Before you begin: This is a big topic, and big topics beget big slide-sets. There’s a natural break around slide 172; I placed a *break time!* slide at that point to mark it.
Horner Syndrome

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

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

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

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

- 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
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.

- What does this ‘abnormal narrowing’ involve?
  - Both

- How is it (mal)positioned in ptosis secondary to Horner’s?
  - 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 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 Horner’s?
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 secondary to Horners?
The upper lid is too... low
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 secondary to Horner’s?**
The upper lid is too...low
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 interpupillary 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 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 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
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 Horner's syndrome?
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 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

**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 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 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 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
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?
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

In 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

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

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

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 Horners?**
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 Horners?
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

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

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

In regard to each lid, what 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

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
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?**

*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 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
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

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
  - 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 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 # mm or so

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

No
**Horner Syndrome**

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

**Ptosis**

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

- **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

In regard to each lid, the upper lid is too...low

The lower lid is too...high
Horner Syndrome

Horner’s ptosis in adult

Horner’s ptosis in infant

Horner syndrome: Ptosis
Horner Syndrome

Horner’s ptosis in adult

Not Horner’s ptosis in child (ptoo ptotic)

Horner’s ptosis in infant

Not Horner’s ptosis in adult (ptoo ptotic)

Horner syndrome: Ptosis
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?*

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

**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 the positioning described?
- 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.)

*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 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 the positioning described?
- 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.)

*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

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, 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 capsulopalpebral 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?
No

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

**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 contains nerve 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 capsulopalpebral 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?**
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

**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 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**

*How does sympathetic dysfunction result in a relatively miotic 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-dilation) innervation is reduced in one eye, its relatively unopposed parasympathetic (=pro-miosis) inputs will have an outsized effect, and the 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-dilation) innervation is reduced in one eye, its relatively unopposed parasympathetic (=pro-miosis) inputs will have an outsized effect, and the 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-dilation) innervation is reduced in one eye, its relatively unopposed parasympathetic (=pro-miosis) inputs will have an outsized effect, and the 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?

At any given moment, the size of a pupil is determined by the sum total of sympathetic and parasympathetic inputs to its dilator and sphincter muscles, respectively. Thus, if sympathetic innervation is reduced in one eye, its relatively unopposed parasympathetic inputs will have an outsized effect, resulting in a relatively smaller pupil compared to 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? The pupil (if either) that is 'the culprit' is the one that is failing to constrict properly in bright light or dilate properly in dim light.

Likewise, if the anisocoria is more pronounced in bright light, the larger pupil isn't constricting properly and is therefore abnormal. A pupil that fails to constrict as it should 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? **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?
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’; 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?

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.

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?

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 suggests 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?

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 suggests 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

‘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 suggests 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’; 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 suggests 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.

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 miosis in comparison to that of the fellow eye.
Horner Syndrome

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

`Relatively miosis’ 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 suggests 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

`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 suggests 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

Horner Syndrome

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'; 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 *suggests* 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.

Hold the phone: The word ‘suggests’ here seems to indicate it’s possible that anisocoria-greater-in-dim-light isn’t necessarily diagnostic of a sympathetic lesion. Is this the case?

It is, unfortunately—physiologic anisocoria sometimes displays the same pattern, ie, it is worse in dim light. This can make differentiating Horner’s anisocoria from physiologic anisocoria especially challenging.

Is there anything about pupil function that distinguishes a Horner’s pupil from a physiologically smaller one?

There is indeed. Whatever dilation in dim light that does occur in the miotic pupil in physiologic anisocoria proceeds at the same speed as the dilation occurring in the fellow pupil. In contrast, in Horner syndrome the miotic eye dilates much slower than its fellow eye. Thus, for the first 4-5 seconds in dim light, the anisocoria will become much more pronounced in Horner syndrome, a phenomenon not found in physiologic anisocoria.
Horner Syndrome

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

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'; 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 suggests the smaller pupil isn't dilating properly, and thus is abnormal. A pupil that fails to dilate is suggestive of a sympathetic problem.

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It is, unfortunately—physiologic anisocoria sometimes displays the same pattern, ie, it is worse in dim light.
Horner Syndrome

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

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-miosis) inputs will have an outsized effect, and its pupil will be relatively miosed in comparison to that of the fellow eye.

'Relatively miosed' 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 suggests 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.

Hold the phone: The word ‘suggests’ here seems to indicate it’s possible that anisocoria-greater-in-dim-light isn’t necessarily diagnostic of a sympathetic lesion. Is this the case?

It is, unfortunately—physiologic anisocoria sometimes displays the same pattern, i.e., it is worse in dim light. This can make differentiating Horner's anisocoria from physiologic anisocoria especially challenging.

Nonpathologic or physiological anisocoria (a common finding)

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

Then it is nonpathologic or physiological anisocoria.
Horner Syndrome

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

Horner Syndrome

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-miosis) inputs will have an outsized effect, and its pupil will be relatively miosis 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’; 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 suggests the smaller pupil isn’t dilating properly, and thus is abnormal. A pupil that fails to dilate is suggestive of a sympathetic problem.

