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OK then, what is the mechanism underlying RVO?
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Thrombosis of the venous structure
Is retinal vein occlusion (RVO) an embolic condition?
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OK then, what is the mechanism underlying RVO?
Thrombosis

In CRVO, where does thrombosis typically occur?
Thrombosis or
Is retinal vein occlusion (RVO) an embolic condition?
No! (How would an embolism get to the venous side of the retinal vascular bed?)

OK then, what is the mechanism underlying RVO?
Thrombosis of the venous structure.

In CRVO, where does thrombosis typically occur?
At the lamina cribrosa, or just posterior to it.

In BRVO, at what type of location does thrombosis typically occur?
At an A-V crossing point.
Is retinal vein occlusion (RVO) an embolic condition?
No! (How would an embolism get to the venous side of the retinal vascular bed?)

OK then, what is the mechanism underlying RVO?
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What should you consider if a BRVO occurs at a non-crossing point?
**Q/A**

Is retinal vein occlusion (RVO) an embolic condition?

No! (How would an embolism get to the venous side of the retinal vascular bed?)

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**Thrombosis**

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What should you consider if a BRVO occurs at a non-crossing point?

You should consider whether the pt has some form of inflammatory condition
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Is retinal vein occlusion (RVO) an embolic condition?
No! (How would an embolism get to the venous side of the retinal vascular bed?)

OK then, what is the mechanism underlying RVO?
Thrombosis of the venous structure

Do RVO pts tend to be vasculopaths?
Is retinal vein occlusion (RVO) an embolic condition?
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Do RVO pts tend to be vasculopaths?
Yes. HTN is mos def a risk factor for all forms of RVO
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What about diabetes—is it a risk factor for RVO? 
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Regarding RVO risk factors—may I introduce ‘the H’s.’
You know three already; what are the others?

--Hypertension
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--Hyperglycemia (in CRVO fer shur; not clear re BRVO)
--Hyperlipidemia
--Hypercoagulability
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There’s another risk factor for BRVO that isn’t on this list. What is it?

--- Smoking
Is retinal vein occlusion (RVO) an embolic condition?
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All that being said, the Retina book emphasizes two risk factors for RVO. Which two? (Note: One of them is not on the list above.)

HTN and advancing age.
Is retinal vein occlusion (RVO) an embolic condition? No! (How would an embolism get to the venous side of the retinal vascular bed?)

OK then, what is the mechanism underlying RVO? Thrombosis of the venous structure.

Do RVO pts tend to be vasculopaths? Yes. HTN is mos def a risk factor for all forms of RVO.

In a sense, HTN is a 'double risk factor.' What sense is being referred to here? In the sense that not only is HTN itself a risk factor, but the \textit{treatment} of HTN can also increase the risk of a RVO event.

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OK then, what is the mechanism underlying RVO?
Thrombosis of the venous structure

Do RVO pts tend to be vasculopaths?
Yes. HTN

In a sense, HTN is a ‘double risk factor.’ What sense is being referred to here?
In the sense that not only is HTN itself a risk factor, but the treatment of HTN can also increase the risk of an RVO event.

How might the tx of HTN be causative vis a vis an RVO?
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Which one factor is the strongest for CRVO?
Is retinal vein occlusion (RVO) an embolic condition?
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OK then, what is the mechanism underlying RVO?
Thrombosis of the venous structure

Do RVO pts tend to be vasculopaths?
Yes. HTN is mos def a risk factor for all forms of RVO

In a sense, HTN is a ‘double risk factor.’ What sense is being referred to here?
In the sense that not only is HTN itself a risk factor, but the treatment of HTN can also increase the risk of a RVO event.

How might the tx of HTN be causative vis a vis an RVO?
Recumbent positioning during sleep increases retinal venous pressure. If this increased pressure is accompanied by a decrease in perfusion pressure, the resulting venous stasis can lead to thrombus formation. For this reason, broad nocturnal hypotension.

What about diabetes—is it a risk factor for RVO?
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All that being said, the Retina book emphasizes two risk factors for RVO. Which two? (Note: One of them is not on the list above.)
**HTN and advancing age**

Which one factor is the strongest for CRVO?
**Age.** Over % of CRVO pts are older than #
Is retinal vein occlusion (RVO) an embolic condition? No! (How would an embolism get to the venous side of the retinal vascular bed?)

OK then, what is the mechanism underlying RVO? Thrombosis of the venous structure.

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---Hypercoagulability

All that being said, the Retina book emphasizes two risk factors for RVO. Which two? (Note: One of them is not on the list above.) HTN and **advancing age.**

*Which one factor is the strongest for CRVO? Age.* Over 90% of CRVO pts are older than 50!
Is retinal vein occlusion (RVO) an embolic condition?
No! (How would an embolism get to the venous side of the retinal vascular bed?)

OK then, what is the mechanism underlying RVO?
Thrombosis of the venous structure

Do RVO pts tend to be vasculopaths?
Yes. HTN is mos def a risk factor for all forms of RVO

What role does vasculopathy play in the genesis of a RVO?
Is retinal vein occlusion (RVO) an embolic condition? 
No! (How would an embolism get to the venous side of the retinal vascular bed?)

OK then, what is the mechanism underlying RVO? 
Thrombosis of the venous structure

Do RVO pts tend to be vasculopathics? 
Yes. HTN is mos def a risk factor for all forms of RVO

What role does vasculopathy play in the genesis of a RVO? 
Vasculopathy contributes to the development of atherosclerotic dz. And it’s atherosclerotic changes to retinal arterial vessels that cause them to impinge upon and compress adjacent venous vessels.
Is retinal vein occlusion (RVO) an embolic condition?
No! (How would an embolism get to the venous side of the retinal vascular bed?)

