Horner Syndrome

- Cause: *Sympathetic dysfunction*
- Triad:
  - Ptosis
  - Miosis
  - Anhidrosis
Horner Syndrome

- **Cause:** *Sympathetic dysfunction*
- **Triad:**
  - Ptosis
  - Miosis
  - Anhidrosis
What does the term ‘ptosis’ mean in this context?

Both

The upper lid is too...low
The lower lid is too...high
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - Ptosis
  - Miosis
  - Anhidrosis

**What does the term ‘ptosis’ mean in this context?**

It describes an abnormal and unintended narrowing of the interpupillary fissure.
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - **Ptosis**

What does the term ‘ptosis’ mean in this context?
It describes an abnormal and unintended narrowing of the interpalpebral fissure

In Horner syndrome, does this ‘abnormal narrowing’ involve the upper lid, the lower lid, or both?
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - **Ptosis**

**What does the term ‘ptosis’ mean in this context?**
It describes an abnormal and unintended narrowing of the interpalpebral fissure.

*In Horner syndrome, does this ‘abnormal narrowing’ involve the upper lid, the lower lid, or both?*
Both
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - **Ptosis**

What does the term ‘ptosis’ mean in this context?
It describes an abnormal and unintended narrowing of the interpalpebral fissure

In Horner syndrome, does this ‘abnormal narrowing’ involve the upper lid, the lower lid, or both?
Both

With regard to each lid, how is it (mal)positioned in ptosis secondary to Horners?
The upper lid is too…
The lower lid is too…
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - **Ptosis**

*What does the term ‘ptosis’ mean in this context?*
It describes an abnormal and unintended narrowing of the interpalpebral fissure.

*In Horner syndrome, does this ‘abnormal narrowing’ involve the upper lid, the lower lid, or both?*
Both

*With regard to each lid, how is it (mal)positioned in ptosis 2ndry to Horners?*
The upper lid is too…low
The lower lid is too…high
Horner Syndrome

- Cause: Sympathetic dysfunction
- Triad:
  - Ptosis

What does the term ‘ptosis’ mean in this context?
It describes an abnormal and unintended narrowing of the interpalpebral fissure.

In Horner syndrome, does this ‘abnormal narrowing’ involve the upper lid, the lower lid, or both?
Both

With regard to each lid, how is it (mal)positioned in ptosis 2ndry to Horner's?
The upper lid is too... low.
The lower lid is too... high.

Note: Some authors refer to this malpositioning of the LL as ‘reverse ptosis;' however, to the best of my ability to ascertain, this term does not appear in any BCSC book.
Horner Syndrome

- Cause: Sympathetic dysfunction
- Triad:
  - Ptosis

What does the term 'ptosis' mean in this context?

It describes an abnormal and unintended narrowing of the interpalpebral fissure.

In Horner syndrome, does this 'abnormal narrowing' involve the upper lid, the lower lid, or both?

Both

With regard to each lid, how is it (mal)positioned in ptosis secondary to Horner's?

The upper lid is too...low
The lower lid is too...high

What muscle is most influential in terms of positioning the upper lid?

The levator palpebrae superioris

What nerve innervates the levator?

CN3

Is levator dysfunction implicated in the ptosis associated with Horner's?

No
Horner Syndrome

- **Cause:** *Sympathetic dysfunction*
- **Triad:**
  - **Ptosis**

What muscle is most influential in terms of positioning the upper lid?
The levator palpebrae superioris

What nerve innervates the levator?
CN3

Is levator dysfunction implicated in the ptosis associated with Horner’s?
No

What does the term ‘ptosis’ mean in this context?
It describes an abnormal and unintended narrowing of the interpalpebral fissure.

With regard to each lid, how is it (mal)positioned in ptosis secondary to Horner’s?
- **Upper lid:** too...low
- **Lower lid:** too...high
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - Ptosis
  - Miosis
  - Anhidrosis

What does the term 'ptosis' mean in this context?

It describes an abnormal and unintended narrowing of the interpalpebral fissure.

In Horner syndrome, does this 'abnormal narrowing' involve the upper lid, the lower lid, or both?

Both

With regard to each lid, how is it (mal)positioned in ptosis secondary to Horner's?

- The upper lid is too...low
- The lower lid is too...high

What muscle is most influential in terms of positioning the upper lid?

The levator palpebrae superioris

What nerve innervates the levator?

CN3

Is levator dysfunction implicated in the ptosis associated with Horner's?

No
Horner Syndrome

- **Cause**: Sympathetic dysfunction
- **Triad**:
  - **Ptosis**

What does the term 'ptosis' mean in this context?
It describes an abnormal and unintended narrowing of the interpalpebral fissure. In Horner syndrome, does this 'abnormal narrowing' involve the upper lid, the lower lid, or both?
Both

With regard to each lid, how is it (mal)positioned in ptosis due to Horner’s?
The upper lid is too... low
The lower lid is too... high

What muscle is most influential in terms of positioning the upper lid?
The levator palpebrae superioris

What nerve innervates the levator?
CN3

Is levator dysfunction implicated in the ptosis associated with Horner’s?
No
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - **Ptosis**

What does the term 'ptosis' mean in this context?

It describes an abnormal and unintended narrowing of the interpalpebral fissure.

In Horner syndrome, does this 'abnormal narrowing' involve the upper lid, the lower lid, or both?

Both

With regard to each lid, how is it (mal)positioned in ptosis secondary to Horner's?

- The upper lid is too...low
- The lower lid is too...high

What muscle is most influential in terms of positioning the upper lid?
The levator palpebrae superioris

What nerve innervates the levator?
CN3

Is levator dysfunction implicated in the ptosis associated with Horner's?

No
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - **Ptosis**
    - What muscle is most influential in terms of positioning the upper lid? The levator palpebrae superioris
    - What nerve innervates the levator? CN3
    - Is levator dysfunction implicated in the ptosis associated with Horner’s? No
    - The upper lid is too...low
    - The lower lid is too...high

- **Triad:**
  - Ptosis
  - Miosis
  - Anhidrosis
**Horner Syndrome**

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - **Ptosis**

*What does the term 'ptosis' mean in this context?*

It describes an abnormal and unintended narrowing of the interpalpebral fissure.

*In Horner syndrome, does this 'abnormal narrowing' involve the upper lid, the lower lid, or both?*

Both

*With regard to each lid, how is it (mal)positioned in ptosis secondary to Horner’s?*

The upper lid is too...low

The lower lid is too...high

*What muscle is most influential in terms of positioning the upper lid?*

The levator palpebrae superioris

*What nerve innervates the levator?*

CN3

*Is levator dysfunction implicated in the ptosis associated with Horner’s?*

No

*If not the levator, what named muscle is implicated in the ptosis associated with Horner’s?*

Müller’s muscle

*Are the fibers in Müller’s muscle striated, or smooth?*

Smooth

*Where is Müller’s muscle located?*

It forms a narrow strip between the distal tendon of the levator and the tarsal plate of the upper lid.
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - **Ptosis**

What does the term 'ptosis' mean in this context?
It describes an abnormal and unintended narrowing of the interpalpebral fissure.

In Horner syndrome, does this 'abnormal narrowing' involve the upper lid, the lower lid, or both?
Both

With regard to each lid, how is it (mal)positioned in ptosis secondary to Horners?
The upper lid is too...low.
The lower lid is too...high.

What muscle is most influential in terms of positioning the upper lid?
The levator palpebrae superioris.

What nerve innervates the levator?
CN3

Is levator dysfunction implicated in the ptosis associated with Horners?
No

If not the levator, what named muscle is implicated in the ptosis associated with Horners?
Müller’s muscle

Are the fibers in Müller’s muscle striated, or smooth?
Smooth

Where is Müller’s muscle located?
It forms a narrow strip between the distal tendon of the levator and the tarsal plate of the upper lid.
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - **Ptosis**

What does the term 'ptosis' mean in this context?
It describes an abnormal and unintended narrowing of the interpalpebral fissure.

In Horner syndrome, does this 'abnormal narrowing' involve the upper lid, the lower lid, or both?
Both

With regard to each lid, how is it (mal)positioned in ptosis secondary to Horner's?
The upper lid is too...low
The lower lid is too...high

What muscle is most influential in terms of positioning the upper lid?
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What nerve innervates the levator?
CN3

Is levator dysfunction implicated in the ptosis associated with Horner's?
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If not the levator, what named muscle is implicated in the ptosis associated with Horner's?
Müller's muscle

Are the fibers in Müller's muscle striated, or smooth?
Smooth

Where is Müller's muscle located?
It forms a narrow strip between the distal tendon of the levator and the tarsal plate of the upper lid.
**Horner Syndrome**

- **Cause:** *Sympathetic dysfunction*
- **Triad:**
  - **Ptosis**

**What does the term 'ptosis' mean in this context?**
It describes an abnormal and unintended narrowing of the interpalpebral fissure.

In Horner syndrome, does this 'abnormal narrowing' involve the upper lid,
the lower lid, or both?
Both

What muscle is most influential in terms of positioning the upper lid?
The levator palpebrae superioris

What nerve innervates the levator?
CN3

Is levator dysfunction implicated in the ptosis associated with Horner's?
No

If not the levator, what named muscle is implicated in the ptosis associated with Horner's?
Müller’s muscle

Are the fibers in Müller’s muscle striated, or smooth?
Smooth

The upper lid is too... low
The lower lid is too... high
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - **Ptosis**

What muscle is most influential in terms of positioning the upper lid?
The levator palpebrae superioris

What nerve innervates the levator?
CN3

Is levator dysfunction implicated in the ptosis associated with Horner's?
No

The upper lid is too...low
The lower lid is too...high

If not the levator, what named muscle is implicated in the ptosis associated with Horner's?
Müller’s muscle

Are the fibers in Müller’s muscle striated, or smooth?
Smooth

Smooth muscle fibers...What does this imply about the innervation of Müller’s muscle?

It implies its innervation is via the ANS (in this case, the sympathetic branch of the ANS)
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - **Ptosis**

  What muscle is most influential in terms of positioning the upper lid?
  The levator palpebrae superioris

  What nerve innervates the levator?
  CN3

  Is levator dysfunction implicated in the ptosis associated with Horner's?
  No

  The upper lid is too...low
  The lower lid is too...high

  If not the levator, what named muscle is implicated in the ptosis associated with Horner's?
  Müller's muscle

  Are the fibers in Müller's muscle striated, or smooth?
  Smooth

  Smooth muscle fibers...What does this imply about the innervation of Müller's muscle?
  It implies its innervation is via the ANS (in this case, the sympathetic branch of the ANS)
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - **Ptosis**

What does the term 'ptosis' mean in this context?

It describes an abnormal and unintended narrowing of the interpalpebral fissure in Horner syndrome. Does this 'abnormal narrowing' involve the upper lid, the lower lid, or both?

Both

With regard to each lid, how is it (mal)positioned in ptosis secondary to Horner's?

- The upper lid is too...low
- The lower lid is too...high

What muscle is most influential in terms of positioning the upper lid?

The levator palpebrae superioris

What nerve innervates the levator?

CN3

Is levator dysfunction implicated in the ptosis associated with Horner's?

No

If not the levator, what named muscle is implicated in the ptosis associated with Horner's?

Müller's muscle

Are the fibers in Müller’s muscle striated, or smooth?

Smooth

Where is Müller's muscle located?
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - **Ptosis**

What muscle is most influential in terms of positioning the upper lid?
The levator palpebrae superioris

What nerve innervates the levator?
CN3

Is levator dysfunction implicated in the ptosis associated with Horner’s?
No

If not the levator, what named muscle is implicated in the ptosis associated with Horner’s?
Müller’s muscle

Are the fibers in Müller’s muscle striated, or smooth?
Smooth

Where is Müller’s muscle located?
Deep to the distal tendon of the levator; it attaches to the superior border of the tarsal plate of the upper lid
Horner Syndrome

Müller’s muscle
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - **Ptosis**

What does the term 'ptosis' mean in this context?

It describes an abnormal and unintended narrowing of the interpalpebral fissure.

In Horner syndrome, does this 'abnormal narrowing' involve the upper lid, the lower lid, or both?

Both

With regard to each lid, how is it (mal)positioned in ptosis secondary to Horner's?

- The upper lid is too... low
- The lower lid is too... high

What muscle is most influential in terms of positioning the upper lid?

*levator palpebrae superioris*

What nerve innervates the levator?

CN3

Is levator dysfunction implicated in the ptosis associated with Horner's?

No

If not the levator, what named muscle is implicated in the ptosis associated with Horner's?

*Müller's muscle*

Are the fibers in Müller's muscle striated, or smooth?

Smooth

Where is Müller's muscle located?

Deep to the distal tendon of the levator; it attaches to the superior border of the tarsal plate of the upper lid.
**Cause:** Sympathetic dysfunction

**Triad:**
- **Ptosis**

What does the term 'ptosis' mean in this context? It describes an abnormal and unintended narrowing of the interpalpebral fissure.

In Horner syndrome, does this 'abnormal narrowing' involve the upper lid, the lower lid, or both? Both.

With regard to each lid, how is it (mal)positioned in ptosis secondary to Horner's? The upper lid is too...low, the lower lid is too...high.

What muscle is most influential in terms of positioning the upper lid? The levator palpebrae superioris.

If innervation to the levator is lost, how much ptosis results? Total/complete—the lid is closed.

Is levator dysfunction implicated in the ptosis associated with Horner's? No.

If not the levator, what named muscle is implicated in the ptosis associated with Horner's? Müller's muscle.

Are the fibers in Müller's muscle striated, or smooth? Smooth.

Where is Müller's muscle located? Deep to the distal tendon of the levator; it attaches to the superior border of the tarsal plate of the upper lid.
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - **Ptosis**

What does the term 'ptosis' mean in this context? It describes an abnormal and unintended narrowing of the interpalpebral fissure. In Horner syndrome, does this 'abnormal narrowing' involve the upper lid, the lower lid, or both? Both.

With regard to each lid, how is it (mal)positioned in ptosis secondary to Horner's? The upper lid is too...low, and the lower lid is too...high.

What muscle is most influential in terms of positioning the upper lid? The levator palpebrae superioris.

If innervation to the levator is lost, how much ptosis results? Total/complete—the lid is closed.

If innervation to Müller’s muscle is lost, how much ptosis results? Not nearly so much—about 2 mm or so.

Where is Müller’s muscle located? Deep to the distal tendon of the levator; it attaches to the superior border of the tarsal plate of the upper lid.

Are the fibers in Müller’s muscle striated, or smooth? Smooth.