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Hold the phone: The word ‘suggests’ here seems to indicate it’s possible that anisocoria-greater-in-dim-light isn’t necessarily diagnostic of a sympathetic lesion. Is this the case?

It is, unfortunately—physiologic anisocoria sometimes displays the same pattern, ie, it is worse in dim light. This can make differentiating Horner’s anisocoria from physiologic anisocoria especially challenging.

Is there anything about pupil function that distinguishes a Horner’s pupil from a physiologically smaller one?

There is indeed. Whatever dilation in dim light that does occur in the miotic pupil in physiologic anisocoria proceeds at the same speed as the dilation occurring in the fellow pupil. In contrast, in Horner syndrome the miotic eye dilates much slower than its fellow eye. Thus, for the first 4-5 seconds in dim light, the anisocoria will become much more pronounced in a Horner syndrome, a phenomenon not found in physiologic anisocoria.
**Horner Syndrome**

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

Horner Syndrome

How does sympathetic dysfunction result in a relatively miosis 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-miosis) inputs will have an outsized effect, and its pupil will be relatively miosis in comparison to that of the fellow eye.

'Relatively miosis' 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 gating effect of the pupillary light reflex, which occurs when the pupil constricts in bright light and dilates in dim light.

Anisocoria is more pronounced in dim light, this suggests 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.

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There is indeed. Whatever dilation in dim light that does occur in the miosis pupil in physiologic anisocoria proceeds at the same speed as the dilation occurring in the fellow pupil.
Horner Syndrome

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

**Horner Syndrome**

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'; 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 degree of anisocoria present under each lighting condition. If the anisocoria is more pronounced in **dim** light, this suggests 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.

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There is indeed. Whatever dilation in dim light that does occur in the miotic pupil in physiologic anisocoria proceeds at the same speed as the dilation occurring in the fellow pupil. In contrast, in Horner syndrome the miotic eye dilates much faster than its fellow eye.
Horner Syndrome

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

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-miosis) inputs will have an outsized effect, and its pupil will be relatively miotic 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'; 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 suggests 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.

Hold the phone: The word ‘suggests’ here seems to indicate it’s possible that anisocoria-greater-in-dim-light isn’t necessarily diagnostic of a sympathetic lesion. Is this the case?

It is, unfortunately—physiologic anisocoria sometimes displays the same pattern, ie, it is worse in dim light. This can make differentiating Horners anisocoria from physiologic anisocoria especially challenging.

Is there anything about pupil function that distinguishes a Horners pupil from a physiologically smaller one?

There is indeed. Whatever dilation in dim light that does occur in the miotic pupil in physiologic anisocoria proceeds at the same speed as the dilation occurring in the fellow pupil. In contrast, in Horner syndrome the miotic eye dilates much slower than its fellow eye.
Horner Syndrome

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

**Horner Syndrome**

*Hold the phone: The word ‘suggests’ here seems to indicate it’s possible that anisocoria-greater-in-dim-light isn’t necessarily diagnostic of a sympathetic lesion. Is this the case?*

It is, unfortunately—physiologic anisocoria sometimes displays the same pattern, ie, it is worse in dim light. This can make differentiating Horner’s anisocoria from physiologic anisocoria especially challenging.

Is there anything about pupil function that distinguishes a Horner’s pupil from a physiologically smaller one? There is indeed. Whatever dilation in dim light that does occur in the miotic pupil in physiologic anisocoria proceeds at the same speed as the dilation occurring in the fellow pupil. In contrast, in Horner syndrome the miotic eye dilates much slower than its fellow eye. Thus, for the first 4-5 seconds in dim light, the anisocoria will become much more pronounced in a Horner syndrome, a phenomenon not found in physiologic anisocoria.

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

By determining the lagging pupil, that pupil is abnormal. Once the lagging pupil is identified, you proceed to the next step—

**anisocoria is more pronounced in dim light, this suggests** 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
  - Anhidrosis

Horner Syndrome

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'; 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 suggests 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.

Hold the phone: The word ‘suggests’ here seems to indicate it’s possible that anisocoria-greater-in-dim-light isn’t necessarily diagnostic of a sympathetic lesion. Is this the case?

It is, unfortunately—physiologic anisocoria sometimes displays the same pattern, ie, it is worse in dim light. This can make differentiating Horners anisocoria from physiologic anisocoria especially challenging.

Is there anything about pupil function that distinguishes a Horner pupil from a physiologically smaller one?

There is indeed. Whatever dilation in dim light that does occur in the miotic pupil in physiologic anisocoria proceeds at the same speed as the dilation occurring in the fellow pupil, whereas in Horner syndrome the miotic eye dilates much slower than its fellow eye. Thus, for the first 4-5 seconds in dim light, the anisocoria will become much more pronounced in a Horner syndrome, a phenomenon not found in physiologic anisocoria.

By what name is this phenomenon known?

Dilation lag
Hold the phone: The word ‘suggests’ here seems to indicate it’s possible that anisocoria-greater-in-dim-light isn’t necessarily diagnostic of a sympathetic lesion. Is this the case?