OK then, what is the mechanism underlying RVO?
Thrombosis of the venous structure

Do RVO pts tend to be vasculopathes?
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What role does vasculopathy play in the genesis of a RVO?
Vasculopathy contributes to the development of atherosclerotic dz. And it’s atherosclerotic changes to retinal arterial vessels that cause them to impinge upon and compress adjacent venous vessels. Impingement impedes blood flow through the venous vessel, as well as damages its endothelial cells. The combination of endothelial damage and impeded blood flow initiates the clotting cascade, the result being formation of a thrombus.
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What two DFE findings are the hallmark of an RVO event?
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What two DFE findings are the hallmark of an RVO event?
--Intraretinal hemorrhages
--Tortuosity of the involved retinal vasculature
CRVO: Tortuous veins; retinal hemorrhages
Is retinal vein occlusion (RVO) an embolic condition? No! (How would an embolism get to the venous side of the retinal vascular bed?)

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What two DFE findings are the hallmark of an RVO event? --Intraretinal hemorrhages --Tortuosity of the involved retinal vasculature

In BRVO, the retinal findings are limited to a single quadrant. Which quadrant is most likely to be involved?
Is retinal vein occlusion (RVO) an embolic condition?
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In BRVO, the retinal findings are limited to a single quadrant. Which quadrant is most likely to be involved?
The superotemporal
BRVO in the S-T quad
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What modality is the ‘mainstay treatment’ for RVO, per the Retina book?
**Is retinal vein occlusion (RVO) an embolic condition?**
No! (How would an embolism get to the venous side of the retinal vascular bed?)

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**What two DFE findings are the hallmark of an RVO event?**
--Intraretinal hemorrhages
--Tortuosity of the involved retinal vasculature

**What modality is the ‘mainstay treatment’ for RVO, per the Retina book?**
Intravitreal injection of anti-VEGF meds
Is retinal vein occlusion (RVO) an embolic condition?
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Yes. HTN is mos def a risk factor for all forms of RVO

What role does vasculopathy play in the genesis of RVO?
Vasculopathy contributes to the development of atherosclerotic dz. And it’s atherosclerotic changes to retinal arterial vessels that cause them to impinge upon and compress adjacent venous vessels. Impingement impedes blood flow through the venous vessel, as well as damages its endothelial cells. The combination of endothelial damage and impeded blood flow initiates the clotting cascade, the result being formation of a thrombus.

What two DFE findings are the hallmark of an RVO event?
--Intraretinal hemorrhages
--Tortuosity of the involved retinal vasculature

What modality is the ‘mainstay treatment’ for RVO, per the Retina book?
Intravitreal injection of anti-VEGF meds

Next we will look more closely at BRVO
In the present context, what does BVOS stand for?
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Branch Vein Occlusion Study, a major clinical trial regarding BRVO mgmt
In the present context, what does BVOS stand for? Branch Vein Occlusion Study, a major clinical trial regarding BRVO mgmt

What three questions did the BVOS seek to answer?
1) 
2) 
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In the present context, what does BVOS stand for? Branch Vein Occlusion Study, a major clinical trial regarding BRVO mgmt

What three questions did the BVOS seek to answer?
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2) If a BRVO does not have neo, will scatter photocoagulation prevent it?
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There’s an obvious question that the BVOS did not ask—what is it?
‘Are intravitreal anti-VEGF agents safe and effective in managing BRVO?’
**Q**

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Because their use wasn’t even a gleam in Dr Flynn’s eye when the BVOS was performed. (To be clear, I’m referring here to Harry Flynn, not myself. And no relation, if you’re wondering.)
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Note: Because the Retina book runs through the BVOS findings/recs re laser tx for macular edema after BRVO, we will do the same
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Note: Because the Retina book runs through the BVOS findings/recs re laser tx for macular edema after BRVO, we will do the same. However, bear in mind that, as just stated, pharmacologic tx is currently considered first-line!
BVOS recs re *macular edema* after BRVO:
- Wait for spontaneous resolution

Q
• BVOS recs re *macular edema* after BRVO:
  • Wait **3 months** for spontaneous resolution
Macular edema after BRVO
- BVOS recs re macular edema after BRVO:
  - Wait **3 months** for spontaneous resolution

_Apropos of what we just noted: We don’t wait 3 months hoping for spontaneous resolution any more. Rather, treat (pharmacologically) ME after BRVO immediately!_
• BVOS recs re *macular edema* after BRVO:
  • Wait **3 months** for spontaneous resolution
  • Perform grid macular laser (GML) if:
  • VA is **Snellen to Snellen**, and…
BVOS recs re macular edema after BRVO:

- Wait **3 months** for spontaneous resolution
- Perform grid macular laser (GML) if:
  - VA is **20/40** to **20/200**, and...
• BVOS recs re *macular edema* after BRVO:
  • Wait 3 months for spontaneous resolution
  • Perform grid macular laser (GML) if:
    • VA is 20/40 to 20/200, and…
    • FA reveals no two words
BVOS recs re *macular edema* after BRVO:

- Wait **3 months** for spontaneous resolution
- Perform grid macular laser (GML) if:
  - VA is **20/40** to **20/200**, *and*...
  - FA reveals no *foveal ischemia*
• BVOS recs re *macular edema* after BRVO:
  • Wait **3 months** for spontaneous resolution
  • Perform grid macular laser (GML) if:
    • VA is **20/40** to **20/200**, *and*...
    • FA reveals no *foveal ischemia*
  • Per the BVOS, patients treated with GML are:
    • twice as likely to ?Gain VA? Not lose VA? *and*
BVOS recs re *macular edema* after BRVO:

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- Perform grid macular laser (GML) if:
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- Per the BVOS, patients treated with GML are:
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BVOS recs re *macular edema* after BRVO:

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- Perform grid macular laser (GML) if:
  - VA is **20/40** to **20/200**, and…
  - FA reveals no *foveal ischemia*
- Per the BVOS, patients treated with GML are:
  - twice as likely to **gain 2 lines of VA**, and
  - twice as likely to have a final VA ≥ **Snellen**
BVOS recs re *macular edema* after BRVO:

- Wait **3 months** for spontaneous resolution
- Perform grid macular laser (GML) if:
  - VA is **20/40** to **20/200**, and…
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  - twice as likely to **gain 2 lines of VA**, and
  - twice as likely to have a final VA $\geq$ **20/40**
• BVOS recs re *macular edema* after BRVO:
  • Wait 3 months for spontaneous resolution
  • Perform grid macular laser (GML) if:
    • VA is 20/40 to 20/200, and...
    • FA reveals no foveal ischemia
  • Per the BVOS, patients treated with GML are:
    • twice as likely to gain 2 lines of VA, and
    • twice as likely to have a final VA \( \geq 20/40 \)
• Re *eyes with neovascularization* after BRVO...
  • Scatter photocoagulation reduces the risk of vitreous hemorrhage by \( \% \)
BVOS recs re *macular edema* after BRVO:

- Wait **3 months** for spontaneous resolution
- Perform grid macular laser (GML) if:
  - VA is **20/40 to 20/200**, and…
  - FA reveals no *foveal ischemia*
- Per the BVOS, patients treated with GML are:
  - twice as likely to **gain 2 lines of VA**, and
  - twice as likely to have a final VA ≥ **20/40**

Re *eyes with neovascularization* after BRVO…

- Scatter photocoagulation reduces the risk of vitreous hemorrhage by **50%**
Re eyes with neovascularization after BRVO...

- Scatter photocoagulation reduces the risk of vitreous hemorrhage by 50%
To what area/aspect of the retina should scatter laser be applied?
To areas of capillary nonperfusion

Re eyes with neovascularization after BRVO...
- Scatter photocoagulation reduces the risk of vitreous hemorrhage by 50%
BRVO: Scatter laser scars
To what area/aspect of the retina should scatter laser be applied?
To areas of capillary nonperfusion

Speaking of capillary nonperfusion…Per the BVOS, what finding put a BRVO eye at risk for developing neo?

Re eyes with neovascularization after BRVO…

Scatter photocoagulation reduces the risk of vitreous hemorrhage by 50%
To what area/aspect of the retina should scatter laser be applied?
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Speaking of capillary nonperfusion…Per the BVOS, what finding put a BRVO eye at risk for developing neo?
The presence of “extensive retinal ischemia”

Re *eyes with neovascularization* after BRVO…

Scatter photocoagulation reduces the risk of vitreous hemorrhage by 50%
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Speaking of capillary nonperfusion…Per the BVOS, what finding put a BRVO eye at risk for developing neo?
The presence of “extensive retinal ischemia”

How did the BVOS define ‘extensive’ in this regard?

Re eyes with neovascularization after BRVO…

Scatter photocoagulation reduces the risk of vitreous hemorrhage by 50%
BVO recs re macular edema after BRVO:
- Wait 3 months for spontaneous resolution
- Perform grid macular laser (GML) if:
  - VA is 20/40 to 20/200,
  - FA reveals no foveal ischemia
- Per the BVOS, patients treated with GML are:
  - twice as likely to gain 2 lines of VA,
  - twice as likely to have a final VA ≥ 20/40
Re eyes with neovascularization after BRVO...:
- Scatter photocoagulation reduces the risk of vitreous hemorrhage by 50%
To what area/aspect of the retina should scatter laser be applied? To areas of capillary nonperfusion.

Speaking of capillary nonperfusion... Per the BVOS, what finding put a BRVO eye at risk for developing neo? The presence of "extensive retinal ischemia".

How did the BVOS define 'extensive' in this regard? It was defined as an area of nonperfusion 5 or more DDs in size.

Re eyes with neovascularization after BRVO...

Scatter photocoagulation reduces the risk of vitreous hemorrhage by 50%.
To what area/aspect of the retina should scatter laser be applied?
To areas of capillary nonperfusion

Speaking of capillary nonperfusion…Per the BVOS, what finding put a BRVO eye at risk for developing neo?
The presence of “extensive retinal ischemia”

How did the BVOS define ‘extensive’ in this regard?
It was defined as an area of nonperfusion 5 or more DDs in size

Again per the BVOS: What proportion of eyes with extensive retinal ischemia went on the develop neo?

Re eyes with neovascularization after BRVO…

Scatter photocoagulation reduces the risk of vitreous hemorrhage by 50%
To what area/aspect of the retina should scatter laser be applied?
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Speaking of capillary nonperfusion…Per the BVOS, what finding put a BRVO eye at risk for developing neo?
The presence of “extensive retinal ischemia”

How did the BVOS define ‘extensive’ in this regard?
It was defined as an area of nonperfusion 5 or more DDs in size

Again per the BVOS: What proportion of eyes with extensive retinal ischemia went on to develop neo?
A little over a third

Re eyes with neovascularization after BRVO…

Scatter photocoagulation reduces the risk of vitreous hemorrhage by 50%
BRVO: Neovascularization
To what area/aspect of the retina should scatter laser be applied?
To areas of capillary nonperfusion

Speaking of capillary nonperfusion…Per the BVOS, what finding put a BRVO eye at risk for developing neo?
The presence of “extensive retinal ischemia”

How did the BVOS define ‘extensive’ in this regard?
It was defined as an area of nonperfusion ≥ 5 DDs in size

Again per the BVOS: What proportion of eyes with extensive retinal ischemia went on to develop neo?
A little over a third

Finally, and yet again per the BVOS: What proportion of eyes that developed neo went on to have a vitreous hemorrhage?
Most—at least 60%, and perhaps as many as 90%

Re eyes with neovascularization after BRVO…

Scatter photocoagulation reduces the risk of vitreous hemorrhage by 50%
**BVOS recs re macular edema**

- Wait 3 months for spontaneous resolution
- Perform grid macular laser (GML) if:
  - VA is 20/40 to 20/200, and
  - FA reveals no foveal ischemia

Per the BVOS, patients treated with GML are:
- Twice as likely to gain 2 lines of VA, and
- Twice as likely to have a final VA ≥ 20/40

**eyes with neovascularization** after BRVO...

- Scatter photocoagulation reduces the risk of vitreous hemorrhage by **50%**

---

**Q/A**

To what area/aspect of the retina should scatter laser be applied?
To areas of capillary nonperfusion

Speaking of capillary nonperfusion…Per the BVOS, what finding put a BRVO eye at risk for developing neo?
The presence of “extensive retinal ischemia”

How did the BVOS define ‘extensive’ in this regard?
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Again per the BVOS: What proportion of eyes with extensive retinal ischemia went on the develop neo?
A little over a third

Finally, and yet again per the BVOS: What proportion of eyes that developed neo went on to have a vitreous hemorrhage?
Most—at least %, and perhaps as many as %
To what area/aspect of the retina should scatter laser be applied?