Is levator dysfunction implicated in the ptosis associated with Horner’s? No.
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - Ptosis
  - Miosis
  - Anhidrosis

**Ptosis**

What muscle is most influential in terms of positioning the upper lid?
- **levator palpebrae superioris**

*If innervation to the levator is lost, how much ptosis results?*
- Total/complete—the lid is closed

*If innervation to Müller’s muscle is lost, how much ptosis results?*
- Not nearly so much—about 2 mm or so

Are the fibers in Müller’s muscle striated, or smooth?
- Smooth

Where is Müller’s muscle located?
- Deep to the distal tendon of the levator; it attaches to the superior border of the tarsal plate of the upper lid

What does the term ‘ptosis’ mean in this context?
- It describes an abnormal and unintended narrowing of the interpalpebral fissure

In Horner syndrome, does this ‘abnormal narrowing’ involve the upper lid, the lower lid, or both?
- Both

With regard to each lid, how is it (mal)positioned in ptosis secondary to Horner’s?
- The upper lid is too...low
- The lower lid is too...high

Is levator dysfunction implicated in the ptosis associated with Horner’s?
- No

If not the levator, what named muscle is implicated in the ptosis associated with Horner’s?
- Müller’s muscle
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - Ptosis
  - Miosis
  - Anhidrosis

What does the term 'ptosis' mean in this context?

- It describes an abnormal and unintended narrowing of the interpalpebral fissure.

In Horner syndrome, does this 'abnormal narrowing' involve the upper lid, the lower lid, or both?

- Both

With regard to each lid, how is it (mal)positioned in ptosis secondary to Horner's?

- The upper lid is too...low
- The lower lid is too...high

What muscle is most influential in terms of positioning the upper lid?

- The levator palpebrae superioris

If innervation to the levator is lost, how much ptosis results?

- Total/complete—the lid is closed

If innervation to Müller’s muscle is lost, how much ptosis results?

- Not nearly so much—about 2 mm or so

Is levator dysfunction implicated in the ptosis associated with Horner’s?

- No

If not the levator, what named muscle is implicated in the ptosis associated with Horner’s?

- Müller’s muscle

Are the fibers in Müller’s muscle striated, or smooth?

- Smooth

Where is Müller’s muscle located?

- Deep to the distal tendon of the levator; it attaches to the superior border of the tarsal plate of the upper lid.
Horner Syndrome

Horner’s ptosis in adult

Horner’s ptosis in infant

Horner syndrome: Ptosis
Horner Syndrome

Horner’s ptosis in adult

\textbf{Not} Horner’s ptosis in child (ptoo ptotic)

Horner’s ptosis in infant

\textbf{Not} Horner’s ptosis in adult (ptoo ptotic)

Horner syndrome: Ptosis
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - Ptosis
  - Miosis
  - Anhidrosis

**What does the term 'ptosis' mean in this context?**
It describes an abnormal and unintended narrowing of the interpalpebral fissure.

**In Horner syndrome, does this 'abnormal narrowing' involve the upper lid, the lower lid, or both?**
Both.

**With regard to each lid, how is it (mal)positioned in ptosis secondary to Horner's?**
The upper lid is too low.
The lower lid is too high.

**What muscle is most influential in terms of positioning the upper lid?**
The levator palpebrae superioris.

**What nerve innervates the levator?**
CN3.

**Is levator dysfunction implicated in the ptosis associated with Horner's?**
No.

**If not the levator, what named muscle is implicated in the ptosis associated with Horner's?**
Müller's muscle.

**Are the fibers in Müller's muscle striated, or smooth?**
Smooth.

**Where is Müller's muscle located?**
Deep to the distal tendon of the levator; it attaches to the superior border of the tarsal plate of the upper lid.

**If Müller's muscle is in the upper lid, what accounts for the Horner-related ptosis of the lower lid?**
The lower lid contains a set of smooth-muscle fibers that function in a manner analogous to Müller's muscle, and are innervated in identical fashion. (These LL fibers are less-organized and far weaker than those comprising Müller's muscle.)
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - **Ptosis**

**What muscle is most influential in terms of positioning the upper lid?**
The levator palpebrae superioris

**What nerve innervates the levator?**
CN3

**Is levator dysfunction implicated in the ptosis associated with Horner's?**
No

With regard to each lid, how is it (mal)positioned in ptosis secondary to Horner's?
The upper lid is too...low
The lower lid is too...high

**If Müller's muscle is in the upper lid, what accounts for the Horner-related ptosis of the lower lid?**
The lower lid contains a set of smooth-muscle fibers that function in a manner analogous to Müller’s muscle, and are innervated in identical fashion. (These LL fibers are less-organized and far weaker than those comprising Müller’s muscle.)

Deep to the distal tendon of the levator, it attaches to the superior border of the tarsal plate of the upper lid.
Horner Syndrome

- Cause: Sympathetic dysfunction
- Triad:
  - Ptosis

What muscle is most influential in terms of positioning the upper lid?
The levator palpebrae superioris

What nerve innervates the levator?
CN3

Is levator dysfunction implicated in the ptosis associated with Horner’s?
No

With regard to each lid, how is it positioned in ptosis secondary to Horner’s?
The upper lid is too…low
The lower lid is too…high

What muscle is most influential in terms of positioning the upper lid?
The levator palpebrae superioris

What nerve innervates the levator?
CN3

Is levator dysfunction implicated in the ptosis associated with Horner’s?
No

If not the levator, what named muscle is implicated in the ptosis associated with Horner’s?
Müller’s muscle

Are the fibers in Müller’s muscle striated, or smooth?
Smooth

Where is Müller’s muscle located?
Deep to the distal tendon of the levator; it attaches to the superior border of the tarsal plate of the upper lid

If Müller’s muscle is in the upper lid, what accounts for the Horner-related ptosis of the lower lid?
A set of smooth-muscle fibers in the lower lid, that function in a manner analogous to Müller’s muscle, and are innervated in identical fashion. (These LL fibers are less organized and far weaker than those comprising Müller’s muscle.)

Does this collection of LL smooth muscle fibers have a name?
Not really (although it is sometimes referred to as the capsulopalpebral muscle because of its location)
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - **Ptosis**
  - **Miosis**
  - **Anhidrosis**

What does the term 'ptosis' mean in this context?

It describes an abnormal and unintended narrowing of the interpalpebral fissure.

In Horner syndrome, does this 'abnormal narrowing' involve the upper lid, the lower lid, or both?

Both

With regard to each lid, how is it (mal)positioned in ptosis secondary to Horner's?

The upper lid is too...low

The lower lid is too...high

What muscle is most influential in terms of positioning the upper lid?

The levator palpebrae superioris

What nerve innervates the levator?

CN3

Is levator dysfunction implicated in the ptosis associated with Horner's?

No

If not the levator, what named muscle is implicated in the ptosis associated with Horner's?

Müller's muscle

Are the fibers in Müller's muscle striated, or smooth?

Smooth

Where is Müller's muscle located?

Deep to the distal tendon of the levator; it attaches to the superior border of the tarsal plate of the upper lid

If Müller's muscle is in the upper lid, what accounts for the Horner-related ptosis of the lower lid?

A set of smooth-muscle fibers that function in a manner analogous to Müller's muscle, and are innervated in identical fashion. (These LL fibers are less-organized and far weaker than those comprising Müller's muscle.)

Does this collection of LL smooth muscle fibers have a name?

Not really (although it is sometimes referred to as the muscle because of its location)
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - **Ptosis**

What muscle is most influential in terms of positioning the upper lid?
The levator palpebrae superioris

What nerve innervates the levator?
CN3

Is levator dysfunction implicated in the ptosis associated with Horner's syndrome?
No

With regard to each lid, note...
The upper lid is too... low
The lower lid is too... high

If not the levator, what named muscle is implicated in the ptosis associated with Horner's syndrome?
Müller's muscle

Are the fibers in Müller's muscle striated, or smooth?
Smooth

Where is Müller's muscle located?
Deep to the distal tendon of the levator; it attaches to the superior border of the tarsal plate of the upper lid, the... palpebral fissure

If Müller's muscle is in the upper lid, what accounts for the Horner-related ptosis of the lower lid?
The lower lid contains a set of smooth-muscle fibers that function in a manner analogous to Müller's muscle, and are innervated in identical fashion. (These LL fibers are less organized and far weaker.)

Does this collection of LL smooth muscle fibers have a name?
Not really (although it is sometimes referred to as the capsulopalpebral muscle because of its location)
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - Ptosis
  - **Miosis**

How does sympathetic dysfunction result in a relatively miosis pupil?
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - Ptosis
  - Miosis

How does sympathetic dysfunction result in a relatively miotic pupil? At any given moment, the size of a pupil is determined by the sum total of sympathetic and parasympathetic innervation being received by its dilator and sphincter muscles, respectively.
Horner Syndrome

• Cause: *Sympathetic dysfunction*

• Triad:
  • Ptosis
  • **Miosis**

*How does sympathetic dysfunction result in a relatively miotic pupil?*

At any given moment, the size of a pupil is determined by the sum total of sympathetic and parasympathetic innervation being received by its dilator and sphincter muscles, respectively. Thus, if the amount of sympathetic (=pro-dilating) innervation is reduced in one eye, its relatively unopposed parasympathetic (=pro-miosing) inputs will have an outsized effect, and its pupil will be relatively miosed in comparison to that of the fellow eye.
Horner Syndrome

Horner’s miosis in adult

Horner’s miosis in infant

Horner syndrome: Miosis
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - Ptosis
  - Miosis

‘Relatively miotic’ implies the pupils are not the same size. What term describes a state of unequal pupil sizes?

How does sympathetic dysfunction result in a relatively miotic pupil?
At any given moment, the size of a pupil is determined by the sum total of sympathetic and parasympathetic innervation being received by its dilator and sphincter muscles, respectively. Thus, if the amount of sympathetic (=pro-dilating) innervation is reduced in one eye, its relatively unopposed parasympathetic (=pro-miosing) inputs will have an outsized effect, and its pupil will be relatively miosed in comparison to that of the fellow eye.
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - Ptosis
  - Miosis

‘Relatively miotic’ implies the pupils are not the same size. What term describes a state of unequal pupil sizes?
Anisocoria

How does sympathetic dysfunction result in a relatively miotic pupil?
At any given moment, the size of a pupil is determined by the sum total of sympathetic and parasympathetic innervation being received by its dilator and sphincter muscles, respectively. Thus, if the amount of sympathetic (=pro-dilating) innervation is reduced in one eye, its relatively unopposed parasympathetic (=pro-miosing) inputs will have an outsized effect, and its pupil will be relatively miosed in comparison to that of the fellow eye.
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - Ptosis
  - Miosis

'Relatively miotic' implies the pupils are not the same size. What term describes a state of unequal pupil sizes?

**Anisocoria**

When faced with anisocoria, what do you want to know first and foremost?

By determining the lighting condition under which the anisocoria is more pronounced. If the anisocoria is more pronounced in **dim** light, this indicates the smaller pupil isn't dilating properly, and thus is abnormal. A pupil that fails to dilate is suggestive of a sympathetic problem. Likewise, if the anisocoria is more pronounced in **bright** light, the larger pupil isn't constricting properly, and is therefore abnormal. A pupil that doesn't constrict as it should is suggestive of a parasympathetic problem.
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - Ptosis
  - Miosis

‘Relatively miotic’ implies the pupils are not the same size. What term describes a state of unequal pupil sizes?

Anisocoria

When faced with anisocoria, what do you want to know first and foremost?

Which pupil (if either) is ‘the culprit’; ie, is the larger pupil failing to constrict properly, or is the smaller pupil failing to dilate properly?

At any given moment, the size of a pupil is determined by the sum total of sympathetic and parasympathetic innervation being received by its dilator and sphincter muscles, respectively. Thus, if the amount of sympathetic (=pro-dilating) innervation is reduced in one eye, its relatively unopposed parasympathetic (=pro-miosis) inputs will have an outsized effect, and its pupil will be relatively miotic in comparison to that of the fellow eye.

If the anisocoria is more pronounced in dim light, this indicates the smaller pupil isn’t dilating properly, and thus is abnormal. A pupil that fails to dilate is suggestive of a sympathetic problem. Likewise, if the anisocoria is more pronounced in bright light, the larger pupil isn’t constricting properly, and is therefore abnormal. A pupil that doesn’t constrict as it should is suggestive of a parasympathetic problem.
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - Ptosis
  - Miosis

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**Anisocoria**

When faced with anisocoria, what do you want to know first and foremost?
Which pupil (if either) is 'the culprit'; ie, is the larger pupil failing to constrict properly, or is the smaller pupil failing to dilate properly?

How can you tell which pupil is the culprit?

At any given moment, the size of a pupil is determined by the sum total of sympathetic and parasympathetic innervation being received by its dilator and sphincter muscles, respectively. Thus, if the amount of sympathetic (=pro-dilating) innervation is reduced in one eye, its relatively unopposed parasympathetic (=pro-miotic) inputs will have an outsized effect, and its pupil will be relatively miotic in comparison to that of the fellow eye.
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - Ptosis
  - Miosis

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Anisocoria

When faced with anisocoria, what do you want to know first and foremost? Which pupil (if either) is 'the culprit'; ie, is the larger pupil failing to constrict properly, or is the smaller pupil failing to dilate properly?

**How can you tell which pupil is the culprit?**

By determining the lighting condition under which the anisocoria is more pronounced. If the anisocoria is more pronounced in **dim** light, this indicates the smaller pupil isn't dilating properly, and thus is abnormal. A pupil that fails to dilate is suggestive of a **sympathetic** problem.
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - Ptosis
  - Miosis

'Relatively miotic' implies the pupils are not the same size. What term describes a state of unequal pupil sizes?

When faced with anisocoria, what do you want to know first and foremost?
Which pupil (if either) is 'the culprit'; i.e., is the larger pupil failing to constrict properly, or is the smaller pupil failing to dilate properly?

How can you tell which pupil is the culprit?
By determining the lighting condition under which the anisocoria is more pronounced. If the anisocoria is more pronounced in **dim** light, this indicates the smaller pupil isn't dilating properly, and thus is abnormal. A pupil that fails to dilate is suggestive of a sympathetic problem.
Horner Syndrome

Horner syndrome: Anisocoria greater in dim light
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - Ptosis
  - Miosis

How does sympathetic dysfunction result in a relatively miotic pupil?

At any given moment, the size of a pupil is determined by the sum total of sympathetic and parasympathetic innervation being received by its dilator and sphincter muscles, respectively. Thus, if the amount of sympathetic (=pro-dilating) innervation is reduced in one eye, its relatively unopposed parasympathetic (=pro-miosing) inputs will have an outsized effect, and its pupil will be relatively miosed in comparison to that of the fellow eye.

'Relatively miotic' implies the pupils are not the same size. What term describes a state of unequal pupil sizes?