It is, unfortunately—physiologic anisocoria sometimes displays the same pattern, ie, it is worse in dim light. This can make differentiating Horners anisocoria from physiologic anisocoria especially challenging.

Is there anything about pupil function that distinguishes a Horner pupil from a physiologically unequal one?

There is indeed. Whatever dilation in dim light that does occur in the miotic pupil in physiologic anisocoria proceeds at the same speed as the dilation occurring in the fellow pupil. In contrast, the miotic eye dilates much slower than its fellow eye. Thus, for the first 4-5 seconds in dim light, the anisocoria will become much more pronounced in a Horner syndrome, a phenomenon not found in physiologic anisocoria.

By what name is this phenomenon known?

‘Dilation lag’

How can you tell which pupil is the culprit?

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.

Anisocoria is more pronounced in dim light, this suggests 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
  - **Anhidrosis**

*What does anhidrosis mean?*
Horner Syndrome

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

*What does anhidrosis mean?*
An inability to sweat
Horner Syndrome

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

*What does anhidrosis mean?*
An inability to sweat

*Do Horner pts develop anhidrosis over their entire bodies?*
Horner Syndrome

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

*What does anhidrosis mean?*
An inability to sweat

*Do Horner pts develop anhidrosis over their entire bodies?*
No, it is ipsilateral vs contralateral to the lesion
**Horner Syndrome**

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

**What does anhidrosis mean?**
An inability to sweat

**Do Horner pts develop anhidrosis over their entire bodies?**
No, it is ipsilateral to the lesion
Horner Syndrome

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

*What does anhidrosis mean?*
An inability to sweat

*Do Horner pts develop anhidrosis over their entire bodies?*
No, it is **ipsilateral** to the lesion, and occurs in one of the following patterns of distribution: 

---

- The head, face and neck (in first- and second-order Horner's)
- The forehead (in third-order Horner's)
---

*What determines which pattern a pt will manifest?*
The **order** of the Horner's, i.e., whether s/he has a first-, second- or third-order Horner syndrome.
**Horner Syndrome**

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

*What does anhidrosis mean?*
An inability to sweat

*Do Horner pts develop anhidrosis over their entire bodies?*
No, it is ipsilateral to the lesion, and occurs in one of two patterns of distribution
--?
--?
Horner Syndrome

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

*What does anhidrosis mean?*
An inability to sweat

*Do Horner pts develop anhidrosis over their entire bodies?*
No, it is ipsilateral to the lesion, and occurs in one of two patterns of distribution:
-- The three locations
-- ?
**Horner Syndrome**

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

What does anhidrosis mean?
An inability to sweat

Do Horner pts develop anhidrosis over their entire bodies?
No, it is ipsilateral to the lesion, and occurs in one of two patterns of distribution:
--The head, face and neck
--?
Horner Syndrome

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

What does anhidrosis mean?
An inability to sweat

Do Horner pts develop anhidrosis over their entire bodies?
No, it is ipsilateral to the lesion, and occurs in one of two patterns of distribution:
--The head, face and neck
--The one location
Horner Syndrome

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

*What does anhidrosis mean?*
An inability to sweat

*Do Horner pts develop anhidrosis over their entire bodies?*
No, it is ipsilateral to the lesion, and occurs in one of two patterns of distribution:
-- The head, face and neck
-- The forehead
**Horner Syndrome**

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

*What does anhidrosis mean?*
An inability to sweat

*Do Horner pts develop anhidrosis over their entire bodies?*
No, it is ipsilateral to the lesion, and occurs in one of two patterns of distribution:
--The head, face and neck
--The forehead

*What determines which pattern a pt will manifest?*
Horner Syndrome

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

*What does anhidrosis mean?*
An inability to sweat

*Do Horner pts develop anhidrosis over their entire bodies?*
No, it is ipsilateral to the lesion, and occurs in one of two patterns of distribution:
--The head, face and neck
--The forehead

*What determines which pattern a pt will manifest?*
The order of the Horners, ie, whether s/he has a first-, second-, or third-order Horner syndrome
Horner Syndrome

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

**What does anhidrosis mean?**
An inability to sweat

**Do Horner pts develop anhidrosis over their entire bodies?**
No, it is ipsilateral to the lesion, and occurs in one of two patterns of distribution:
- The head, face and neck
- The forehead

**What determines which pattern a pt will manifest?**
The *order* of the Horners, ie, whether s/he has a **first-**, **second-**, or **third-order Horner syndrome**

**What does the word order refer to in this context?**
It refers to which neuron in the sympathetic chain—the first, second, or third— isn't working, and is thus responsible for the Horner's. (No worries if you're unsure about this 'sympathetic chain' thing—we will fully unpack this concept shortly.)
Horner Syndrome

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

*What does anhidrosis mean?*
An inability to sweat

*Do Horner pts develop anhidrosis over their entire bodies?*
No, it is ipsilateral to the lesion, and occurs in one of two patterns of distribution:
--The head, face and neck
--The forehead

*What determines which pattern a pt will manifest?*
The order of the Horners, ie, whether s/he has a first-, second-, or third-order Horner syndrome

*What does the word *order* refer to in this context?*
It refers to which neuron in the sympathetic chain—the first, second, or third—isn’t working, and is thus responsible for the Horners. (No worries if you’re unsure about this ‘sympathetic chain’ thing—we will fully unpack this concept shortly.)
Horner Syndrome

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

What does anhidrosis mean?
An inability to sweat.

