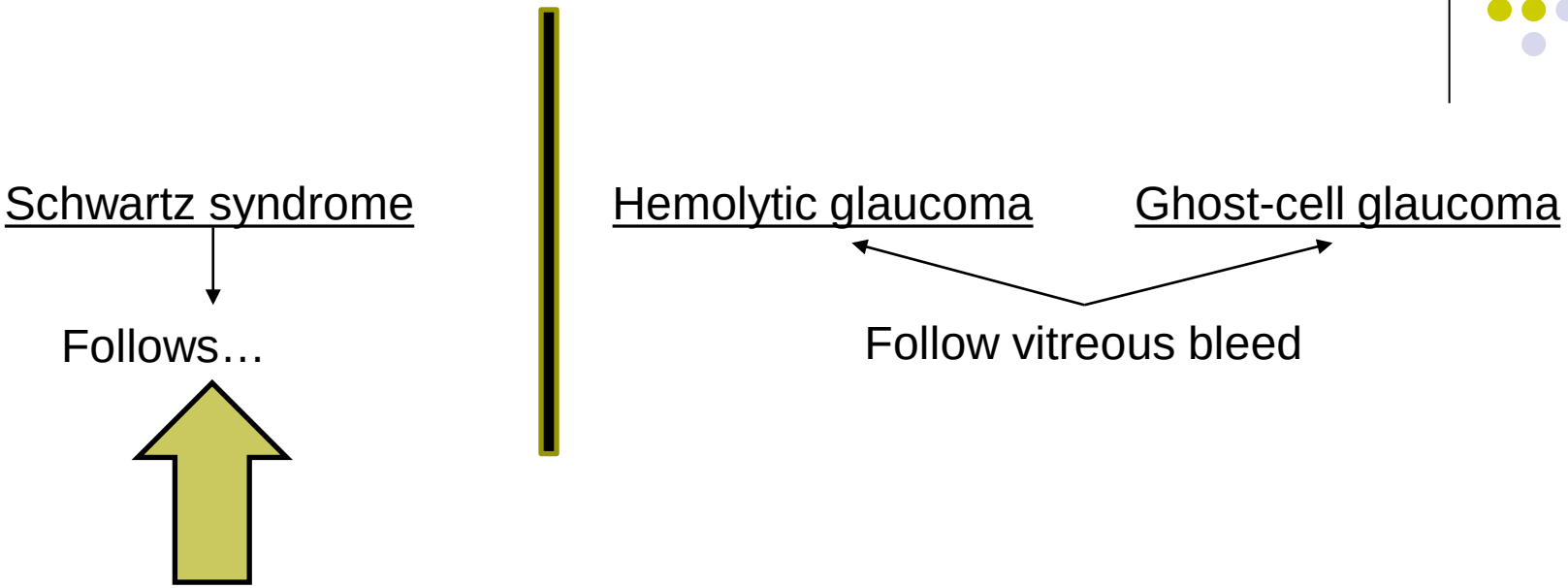
If medical management fails, what is the next step?
AC washout

And if the AC washout fails?
PPV (if the hemorrhage is persistent) vs filtering surgery should be considered