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Speaking of capillary nonperfusion...Per the BVOS, what finding put a BRVO eye at risk for developing neo?

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How did the BVOS define ‘extensive’ in this regard?

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Again per the BVOS: What proportion of eyes with extensive retinal ischemia went on the develop neo?

A little over a third

Finally, and yet again per the BVOS: What proportion of eyes that developed neo went on to have a vitreous hemorrhage?

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Re eyes with neovascularization after BRVO...

Scatter photocoagulation reduces the risk of vitreous hemorrhage by 50%
BRVO: Neovascularization with vitreous hemorrhage
BVOS recs re macular edema after BRVO:
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  - FA reveals no foveal ischemia
- Per the BVOS, patients treated with GML are:
  - twice as likely to gain 2 lines of VA,
  - twice as likely to have a final VA ≥ 20/40
Re eyes with neovascularization after BRVO...
- Scatter photocoagulation reduces the risk of vitreous hemorrhage by 50%

Q

To what area/aspect of the retina should scatter laser be applied?
- To areas of capillary nonperfusion

Speaking of capillary nonperfusion... Per the BVOS, what finding put a BRVO eye at risk for developing neo?
- The presence of "extensive retinal ischemia"

How did the BVOS define "extensive" in this regard?
- It was defined as an area of nonperfusion 5 or more DDs in size

Again per the BVOS, how did they perform their assessments? What proportion of eyes with extensive retinal ischemia went on to develop neo?
- A little over a third

Finally, and yet again per the BVOS, what proportion of eyes that developed neo went on to have a vitreous hemorrhage?
- Most—approximately 60%, and perhaps as many as 90%

By what means did the BVOS determine that extensive nonperfusion was present?
- By fluorescein angiography (FA)
BVOS recs re macular edema after BRVO:

- Wait 3 months for spontaneous resolution
- Perform grid macular laser (GML) if:
  - VA is 20/40 to 20/200,
  - FA reveals no foveal ischemia
- Per the BVOS, patients treated with GML are:
  - Twice as likely to gain 2 lines of VA,
  - Twice as likely to have a final VA ≥ 20/40

Re eyes with neovascularization after BRVO:

- Scatter photocoagulation reduces the risk of vitreous hemorrhage by 50%

To what area/aspect of the retina should scatter laser be applied?
To areas of capillary nonperfusion

Speaking of capillary nonperfusion... Per the BVOS, what finding put a BRVO eye at risk for developing neo?
The presence of "extensive retinal ischemia"

How did the BVOS define 'extensive' in this regard?
It was defined as an area of nonperfusion 5 or more DDs in size

Again per the BVOS, what proportion of eyes with extensive retinal ischemia went on to develop neo?
A little over a third

Finally, per the BVOS, what proportion of eyes that developed neo went on to have a vitreous hemorrhage?
Most—at least 60%, and perhaps as many as 90%

By what means did the BVOS determine that extensive nonperfusion was present?
By FA
BRVO: Waaaaay more than 5DD nonperfusion
BVOS recs re macular edema after BRVO:
- Wait 3 months for spontaneous resolution
- Perform grid macular laser (GML) if:
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  - FA reveals no foveal ischemia

Per the BVOS, patients treated with GML are:
- Twice as likely to gain 2 lines of VA,
- Twice as likely to have a final VA ≥ 20/40

RVOs
- Scatter photocoagulation reduces the risk of vitreous hemorrhage by 50%

Q

To what area/aspect of the retina should scatter laser be applied?
To areas of capillary nonperfusion

Speaking of capillary nonperfusion... Per the BVOS, what finding put a BRVO eye at risk for developing neo?
The presence of "extensive retinal ischemia"

How did the BVOS define 'extensive' in this regard?
It was defined as an area of nonperfusion 5 or more DDs in size

By what means did the BVOS determine that extensive nonperfusion was present?
By FA

OK, so if a BRVO pt is found to have 5+ DD of nonperfusion on FA, should you go ahead and perform scatter?

Re eyes with neovascularization after BRVO...
- Scatter photocoagulation reduces the risk of vitreous hemorrhage by 50%
To what area/aspect of the retina should scatter laser be applied?
To areas of capillary nonperfusion

Speaking of capillary nonperfusion... Per the BVOS, what finding put a BRVO eye at risk for developing neo?
The presence of “extensive retinal ischemia”

How did the BVOS define “extensive” in this regard?
It was defined as an area of nonperfusion 5 or more DDs in size

By what means did the BVOS determine that extensive nonperfusion was present?
By FA

OK, so if a BRVO pt is found to have 5+ DD of nonperfusion on FA, should you go ahead and perform scatter?
No; what you should do is follow them closely, and be ready to scatter them if neo should occur

Re eyes with neovascularization after BRVO...

Scatter photocoagulation reduces the risk of vitreous hemorrhage by 50%
To what area/aspect of the retina should scatter laser be applied?
To areas of capillary nonperfusion

Speaking of capillary nonperfusion... Per the BVOS, what finding put a BRVO eye at risk for developing neo?
The presence of "extensive retinal ischemia"

How did the BVOS define "extensive" in this regard?
It was defined as an area of nonperfusion \( \geq 5 \) or more DDs in size

Again per the BVOS, what proportion of eyes with extensive nonperfusion went on to develop neo?
A little over a third

By what means did the BVOS determine that extensive nonperfusion was present?
By FA

Finally, approximately what proportion of eyes with extensive nonperfusion went on to develop neo?
Most—around 50%

OK, so if a BRVO pt is found to have 5+ DD of nonperfusion on FA, should you go ahead and perform scatter?
No; what you should do is follow them closely, and be ready to scatter them if neo should occur

Re eyes with neovascularization after BRVO...

Speaking of neo... Is neovascularization of the iris (NVI) a common occurrence in BRVO?