Do Horner pts develop anhidrosis over their entire bodies?
No, it is ipsilateral to the lesion, and occurs in one of two patterns of distribution:
-- The head, face and neck in...
-- The forehead in...

What determines which pattern a pt will manifest?
The order of the Horners, ie, whether s/he has a first-, second-, or third-order Horner syndrome.

For completeness’ sake: Which order of Horner syndrome produces each pattern of anhidrosis?
Horner Syndrome

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

**What does anhidrosis mean?**
An inability to sweat

**Do Horner pts develop anhidrosis over their entire bodies?**
No, it is ipsilateral to the lesion, and occurs in one of two patterns of distribution:
- The head, face and neck in...first- and second-order Horners
- The forehead in...third-order Horners

**What determines which pattern a pt will manifest?**
The *order* of the Horners, ie, whether s/he has a **first-, second-**, or **third-order Horner syndrome**

**What does the word order refer to in this context?**
It refers to which neuron in the sympathetic chain—the first, second, or third—isn’t working.

*For completeness’ sake:* Which order of Horner syndrome produces each pattern of anhidrosis?

---
Horner Syndrome

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

**What does anhidrosis mean?**

In addition to anhidrosis, the appearance of the ipsilateral face may differ from the other side.

In what way?

- The head, face and neck in...first- and second-order Horners
- The forehead in...third-order Horners

**What determines which pattern a pt will manifest?**

The **order** of the Horners, ie, whether s/he has a **first-**, **second-**, or **third-order Horner syndrome**
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - Ptosis
  - Miosis
  - **Anhidrosis** +/- ipsilateral facial

What does anhidrosis mean?

In addition to anhidrosis, the appearance of the ipsilateral face may differ from the other side. In what way? It may be paler vs redder than the unaffected side.

-- The head, face and neck in... first- and second-order Horners
-- The forehead in... third-order Horners

What determines which pattern a pt will manifest? The order of the Horner's, ie, whether s/he has a first-, second-, or third-order Horner syndrome.
Horner Syndrome

- **Cause:** Sympathetic dysfunction
- **Triad:**
  - Ptosis
  - Miosis
  - **Anhidrosis** +/- ipsilateral facial pallor

*What does anhidrosis mean?*

In addition to anhidrosis, the appearance of the ipsilateral face may differ from the other side. In what way? It may be paler than the unaffected side.

---The head, face and neck in... first- and second-order Horner's
---The forehead in... third-order Horner's

*What determines which pattern a pt will manifest?*

The order of the Horner's, i.e., whether s/he has a first-, second-, or third-order Horner syndrome.
Horner Syndrome

- **Cause:** *Sympathetic dysfunction*
- **Triad:**
  - Ptosis
  - Miosis
  - **Anhidrosis +/- ipsilateral facial pallor**

*What does anhidrosis mean?*
*In addition to anhidrosis, the appearance of the ipsilateral face may differ from the other side. In what way? It may be paler than the unaffected side.*

*By what name is this phenomenon known?*

-- The head, face and neck in...first- and second-order Horner's
-- The forehead in...third-order Horner's

*What determines which pattern a pt will manifest?*
The *order* of the Horner's, ie, whether s/he has a *first-, second-, or third-order Horner syndrome*
**Horner Syndrome**

- **Cause:** *Sympathetic dysfunction*
- **Triad:**
  - Ptosis
  - Miosis
  - **Anhidrosis** +/- *ipsilateral facial pallor*

*What does anhidrosis mean?*

In addition to anhidrosis, the appearance of the ipsilateral face may differ from the other side.

In what way?

It may be paler than the unaffected side.

By what name is this phenomenon known?

Harlequin syndrome

What determines which pattern a pt will manifest?

The *order* of the Horners, ie, whether s/he has a first-, second-, or *third-order Horner syndrome*
Horner Syndrome

Harlequin syndrome in Horners (note the attendant ptosis and miosis)
Horner Syndrome

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

Anhidrosis means:
An inability to sweat

Do Horner patients develop anhidrosis over their entire bodies?
No, it is ipsilateral to the lesion, and occurs in one of two patterns of distribution:
- Head, face, and neck in first- and second-order Horner syndromes
- Forehead in third-order Horner syndrome

What determines which pattern a patient will manifest?
The order of the Horner's syndrome, i.e., whether they have a first-, second-, or third-order Horner syndrome.