Anisocoria

When faced with anisocoria, what do you want to know first and foremost?

Which pupil (if either) is 'the culprit'; i.e., is the larger pupil failing to constrict properly, or is the smaller pupil failing to dilate properly?

How can you tell which pupil is the culprit?

By determining the lighting condition under which the anisocoria is more pronounced. If the anisocoria is more pronounced in dim light, this indicates the smaller pupil isn't dilating properly, and thus is abnormal. A pupil that fails to dilate is suggestive of a sympathetic problem. Likewise, if the anisocoria is more pronounced in bright light, the larger pupil isn't constricting properly, and is therefore abnormal. A pupil that doesn't constrict as it should is suggestive of a parasympathetic problem.
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - Ptosis
  - Miosis

‘Relatively miotic’ implies the pupils are not the same size. What term describes a state of unequal pupil sizes? Anisocoria

When faced with anisocoria, what do you want to know first and foremost?
Which pupil (if either) is ‘the culprit’; ie, is the larger pupil failing to constrict properly, or is the smaller pupil failing to dilate properly?

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**Horner Syndrome**

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - Ptosis
  - Miosis

’Relatively miotic’ implies the pupils are not the same size. What term describes a state of unequal pupil sizes?

- Anisocoria

When faced with anisocoria, what do you want to know first and foremost?

Which pupil (if either) is the culprit, is the larger pupil failing to constrict properly, or is the smaller pupil failing to dilate properly?

How can you tell which pupil is the culprit?

By determining the lighting condition under which the anisocoria is more pronounced. If the anisocoria is more pronounced in *dim* light, this indicates the smaller pupil isn’t dilating properly, and thus is abnormal. A pupil that fails to dilate is suggestive of a sympathetic problem. Likewise, if the anisocoria is more pronounced in *bright* light, the larger pupil isn’t constricting properly, and is therefore abnormal. A pupil that doesn’t constrict as it should is suggestive of a parasympathetic problem.

What if the anisocoria is the same under all lighting conditions?

Then it is nonpathologic or physiological anisocoria (a common finding).
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - Ptosis
  - Miosis
  - Anhidrosis

‘Relatively miotic’ implies the pupils are not the same size. What term describes a state of unequal pupil sizes?

Anisocoria

When faced with anisocoria, what do you want to know first and foremost?
Which pupil (if either) is ‘the culprit’, ie, is the larger pupil failing to constrict properly, or is the smaller pupil failing to dilate properly?

How can you tell which pupil is the culprit?
By determining the lighting condition under which the anisocoria is more pronounced. If the anisocoria is more pronounced in dim light, this indicates the smaller pupil isn’t dilating properly, and thus is abnormal. A pupil that fails to dilate is suggestive of a sympathetic problem.
Likewise, if the anisocoria is more pronounced in bright light, the larger pupil isn’t constricting properly, and is therefore abnormal. A pupil that doesn’t constrict as it should is suggestive of a parasympathetic problem.

What if the anisocoria is the same under all lighting conditions?
Then it is nonpathologic or physiological anisocoria (a common finding).
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - Ptosis
  - Miosis

[Yellow rounded box]

'Relatively miotic' implies the pupils are not the same size.
What term describes a state of unequal pupil sizes?

- Anisocoria

Purple rounded box:

When faced with anisocoria, what do you want to know first and foremost?
Which pupil (if either) is 'the culprit'; i.e., is the larger pupil failing to constrict properly, or is the
smaller pupil failing to dilate properly?

How can you tell which pupil is the culprit?

By determining the lighting condition under which the anisocoria is more pronounced. If the
anisocoria is more pronounced in dim light, this indicates the smaller pupil isn't dilating properly,
and thus is abnormal. A pupil that fails to dilate is suggestive of a sympathetic problem.
Likewise, if the anisocoria is more pronounced in bright light, the larger pupil isn't constricting
properly, and is therefore abnormal. A pupil that doesn't constrict as it should is suggestive of a
parasympathetic problem.

*Next we will embark on an extensive review of the sympathetic pathway (and less extensively, the parasympathetic) as it relates to the eye and orbit. Buckle up!*
Horner Syndrome

*Neural pathway in Horner syndrome:*

- **First of three components**
- **Second of three components**
- **Third of three components**
Horner Syndrome

*Neural pathway in Horner syndrome:*

First-order neurons

Second-order neurons

Third-order neurons
Horner Syndrome

*Neural pathway in Horner syndrome:*

**First-order neurons**
--Originate in hypothalamus

**Second-order neurons**
--Originates at Budge center
--Exits spinal cord
--Travels in sympathetic chain
--Synapses in superior cervical ganglion

**Third-order neurons**
--Originates in superior cervical ganglion
--Travels with internal carotid artery into cavernous sinus
--Hops onto VI, then V1 to enter orbit
Horner Syndrome

Neural pathway in Horner syndrome:
First-order neurons
--Originate in hypothalamus

Second-order neurons

Third-order neurons
Horner Syndrome

*Neural pathway in Horner syndrome:*

**First-order neurons**
--Originate in hypothalamus
--Travel in two words

**Second-order neurons**

**Third-order neurons**
Horner Syndrome

*Neural pathway in Horner syndrome:*

**First-order neurons**
--Origin in hypothalamus
--Travel in spinal cord

Second-order neurons

Third-order neurons
Horner Syndrome

Neural pathway in Horner syndrome:

First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons

Third-order neurons
Horner Syndrome

*Neural pathway in Horner syndrome:*

**First-order neurons**
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

**Second-order neurons**

**Third-order neurons**
Horner Syndrome

Neural pathway in Horner syndrome:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons

Third-order neurons

At what level of the spinal cord is the center of Budge found?

C8-T2
Horner Syndrome

Neural pathway in Horner syndrome:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons

Third-order neurons

At what level of the spinal cord is the center of Budge found?
C8-T2
Horner Syndrome

Müller's muscle
Horner Syndrome

*Neural pathway in Horner syndrome:*

**First-order neurons**
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

**Second-order neurons**
--Originate at Budge center
--Exit two words

**Third-order neurons**
Horner Syndrome

*Neural pathway in Horner syndrome:*

**First-order neurons**
--Origin in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

**Second-order neurons**
--Origin in Budge center
--Exit spinal cord

**Third-order neurons**
Horner Syndrome

*Neural pathway in Horner syndrome:*

**First-order neurons**
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

**Second-order neurons**
--Originate at Budge center
--Exit spinal cord
--Travel in...
Horner Syndrome

*Neural pathway in Horner syndrome:*

**First-order neurons**
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

**Second-order neurons**
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain

**Third-order neurons**
Horner Syndrome

*Neural pathway in Horner syndrome:*
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain

Third-order neurons

**What major structure do these fibers pass over?** The lung apex
Horner Syndrome

*Neural pathway in Horner syndrome:*
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain

Third-order neurons

*What major structure do these fibers pass over?*
The lung apex
Horner Syndrome

*Neural pathway in Horner syndrome:*

First-order neurons
--Origin in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons
--Origin at Budge center
--Exit spinal cord
--Travel in sympathetic chain

Third-order neurons

---

What major structure do these fibers pass over?

*The lung apex*  

Foreshadowing alert!
Horner Syndrome

Neural pathway in Horner syndrome:

First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in three words

Third-order neurons
Horner Syndrome

*Neural pathway in Horner syndrome:*

**First-order neurons**
- Originate in hypothalamus
- Travel in spinal cord
- Synapse in ciliospinal center of Budge

**Second-order neurons**
- Originate at Budge center
- Exit spinal cord
- Travel in sympathetic chain
- Synapse in superior cervical ganglion

**Third-order neurons**
Horner Syndrome

Sympathetic pathway: 2\textsuperscript{nd} order neuron
Horner Syndrome

*Neural pathway in Horner syndrome:*
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in *superior cervical ganglion aka*...

Third-order neurons

*By what other name is the superior cervical ganglion known?*
Horner Syndrome

*Neural pathway in Horner syndrome:*
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in **superior cervical ganglion** aka...the **stellate ganglion**

By what other name is the **superior cervical ganglion** known?
The **stellate ganglion**
Horner Syndrome

*Neural pathway in Horner syndrome:*
- **First-order neurons**
  -- Originate in hypothalamus
  -- Travel in spinal cord
  -- Synapse in ciliospinal center of Budge

**Second-order neurons** *aka...?*
- Originate at Budge center
- Exit spinal cord
- Travel in sympathetic chain
- Synapse in superior cervical ganglion *aka...the stellate ganglion*

**Third-order neurons**

*By what other name is the superior cervical ganglion known?*
*The stellate ganglion*

*Speaking of other names...The second-order neurons are often referred to by another name, one owing to the relationship between these neurons and the ganglion to which they are headed. What is that name?*
Horner Syndrome

Neural pathway in Horner syndrome:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons *aka...pre-ganglionic neurons*
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion *aka...the stellate ganglion*

Third-order neurons

*By what other name is the superior cervical ganglion known?*
The *stellate ganglion*

*Speaking of other names...The second-order neurons are often referred to by another name, one owing to the relationship between these neurons and the ganglion to which they are headed. What is that name?*
*Pre-ganglionic neurons*
Horner Syndrome

Neural pathway in Horner syndrome:

First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons aka...pre-ganglionic neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion aka...the stellate ganglion

Third-order neurons
--Originate in superior cervical ganglion

(No question—proceed when ready)
Horner Syndrome

Sympathetic pathway: 3rd order neuron
Horner Syndrome

Neural pathway in Horner syndrome:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons *aka*...*pre-ganglionic neurons*
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion *aka*...*the stellate ganglion*

Third-order neurons *aka*...?
--Originate in superior cervical ganglion

Likewise, the third-order neurons are also referred to by a term owing to their relationship with the stellate ganglion. What is that term?
Horner Syndrome

*Neural pathway in Horner syndrome:*
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in cilioospinal center of Budge

Second-order neurons *aka...pre-ganglionic neurons*
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion *aka...the stellate ganglion*

Third-order neurons *aka...post-ganglionic neurons*
--Originate in superior cervical ganglion

Likewise, the third-order neurons are also referred to by a term owing to their relationship with the stellate ganglion. What is that term?
**Post-ganglionic neurons**
Horner Syndrome

*Neural pathway in Horner syndrome:*

**First-order neurons**
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

**Second-order neurons** *aka*...pre-ganglionic neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion *aka*...the stellate ganglion

**Third-order neurons** *aka*...post-ganglionic neurons
--Originate in superior cervical ganglion
--Travel with three words to enter the two words
Horner Syndrome

Neural pathway in Horner syndrome:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons aka...pre-ganglionic neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion aka...the stellate ganglion

Third-order neurons aka...post-ganglionic neurons
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus
Horner Syndrome

Sympathetic pathway: 3rd order neuron
Horner Syndrome

Neural pathway in Horner syndrome:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons aka...pre-ganglionic neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion aka...the stellate ganglion

Third-order neurons aka...post-ganglionic neurons
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus
--In the sinus:
----Fibers bound for the pupil join cranial nerve, then different cranial nerve
Neural pathway in Horner syndrome:

First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons aka...pre-ganglionic neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion aka...the stellate ganglion

Third-order neurons aka...post-ganglionic neurons
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus
--In the sinus:
----Fibers bound for the pupil join CN6 , then V1

Horner Syndrome
Horner Syndrome

Sympathetic pathway: 3rd order neuron
Horner Syndrome

*Neural pathway in Horner syndrome:*
First-order neurons
--- Originate in hypothalamus
--- Travel in spinal cord
--- Synapse in cilio-spinal center of Budge

Second-order neurons  *aka...pre-ganglionic neurons*
--- Originate at Budge center
--- Exit spinal cord
--- Travel in sympathetic chain

*For how long do these pupil-bound postganglionic sympathetic fibers run with CN6?*

--- In the sinus:

---- Fibers bound for the pupil join  CN6, then  V1
Horner Syndrome

*Neural pathway in Horner syndrome:*
First-order neurons
--Origin in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons *aka...pre-ganglionic neurons*
--Origin at Budge center
--Exit spinal cord
--Travel in sympathetic chain

For how long do these pupil-bound postganglionic sympathetic fibers run with CN6?
Not long--just a few millimeters

--In the sinus:

----Fibers bound for the pupil join CN6, then V1
Horner Syndrome

Neural pathway in Horner syndrome:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons aka…pre-ganglionic neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain

For how long do these pupil-bound postganglionic sympathetic fibers run with CN6?
Not long--just a few millimeters

If it's so trivial, why bother mentioning the relationship at all?

---in the sinus:

----Fibers bound for the pupil join CN6, then V1
Horner Syndrome

Neural pathway in Horner syndrome:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons aka pre-ganglionic neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain

For how long do these pupil-bound postganglionic sympathetic fibers run with CN6?
Not long--just a few millimeters

If it's so trivial, why bother mentioning the relationship at all?
Because of its importance in lesion localization. If a pt presents with a LR palsy + ipsilateral miotic pupil, the lesion must be located in the cavernous sinus!

----Fibers bound for the pupil join CN6, then V1
Horner Syndrome

Neural pathway in Horner syndrome:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion

Third-order neurons
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus
--In the sinus:
----Fibers bound for the pupil join CN6, then V1

V1 (aka the ophthalmic nerve)
Horner Syndrome

Neural pathway in Horner syndrome:

First-order neurons
---Originate in hypothalamus
---Travel in spinal cord
---Synapse in ciliospinal center of Budge

Second-order neurons
---Originate at Budge center
---Exit spinal cord
---Travel in sympathetic chain
---Synapse in superior cervical ganglion

Third-order neurons
---Originate in superior cervical ganglion
---Travel with internal carotid artery to enter the cavernous sinus
----Fibers bound for the pupil join CN6, then V1
Horner Syndrome

Neural pathway in Horner syndrome:

First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion

Third-order neurons
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus
--In the sinus:
----Fibers bound for the pupil join CN6, then V1

V1 (aka the ophthalmic nerve) breaks into three branches. What are they?

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V1 (aka the ophthalmic nerve) breaks into three branches. What are they?
Horner Syndrome

Neural pathway in Horner syndrome:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion

Third-order neurons
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus
--In the sinus:
----Fibers bound for the pupil join CN6, then V1

V1 (aka the ophthalmic nerve) breaks into three branches. What are they?

Mnemonic forthcoming…
Horner Syndrome

Neural pathway in Horner syndrome:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion

Third-order neurons
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus
--In the sinus:
----Fibers bound for the pupil join CN6, then V1

V1 (aka the ophthalmic nerve) breaks into three branches. What are they?
--N
--F
--L

Mnemonic forthcoming…
Horner Syndrome

Neural pathway in Horner syndrome:

First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion

Third-order neurons
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus.