Scatter reduces the risk of vitreous hemorrhage by 50%
To what area/aspect of the retina should scatter laser be applied?
- To areas of capillary nonperfusion

Speaking of capillary nonperfusion... Per the BVOS, what finding put a BRVO eye at risk for developing neo?
- The presence of "extensive retinal ischemia"

How did the BVOS define "extensive" in this regard?
- It was defined as an area of nonperfusion 5 or more DDs in size

Again per the BVOS, what proportion of eyes with extensive retinal ischemia went on to develop neo?
- A little over a third

By what means did the BVOS determine that extensive nonperfusion was present?
- By FA

Finally, among people with extensive nonperfusion, what proportion developed neo?
- Most—a little over a third

OK, so if a BRVO pt is found to have 5+ DD of nonperfusion on FA, should you go ahead and perform scatter?
- No; what you should do is follow them closely, and be ready to scatter them if neo should occur

Speaking of neo... Is neovascularization of the iris (NVI) a common occurrence in BRVO?
- Not really—it only occurs in about 2% of cases

Re eyes with neovascularization after BRVO...
BVOS recs re macular edema after BRVO:

- Wait 3 months for spontaneous resolution
- Perform grid macular laser (GML) if:
  - VA is 20/40 to 20/200,
  - FA reveals no foveal ischemia
- Per the BVOS, patients treated with GML are:
  - twice as likely to gain 2 lines of VA,
  - twice as likely to have a final VA ≥ 20/40

Re eyes with neovascularization after BRVO:

- Scatter photocoagulation reduces the risk of vitreous hemorrhage by 50%.

To what area/aspect of the retina should scatter laser be applied?
- To areas of capillary nonperfusion

Speaking of capillary nonperfusion... Per the BVOS, what finding put a BRVO eye at risk for developing neo?
- The presence of "extensive retinal ischemia"

How did the BVOS define "extensive" in this regard?
- It was defined as an area of nonperfusion 5 or more DDs in size

Again per the BVOS, what proportion of BRVO eyes with extensive nonperfusion went on to develop neovascularization?
- A little over a third

By what means did the BVOS determine that extensive nonperfusion was present?
- By FA

Finally, a BRVO pt has extensive nonperfusion on FA; should you go ahead and perform scatter?
- No; what you should do is follow them closely, and be ready to scatter them if neo should occur

Speaking of neo... Is neovascularization of the iris (NVI) a common occurrence in BRVO?
- Not really—it only occurs in about 2% of cases
To what area/aspect of the retina should scatter laser be applied?
To areas of capillary nonperfusion

Speaking of capillary nonperfusion ... Per the BVOS, what finding put a BRVO eye at risk for developing neo?
The presence of "extensive retinal ischemia"

How did the BVOS define "extensive" in this regard?
In 5 DDs or more

Again per the BVOS, what proportion of eyes with extensive retinal ischemia went on to develop neo?
A little over a third

Finally, a small proportion of patients already with neo went on to develop another.
Most—around 60%

If a BRVO pt is found to have 5+ DD of nonperfusion on FA, should you go ahead and perform scatter?
No; what you should do is follow them closely, and be ready to scatter them if neo should occur.

Speaking of neo... Is neovascularization of the iris (NVI) a common occurrence in BRVO?
Not really—it only occurs in about 2% of cases.
Q

DDx for a CRVO-like fundus

?  CRVO (duh)  ?

93
DDx for a CRVO-like fundus

- Hyperviscosity syndrome
- CRVO
- OIS
DDx for a CRVO-like fundus

Hyperviscosity syndrome

CRVO

OIS

What does OIS stand for in this context?
DDx for a CRVO-like fundus

- Hyperviscosity syndrome
- CRVO
- OIS

What does OIS stand for in this context?
Ocular ischemic syndrome
DDx for a CRVO-like fundus

Hyperviscosity syndrome

CRVO

OIS

What does OIS stand for in this context?
Ocular ischemic syndrome

In a nutshell, what is OIS?
CRVO-like fundus DDx for a CRVO-like fundus

Hyperviscosity syndrome

CRVO

OIS

What does OIS stand for in this context?
Ocular ischemic syndrome

In a nutshell, what is OIS?
A constellation of signs and symptoms owing to chronic ocular hypoperfusion
DDx for a CRVO-like fundus

Hyperviscosity syndrome

CRVO

OIS

What does OIS stand for in this context? Ocular ischemic syndrome

In a nutshell, what is OIS? A constellation of signs and symptoms owing to chronic ocular hypoperfusion

What are the signs/symptoms of OIS?

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CRVO

DDx for a CRVO-like fundus

Hyperviscosity syndrome

CRVO

OIS

What does OIS stand for in this context?
Ocular ischemic syndrome

In a nutshell, what is OIS?
A constellation of signs and symptoms owing to chronic ocular hypoperfusion

What are the signs/symptoms of OIS?

**Signs:**
- Retinal hemorrhages
- NVI/NVA
- AC cell/flare

**Symptoms:**
- 
- 
-
DDx for a CRVO-like fundus

Hyperviscosity syndrome  CRVO  OIS

What does OIS stand for in this context?
Ocular ischemic syndrome

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- NVI/NVA
- AC cell/flare

**Symptoms:**
- ?
- ?
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In a nutshell, what is OIS? A constellation of signs and symptoms owing to chronic ocular hypoperfusion.

What are the signs/symptoms of OIS?

**Signs:**
- Retinal hemorrhages
- NVI/NVA
- AC cell/flare

**Symptoms:**
- Decreased vision
- Pain
- Prolonged photostress recovery time
DDx for a CRVO-like fundus

Hyperviscosity syndrome ➔ CRVO ➔ OIS

What does OIS stand for in this context?
Ocular ischemic syndrome

In a nutshell, what is OIS?
A constellation of signs and symptoms owing to chronic ocular hypoperfusion

What are the signs/symptoms of OIS?