Next we will embark on an extensive review of the sympathetic pathway (and less extensively, the parasympathetic) as it relates to the eye/orbit. Get comfy—this will take a while!
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
-- 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 into cavernous sinus
-- Hop 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 spinal cord

Second-order neurons

Third-order neurons
--Originates at Budge center
--Exits spinal cord
--Travels in sympathetic chain
--Synapses in superior cervical ganglion
--Originates in superior cervical ganglion
--Travels with internal carotid artery into cavernous sinus
--Hops onto VI, then V1 to enter orbit

two words
Horner Syndrome

*Neural pathway in Horner syndrome:*

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

**Second-order neurons**
--Originate at 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 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**
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
--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

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 cilio-spinal 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*

Third-order neurons

*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*

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
--Originates in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

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

Third-order neurons *aka...?*
--Originates 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 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

*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
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**
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

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**
--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

---*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?

----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 nerve)

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?

With which branch do the postganglionic sympathetics run?
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
--In the sinus:
----Fibers bound for the pupil join CN6, then V1

V1 (aka the ophthalmic 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
--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?
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…
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…
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

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

Mnemonic forthcoming…
Horner Syndrome

Ophthalmic nerve (V₁)
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 opthalmic nerve) breaks into three branches. What are they?*
--Nasociliary
--Frontal
--Lacrimal

*With which branch do the postganglionic sympathetics run?*
The nasociliary
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

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

With which branch do the postganglionic sympathetics run?
The nasociliary

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

--Nasociliary
--Frontal
--Lacrimal

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

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
**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

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**

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

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

With which branch do the postganglionic sympathetics run?
The nasociliary

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

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

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?

Horner Syndrome
**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

--- 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

Sympathetic pathway: 3rd order neuron
Neural pathway in Horner syndrome:

First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliocspinal 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...

(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 [yellow] and [yellow] 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
Neural pathway in Horner syndrome:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliovisceral 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 the rest of the face
--- 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 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 the forehead hop onto the ophthalmic artery, and then onto its frontal and lacrimal branches
--- Fibers bound for sweat glands of the rest of the face
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 ophthalmic artery, and then onto its frontal and lacrimal branches
--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.

Fibers bound for other glands of the face head hop onto the ophthalmic artery, and then onto its frontal and lacrimal branches.

--Fibers bound for the lacrimal gland?
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.

Fibers bound for the lacrimal gland? 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

*Fibers bound for the lacrimal gland? 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?***

*cranial nerve?*
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
--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
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?
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?*
**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

*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 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
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.

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?
The greater petrosal 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

- **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 also travel through the cavernous sinus? No—these fibers hop off the internal carotid artery 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—what is its name? The deep petrosal nerve. By what passage does the vidian nerve exit the skull? The vidian canal. These preganglionic parasympathetic fibers form a named nerve—what is its name? The greater petrosal nerve.

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

**The deep petrosal nerve**
- 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
--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

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

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...
--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--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?
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.

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

The vidian nerve aka...the nerve of the vidian canal
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 postganglionic sympathetic fibers form a named nerve of their own--what is its name?
The deep petrosal nerve

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

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
--Originates in hypothalamus
--Travels in spinal cord
--Synapses in the ciliaospinal center of Budge

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

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

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

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

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The deep petrosal and greater petrosal nerves join up, they form a new named nerve—what is its name?
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They will pass through the orbital fissure to join the nerve on its way to the gland

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Horner Syndrome

Sympathetic pathway overview
Horner Syndrome

Sympathetic pathway overview

Fig. 9.2  See discussion in text.
(This is a good point in the set to take a break)
For each condition, identify the type of Horner syndrome *(central, pre-ganglionic or post-ganglionic)* with which it is associated

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

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Is the Horner pupil in Wallenberg syndrome ipsi- or contralateral to the lesion?
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?
Ipsilateral
What is the noneponymous name for Wallenberg syndrome? Lateral medullary syndrome

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Wallenberg’s hallmark symptom is sensory—what is it?
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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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

Speaking of intractable hiccups: Only two conditions discussed in the BCSC present with them. One is Wallenberg; what is the other?
Neuromyelitis optica spectrum disorder (NMOSD)

In a nutshell, what is NMOSD?
An immune-mediated inflammatory condition of the CNS involving the optic nerve, spinal cord, and various other CNS centers

What is the classic ocular manifestation in NMOSD?
Optic neuritis

What is the classic spinal cord manifestation?
Transverse myelitis

Intractable hiccups implies involvement of what CNS center?
The area postrema

What are the two other symptoms of area postrema syndrome?
--Nausea and vomiting
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The area postrema

What are the two other symptoms of area postrema syndrome?
---Cerebellar signs
---Speech and swallowing difficulties; occasionally, intractable hiccups
Wallenberg syndrome: Central Horner syndrome

- For each condition, identify the type of Horner syndrome with which it is associated:
- Wallenberg syndrome: Lateral medullary syndrome
- 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; occasionally, intractable hiccups

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

Speaking of intractable hiccups: Only two conditions discussed in the BCSC present with them. One is Wallenberg; what is the other?
Neuromyelitis optica spectrum disorder (NMOSD)

**In a nutshell, what is NMOSD?**
An immune-mediated inflammatory condition of the CNS involving the optic nerve, spinal cord, and various other CNS centers

**What is the classic ocular manifestation in NMOSD?**
Optic neuritis

**What is the classic spinal cord manifestation?**
Transverse myelitis

**Intractable hiccups implies involvement of what CNS center?**
The area postrema

**What are the two other symptoms of area postrema syndrome?**
Nausea and vomiting
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated.