----Fibers bound for the pupil join CN6, then V1

V1 (aka the ophthalmic nerve) breaks into three branches. What are they?

--Nasociliary
--Frontal
--Lacrimal

Mnemonic forthcoming…
Horner Syndrome

Ophthalmic nerve ($V_1$)
Horner Syndrome

Neural pathway in Horner syndrome:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion

Third-order neurons
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus
--In the sinus:
----Fibers bound for the pupil join CN6, then V1

V1 (aka the ophthalmic nerve) breaks into three branches. What are they?
--Nasociliary
--Frontal
--Lacrimal

With which branch do the postganglionic sympathetics run?
Horner Syndrome

Neural pathway in Horner syndrome:

First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion

Third-order neurons
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus
--In the sinus:
----Fibers bound for the pupil join CN6, then V1

V1 (aka the ophthalmic nerve) breaks into three branches. What are they?
--Nasociliary
--Frontal
--Lacrimal

With which branch do the postganglionic sympathetics run?
The nasociliary

Horner Syndrome aka…pre-ganglionic neurons
aka…the stellate ganglion
aka…post-ganglionic neurons

V1 (aka the ophthalmic nerve) breaks into three branches. What are they?
--Nasociliary
--Frontal
--Lacrimal

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Neural pathway in Horner syndrome:

First-order neurons:
- Originate in hypothalamus
- Travel in spinal cord
- Synapse in ciliospinal center of Budge

Second-order neurons:
- Originate at Budge center
- Exit spinal cord
- Travel in sympathetic chain
- Synapse in superior cervical ganglion

Third-order neurons:
- Originate in superior cervical ganglion
- Travel with internal carotid artery to enter the cavernous sinus
- In the sinus:
  - Fibers bound for the pupil join CN6, then V1

Horner Syndrome

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The nasociliary nerve also carries preganglionic parasympathetics in need of a ganglion in which to synapse. To which ganglion are these fibers headed?

The ciliary ganglion

Upon leaving the ganglion, with which nerves do the sympathetics ride on their way to the dilator muscle?
The long ciliary nerves
Horner Syndrome

Neural pathway in Horner syndrome:

First-order neurons --Originate in hypothalamus--Travel in spinal cord--Synapse in ciliospinal center of Budge

Second-order neurons --Originate at Budge center--Exit spinal cord--Travel in sympathetic chain--Synapse in superior cervical ganglion

Third-order neurons --Originate in superior cervical ganglion--Travel with internal carotid artery to enter the cavernous sinus

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Will the sympathetics synapse in the ciliary ganglion as well?
No. Remember, these are postganglionic sympathetics. They will pass through the ganglion without synapsing.

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---In the sinus.
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Horner Syndrome

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--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion

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--Travel with internal carotid artery to enter the cavernous sinus
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Horner Syndrome

aka…pre-ganglionic neurons
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Second-order neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion

Third-order neurons
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus
--In the sinus:
  ----Fibers bound for the pupil join CN6, then V1

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The long ciliary nerves
Horner Syndrome

Sympathetic pathway: 3rd order neuron
Horner Syndrome

*Neural pathway in Horner syndrome:*

**First-order neurons**
--Originates in the hypothalamus
--Travel in the spinal cord
--Synapse in the ciliospinal center of Budge

**Second-order neurons** aka... *pre-ganglionic neurons*
--Originates at the Budge center
--Exits the spinal cord
--Travels in the sympathetic chain
--Synapses in the superior cervical ganglion aka... *the stellate ganglion*

**Third-order neurons** aka... *post-ganglionic neurons*
--Originates in the superior cervical ganglion
--Travels with the internal carotid artery to enter the cavernous sinus
--In the sinus:
----Fibers bound for the pupil join CN6, then V1
----Fibers bound for Mueller’s muscle, as well as…

*(No question—proceed when ready)*
Horner Syndrome

Neural pathway in Horner syndrome:

First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons aka...pre-ganglionic neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion aka...the stellate ganglion

Third-order neurons aka...post-ganglionic neurons
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus
--In the sinus:
----Fibers bound for the pupil join CN6, then V1
----Fibers bound for Mueller’s muscle, as well as...
----Fibers bound for sweat glands of the forehead hop onto the artery, and then onto its and branches
Horner Syndrome

*Neural pathway in Horner syndrome:*

**First-order neurons**
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

**Second-order neurons** aka...pre-ganglionic neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion aka...the stellate ganglion

**Third-order neurons** aka...post-ganglionic neurons
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus
--In the sinus:
    ----Fibers bound for the pupil join CN6, then V1
    ----Fibers bound for Mueller’s muscle, as well as...
    ----Fibers bound for sweat glands of the forehead hop onto the ophthalmic artery, and then onto its frontal and lacrimal branches
Horner Syndrome

*Neural pathway in Horner syndrome:*
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in cilioospinal center of Budge

Second-order neurons  *aka...pre-ganglionic neurons*
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion *aka...the stellate ganglion*

Third-order neurons  *aka...post-ganglionic neurons*

--- *What about sweat glands of the lower face--how do sympathetics get to them?*
---
------Fibers bound for Mueller’s muscle, as well as...
------Fibers bound for sweat glands of the...
------rest of the face
------... forehead hop onto the ophthalmic artery, and then onto its frontal and lacrimal branches
Horner Syndrome

*Neural pathway in Horner syndrome:*
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons *aka...pre-ganglionic neurons*
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion *aka...the stellate ganglion*

Third-order neurons *aka...post-ganglionic neurons*

--- *What about sweat glands of the lower face--how do sympathetics get to them?*
--- Postganglionic fibers destined to innervate lower-face sweat glands don’t run with the internal carotid; rather, at the carotid bulb they hop onto the external carotid, then onto its branches to reach their destinations on the non-forehead face

--- Fibers bound for Mueller’s muscle, as well as
--- Fibers bound for sweat glands of the rest of the face
--- Fibers bound for sweat glands of the forehead hop onto the opthalmic artery, and then onto its frontal and lacrimal branches
Horner Syndrome

_Neural pathway in Horner syndrome:_
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons _aka...pre-ganglionic neurons_
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion _aka...the stellate ganglion_

Third-order neurons _aka...post-ganglionic neurons_
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus

What about fibers bound for the lacrimal gland--do they pass through the cavernous sinus as well?

Fibers bound for sweat glands of the forehead hop onto the ophthalmalic artery, and then onto its frontal and lacrimal branches
--Fibers bound for the lacrimal gland?
Horner Syndrome

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Second-order neurons *aka...pre-ganglionic neurons*
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--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion *aka...the stellate ganglion*

Third-order neurons *aka...post-ganglionic neurons*
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus

*What about fibers bound for the lacrimal gland--do they pass through the cavernous sinus as well?*
No--these hop off the internal carotid **before** it enters the sinus, and join the preganglionic parasympathetic fibers on their way to innervate the gland

---Fibers bound for the lacrimal gland?
Horner Syndrome

Neural pathway in Horner syndrome:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons aka...pre-ganglionic neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion aka...the stellate ganglion

Third-order neurons aka...post-ganglionic neurons
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus

What about fibers bound for the lacrimal gland--do they pass through the cavernous sinus as well?
No--these hop off the internal carotid before it enters the sinus, and join the preganglionic parasympathetic fibers on their way to innervate the gland

These preganglionic parasympathetic fibers ‘belong’ to which cranial nerve?
Horner Syndrome

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First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
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Second-order neurons aka...pre-ganglionic neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion aka...the stellate ganglion

Third-order neurons aka...post-ganglionic neurons
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus

What about fibers bound for the lacrimal gland--do they pass through the cavernous sinus as well?
No--these hop off the internal carotid before it enters the sinus, and join the preganglionic parasympathetic fibers on their way to innervate the gland

Fibers bound for the lacrimal gland
--Fibers bound for the lacrimal gland are preganglionic parasympathetic fibers

These preganglionic parasympathetic fibers ‘belong’ to which cranial nerve? CN7
Neural pathway in Horner syndrome:
First-order neurons
--- Originate in hypothalamus
--- Travel in spinal cord
--- Synapse in ciliospinal center of Budge

Second-order neurons aka...pre-ganglionic neurons
--- Originate at Budge center
--- Exit spinal cord
--- Travel in sympathetic chain
--- Synapse in superior cervical ganglion aka...the stellate ganglion

Third-order neurons aka...post-ganglionic neurons
--- Originate in superior cervical ganglion
--- Travel with internal carotid artery to enter the cavernous sinus

What about fibers bound for the lacrimal gland—do they pass through the cavernous sinus as well?
No—these hop off the internal carotid before it enters the sinus, and join the preganglionic parasympathetic fibers on their way to innervate the gland

These preganglionic parasympathetic fibers form a named nerve—what is its name? Cranial nerve?
Neural pathway in Horner syndrome:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons \textit{aka…pre-ganglionic neurons}
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion \textit{aka…the stellate ganglion}

Third-order neurons \textit{aka…post-ganglionic neurons}
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus

\textbf{What about fibers bound for the lacrimal gland—do they pass through the cavernous sinus as well?}
No--these hop off the internal carotid \textbf{before} it enters the sinus, and join the \textbf{preganglionic parasympathetic fibers on their way to innervate the gland}

\textbf{These preganglionic parasympathetic fibers form a named nerve—what is its name? Cranial nerve?}
\textbf{The greater petrosal nerve}
Horner Syndrome

Neural pathway in Horner syndrome:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons aka...pre-ganglionic neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion aka...the stellate ganglion

Third-order neurons aka...post-ganglionic neurons
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus

What about fibers bound for the lacrimal gland -- do they pass through the

These postganglionic sympathetic fibers form a named nerve of their own -- what is its name?

Preganglionic parasympathetic fibers on their way to innervate the gland

These preganglionic parasympathetic fibers form a named nerve -- what is its name? Cranial nerve?

The greater petrosal nerve
Horner Syndrome

Neural pathway in Horner syndrome:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
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--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion aka...the stellate ganglion

Third-order neurons aka...post-ganglionic neurons
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus

What about fibers bound for the lacrimal gland—do they pass through the

These postganglionic sympathetic fibers form a named nerve of their own—what is its name?
The deep petrosal nerve

preganglionic parasympathetic fibers on their way to innervate the gland

These preganglionic parasympathetic fibers form a named nerve—what is its name?
The greater petrosal nerve

Horner Syndrome

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--Travel in spinal cord
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Second-order neurons aka...pre-ganglionic neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion aka...the stellate ganglion

Third-order neurons aka...post-ganglionic neurons
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus
--In the sinus:
  --Fibers bound for the pupil join CN6, then V1
  --Fibers bound for Mueller's muscle
  --Fibers bound for sweat glands of the forehead hop onto the ophthalmic artery, and then onto its frontal and lacrimal branches

What about fibers bound for the lacrimal gland--do they pass through the cavernous sinus as well?
No--these hop off the internal carotid before it enters the sinus, and join the preganglionic parasympathetic fibers on their way to innervate the gland

These preganglionic parasympathetic fibers form a named nerve--what is its name?
The deep petrosal nerve

Once the deep petrosal and greater petrosal nerves join up, they form a new named nerve--what is its name?
The greater petrosal nerve

These preganglionic parasympathetic fibers 'belong' to which cranial nerve?
CN7
Horner Syndrome

Neural pathway in Horner syndrome:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons aka...pre-ganglionic neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion aka...the stellate ganglion

Third-order neurons aka...post-ganglionic neurons
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus

What about fibers bound for the lacrimal gland--do they pass through the cavernous sinus as well?
No--these hop off the internal carotid before it enters the sinus, and join the preganglionic parasympathetic fibers on their way to innervate the gland

These preganglionic parasympathetic fibers form a named nerve--what is its name?
The greater petrosal nerve

Once the deep petrosal and greater petrosal nerves join up, they form a new named nerve--what is its name?
The vidian nerve

These preganglionic parasympathetic fibers form a named nerve--what is its name? Cranial nerve?
Horner Syndrome

*Neural pathway in Horner syndrome:*

First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons *aka...pre-ganglionic neurons*
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion *aka...the stellate ganglion*

Third-order neurons *aka...post-ganglionic neurons*
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus
--In the sinus:
  --Fibers bound for the pupil join CN6, then V1
  --Fibers bound for Mueller's muscle
  --Fibers bound for sweat glands of the forehead hop onto the ophthalmic artery, and then onto its frontal and lacrimal branches

*What about fibers bound for the lacrimal gland? Do they pass through the cavernous sinus as well?*

No--these hop off the internal carotid before it enters the sinus, and join the preganglionic parasympathetic fibers on their way to innervate the gland.

*These preganglionic parasympathetic fibers form a named nerve--what is its name?*

The deep petrosal nerve

The greater petrosal nerve

By what passage does the vidian nerve exit the skull?

The vidian nerve

*aka...*

The vidian nerve *aka...*

These preganglionic parasympathetic fibers form a named nerve--what is its name?

The greater petrosal nerve

*Cranial nerve?*
Horner Syndrome

Neural pathway in Horner syndrome:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons aka...pre-ganglionic neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion aka...the stellate ganglion

Third-order neurons aka...post-ganglionic neurons
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus

What about fibers bound for the lacrimal gland--do they pass through the cavernous sinus as well?
No--these hop off the internal carotid before it enters the sinus, and join the preganglionic parasympathetic fibers on their way to innervate the gland

By what passage does the vidian nerve exit the skull?
The vidian canal

These preganglionic parasympathetic fibers form a new named nerve--what is its name?
The greater petrosal nerve

The vidian nerve aka...the nerve of the vidian canal

These preganglionic parasympathetic fibers form a named nerve--what is its name? Cranial nerve?

The deep petrosal nerve
Neural pathway in Horner syndrome:
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--Synapse in ciliospinal center of Budge

Second-order neurons aka...pre-ganglionic neurons
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--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion

Third-order neurons aka...post-ganglionic neurons
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus
--In the sinus:
  --Fibers bound for the pupil join CN6, then V1
  --Fibers bound for Mueller's muscle
  --Fibers bound for sweat glands of the forehead hop onto the ophthalmic artery, and then onto its frontal and lacrimal branches

Horner Syndrome aka...pre-ganglionic neurons aka...the stellate ganglion aka...post-ganglionic neurons

What about fibers bound for the lacrimal gland--do they pass through the cavernous sinus as well?
No--these hop off the internal carotid before it enters the sinus, and join the preganglionic parasympathetic fibers on their way to innervate the gland

These postganglionic sympathetic fibers form a named nerve of their own--what is its name?
The deep petrosal nerve

By what passage does the vidian nerve exit the skull?
The vidian canal aka...the nerve of the vidian canal

Where is the vidian nerve headed when it leaves the skull?
The pterygopalatine ganglion

Will the sympathetic fibers synapse in the pterygopalatine ganglion?
No, they are postganglionic, and will pass through the ganglion without synapsing. Only the preganglionic parasympathetics will synapse in the pterygopalatine ganglion.
Horner Syndrome

Neural pathway in Horner syndrome:
First-order neurons
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--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons aka...pre-ganglionic neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion

Third-order neurons aka...post-ganglionic neurons
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus

What about fibers bound for the lacrimal gland—do they pass through the cavernous sinus as well?
No; these hop off the internal carotid before it enters the sinus and join the preganglionic parasympathetic fibers on their way to innervate the gland.