**Signs:**
- Retinal hemorrhages
- NVI/NVA
- AC cell/flare
- Decreased vision
- Pain
- Prolonged photostress recovery time

What is 'photostress recovery time'?
It refers to the amount of time it takes for vision to recover after the retina has been subjected to a very bright light.
DDx for a CRVO-like fundus

Hyperviscosity syndrome

CRVO

OIS

What does OIS stand for in this context?
Ocular ischemic syndrome

In a nutshell, what is OIS?
A constellation of signs and symptoms following to chronic ocular hypoperfusion

What are the signs/symptoms of OIS?

Signs:
--Retinal hemorrhages
--NVI/NVA
--AC cell/flare
--Decreased vision
--Pain
--Prolonged photostress recovery time

What is ‘photostress recovery time’?
It refers to the amount of time it takes for vision to recover after the retina has been subjected to a very bright light.
What does OIS stand for in this context?
Ocular ischemic syndrome

In a nutshell, what is OIS?
A constellation of signs and symptoms owing to chronic ocular hypoperfusion

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What simple, noninvasive test can be performed that reliably differentiates between OIS and CRVO?

Ophthalmodynamometry

What does ophthalmodynamometry measure?

Perfusion pressure of the retinal arterial tree

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The Retina book mentions three causes of hyperviscosity syndrome—what are they?
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DDx for a CRVO-like fundus

Hyperviscosity syndrome

- Waldenström macroglobulinemia
- Multiple myeloma
- Polycythemia vera

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What key finding strongly suggests a CRVO-like presentation is in fact a manifestation of a hyperviscosity syndrome?
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DDx for a CRVO-like fundus

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If hyperviscosity syndrome is suspected, what tests should be ordered?
-- CBC
-- Serum electrophoresis
-- Measurement of whole-blood viscosity
DDx for a CRVO-like fundus

Hyperviscosity syndrome

- Waldenström macroglobulinemia
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In addition to the H’s, the Retina book mentions two more risk factors specifically with regards to CRVO. What are they?

- Hypertension
- High IOP (ie, OAG)
- Hyperglycemia
- Hyperlipidemia
- Hypercoagulability
- ?
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(Unfortunately, neither starts with a ‘H.’)
DDx for a CRVO-like fundus

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--Diuretics

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DDx for a CRVO-like fundus

What systemic medical conditions may contribute to or result in a hypercoagulable state?

- Hyperhomocystinemia (Note: yet another 'H')
- Protein S deficiency
- Protein C deficiency
- Sarcoid
- SLE
- Hypertension
- High IOP (i.e., OAG)
- Hyperglycemia
- Hyperlipidemia
- Oral contraceptive use
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DDx for a CRVO-like fundus

What systemic medical conditions may contribute to or result in a hypercoagulable state?

Conditions that directly affect coagulation:
- Hyperhomocystinemia (Note: yet another 'H')
- Protein S deficiency
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Conditions that can incite vasculitis:
- Sarcoid
- SLE

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Relevant systemic conditions:
- Hypertension
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**So does every CRVO pt need a hypercoagulability workup?**

No, only those who:
- are younger than 50, and/or
- have none of the common risk factors

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The traditional way to divvy them up

CRVO

Q
The traditional way to divvy them up

Ischemic

Nonischemic

(We’ll define *ischemic* and *nonischemic* shortly)
What if, for whatever reason, a CRVO’s ischemia-status cannot be determined?
What if, for whatever reason, a CRVO's ischemia-status cannot be determined? Such a CRVO is classified as indeterminate.
What if, for whatever reason, a CRVO’s ischemia-status cannot be determined? Such a CRVO is classified as *indeterminate*.

What is the natural history of indeterminate CRVOs?
What if, for whatever reason, a CRVO’s ischemia-status cannot be determined? Such a CRVO is classified as *indeterminate*.

What is the natural history of indeterminate CRVOs? A big % of them turn out to be ischemic, you got a 50:50 shot...
What if, for whatever reason, a CRVO’s ischemia-status cannot be determined? Such a CRVO is classified as indeterminate.

What is the natural history of indeterminate CRVOs? ~80% of them turn out to be ischemic.
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~80% of them turn out to be ischemic.

As an (important) aside: A number of CRVOs initially classified as nonischemic will ‘convert’ to ischemic. What depressingly-high percentage will do so by 36 months post-event?
What if, for whatever reason, a CRVO’s ischemia-status cannot be determined? Such a CRVO is classified as indeterminate. What is the natural history of indeterminate CRVOs? ~80% of them turn out to be ischemic.

As an (important) aside: A number of CRVOs initially classified as nonischemic will ‘convert’ to ischemic. What depressingly-high percentage will do so by 36 months post-event? About a third.
What test must be run to determine whether a CRVO is ischemic or nonischemic?

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<th>Nonischemic CRVO</th>
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What FA finding is common to both ischemic and nonischemic subtypes?
- Prolonged retinal circulation time

What FA finding defines an ischemic CRVO?
- 10+ disc diameters of capillary nonperfusion
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**CRVO**

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**What test must be run to determine whether a CRVO is ischemic or nonischemic?** *Fluorescein angiography*
**Ischemic CRVO**

- What is the classic description of the fundus in CRVO?
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- How are such CRVOs classified?
  - To determine whether a CRVO is ischemic or not?

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How are such CRVOs classified?  
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Heme and cotton-wool spots (CWS) may obscure FA hyperfluorescence, rendering FA interpretation problematic.
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CRVO: Prolonged circ time (note the timer)
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Fluorescein angiography

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**What FA finding differentiates ischemic from nonischemic CRVO?**
The extent of capillary nonperfusion. In ischemic CRVO, at least 10 disc diameters of capillary nonperfusion are present, whereas in nonischemic, only a minimal amount (if any) is present.
CRVO: Nonischemic

(A) Fundus photograph of a central retinal vein occlusion demonstrating typical features of venous tortuosity, macular thickening, and intraretinal hemorrhage in all four quadrants of the fundus. (B) Early-phase angiogram of the fundus depicted in A, demonstrating an intact parafoveal capillary network in this perfused central retinal vein occlusion.
CRVO: Ischemic

(A) Fundus photograph of an eye with central retinal vein occlusion demonstrating scattered retinal hemorrhages, venous engorgement, and cotton-wool spots. (B) Midphase fluorescein angiogram of the eye shown in A, demonstrating capillary nonperfusion involving the foveal center. This eye also had extensive peripheral nonperfusion and is an example of the nonperfused form of central retinal vein occlusion.