Khaki-colored hemorrhage in the vitreous

Q

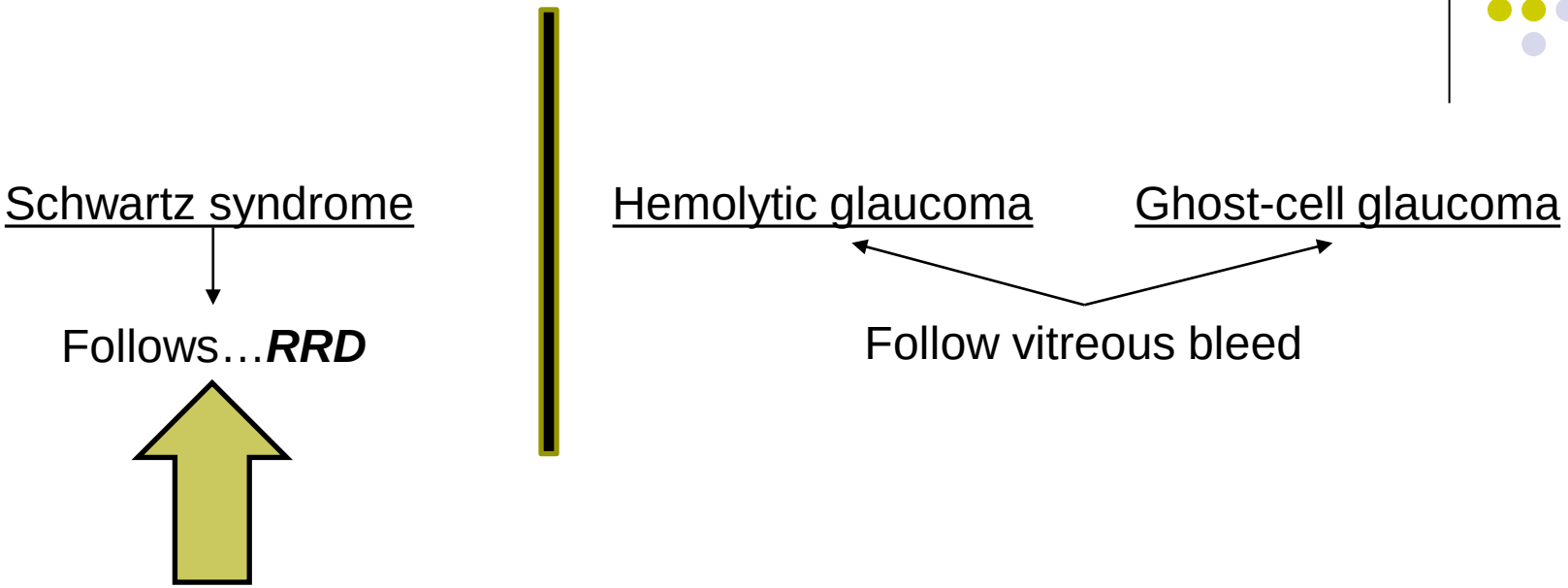
Glaucoma After Intraocular Bleed



Changing gears slightly…There is another form of secondary OAG called Schwartz syndrome *that, like hemolytic- and ghost-cell glaucoma, follows a posterior-segment event—but* not *a bleed. What event does it follow?*

A

Glaucoma After Intraocular Bleed



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Rhegmatogenous retinal detachment (RRD)

Q

Glaucoma After Intraocular Bleed

Schwartz syndrome → Follows…***RRD***

Hemolytic glaucoma, Ghost-cell glaucoma → Follow vitreous bleed

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Huh? I thought RRD was associated with **reduced** *IOP. What gives?*

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Glaucoma After Intraocular Bleed

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Acute RRD is indeed associated with reduced IOP. Schwartz syndrome is associated with **chronic** RRD.

Q

Glaucoma After Intraocular Bleed

Schwartz syndrome → Follows…***RRD***

Hemolytic glaucoma, Ghost-cell glaucoma → Follow vitreous bleed

What is the mechanism of reduced IOP in acute RRD?

dary OAG called
aucoma, follows a
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Glaucoma After Intraocular Bleed

Schwartz syndrome → Follows…***RRD***

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What is the mechanism of reduced IOP in acute RRD?
Recall that one function of the RPE is to deturgesce the subretinal space by actively pumping fluid out of it. RRD allows intraocular fluid to pass into the subretinal space, where the RPE attempts to remove it.

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Glaucoma After Intraocular Bleed

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Recall that one function of the RPE is to deturgesce the subretinal space by actively pumping fluid out of it. RRD allows intraocular fluid to pass into the subretinal space, where the RPE attempts to remove it. If a significant enough portion of this fluid is removed, IOP will go down.

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Acute RRD is indeed associated with reduced IOP. Schwartz syndrome is associated with **chronic** RRD.

Glaucoma After Intraocular Bleed

Schwartz syndrome

Hemolytic glaucoma → TM clogged

Ghost-cell glaucoma → TM clogged

In both hemolytic and ghost-cell glaucomas, increased IOP results from clogging of the TM that impedes aqueous egress.