These preganglionic parasympathetic fibers form a named nerve—what is its name?
The deep petrosal nerve

By what passage does the vidian nerve exit the skull?
The vidian canal

Where is the vidian nerve headed when it leaves the skull?
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The sympathetic fibers synapse in the pterygopalatine ganglion?
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Horner Syndrome

Neural pathway in Horner syndrome:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons  
aka...pre-ganglionic neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion

Third-order neurons  
aka...post-ganglionic neurons
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus
--In the sinus:
  --Fibers bound for the pupil join CN6, then V1
  --Fibers bound for Mueller's muscle
  --Fibers bound for sweat glands of the forehead hop onto the ophthalmic artery, and then onto its frontal and lacrimal branches

What about fibers bound for the lacrimal gland--do they pass through the cavernous sinus as well?
No--these hop off the internal carotid before it enters the sinus, and join the preganglionic parasympathetic fibers on their way to innervate the gland

These postganglionic sympathetic fibers form a named nerve of their own--what is its name?
The deep petrosal nerve

By what passage does the vidian nerve exit the skull?
The vidian canal

Where is the vidian nerve headed when it leaves the skull?
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No, they are postganglionic, and will pass through the ganglion without synapsing. Only the preganglionic parasympathetics will synapse in the pterygopalatine ganglion.

These preganglionic parasympathetic fibers form a named nerve--what is its name?
The greater petrosal nerve
Horner Syndrome

Neural pathway in Horner syndrome:
First-order neurons
-- Originate in hypothalamus
-- Travel in spinal cord
-- Synapse in ciliospinal center of Budge

Second-order neurons aka... pre-ganglionic neurons
-- Originate at Budge center
-- Exit spinal cord
-- Travel in sympathetic chain
-- Synapse in superior cervical ganglion

Third-order neurons aka... post-ganglionic neurons
-- Originate in superior cervical ganglion
-- Travel with internal carotid artery to enter the cavernous sinus
-- In the sinus:
  -- Fibers bound for the pupil join CN6, then V1
  -- Fibers bound for Mueller's muscle
  -- Fibers bound for sweat glands of the forehead hop onto the ophthalmic artery, and then onto its frontal and lacrimal branches

Horner Syndrome aka... pre-ganglionic neurons
aka... the stellate ganglion
aka... post-ganglionic neurons

What about fibers bound for the lacrimal gland--do they pass through the cavernous sinus as well?
No--these hop off the internal carotid before it enters the sinus, and join the preganglionic parasympathetic fibers on their way to innervate the gland.

These preganglionic parasympathetic fibers form a named nerve--what is its name?
The deep petrosal nerve
These preganglionic parasympathetic fibers on their way to innervate the gland

What is the vidian nerve headed when it leaves the skull?
The pterygopalatine ganglion

Will the sympathetic fibers synapse in the pterygopalatine ganglion?
No, they are postganglionic, and will pass through the ganglion without synapsing. Only the preganglionic parasympathetics will synapse in the pterygopalatine ganglion.

By what passage does the vidian nerve exit the skull?
The vidian canal

Are they forming a new named nerve--what is its name?
The vidian nerve aka... the nerve of the vidian canal

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The greater petrosal nerve

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Neural pathway in Horner syndrome:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord

**Finally: How will the postganglionic sympathetics and (now) postganglionic parasympathetics get to the lacrimal gland?**

Second-order neurons  
aka...pre-ganglionic neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion

**Where is the vidian nerve headed when it leaves the skull?**
The pterygopalatine ganglion

**Will the sympathetic fibers synapse in the pterygopalatine ganglion?**
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These postganglionic sympathetic fibers on their way to innervate the gland form a new named nerve--what is its name?

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They will pass through the inferior orbital fissure to join the lacrimal nerve on its way to the gland
Horner Syndrome

Neural pathway in Horner syndrome:
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The vidian nerve

Will these preganglionic parasympathetic fibers form a named nerve on their way to innervate the gland?
Yes, the vidian nerve

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Horner Syndrome

Sympathetic pathway overview
Horner Syndrome

Sympathetic pathway overview
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome:
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- Wallenberg syndrome: Central
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: Central

What is the noneponymous name for Wallenberg syndrome?

Lateral medullary syndrome

- Is the Horner pupil in Wallenberg syndrome ipsi- or contralateral to the lesion?
  - Ipsilateral

- Wallenberg's hallmark symptom is sensory—what is it?
  - Loss of pain and temperature sensation to the ipsilateral face and contralateral body

- Besides the Horner and sensory findings, what are the main signs/symptoms?
  - Cerebellar signs: Disequilibrium, ataxia, nystagmus, skew deviation
  - Speech and swallowing difficulties

- Occlusion of what vessel is implicated in Wallenberg syndrome?
  - The ipsilateral vertebral or (less commonly) posterior inferior cerebellar artery
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central

What is the non-eponymous name for Wallenberg syndrome?
Lateral medullary syndrome
Wallenberg (aka *lateral medullary*) syndrome
Wallenberg syndrome: Central

What is the noneponymous name for Wallenberg syndrome?
Lateral medullary syndrome

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Wallenberg syndrome: **Central**

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What is the non-eponymous name for Wallenberg syndrome? Lateral medullary syndrome

Speaking of disequilibrium: Wallenberg pts often c/o feeling like their body is being ‘pulled to one side.’ What is the name for this sensation? Lateropulsion

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Besides the Horner and sensory findings, what are the main signs/symptoms?

- **Cerebellar signs:** Disequilibrium, ataxia, nystagmus, skew deviation
- **Speech and swallowing difficulties**

Occlusion of what vessel is implicated in Wallenberg syndrome?
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Q
Wallenberg syndrome: **Central**

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  - Lateral medullary syndrome

- **Speaking of disequilibrium: Wallenberg pts often c/o feeling like their body is being ‘pulled to one side.’** What is the name for this sensation?
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- **What are the main signs/symptoms?**
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  - Speech and swallowing difficulties

- **Occlusion of what vessel is implicated in Wallenberg syndrome?**
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Q

For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

Wallenberg syndrome: Central

What is the non-eponymous name for Wallenberg syndrome?
Lateral medullary syndrome

Speaking of disequilibrium: Wallenberg pts often c/o feeling like their body is being ‘pulled to one side.’ What is the name for this sensation?
Lateropulsion

In Wallenberg, do pts feel like their being pulled toward the lesion side, or away from it?
Disequilibrium

--Cerebellar signs: ataxia, nystagmus, skew deviation
--Speech and swallowing difficulties

Besides the Horner and sensory findings, what are the main signs/symptoms?
--Cerebellar signs: ataxia, nystagmus, skew deviation
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Occlusion of what vessel is implicated in Wallenberg syndrome?
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Lateropulsion

In Wallenberg, do pts feel like their being pulled toward the lesion side, or away from it?
Disequilibrium

--Cerebellar signs: ataxia, nystagmus, skew deviation
--Speech and swallowing difficulties

Occlusion of what vessel is implicated in Wallenberg syndrome?
The ipsilateral vertebral or (less commonly) posterior inferior cerebellar artery
Wallenberg syndrome: Central

What is the noneponymous name for Wallenberg syndrome?
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Speaking of disequilibrium: Wallenberg pts often c/o feeling like their body is being ‘pulled to one side.’ What is the name for this sensation?
Lateropulsion

In Wallenberg, do pts feel like their being pulled toward the lesion side, or away from it?
Toward it

--Cerebellar signs: Dysmetria, ataxia, nystagmus, skew deviation
--Speech and swallowing difficulties

Disequilibrium

Occlusion of what vessel is implicated in Wallenberg syndrome?
The ipsilateral vertebral or (less commonly) posterior inferior cerebellar artery
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

**Wallenberg syndrome:** Central

- **What is the noneponymous name for Wallenberg syndrome?** Lateral medullary syndrome

- **Speaking of lateropulsion: Wallenberg pts often manifest something called ocular lateropulsion. What are the findings in this condition?**
  - --
  - --
  - --

- **Speaking of disequilibrium:** Wallenberg pts often feel like their body is being 'pulled to one side.' What is the name for this sensation? Lateropulsion

- **In Wallenberg, do pts feel like they are being pulled towards the lesion or away from it?** Toward it

- **Cerebellar signs:** Disequilibrium, ataxia, nystagmus, skew deviation

- **Speech and swallowing difficulties**
Wallenberg syndrome: Central

What is the non-eponymous name for Wallenberg syndrome?
Lateral medullary syndrome

Speaking of lateropulsion: Wallenberg pts often manifest something called ocular lateropulsion. What are the findings in this condition?
--Lateral-gaze movements toward the lesion side are notably slower than are lateral movements toward the contralateral side
--When the pt is not fixating a visual target (eg, during eye closure), the eyes will move into lateral gaze toward the lesion side
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

Wallenberg syndrome: Central

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Speech and swallowing difficulties

In Wallenberg, do pts feel like their body is being 'pulled' or away from it? Toward it

Lateropulsion

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When the pt is not fixating a visual target (eg, during eye closure), the eyes will move toward the lesion side

What symptoms?

Wallenberg's hallmark symptom is sensory--what is it?
Loss of pain and temperature sensation to the ipsilateral face and contralateral body

Besides the Horner and sensory findings, what are the main signs/symptoms?
--Cerebellar signs: Disequilibrium, ataxia, nystagmus, skew deviation
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Occlusion of what vessel is implicated in Wallenberg syndrome?
The ipsilateral vertebral or (less commonly) posterior inferior cerebellar artery

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--Cerebellar signs: Disequilibrium, ataxia, nystagmus, skew deviation
--Speech and swallowing difficulties

In Wallenberg, do pts feel like being pulled toward or away from it? Toward it
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: **Central**

  - What is the noneponymous name for Wallenberg syndrome?
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  - Is the Horner pupil in Wallenberg syndrome ipsi- or contralateral to the lesion?
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  - In Wallenberg, do pts feel like their body is being ‘pulled to one side.’ What is the name for this sensation?
    - Lateropulsion
  - In Wallenberg, do pts feel like their body is being pulled toward the lesion side, or away from it?
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Wallenberg syndrome is a form of CVA. In that regard:  
What very common sign/symptom of a CVA is **not** listed here, i.e., is not a component of Wallenberg's?  
Paralysis

Why no paralysis in Wallenberg's?  
As in real estate, the three most important factors in CVA are location, location, and location. And with respect to the location rule is, events that affect the lateral brainstem cause sensory loss, not paralysis (aka "stroke without paralysis").
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

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Wallenberg syndrome is a form of CVA. In that regard: What very common sign/symptom of a CVA is not listed here, i.e., is not a component of Wallenberg’s? Paralysis

Why no paralysis in Wallenberg’s? As in real estate, the three most important factors in CVA are location, location, and location.
Wallenberg syndrome: **Central**

What is the noneponymous name for Wallenberg syndrome?
Lateral medullary syndrome

Is the Horner pupil in Wallenberg syndrome ipsi- or contralateral to the lesion?
Ipsilateral

Wallenberg's hallmark symptom is sensory—what is it?
Loss of pain and temperature sensation to the ipsilateral face and contralateral body

Besides the Horner and sensory findings, what are the main signs/symptoms?
-- Cerebellar signs: Disequilibrium, ataxia, nystagmus, skew deviation
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What very common sign/symptom of a CVA is not listed here, ie, is not a component of Wallenberg’s?
Paralysis

Why no paralysis in Wallenberg’s?
As in real estate, the three most important factors in CVA are location, location, and location. And with respect to CVA location, the general rule is, events that affect the lateral brainstem cause sensory loss, not paralysis (aka “stroke without paralysis”).
Wallenberg syndrome: **Central**

- **What is the noneponymous name for Wallenberg syndrome?**
  - *Lateral medullary syndrome*

- **Is the Horner pupil in Wallenberg syndrome ipsi- or contralateral to the lesion?**
  - Ipsilateral

- **Wallenberg’s hallmark symptom is sensory—what is it?**
  - Loss of pain and temperature sensation to the ipsilateral face and contralateral body

- **Besides the Horner and sensory findings, what are the main signs/symptoms?**
  - **Cerebellar signs**: Disequilibrium, ataxia, nystagmus, skew deviation
  - **Speech and swallowing difficulties**

- **Occlusion of what vessel is implicated in Wallenberg syndrome?**
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- **Why no paralysis in Wallenberg’s?**
  - As in real estate, the three most important factors in CVA are location, location, and location. And with respect to CVA location, the general rule is, events that affect the lateral brainstem cause sensory loss, not paralysis (aka “stroke without paralysis”).

*Hence Wallenberg’s noneponymous name*
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- **Wallenberg syndrome**: Central

**What is the noneponymous name for Wallenberg syndrome?**
Lateral medullary syndrome

**Is the Horner pupil in Wallenberg syndrome ipsi- or contralateral to the lesion?**
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**Wallenberg’s hallmark symptom is sensory--what is it?**
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**Occlusion of what vessel is implicated in Wallenberg syndrome?**
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central

What is the noneponymous name for Wallenberg syndrome?
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Is the Horner pupil in Wallenberg syndrome ipsi- or contralateral to the lesion?
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Wallenberg’s hallmark symptom is sensory—what is it?
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Besides the Horner and sensory findings, what are the main signs/symptoms?
--Cerebellar signs: Disequilibrium, ataxia, nystagmus, skew deviation
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Occlusion of what vessel is implicated in Wallenberg syndrome?
The ipsilateral vertebral or (less commonly) posterior inferior cerebellar artery
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

Wallenberg syndrome: Central

What is the non-eponymous name for Wallenberg syndrome?
Lateral medullary syndrome

Is the Horner pupil in Wallenberg syndrome ipsi- or contralateral to the lesion?
Ipsilateral

Wallenberg’s hallmark symptom is sensory—what is it?
Loss of pain and temperature sensation to the ipsilateral face and contralateral body

Besides the Horner and sensory findings, what are the main signs/symptoms?
--Cerebellar signs: Disequilibrium, ataxia, nystagmus, skew deviation
--Speech and swallowing difficulties

What mechanism is typically responsible for occluding the vessel in:
--An older vasculopath?
--A young adult?
--A pt with valvular dz, or arrhythmia?