CRVO: Ischemic
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When initial VA is… **≥20/40**

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**When initial VA is...** ≥20/40

**...final VA is likely to be...**

**Good? Bad?** The question
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When initial VA is... ≤20/200

...final VA is likely to be... Good

As bad, or even worse
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**tl;dr for Final VA after CRVO:**

- Ischemic CRVO: Good vision stays good, Bad vision stays bad
- Nonischemic CRVO: Good vision stays good, Bad vision remains bad

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*tl;dr for Final VA after CRVO:* **Good vision stays good**…

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**tl;dr for Final VA after CRVO:** *Good vision stays good…Bad vision stays bad*

**When initial VA is…**
- **≥20/40**
  - **Final VA is likely to be…** Good
- **20/50 - 20/200**
  - 50% stabilize 20% improve 30% worsen
- **≤20/200**
  - As bad, or even worse

(No question—proceed when ready)
What physiological process accounts for improvement in such cases?

- The development of collaterals (aka shunt vessels)
- What does it mean to say the blood is shunted?
  - It means blood entering the retinal circulation finds an anatomic pathway by which to bypass the occluded CRV and leave the eye
- Where does the blood go instead of into the CRV?
  - Into the choroidal circulation
- Where are these vessels typically located?
  - In the peripapillary region
- By what name are these collaterals known?
  - 'Optociliary shunt vessels'

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When initial VA is ≥20/40 20/50 - 20/200 ≤20/200...
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The development of collaterals (aka *shunt vessels*).

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20% improve

30% worsen

Bad, or even worse

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**Ischemic CRVO**

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<td></td>
<td>30% worsen</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20% improve</td>
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**Nonischemic CRVO**

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**Clinical findings**

- Prolonged retinal circ time with…
- 10+ DD capillary nonperfusion
What physiological process accounts for improvement in such cases?
The development of collaterals (aka *shunt vessels*).

What does it mean to say the blood is shunted?
It means blood entering the retinal circulation finds an anatomic pathway by which to bypass the occluded CRV and leave the eye.

Where does the blood go instead of into the CRV?
Into the choroidal circulation.

But the choroid is still *in the eye.* Where does the blood go from there?
Into the vortex veins, which in turn drain into the inferior and superior ophthalmic veins.

When initial VA is …
≥20/40
20/50 - 20/200
≤20/200
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Good
50% stabilize
20% improve
30% worsen
Bad, or even worse
### Q/A

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</tr>
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- 50% stabilize
- 20% improve
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<td></td>
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50% stabilize

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How many vortex veins are there? Usually four, occasionally five.

When initial VA is "≥20/40 20/50 - 20/200 ≤20/200," final VA is likely to be... Good. 50% stabilize, 20% improve, 30% worsen. As bad, or even worse.

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### CRVO

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**One aspect of the vortex veins is visible on DFE. What is it?**
Vortex veins.

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**Q/A**

**What does it mean to say the blood is shunted?**

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Usually right at the retina’s equator.

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...final VA is likely to be...

...≥20/40
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50% stabilize
30% improve

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...≤20/200
Bad, or even worse

20% improve

RVO
Vortex vein ampullae
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For final VA:

- $\geq 20/40$: Likely to be good
- $20/50 - 20/200$: $50\%$ stabilize, $20\%$ improve, $30\%$ worsen
- $\leq 20/200$: Bad, or even worse

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Vortex vein ampullae (blue circle indicates the equator)
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- ≥20/40: Good
- 20/50 - 20/200: 50% stabilize
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*Note: VA stands for Visual Acuity.*
Optociliary shunt vessels

CRVO
Bruh, that sure looks like NVD to me. How could you distinguish between optociliary shunt vessels and NVD?
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You could perform FA (fluorescein angiography). How does FA differentiate between NVD and shunt vessels? Whereas NVD vessels don't leak on FA, optociliary shunt vessels don't.
Bruh, that sure looks like NVD to me. How could you distinguish between optociliary shunt vessels and NVD?
You could perform FA

Optociliary shunt vessels
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How does FA differentiate between NVD and shunt vessels?
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How does FA differentiate between NVD and shunt vessels?
Whereas NVD vessels do not leak on FA, optociliary shunt vessels do not.
Bruh, that sure looks like NVD to me. How could you distinguish between optociliary shunt vessels and NVD?

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How does FA differentiate between NVD and shunt vessels?
Whereas NVD vessels do leak on FA, optociliary shunt vessels don’t
Re NVI after CRVO: According to the CVOS...

What does CVOS stand for in this context?
Re NVI after CRVO: According to the CVOS…

What does CVOS stand for in this context? Central Vein Occlusion Study
Re NVI after CRVO: According to the CVOS…

What is the #1 predictor for neo?
Re NVI after CRVO: According to the CVOS…

- *What is the #1 predictor for neo? Poor VA*
Re NVI after CRVO: According to the CVOS…

- What is the #1 predictor for neo? Poor VA
- If a CRVO is demonstrably ischemic, should PRP be performed in anticipation of the development of NVI, in order to prevent its occurrence?
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- What is the #1 predictor for neo? Poor VA
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Most clinicians perform PRP at the first sign of NVI
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When is the follow-up visit after PRP?
- One week; check IOP and assess response; re-treat if needed

Why is this important?
- For many reasons, not least of which is the fact that so many CRVO pts have glaucoma.
- In addition to checking IOP, what other glaucoma-related exam maneuver should be performed?
  - Gonioscopy
- What are you checking for via gonioscopy?
  - First is a basic assessment of the status of the angle. After that is an ongoing evaluation for the development of NVA.
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In addition to checking IOP, what other glaucoma-related exam maneuver should be performed? Gonioscopy

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First is a basic assessment of the status of the angle. After that is an ongoing evaluation for the development of neovascularization/diabetic retinopathy.