Changing gears slightly…There is another term, secondary OHS called Schwartz syndrome that, like hemolytic- and ghost-cell glaucoma, follows a posterior-segment event—but **not** *a bleed. What event does it follow?*

Rhegmatogenous retinal detachment (RRD)

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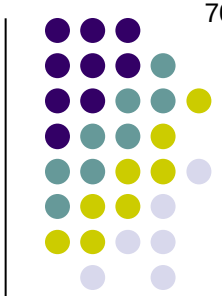
Glaucoma After Intraocular Bleed



Schwartz syndrome	Hemolytic glaucoma	Ghost-cell glaucoma
↓	↓	↓
?	TM clogged	TM clogged

What is the mechanism of IOP elevation in Schwartz syndrome?

In both hemolytic and ghost-cell glaucomas, increased IOP results from clogging of the TM that impedes aqueous egress.

Changing gears slightly: There is another term, secondary OHT called Schwartz syndrome *that, like hemolytic- and ghost-cell glaucoma, follows a posterior-segment event—but* **not** *a bleed. What event does it follow?*

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Glaucoma After Intraocular Bleed

Schwartz syndrome	Hemolytic glaucoma	Ghost-cell glaucoma
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TM clogged	TM clogged	TM clogged

What is the mechanism of IOP elevation in Schwartz syndrome?
The same thing—TM clogging

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Changing gears slightly: There is another term, secondary to RRD, called Schwartz syndrome *that, like hemolytic- and ghost-cell glaucoma, follows a posterior-segment event—but* **not** *a bleed. What event does it follow?*
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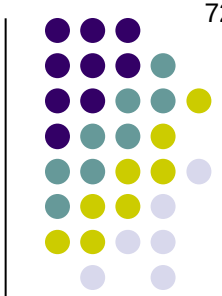
Glaucoma After Intraocular Bleed



Schwartz syndrome	Hemolytic glaucoma	Ghost-cell glaucoma
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TM clogged	TM clogged with… Hgb-laden macrophages	TM clogged with… degenerated RBCs

In hemolytic glaucoma, the TM is clogged with macrophages; in ghost-cell glaucoma, it's degenerated RBCs.

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Glaucoma After Intraocular Bleed

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What is clogging the TM in Schwartz syndrome?

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Glaucoma After Intraocular Bleed

Schwartz syndrome	Hemolytic glaucoma	Ghost-cell glaucoma
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What is clogging the TM in Schwartz syndrome?
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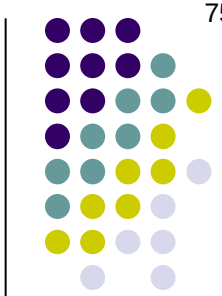
Rhegmatogenous retinal detachment (RRD)

Glaucoma After Intraocular Bleed



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To sum it up: In Schwartz syndrome, chronic RRD allows enough time for liberated PR outer segs to migrate into the AC, where their accumulation in the angle ends up clogging the TM and elevating IOP.

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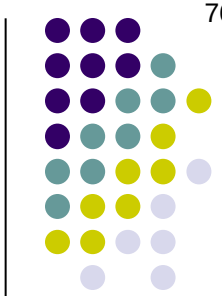

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All these PR outer segs floating around the AC—can they be mistaken for inflammatory cells?

A

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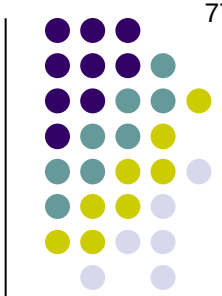

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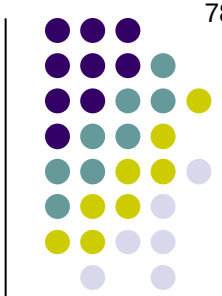
All these PR outer segs floating around the AC—can they be mistaken for inflammatory cells?
Yes, uveitic glaucoma is a common misdiagnosis in Schwartz syndrome

Q

Glaucoma After Intraocular Bleed



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Rhegmatogenous retinal detachment (RRD)

What's the best way to manage Schwartz syndrome?

A

Glaucoma After Intraocular Bleed

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What's the best way to manage Schwartz syndrome?
Repair the RRD