Occlusion of what vessel is implicated in Wallenberg syndrome?
The ipsilateral vertebral or (less commonly) posterior inferior cerebellar artery
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

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What is the noneponymous name for Wallenberg syndrome?
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Occlusion of what vessel is implicated in Wallenberg syndrome?
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What mechanism is typically responsible for occluding the vessel in:
--- An older vasculopath? Atherosclerosis
--- A young adult? A pt with valvular dz, or arrythmia?
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The ipsilateral vertebral or (less commonly) posterior inferior cerebellar artery
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- **Wallenberg syndrome**: Central

**What is the noneponymous name for Wallenberg syndrome?**
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-- Cerebellar signs: Disequilibrium, ataxia, nystagmus, skew deviation
-- Speech and swallowing difficulties

**Occlusion of what vessel is implicated in Wallenberg syndrome?**
The ipsilateral *vertebral* or (less commonly) *posterior inferior cerebellar artery*

**What mechanism is typically responsible for occluding the vessel in:**
-- An older vasculopath? Atherosclerosis
-- A young adult? Dissection
-- A pt with valvular dz, or arrythmia?
Wallenberg syndrome: **Central**

- What is the noneponymous name for Wallenberg syndrome? **Lateral medullary syndrome**
- Is the Horner pupil in Wallenberg syndrome ipsi- or contralateral to the lesion? **Ipsilateral**
- Wallenberg’s hallmark symptom is sensory—what is it? **Loss of pain and temperature sensation to the ipsilateral face and contralateral body**
- Besides the Horner and sensory findings, what are the main signs/symptoms? **Cerebellar signs: Disequilibrium, ataxia, nystagmus, skew deviation**
  
  **Speech and swallowing difficulties**

- Occlusion of what vessel is implicated in Wallenberg syndrome? **Vertebral or (less commonly) posterior inferior cerebellar artery**
- What mechanism is typically responsible for occluding the vessel in:
  -- An older vasculopath? **Atherosclerosis**
  -- A young adult? **Dissection**
  -- A pt with valvular dz, or arrythmia? **Sepsis**

For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.
Wallenberg syndrome: Central

- What is the noneponymous name for Wallenberg syndrome?
  - Lateral medullary syndrome

- Is the Horner pupil in Wallenberg syndrome ipsi- or contralateral to the lesion?
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- Wallenberg’s hallmark symptom is sensory—what is it?
  - Loss of pain and temperature sensation to the ipsilateral face and contralateral body

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- Occlusion of what vessel is implicated in Wallenberg syndrome?
  - The ipsilateral vertebral or (less commonly) posterior inferior cerebellar artery

- What mechanism is typically responsible for occluding the vessel in:
  - An older vasculopath? Atherosclerosis
  - A young adult? Dissection
  - A pt with valvular dz, or arrythmia? Embolism
Wallenberg syndrome: **Central**

**Does Wallenberg carry a good, or poor prognosis?**

Lateral medullary syndrome

**Is the Horner pupil in Wallenberg syndrome ipsi- or contralateral to the lesion?**

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**Wallenberg’s hallmark symptom is sensory--what is it?**

Loss of pain and temperature sensation to the ipsilateral face and contralateral body

**Besides the Horner and sensory findings, what are the main signs/symptoms?**

--Cerebellar signs: Disequilibrium, ataxia, nystagmus, skew deviation

--Speech and swallowing difficulties

**Oclusion of what vessel is implicated in Wallenberg syndrome?**

The ipsilateral vertebral or (less commonly) posterior inferior cerebellar artery
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- **Wallenberg syndrome**: Central

**Does Wallenberg carry a good, or poor prognosis?**
Good--most pts recover with minimal sequelae

**Is the Horner pupil in Wallenberg syndrome ipsi- or contralateral to the lesion?**
Ipsilateral

**Wallenberg's hallmark symptom is sensory--what is it?**
Loss of pain and temperature sensation to the ipsilateral face and contralateral body

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**Occlusion of what vessel is implicated in Wallenberg syndrome?**
The ipsilateral vertebral or (less commonly) posterior inferior cerebellar artery
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: Central
- Neck trauma:
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: **Central**
- Neck trauma: **Pre- or post-ganglionic**
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic

If an adult with a pre- or post-ganglionic Horner’s has no history of trauma, what process should be suspected?
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic

If an adult with a pre- or post-ganglionic Horner’s has no history of trauma, what process should be suspected?

An intrathoracic malignancy
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma:
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic

Where does Nb rank as a cause of cancer in childhood?

- It is the most common cause of extracranial solid cancer (ie, not leukemia) in childhood.
- In infants (ie, prior to age 12 months), it is #1.
- What proportion of pediatrics cancer deaths are due to Nb? 20%.
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic

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- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- **Neuroblastoma**: Pre-ganglionic

*Where does Nb rank as a cause of cancer in childhood?*
It is the most common cause of extracranial solid cancer (ie, not leukemia) in childhood

*How about in infants (ie, prior to age 12 months)*?
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

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What proportion of peds cancer deaths are due to Nb?
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

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- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- **Neuroblastoma**: Pre-ganglionic

 Where does Nb rank as a cause of cancer in childhood?
 It is the most common cause of extracranial solid cancer (ie, not leukemia) in childhood.

 The cancerous cell in NB—the neuroblast—what is it?

 What proportion of peds cancer deaths are due to Nb?
 20%
A

For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- **Neuroblastoma**: Pre-ganglionic

Where does Nb rank as a cause of cancer in childhood? It is the most common cause of extracranial solid cancer (ie, not leukemia) in childhood.

*The cancerous cell in NB—the neuroblast—*what is it? It is the progenitor cell that gives rise to neuron and related cells.

What proportion of peds cancer deaths are due to Nb? 20%
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- Neck trauma: Pre- or post-ganglionic
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*Which ‘neurons’ and ‘related cells’ are involved in Nb, ie, where are the primaries?*
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
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What proportion of pediatrics cancer deaths are due to Nb? 20%.

Which ‘neurons’ and ‘related cells’ are involved in Nb, ie, where are the primaries? The sympathetic chain, and the adrenal medulla.
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
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Of the two sites, which can produce a Horner syndrome? The sympathetic chain and the adrenal medulla.
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
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What proportion of peds cancer deaths are due to Nb?
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Of the two sites, which can produce a Horner syndrome?
The sympathetic chain (provided the tumor is in the cervical portion)
- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- **Neuroblastoma**: Pre-ganglionic

**For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated**

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What proportion of pediatric cancer deaths are due to Nb?
20%

Of the two sites, which can produce a Horner syndrome?
The sympathetic chain (provided the tumor is in the cervical portion) and the adrenal medulla.
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

Primary tumor in sympathetic chain

Horner syndrome 2ndry to Nb
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
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*Where does Nb rank as a cause of cancer in childhood?*
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*The cancerous cell in NB—the neuroblast—what is it?*
It is the progenitor cell that gives rise to neuron and related cells

*Neuroblastoma is notorious for three other ophthalmic manifestations—what are they?*

- Sympathetic chain neurons
- Adrenal-medulla cells

*Of the two sites, which can produce a Horner syndrome?*
The sympathetic chain (provided the tumor is in the cervical portion)
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
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The cancerous cell in NB—the neuroblast—what is it? It is the progenitor cell that gives rise to neuron and related cells.

Neuroblast is notorious for three other ophthalmic manifestations—what are they?--Periorbital ecchymosis (aka raccoon eyes)
--Proptosis
--Opsoclonus

Of the two sites, which can produce a Horner syndrome? The sympathetic chain (provided the tumor is in the cervical portion) and the adrenal medulla.
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic

**Where does Nb rank as a cause of cancer in childhood?**
It is the most common cause of extracranial solid cancer (i.e., not leukemia) in childhood.

**The cancerous cell in NB—the neuroblast—what is it?**
It is the progenitor cell that gives rise to neuron and related cells

**Nb is notorious for three other ophthalmic manifestations—what are they?**
-- Periorbital ecchymosis (aka raccoon eyes)
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**Of the two sites, which can produce a Horner syndrome?**
The sympathetic chain (provided the tumor is in the cervical portion)
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
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- Sympathetic chain neurons
- Adrenal-medulla cells

**Which 'neurons' and 'related cells' are involved in Nb, ie, where are the primaries?**
The sympathetic chain, and the adrenal medulla

**Of the two sites, which can produce a Horner syndrome?**
- The sympathetic chain (provided the tumor is in the cervical portion)
- The sympathetic chain, and the adrenal medulla

**Nb is notorious for three other ophthalmic manifestations—what are they?**
- **Periorbital ecchymosis** (aka *racoon eyes*)
- **Proptosis**
- **Opsoclonus**

**What process leads to ecchymosis and/or proptosis?**
Orbital metastasis
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic

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The cancerous cell in NB—the neuroblast—what is it? It is the progenitor cell that gives rise to neuron and related cells.

Which 'neurons' and 'related cells' are involved in Nb, ie, where are the primaries? The sympathetic chain, and the adrenal medulla.

Of the two sites, which can produce a Horner syndrome? The sympathetic chain (provided the tumor is in the cervical portion).

What process leads to ecchymosis and/or proptosis? Orbital metastasis.

- Periorbital ecchymosis (aka raccoon eyes)
- Proptosis
- Opsoclonus
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

Nb: ‘Raccoon eyes’
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

Nb: Proptosis
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic

Where does Nb rank as a cause of cancer in childhood? It is the most common cause of extracranial solid cancer (ie, not leukemia) in childhood.

The cancerous cell in NB—the neuroblast—what is it? It is the progenitor cell that gives rise to neuron and related cells (Sympathetic chain neurons, Adrenal-medulla cells).

Which 'neurons' and 'related cells' are involved in Nb, ie, where are the primaries? The sympathetic chain, and the adrenal medulla.

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Nb is notorious for three other ophthalmic manifestations—what are they?--Periorbital ecchymosis (aka racoon eyes)--Proptosis--Opsoclonus

What is opsoclonus? A saccadic intrusion characterized by multivectorial, large-amplitude movements.

Is opsoclonus secondary to orbital metastasis, like ecchymosis and proptosis? No—it is a paraneoplastic phenomenon.
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

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*For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated*

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It is the progenitor cell that gives rise to neuron and related cells

**Sympathetic chain neurons**
**Adrenal-medulla cells**

*Which 'neurons' and 'related cells' are involved in Nb, ie, where are the primaries?*
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*Where does Nb rank as a cause of cancer in childhood?*
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*Of the two sites, which can produce a Horner syndrome?*
The sympathetic chain (provided the tumor is in the cervical portion)
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: **Central**
- Neck trauma: **Pre- or post-ganglionic**
- Neuroblastoma: **Pre-ganglionic**
- Internal carotid dissection:
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic

What percent of carotid-artery dissection pts will present with a Horner? About 60%
Wallenberg syndrome: Central
Neck trauma: Pre- or post-ganglionic
Neuroblastoma: Pre-ganglionic
Internal carotid dissection: Post-ganglionic

What percent of carotid-artery dissection pts will present with a Horner? About 60
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic

What percent of carotid-artery dissection pts will present with a Horner? About 60

What systemic conditions predispose to carotid-artery dissection?
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic

What percent of carotid-artery dissection pts will present with a Horner? About 60

What systemic conditions predispose to carotid-artery dissection? Connective-tissue disorders; eg, Marfan’s and Ehler-Danlos
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic

What percent of carotid-artery dissection pts will present with a Horner?
About 60

What systemic conditions predispose to carotid-artery dissection?
Connective-tissue disorders; eg, Marfan’s and Ehler-Danlos

Is carotid-artery dissection always associated with trauma?
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic

What percent of carotid-artery dissection pts will present with a Horner?
About 60

What systemic conditions predispose to carotid-artery dissection?
Connective-tissue disorders; eg, Marfan’s and Ehler-Danlos

Is carotid-artery dissection always associated with trauma?
No, it can occur spontaneously
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
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What systemic conditions predispose to carotid-artery dissection?
Connective-tissue disorders; eg, Marfan’s and Ehler-Danlos

Is carotid-artery dissection always associated with trauma?
No, it can occur spontaneously

Name a classic cause of ‘iatrogenic’ (I'm using the term loosely here) carotid-artery dissection:
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic

What percent of carotid-artery dissection pts will present with a Horner?
About 60

What systemic conditions predispose to carotid-artery dissection?
Connective-tissue disorders; eg, Marfan’s and Ehler-Danlos

Is carotid-artery dissection always associated with trauma?
No, it can occur spontaneously

Name a classic cause of ‘iatrogenic’ (I’m using the term loosely here) carotid-artery dissection:
Cervical-spine manipulation by a chiropractor
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic

What percent of carotid-artery dissection pts will present with a Horner? About 60

What systemic conditions predispose to carotid-artery dissection? Connective-tissue disorders; eg, Marfan’s and Ehler-Danlos

Is carotid-artery dissection always associated with trauma? No, it can occur spontaneously

Name a classic cause of ‘iatrogenic’ (I’m using the term loosely here) carotid-artery dissection: Cervical-spine manipulation by a chiropractor

If carotid dissection is suspected, what is the first step in management? Emergent neuroimaging

What imaging study should be ordered? Angiography—either CTA or MRA

Wouldn’t that suffice? No, it is not adequate
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic

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If carotid dissection is suspected, what is the first step in management?
- Emergent neuroimaging

What imaging study should be ordered?
- Angiography—either CTA or MRA

Wouldn’t a carotid doppler study suffice?
- No, it is not adequate
Wallenberg syndrome: Central
Neck trauma: Pre- or post-ganglionic
Neuroblastoma: Pre-ganglionic
Internal carotid dissection: Post-ganglionic

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- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic

What percent of carotid-artery dissection pts will present with a Horner? About 60%

What systemic conditions predispose to carotid-artery dissection? Connective tissue disorders; e.g., Marfan’s and Ehler-Danlos

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If carotid dissection is suspected, what is the first step in management? Emergent neuroimaging

What imaging study should be ordered? Angiography—either CTA or MRA

Cervical-spine manipulation by a chiropractor
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

Carotid dissection
Q

For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic

What percent of carotid-artery dissection pts will present with a Horner? About 60

What systemic conditions predispose to carotid-artery dissection? Connective-tissue disorders; eg, Marfan's and Ehler-Danlos

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What imaging study should be ordered? Angiography--either CTA or MRA

What about carotid doppler study--wouldn't that suffice?