**Wallenberg Syndrome**

**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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**Intractable hiccups** implies involvement of what CNS center?
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**What are the two other symptoms of area postrema syndrome?**
--Nausea and vomiting
--Speech and swallowing difficulties; occasionally, intractable hiccups

For more on NMOSD, see slide-set N8
Wallenberg syndrome: **Central**

**What is the noneponymous 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?
**Disequilibrium**

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

**What are the main signs/symptoms?**
---Cerebellar signs: Disequilibrium, ataxia, nystagmus, skew deviation
---Speech and swallowing difficulties; occasionally, intractable hiccups

**Ipsilateral**
Wallenberg syndrome: **Central**

- What is the noneponymous 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

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

- Occlusion of what vessel is implicated in Wallenberg syndrome?
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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 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 they’re being pulled toward the lesion side, or away from it?
    - Toward it

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

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

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 faster than are lateral movements toward the contralateral side
- During vertical saccades, the eyes will move toward the lesion side
- When the pt is not fixating a visual target (e.g., during eye closure), the eyes will move into lateral gaze toward the lesion side

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

Speech and swallowing difficulties; occasionally, intractable hiccups

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

Speaking of disequilibrium: Wallenberg pts often manifest something called disequilibrium. What are the findings in this condition?

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

**Wallenberg syndrome:** Central

**Q/A**

What is the non-eponymous name for Wallenberg syndrome?

Lateral medullary syndrome

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

- Lateral-gaze movements toward the lesion side are notably **faster** than are lateral movements toward the contralateral side

- During vertical saccades, the eyes will move **toward** the lesion 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

In Wallenberg, do pts feel like they are being pulled to one side or away from it?

Toward it

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

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- During vertical saccades, the eyes will move **toward** the lesion 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

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**Disequilibrium**

- Cerebellar signs: ataxia, nystagmus, skew deviation

- Speech and swallowing difficulties; occasionally, intractable hiccups
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?

---Lateral-gaze movements toward the lesion side are notably faster than are lateral movements toward the contralateral side.
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In Wallenberg, do pts feel like their body is being 'pulled to one side.'

Lateropulsion

Speaking of disequilibrium: Wallenberg pts often feel like their body is being 'pulled to one side.'

Disequilibrium

---Cerebellar signs: Ataxia, nystagmus, skew deviation
---Speech and swallowing difficulties; occasionally, intractable hiccups

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

Toward it

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

---A
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; occasionally, intractable hiccups.

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

Speaking of disequilibrium: Wallenberg pts often manifest something called **ocular lateropulsion**. What are the findings in this condition?---Lateral-gaze movements toward the lesion side are notably faster than are lateral movements toward the contralateral side.---During vertical saccades, the eyes will move toward the lesion 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.

In Wallenberg, do pts feel like their body is being ‘pulled’ to one side? Toward it.

Speaking of lateropulsion: Wallenberg pts often manifest something called lateropulsion. 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? 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? *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:** Occasionally, intractable hiccups

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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 it, or away from it? **Toward it**
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**

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—which 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?
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In Wallenberg, do pts feel like their body is being ‘pulled to one side’?
**Toward it**

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 faster than are lateral movements toward the contralateral side
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Disequilibrium
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

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

Speaking of disequilibrium: Wallenberg pts often manifest something called disequilibrium. What is this sensation? Feeling like the body is being ‘pulled’ or away from it
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?  
The ipsilateral vertebral or (less commonly) posterior inferior cerebellar artery

**Wallenberg syndrome is a form of CVA. In that regard:**  
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**

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

- **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?**
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- **Besides the Horner and sensory findings, what are the main signs/symptoms?**
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- Paralysis or weakness

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Wallenberg syndrome: Central

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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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Wallenberg's hallmark symptom is sensory--what is it?
Loss of pain and temperature sensation

Besides the Horner and sensory findings, what else?
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Wallenberg syndrome: **Central**

- **Loss of pain and temperature sensation**
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Besides the Horner and sensory findings, what are the main signs/symptoms?
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Hence Wallenberg's noneponymous name

No question—proceed when ready
Wallenberg syndrome: Central

What is the noneponymous name for Wallenberg syndrome?
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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

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

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

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

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

Wallenberg syndrome: Central
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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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?
**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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--An older vasculopath? Atherosclerosis
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**Occlusion of what vessel is implicated in Wallenberg syndrome?**
The ipsilateral vertebral or (less commonly) the posterior inferior cerebellar artery

**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?
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 (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

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

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

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

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**
- 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
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

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

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:
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.

How about in infants (ie, prior to age 12 months)?

It is #1.

What proportion of peds cancer deaths are due to Nb?