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- **What is the #1 predictor for neo?** Poor VA
- **If a CRVO is demonstrably ischemic, should PRP be performed in anticipation of the development of NVI?** No. The CVOS demonstrated that prophylactic PRP did not prevent the development of NVI, and in fact seemed to reduce the effectiveness of subsequent PRP that was placed when NVI developed.

When is the follow-up visit after PRP? One week; check IOP and assess response; re-treat if needed.

Assuming no PRP or other treatment (a subject we’ll get to shortly), how frequently should a CRVO pt be re-evaluated, and for how long?

In addition to checking IOP, what other glaucoma-related exam maneuver should be performed?

Gonioscopy

What are you checking for via gonioscopy?

First is a basic assessment of the status of the angle. After that is an ongoing evaluation for the development of NVA.

Q

CRVO
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Q/A

- **Why is this important?** For many reasons, not least of which is the fact that so many CRVO pts have glaucoma.

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What are you checking for via gonioscopy?

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Assuming no PRP or other treatment (a subject we’ll get to shortly), **how frequently should a CRVO pt be re-evaluated, and for how long?**

**Every** ___ for at least ___.
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- Is anterior-segment neovascularization common after ischemic CRVO? Very—over 50% of cases will develop it.

- Typically, how much time passes after an ischemic CRVO until NVG appears? Somewhere in the 3-5 month range.
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What is the main thing you’re looking to catch at these visits? The development of NVA (which could result in NVG, a disastrous sequelae).

Why for re-treatment? Assuming no PRP should a CRVO. Every month for...

In addition, what should be performed? For GLA.

For GLA, what are you checking for? For GLA.
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Typically, how much time passes after an ischemic CRVO until NVG appears? Somewhere in the 3-5 month range. This explains the name by which post-CRVO NVG is known. What is that name? 'One-hundred-day glaucoma.'
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OK, it makes sense that we want to preclude development of NVG. But wouldn’t it be better to do this via DFE, looking for the onset of NVD or NVE?
No, that would be a distinctly inadequate strategy.

Why is DFE inadequate as a surveillance method in CRVO?
Because very frequently, anterior-segment neo in CRVO occurs without neovascularization of the posterior segment.

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No, that would be a distinctly inadequate strategy.

Gonio must be performed at every visit.

Why is iris surveillance inadequate?
Because in some cases, NVA in CRVO occurs without neovascularization of the iris.
Re NVI after CRVO: According to the CVOS...

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Why is iris surveillance inadequate?
- Because in some cases, NVA in CRVO occurs without neovascularization of the iris.
Re NVI after CRVO: According to the CVOS...

OK then, it makes sense that to preclude NVG in CRVO, we need to monitor the anterior segment directly for signs of neo. That being said (and assuming gonioscopy at the initial visit at least every visit), why is iris surveillance inadequate?

No, the development of NVA (which could result in NVG, a disastrous sequela) may occur without neovascularization of the iris. Anterior-seg neo in CRVO occurs without neovascularization of the posterior segment.

So, in CRVO NVI occurs in the absence of NVD/NVE, and...

Why is DFE inadequate as a surveillance method in CRVO?

Because very frequently, anterior-seg neo in CRVO occurs without neovascularization of the posterior segment.

Why is iris surveillance inadequate?

Because in some cases, NVA in CRVO occurs without neovascularization of the iris.

So, in CRVO NVI occurs in the absence of NVD/NVE, and NVA occurs in the absence of NVI.

When is the follow-up visit after PRP? One week; check IOP and assess response; re-treat if needed.

(No question—proceed when ready)
Re NVI after CRVO: According to the CVOS...

- What is the #1 predictor for neo?
Poor VA

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Very—over 50% of cases will develop it

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Somewhere in the 3-5 month range

OK, it makes sense that we want to preclude NVG. But wouldn't it be better to do this via DFE, looking for the onset of NVD/NVE?
No, that would be a distinctly inadequate strategy

Why is DFE inadequate as a surveillance method in CRVO?
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For many reasons, not least of which is the fact that so many CRVO pts have glaucoma.

In addition to checking IOP, what other glaucoma-related exam maneuver should be performed?
Gonioscopy.

What are you checking for via gonioscopy?
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  - No, that would be a distinctly inadequate strategy. Gonio must be performed at every visit.

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CVOS recs re macular edema after CRVO...

- Wait for spontaneous resolution
- Perform grid macular laser (GML) if:
  - VA is to , and
  - FA reveals
- Per CVOS, patients treated with GML are:
  - twice as likely to , and
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*Trick question! The CVOS demonstrated that GML improved macular edema *angiographically*, but did not improve vision. For this reason, **GML is contraindicated in CRVO!**
What are the options for CRVO tx?

Two categories of treatment

??
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Surgical  Pharmacologic
Q

What are the options for CRVO tx?

Surgical

? Two specific treatments?

Pharmacologic
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- **Surgical**
  - Vitrectomy
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What are the options for CRVO tx?

- Surgical
  - Vitrectomy
  - PRP
- Pharmacologic
  - Anti-VEGF
  - Steroids

Two specific treatments
We’ve already addressed PRP
(tl;dr Do it at the first sign of NVI)
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What are the three anti-VEGF meds that have been used in clinical trials for the tx of CRVO?
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CRVO tx

Surgical

Pharmacologic

Anti-VEGF

Ranibizumab

Bevacizumab

Aflibercept

Steroids

The clinical trials that had these results—what injection schedule did they use?

Monthly

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PRP

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Of the three, which works best?
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Pharmacologic
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Of the three, which works best? None (ie, all are of equal efficacy)
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What are the two means of IVit steroid delivery?
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Pharmacologic
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  - Steroids
    - Intravitreal injection
    - Intravitreal implant
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What complications/side effects were revealed in IVit steroid clinical trials?
The same two that dog all chronic ocular steroid use—cataract formation and IOP elevation
Finally: Is anti-coagulation therapy indicated in the management of CRVO?
Finally: Is anti-coagulation therapy indicated in the management of CRVO? No. Not only has it failed to demonstrate efficacy, it has been shown to worsen the intraretinal hemorrhages.