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- Wallenberg syndrome: Central
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For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

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- Neck trauma: Pre- or post-ganglionic
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- Emergent neuroimaging

What imaging study should be ordered?
- Angiography--either CTA or MRA

What about carotid doppler study--wouldn't that suffice?
- No, it is not adequate

Imaging must extend from where to where; ie, what anatomic structures delimit the region that needs to be imaged?
- It must extend from the apex of the lung up to the Circle of Willis
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
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Imaging must extend from where to where; ie, what anatomic structures delimit the region that needs to be imaged?
It must extend from the apex of the lung up to the Circle of Willis
Wallenberg syndrome: Central
Neck trauma: Pre- or post-ganglionic
Neuroblastoma: Pre-ganglionic
Internal carotid dissection: Post-ganglionic
Pancoast tumor:
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
Wallenberg syndrome: Central
Neck trauma: Pre- or post-ganglionic
Neuroblastoma: Pre-ganglionic
Internal carotid dissection: Post-ganglionic
Pancoast tumor: Pre-ganglionic

What is a Pancoast tumor?
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic
- **Pancoast tumor**: Pre-ganglionic

*What is a Pancoast tumor?*
A mass at or near the superior sulcus (=apex) of the lung
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

Pancoast tumor
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: HA = ‘Headache’ (but we’ll also use it to mean something else a few slides hence)
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: **Central**
- Neck trauma: **Pre- or post-ganglionic**
- Neuroblastoma: **Pre-ganglionic**
- Internal carotid dissection: **Post-ganglionic**
- Pancoast tumor: **Pre-ganglionic**
- Cluster HA: **Post-ganglionic**
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic

Is Horner syndrome a common finding in cluster HA? Yes--estimates run as high as 50%
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
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- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic

Is Horner syndrome a common finding in cluster HA?
Yes—estimates run as high as 50%

So, Horner’s + HA cinches a diagnosis of cluster HA, then?
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic

Is Horner syndrome a common finding in cluster HA?
Yes—estimates run as high as 50%

So, Horner’s + HA cinches a diagnosis of cluster HA, then?
No! Dissection of the internal carotid artery is also associated with HA, face and/or eye pain
Wallenberg syndrome: Central
Neck trauma: Pre- or post-ganglionic
Neuroblastoma: Pre-ganglionic
Internal carotid dissection: Post-ganglionic
Pancoast tumor: Pre-ganglionic
Cluster HA: Post-ganglionic

Is Horner syndrome a common finding in cluster HA?
Yes--estimates run as high as 50%

So, Horner’s + HA cinches a diagnosis of cluster HA, then?
No! Dissection of the internal carotid artery is also associated with HA, face and/or eye pain

Acute-onset Horner’s + facial/neck pain is an internal carotid dissection until proven otherwise, and must be worked up emergently!
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic
- Forceps delivery:
Wallenberg syndrome: Central
Neck trauma: Pre- or post-ganglionic
Neuroblastoma: Pre-ganglionic
Internal carotid dissection: Post-ganglionic
Pancoast tumor: Pre-ganglionic
Cluster HA: Post-ganglionic
Forceps delivery: Pre- or post-ganglionic
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

**Shoulder dystocia** is another cause of congenital Horner’s. Look for a hx of complicated birth, along with signs and symptoms of brachial-plexus injury/dysfunction.

Forceps delivery/shoulder dystocia
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic
- Forceps delivery: Pre- or post-ganglionic

How does one ‘prove’ a patient has a Horner's?
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic
- Forceps delivery: Pre- or post-ganglionic

How does one ‘prove’ a patient has a Horners?  
**Cocaine drop testing.** Cocaine will essentially eliminate anisocoria *if and only if* the sympathetic chain is intact.
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic
- Forceps delivery: Pre- or post-ganglionic

How does one ‘prove’ a patient has a Horner’s?
Cocaine drop testing. **Cocaine will essentially eliminate anisocoria if and only if the sympathetic chain is intact.**

Why is this? That is, what is it about cocaine drops that allows this assertion to be made?
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic
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- Cluster HA: Post-ganglionic
- Forceps delivery: Pre- or post-ganglionic

How does one ‘prove’ a patient has a Horner’s?
Cocaine drop testing. Cocaine will essentially eliminate anisocoria if and only if the sympathetic chain is intact.

Why is this? That is, what is it about cocaine drops that allows this assertion to be made?
Cocaine’s mechanism of action is to block the re-uptake of norepinephrine. Thus, it can dilate the pupil only if norepinephrine is already present in the neuromuscular junctions of the pupillary dilator muscle. And norepinephrine will be present in the junctions only if the post-ganglionic fibers are being prompted to release it by an intact sympathetic chain. Dysfunction anywhere in the chain will result in the absence of norepinephrine in the neuromuscular junction, and therefore a positive (ie, a failure to dilate) cocaine test.
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic
- Forceps delivery: Pre- or post-ganglionic

How does one ‘prove’ a patient has a Horner’s?

Cocaine drop testing. **Cocaine will essentially eliminate anisocoria if and only if the sympathetic chain is intact.**

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- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic
- Forceps delivery: Pre- or post-ganglionic

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Cocaine drop testing. **Cocaine will essentially eliminate anisocoria if and only if the sympathetic chain is intact.**

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- Wallenberg syndrome: Central
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- Forceps delivery: Pre- or post-ganglionic

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For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

Positive cocaine test (failure of anisocoria to resolve)
Wallenberg syndrome: Central
Neck trauma: Pre- or post-ganglionic
Neuroblastoma: Pre-ganglionic
Internal carotid dissection: Post-ganglionic
Pancoast tumor: Pre-ganglionic
Cluster HA: Post-ganglionic
Forceps delivery: Pre- or post-ganglionic

How does one ‘prove’ a patient has a Horner's?
**Cocaine drop testing.** Cocaine will essentially eliminate anisocoria if and only if the sympathetic chain is intact.

How does one differentiate between a pre- and post-ganglionic Horner's?
Wallenberg syndrome: Central
Neck trauma: **Pre- or post-ganglionic**
Neuroblastoma: Pre-ganglionic
Internal carotid dissection: Post-ganglionic
Pancoast tumor: Pre-ganglionic
Cluster HA: Post-ganglionic
Forceps delivery: Pre- or post-ganglionic

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**How does one ‘prove’ a patient has a Horner’s?**

**Cocaine drop testing.** Cocaine will essentially eliminate anisocoria *if and only if* the sympathetic chain is intact.

**How does one differentiate between a pre- and post-ganglionic Horner’s?**

**Hydroxyamphetamine (HA) drop testing.** HA drops will eliminate anisocoria *if* the post-ganglionic neuron is intact; therefore, pupillary dilation indicates a pre-ganglionic/central Horner’s.
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic

And why is this? That is, what is it about HA drops that allows this assertion to be made?

How does one differentiate between a pre- and post-ganglionic Horner's?

Hydroxyamphetamine (HA) drop testing. HA drops will eliminate anisocoria if the post-ganglionic neuron is intact; therefore, pupillary dilation indicates a pre-ganglionic/central Horner's.
Q/A

For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic

And why is this? That is, what is it about HA drops that allows this assertion to be made? HA's mechanism of action is to cause release? impede uptake? norepinephrine into the neuromuscular junction.

How does one differentiate between a pre- and post-ganglionic Horners? Hydroxyamphetamine (HA) drop testing. HA drops will eliminate anisocoria if the post-ganglionic neuron is intact; therefore, pupillary dilation indicates a pre-ganglionic/central Horners.
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
- Neck trauma: **Pre- or post-ganglionic**
- Neuroblastoma: Pre-ganglionic

*And why is this? That is, what is it about HA drops that allows this assertion to be made?*

HA's mechanism of action is to stimulate the postganglionic fibers to release norepinephrine into the neuromuscular junction.

How does one differentiate between a pre- and post-ganglionic Horner's?

Hydroxyamphetamine (HA) drop testing. HA drops will eliminate anisocoria if the post-ganglionic neuron is intact; therefore, pupillary dilation indicates a pre-ganglionic/central Horner's.
Wallenberg syndrome: Central
Neck trauma: **Pre- or post-ganglionic**
Neuroblastoma: Pre-ganglionic

**For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated**

**How does one 'prove' a patient has a Horner's?**
Cocaine drop testing. Cocaine will essentially eliminate anisocoria if and only if the sympathetic chain is intact.

**How does one differentiate between a pre- and post-ganglionic Horner's?**
Hydroxyamphetamine (HA) drop testing. HA drops will eliminate anisocoria if the post-ganglionic neuron is intact; therefore, pupillary dilation indicates a pre-ganglionic/central Horner's.

**And why is this? That is, what is it about HA drops that allows this assertion to be made?**
HA's mechanism of action is to stimulate the postganglionic fibers to release norepinephrine into the neuromuscular junction. Thus, HA can dilate the pupil only if norepinephrine is in fact present in these bulbs, and norepinephrine will be present in these bulbs only if the post-ganglionic fibers are intact. If these neurons are damaged—i.e., if the pt has a post-ganglionic Horner's—then the degenerated terminal bulbs will have little or no norepinephrine to release, and thus the pupil will dilate poorly or not at all in response to HA. On the other hand, in a central or pre-ganglionic Horner's, the post-ganglionic fibers are intact, and therefore capable of releasing norepinephrine when stimulated to do so by HA.

**Why must cocaine drop testing precede HA drop testing?**
HA drops cannot distinguish between a preganglionic/central Horner's and a non-Horner eye—both will dilate in response to HA. Thus, before HA testing is performed, the cocaine test is needed to establish that a Horner's is present.
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic

And why is this? That is, what is it about HA drops that allows this assertion to be made? HA’s mechanism of action is to stimulate the postganglionic fibers to release norepinephrine into the neuromuscular junction. Thus, HA can dilate the pupil only if norepinephrine is in fact present in these bulbs, and norepinephrine will be present in these bulbs only if the post-ganglionic fibers are intact. If these neurons are damaged—ie, if the pt has a post-ganglionic Horner syndrome—the degenerated terminal bulbs will have little or no norepinephrine to release, and thus the pupil will dilate poorly or not at all in response to HA.

How does one differentiate between a pre- and post-ganglionic Horners? Hydroxyamphetamine (HA) drop testing. HA drops will eliminate anisocoria if the post-ganglionic neuron is intact; therefore, pupillary dilation indicates a pre-ganglionic/central Horners.
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: Central
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How does one differentiate between a pre- and post-ganglionic Horners? Hydroxyamphetamine (HA) drop testing. HA drops will eliminate anisocoria if the post-ganglionic neuron is intact; therefore, pupillary dilation indicates a pre-ganglionic/central Horners.
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

A. Before drops administered (suspected right Horner syndrome).
B. After drops administered. Note the dilation of both pupils. This indicates an intact 3rd-order, postganglionic neuron and localizes the lesion to the 1st-order (central) or 2nd-order (preganglionic) neuron.

HA test
<table>
<thead>
<tr>
<th>Condition</th>
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</tr>
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Why must cocaine drop testing precede HA drop testing?

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Why must cocaine drop testing precede HA drop testing?
HA drops cannot distinguish between a preganglionic/central Horner syndrome and a non-Horner eye (the postganglionic fibers are intact for both, so both will dilate in response to HA. Thus, before HA testing is performed, the cocaine test is needed to establish that a Horner syndrome is present.

How does one differentiate between a pre- and post-ganglionic Horners?
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- Wallenberg syndrome: Central
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- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic
- Forceps delivery: Pre- or post-ganglionic

How does one ‘prove’ a patient has a Horner’s?

Cocaine drop testing. Cocaine will essentially eliminate anisocoria if and only if the sympathetic chain is intact.

How does one differentiate between a pre- and post-ganglionic Horner’s?

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What is the brand name for HA drops?

Paradrine
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

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- Neck trauma: Pre- or post-ganglionic
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What is the brand name for HA drops?
**Paredrine**
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic

Why will HA drop testing be non-localizing if the Horner syndrome is secondary to a history of neck trauma from forceps delivery?

- Forceps delivery: Pre- or post-ganglionic

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**Transynaptic degeneration.** Pre-ganglionic fiber loss prior to age 10 years leads to transynaptic degeneration of the post-ganglionic fibers. Because of this, the HA response would be negative for a pre- or post-ganglionic lesion originating with a forceps injury. After age 10 years, loss of the pre-ganglionic fibers does not result in transynaptic loss, thus preserving the HA response.

● **Forceps delivery: Pre- or post-ganglionic**

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Which is more likely to be associated with neuroblastoma: A congenital Horner's, or one acquired in infancy or early childhood?
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Which is more likely to be associated with neuroblastoma: A congenital Horner’s, or one acquired in infancy or early childhood?

Acquired Horner’s

Absent a clear trauma history, how should one work up a Horner’s acquired in infancy/early childhood?
Wallenberg syndrome: Central
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In addition to a thorough H&P by a pediatrician, urine catecholamine (VMA, etc) testing should be undertaken. Careful consideration should be given to imaging the entire sympathetic chain as well.
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

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In actuality, cocaine and HA drop testing are rarely performed—why?

How does one ‘prove’ a patient has a Horner’s?

**Cocaine drop testing.** Cocaine will essentially eliminate anisocoria if and only if the sympathetic chain is intact.

How does one differentiate between a pre- and post-ganglionic Horner’s?

**Hydroxyamphetamine (HA) drop testing.** HA drops will eliminate anisocoria if the post-ganglionic neuron is intact; therefore, pupillary dilation indicates a pre-ganglionic/central Horner’s.
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Pancoast tumor: Pre-ganglionic
Cluster HA: Post-ganglionic

For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

In actuality, cocaine and HA drop testing are rarely performed—why?
These drugs are highly controlled substances—difficult to acquire and maintain.

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In actuality, cocaine and HA drop testing are rarely performed—why? These drugs are highly controlled substances—difficult to acquire and maintain. What drop test can be performed in their stead?

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What drop test can be performed in their stead? Apraclonidine (Iopidine) testing.

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What drop test can be performed in their stead?
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What is apraclonidine commonly used for?

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An ocular hypotensive, it is used to blunt perioperative pressure spikes.

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What is apraclonidine commonly used for? An ocular hypotensive, it is used to blunt perioperative pressure spikes.

What is its mechanism of action? It is a nonselective alpha-adrenergic agonist.

Which alpha receptors are involved in pupil dilation? Alpha1.

How does one ‘prove’ a patient has a Horner’s?
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How is apraclonidine used in diagnosing Horner syndrome?

How does one ‘prove’ a patient has a Horner’s?