20%
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.
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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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

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

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Q

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

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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

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

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What proportion of peds 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

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%
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%
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%

Which ‘neurons’ and ‘related cells’ are involved in Nb, ie, where are the primaries?
- Wallenberg syndrome: Central
- Neck trauma: Pre- or post-ganglionic
- Neuroblastoma: Pre-ganglionic

**Horner syndrome**

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

**Cancer in childhood**

- 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)?
  - It is #1.

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

**Neuroblastoma**

- 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?
  - Sympathetic chain neurons and adrenal-medulla cells.

**Sympathetic Chain Neurons**

- Adrenal-medulla cells
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 ped's cancer deaths are due to Nb?**
20%

**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
- 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%

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 cells.
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%

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
- 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.

**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.

**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?**

--?

--?

--?
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

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

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
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**

**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.

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

-- Periorbital ecchymosis (aka racoon eyes)
-- ?
-- ?

**The sympathetic chain**
Nb: ‘Raccoon eyes’
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.

Neuroblast is notorious for three other ophthalmic manifestations—what are they?
- Periorbital ecchymosis (aka racoon eyes)
- ? [an orbit-related issue]
- ?

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 (ie, not leukemia) in childhood.

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

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

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.

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.

**Nb is notorious for three other ophthalmic manifestations—what are they?**
- Periorbital ecchymosis (aka racoon eyes)
- Proptosis
- ? [an eye-movement issue]

**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

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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.

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

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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.

What proportion of peds 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.

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.

**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

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?
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- Proptosis
- Opsoclonus

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

Of the two sites, which can produce a Horner syndrome?
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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

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)

Nb is notorious for three other ophthalmic manifestations—what are they?
-- Periorbital ecchymosis (aka raccoon 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

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

Where does Nb rank as a cause of cancer in childhood?
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Adrenal-medulla cells

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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. It is #1 in infants (ie, prior to age 12 months).

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

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).

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

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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
- Neuroblastoma: Pre-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).

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

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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.

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

What’s the difference between a saccadic intrusion and a nystagmus?

**Opsoclonus**

Is opsoclonus secondary to orbital metastasis, like ecchymosis and proptosis?

No—it is a paraneoplastic phenomenon.

Of the two ophthalmic manifestations, which can produce a Horner syndrome?

The sympathetic chain (provided the tumor is in the cervical portion).

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
- Neuroblastoma: Pre-ganglionic

What's the difference between a saccadic intrusion and a nystagmus?
It's all in how the event initiates. Both are characterized by involuntary eye movement that displaces fixation from its intended target; ie, the pt is trying to look at something, but their nystagmus/saccadic intrusion 'pushes' their eyes off of it.

- Opsoclonus
  - Characterized by multivectorial, large-amplitude movements
  - Is opsoclonus secondary to orbital metastasis, like ecchymosis and proptosis?
    - No—it is a paraneoplastic phenomenon

Of the two ophthalmic manifestations:
- Periorbital ecchymosis (aka racoon eyes)
- Proptosis
- Opsoclonus

The sympathetic chain (provided the tumor is in the cervical portion)
- 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
- Neuroblastoma: Pre-ganglionic

What’s the difference between a saccadic intrusion and a nystagmus?
It’s all in how the event initiates. Both are characterized by involuntary eye movement that displaces fixation from its intended target; ie, the pt is trying to look at something, but their nystagmus/saccadic intrusion ‘pushes’ their eyes off of it. It’s in the nature of this initial push that nystagmus differs from saccadic intrusion. In nystagmus, the initial ‘off fixation’ movement is always slow, whereas in a saccadic intrusion the initial movement is always fast.

Opsoclonus

Is opsoclonus secondary to orbital metastasis, like ecchymosis and proptosis?
No—it is a paraneoplastic phenomenon.

Of the two sites:
The sympathetic chain (provided the tumor is in the cervical portion)
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
- Neuroblastoma: Pre-ganglionic

What's the difference between a saccadic intrusion and a nystagmus?
It's all in how the event initiates. Both are characterized by involuntary eye movement that displaces fixation from its intended target; i.e., the pt is trying to look at something, but their nystagmus/saccadic intrusion 'pushes' their eyes off of it. It's in the nature of this initial push that nystagmus differs from saccadic intrusion. In nystagmus, the initial 'off fixation' movement is always slow, whereas in a saccadic intrusion the initial movement is always fast.

Of the two, what does opsoclonus refer to?
Opsoclonus

Which is characterized by multivectorial, large-amplitude movements?
Saccadic intrusion

Is opsoclonus secondary to orbital metastasis, like ecchymosis and proptosis?
No—it is a paraneoplastic phenomenon.

Of the two, which site 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

What’s the difference between a saccadic intrusion and a nystagmus?
It’s all in how the event initiates. Both are characterized by involuntary eye movement that displaces fixation from its intended target; ie, the pt is trying to look at something, but their nystagmus/saccadic intrusion ‘pushes’ their eyes off of it. It’s in the nature of this initial push that nystagmus differs from saccadic intrusion. In nystagmus, the initial ‘off fixation’ movement is always slow, whereas in a saccadic intrusion the initial movement is always fast (ie, it’s a saccade—hence the name).