**Cocaine drop testing.** Cocaine will essentially eliminate anisocoria if and only if the sympathetic chain is intact.

How does one differentiate between a pre- and post-ganglionic Horner’s?

**Hydroxyamphetamine (HA) drop testing.** HA drops will eliminate anisocoria if the post-ganglionic neuron is intact; therefore, pupillary dilation indicates a pre-ganglionic/central Horner’s.
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic
- Forceps delivery: Pre- or post-ganglionic

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For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

A. Before drops administered (suspected left Horner syndrome).
B. After drops administered. Note the slight “reversal of anisocoria” in the left eye

Apraclonidine testing
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

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Forceps delivery: Pre- or post-ganglionic

In actuality, cocaine and HA drop testing are rarely performed—why?
These drugs are highly controlled substances—difficult to acquire and maintain.

What drop test can be performed in their stead?
Apraclonidine (Iopidine) testing

What is apraclonidine commonly used for?

How is apraclonidine used in diagnosing Horner syndrome?
It is instilled in both eyes. If the anisocoria reverses, the Horners is confirmed.

What is the physiological basis of anisocoria reversal in response to apraclonidine in Horner syndrome?
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated:

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic
- Forceps delivery: Pre- or post-ganglionic

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**Apraclonidine (Iopidine) testing**

What is apraclonidine commonly used for?

- How is apraclonidine used in diagnosing Horner syndrome?
  It is instilled in both eyes. **If the anisocoria reverses, the Horners is confirmed.**

- How is apraclonidine used to differentiate between a pre- and post-ganglionic Horner's?
  It can't

What is the physiological basis of anisocoria reversal in response to apraclonidine in Horner syndrome?

**Denervation supersensitivity.** Horner syndrome results in upregulation of alpha1 receptors on the pupillary dilator muscle of the affected eye; therefore, this eye will exhibit a stronger response to apraclonidine instillation, and will thus dilate to a degree greater than the normal fellow eye.
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic
- Forceps delivery: Pre- or post-ganglionic

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*Denervation supersensitivity*

Horner syndrome results in upregulation of alpha1 receptors on the pupillary dilator muscle of the affected eye; therefore, this eye will exhibit a stronger response to apraclonidine instillation, and will thus dilate more than the normal fellow eye.

How long after the Horner-inciting injury to the sympathetic pathway does it take for denervation supersensitivity to develop?
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated:

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic
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- Cluster HA: Post-ganglionic
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What is the physiological basis of anisocoria reversal in response to apraclonidine in Horner syndrome?
Denervation supersensitivity. Horner syndrome results in upregulation of alpha_1_ receptors on the pupillary dilator muscle of the affected eye; therefore, this eye will exhibit a stronger response to apraclonidine instillation and will therefore dilate more than the normal fellow eye.

How long after the Horner-inciting injury to the sympathetic pathway does it take for denervation supersensitivity to develop?
In general, a few days (case reports exist of it occurring in as little as a few hours).
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic
- Forceps delivery: Pre- or post-ganglionic

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  It can’t

What is the physiological basis of anisocoria reversal in response to apraclonidine in Horner syndrome?
**Denervation supersensitivity.** Horner syndrome results in upregulation of alpha₁ receptors on the pupillary dilator muscle of the affected eye; therefore, this eye will exhibit a stronger response to apraclonidine instillation, and will thus dilate to a degree greater than the normal fellow eye.

In addition to anisocoria reversal, what other response to apraclonidine is suggestive of Horner syndrome?
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
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- Pancoast tumor: Pre-ganglionic
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- Forceps delivery: Pre- or post-ganglionic

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What is apraclonidine commonly used for?

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It is instilled in both eyes. If the anisocoria reverses, the Horners is confirmed.

How is apraclonidine used to differentiate between a pre- and post-ganglionic Horner?
It can't.

What is the physiological basis of anisocoria reversal in response to apraclonidine in Horner syndrome?
**Denervation supersensitivity.** Horner syndrome results in upregulation of alpha₁ receptors on the pupillary dilator muscle of the affected eye; therefore, this eye will exhibit a stronger response to apraclonidine instillation, and will thus dilate to a degree greater than the normal fellow eye.

In addition to anisocoria reversal, what other response to apraclonidine is suggestive of Horner syndrome?
Resolution of ptosis
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

A. Before drops administered (suspected left Horner syndrome).
B. After drops administered. Note the slight “reversal of anisocoria” in the left eye and the resolution of ptosis.

Apraclonidine testing
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

Wallenberg syndrome: Central
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Denervation supersensitivity. Horner syndrome results in upregulation of alpha_1 receptors on the pupillary dilator muscle of the affected eye; therefore, this eye will exhibit a stronger response to apraclonidine instillation, and will thus dilate to a degree greater than the normal fellow eye.

In addition to anisocoria reversal, what other response to apraclonidine is suggestive of Horner syndrome? Resolution of ptosis.

What is the pathophysiology of ptosis in Horner syndrome?

In actuality, cocaine and HA drop testing are rarely performed—why?
These drugs are highly controlled substances—difficult to acquire and maintain.

What drop test can be performed in their stead?
Apraclonidine (Iopidine) testing.

What is apraclonidine commonly used for?
How is apraclonidine used in diagnosing Horner syndrome?
It is instilled in both eyes. If the anisocoria reverses, the Horner's is confirmed.

How is apraclonidine used to differentiate between a pre- and post-ganglionic Horner's?
It can't.
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

Wallenberg syndrome: Central
Neck trauma: Pre- or post-ganglionic
Neuroblastoma: Pre-ganglionic
Internal carotid dissection: Post-ganglionic
Pancoast tumor: Pre-ganglionic
Cluster HA: Post-ganglionic
Forceps delivery: Pre- or post-ganglionic

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What drop test can be performed in their stead?
**Apraclonidine (Iopidine) testing**

What is apraclonidine commonly used for?

How is apraclonidine used in diagnosing Horner syndrome?
It is instilled in both eyes. If the anisocoria reverses, the Horner's is confirmed.

How is apraclonidine used to differentiate between a pre- and post-ganglionic Horner's?
It can't.

What is the physiological basis of anisocoria reversal in response to apraclonidine in Horner syndrome?
**Denervation supersensitivity**. Horner syndrome results in upregulation of alpha1 receptors on the pupillary dilator muscle of the affected eye; therefore, this eye will exhibit a stronger response to apraclonidine instillation, and will thus dilate to a degree greater than the normal fellow eye.

In addition to anisocoria reversal, what other response to apraclonidine is suggestive of Horner syndrome?
Resolution of ptosis

What is the pathophysiology of ptosis in Horner syndrome?
The absence of sympathetic stimulation to Müller’s muscle of the lid produces a mild ptosis.
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

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These drugs are highly controlled substances—difficult to acquire and maintain.

What drop test can be performed in their stead?
**Apraclonidine (Iopidine) testing**

What is apraclonidine commonly used for?

How is apraclonidine used in diagnosing Horner syndrome?
It is instilled in both eyes. If the anisocoria reverses, the Horner's is confirmed.

How is apraclonidine used to differentiate between a pre- and post-ganglionic Horner's?

Forceps delivery: Pre- or post-ganglionic?
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

Wallenberg syndrome: Central
Neck trauma: Pre- or post-ganglionic
Neuroblastoma: Pre-ganglionic
Internal carotid dissection: Post-ganglionic
Pancoast tumor: Pre-ganglionic
Cluster HA: Post-ganglionic
Forceps delivery: Pre- or post-ganglionic

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What drop test can be performed in their stead?
Apraclonidine (lopidine) testing

What is apraclonidine commonly used for?
An ocular hypotensive, it is used to blunt perioperative pressure spikes

What is its mechanism of action?
It is a nonselective alpha-adrenergic agonist

Which alpha receptors are involved in pupil dilation?
$\alpha_1$

How is apraclonidine used in diagnosing Horner syndrome?
It is instilled in both eyes. If the anisocoria reverses, the Horner's is confirmed.

How is apraclonidine used to differentiate between a pre- and post-ganglionic Horner's?
It can't.
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

In actuality, cocaine and HA drop testing are rarely performed—why? These drugs are highly controlled substances—difficult to acquire and maintain.

What drop test can be performed in their stead?

Apraclonidine (Iopidine) testing

I’m out of apraclonidine. Can I use brimonidine instead?
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic
- Forceps delivery: Pre- or post-ganglionic

In actuality, cocaine and HA drop testing are rarely performed—why?
These drugs are highly controlled substances—difficult to acquire and maintain.

What drop test can be performed in their stead?
**Apraclonidine (Iopidine) testing**

_I’m out of apraclonidine. Can I use brimonidine instead?_
I’m afraid not
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic
- Forceps delivery: Pre- or post-ganglionic

In actuality, cocaine and HA drop testing are rarely performed—why? These drugs are highly controlled substances—difficult to acquire and maintain.

What drop test can be performed in their stead?

**Apraclonidine (Iopidine) testing**

I’m out of apraclonidine. Can I use brimonidine instead?

I’m afraid not

**Why not? Aren’t they very similar meds?**
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic
- Forceps delivery: Pre- or post-ganglionic

In actuality, cocaine and HA drop testing are rarely performed—why? These drugs are highly controlled substances—difficult to acquire and maintain.

What drop test can be performed in their stead?

**Apraclonidine (Iopidine) testing**

*I’m out of apraclonidine. Can I use brimonidine instead?*

I’m afraid not.

**Why not? Aren’t they very similar meds?**

For purposes of Horner drop-testing, not similar enough. While apraclonidine preferentially stimulates the $\alpha_2$ receptor, it still provides some stimulation of the $\alpha_1$ receptors of the dilator muscles.
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated:

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic
- Forceps delivery: Pre- or post-ganglionic

In actuality, cocaine and HA drop testing are rarely performed—why?
These drugs are highly controlled substances—difficult to acquire and maintain.

What drop test can be performed in their stead?

**Apraclonidine (Iopidine) testing**

*I’m out of apraclonidine. Can I use brimonidine instead?*

I’m afraid not.

*Why not? Aren’t they very similar meds?*

For purposes of Horner drop-testing, not similar enough. While apraclonidine preferentially stimulates the $\alpha_2$ receptor, it still provides some stimulation of the $\alpha_1$ receptors of the dilator muscles. In contrast, bromonidine is a highly-selective $\alpha_2$ agonist, and as such provides little to no $\alpha_1$ stimulation, and therefore will not induce pupil dilation.
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: **Central**
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: **Pre-ganglionic**
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic
- Forceps delivery: Pre- or post-ganglionic

Which drop test differentiates between a pre-ganglionic and central Horners?
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: **Central**
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: **Pre-ganglionic**
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic
- Forceps delivery: Pre- or post-ganglionic

*Which drop test differentiates between a pre-ganglionic and central Horners?*

**None.** A central Horner is usually apparent by the company it keeps, or by history.
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic
- Forceps delivery: Pre- or post-ganglionic

Which drop test differentiates between a pre-ganglionic and central Horner's?
None. A central Horner's is usually apparent by the company it keeps, or by history.

What sorts of findings would be associated with a central Horner's?
Significant neurological impairment including difficulties with speaking, swallowing and/or balance, as well as disordered movements (ie, a Wallenberg-type scenario).
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

- Wallenberg syndrome: **Central**
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: **Pre-ganglionic**
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic
- Forceps delivery: Pre- or post-ganglionic

Which drop test differentiates between a pre-ganglionic and central Horners? **None.** A central Horners is usually apparent by the company it keeps, or by history.

What sorts of findings would be associated with a central Horners? Significant neurological impairment including difficulties with speaking, swallowing and/or balance, as well as disordered movements (ie, a Wallenberg-type scenario)
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

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- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: **Pre-ganglionic**
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic
- Forceps delivery: Pre- or post-ganglionic

Which drop test differentiates between a pre-ganglionic and central Horners? **None.** A central Horners is usually apparent by the company it keeps, or by history.

What history would be associated with a central Horners?
Which drop test differentiates between a pre-ganglionic and central Horner's syndrome?

None. A central Horner's is usually apparent by the company it keeps, or by history.

What history would be associated with a central Horner’s syndrome?

Associated history could include significant intracranial events (CVA, tumor, meningitis, a bleed) or a history of significant high C-spine trauma (fracture, dislocation).

For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated:

- Wallenberg syndrome: **Central**
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: **Pre-ganglionic**
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic
- Forceps delivery: Pre- or post-ganglionic
Unless congenital, and absent a definite trauma history, a Horner syndrome must be worked up with imaging of the:

- Head
- Neck
- Upper chest

...with attention to the:

- Skull base
- Internal carotid artery (esp. at the skull base)
- Paraspinal area
- Mediastinum
Unless congenital, and absent a definite trauma history, a Horner syndrome must be worked up with imaging of the:

- Head
- Neck
- Upper chest
- Skull base
- Internal carotid artery (esp. at the skull base)
- Paraspinal area
- Mediastinum
Unless congenital, and absent a definite trauma history, a Horner syndrome must be worked up with imaging of the:

- Head

...with attention to the:

- specific aspect of head
Unless congenital, and absent a definite trauma history, a Horner syndrome must be worked up with imaging of the:

- Head

...with attention to the:

- Skull base
Unless congenital, and absent a definite trauma history, a Horner syndrome must be worked up with imaging of the:

- Head

...with attention to the:

- Skull base
Unless congenital, and absent a definite trauma history, a Horner syndrome must be worked up with imaging of the:

- Head
- Neck

...with attention to the:

- Skull base
Unless congenital, and absent a definite trauma history, a Horner syndrome must be worked up with imaging of the:

- Head
- Neck
- ...
- ...with attention to the:
  - Skull base
  - Specific structure in neck
Unless congenital, and absent a definite trauma history, a Horner syndrome must be worked up with imaging of the:

- Head
- Neck

...with attention to the:

- Skull base
- Internal carotid artery
Unless congenital, and absent a definite trauma history, a Horner syndrome must be worked up with imaging of the:

- Head
- Neck

...with attention to the:

- Skull base
- Internal carotid artery
Unless congenital, and absent a definite trauma history, a Horner syndrome must be worked up with imaging of the:

- Head
- Neck
- Upper chest

...with attention to the:

- Skull base
- Internal carotid artery
Unless congenital, and absent a definite trauma history, a Horner syndrome must be worked up with imaging of the:

- Head
- Neck
- Upper chest

...with attention to the:

- Skull base
- Internal carotid artery
  - specific aspect of chest 1
  - specific aspect of chest 2
• Unless congenital, and absent a definite trauma history, a Horner syndrome must be worked up with imaging of the:
  • Head
  • Neck
  • Upper chest

• …with attention to the:
  • Skull base
  • Internal carotid artery
  • Paraspinal area
  • Mediastinum