Opsoclonus
- Proptosis
- Opsoclonus

Of the two saccadic intrusion

Is opsoclonus secondary to orbital metastasis, like ecchymosis and proptosis?
No—it is a paraneoplastic phenomenon.

The sympathetic chain (provided the tumor is in the cervical portion)
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
- Neuroblastoma: Pre-ganglionic

What’s the difference between a saccadic intrusion and a nystagmus? It’s all in how the event initiates. Both are characterized by involuntary eye movement that displaces fixation from its intended target; ie, the pt is trying to look at something, but their nystagmus/saccadic intrusion ‘pushes’ their eyes off of it. It’s in the nature of this initial push that differs: in nystagmus, the initial ‘off fixation’ movement is always ‘slow’ (ie, it’s a saccade—hence the name).

For more on nystagmus and/or saccadic intrusions, see set P4

- Proptosis
- 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.

Of the two sympathetic sites, which can produce a Horner syndrome?
- The sympathetic chain (provided the tumor is in the cervical portion)
- 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
- 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%
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
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What percent of carotid-artery dissection pts will present with a Horner? About 60

What systemic conditions predispose to carotid-artery dissection?
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What percent of carotid-artery dissection pts will present with a Horner?
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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

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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?
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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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

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- 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 a carotid doppler study 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.

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Carotid dissection
Q

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

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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
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**In addition to a Horner’s, carotid dissection has another sentinel ophthalmic manifestation—what is it?**

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Dissection of the internal carotid artery is also associated with HA, face and/or eye pain.

In addition to a Horner’s, carotid dissection has another sentinel ophthalmic manifestation—what is it?
Recurrent episodes of **transient monocular vision loss**

Acute-onset Horner’s + facial/neck pain is an internal carotid dissection until proven otherwise, and must be worked up emergently!
Q: 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:
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- Neuroblastoma: Pre-ganglionic
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic
- Forceps delivery: Pre- or post-ganglionic
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.
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 ‘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

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

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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.**

Why is this? That is, what is it about cocaine drops that allows this assertion to be made?
Wallenberg syndrome: Central
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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](https://www.ncbi.nlm.nih.gov/pubmed/33170311). 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
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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.**

**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.
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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)
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

**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?**
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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- 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.

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?

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? 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.
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. On the other hand, in a central or pre-ganglionic Horner syndrome, 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 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 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? 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.
Wallenberg syndrome: Central
Neck trauma: Pre- or post-ganglionic
Neuroblastoma: Pre-ganglionic

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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).

HA test
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 or 2nd-order neuron.
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

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. On the other hand, in a central or pre-ganglionic Horners, 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?

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. 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. On the other hand, in a central or pre-ganglionic Horners, 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 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?
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. 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. On the other hand, in a central or pre-ganglionic Horners, 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 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?**

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 (assuming cocaine testing has established that a Horner syndrome is present).
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?
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.

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
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic
- Forceps delivery: 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

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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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?

**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**

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

Why will HA drop testing be non-localizing if the Horner syndrome is secondary to a history of neck trauma from forceps delivery?

What implications does this hold for managing Horner syndrome in children?
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**?

What implications does this hold for managing Horner syndrome in children?

It implies one cannot rely on HA testing to differentiate between pre- and post-ganglionic Horner’s in children. Because of this, **drop testing cannot be relied upon to rule out 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

Why will HA drop testing be non-localizing if the Horner syndrome is secondary to a history of neck trauma from forceps delivery?

What implications does this hold for managing Horner syndrome in children?
It implies one cannot rely on HA testing to differentiate between pre- and post-ganglionic Horner’s in children. Because of this, drop testing cannot be relied upon to rule out neuroblastoma.

Which is more likely to be associated with neuroblastoma: A congenital Horner’s, or one acquired in infancy or early childhood?
For each condition, identify the type of Horner syndrome (central, pre-ganglionic or post-ganglionic) with which it is associated

<table>
<thead>
<tr>
<th>Condition</th>
<th>Type of Horner Syndrome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wallenberg syndrome</td>
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<tr>
<td>Neuroblastoma</td>
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Why will **HA drop testing be non-localizing if the Horner syndrome is secondary to a history of neck trauma from forceps delivery?**

What implications does this hold for managing Horner syndrome in children? It implies one cannot rely on HA testing to differentiate between pre- and post-ganglionic Horner’s in children. Because of this, **drop testing cannot be relied upon to rule out neuroblastoma.**

Which is more likely to be associated with neuroblastoma: A congenital Horner’s, or one acquired in infancy or early childhood? Acquired 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

Why will HA drop testing be non-localizing if the Horner syndrome is secondary to a history of neck trauma from forceps delivery?

What implications does this hold for managing Horner syndrome in children?
It implies one cannot rely on HA testing to differentiate between pre- and post-ganglionic Horner’s in children. Because of this, drop testing cannot be relied upon to rule out neuroblastoma.

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?
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?**

**What implications does this hold for managing Horner syndrome in children?**

It implies one cannot rely on HA testing to differentiate between pre- and post-ganglionic Horner's in children. Because of this, drop testing cannot be relied upon to rule out neuroblastoma.

**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?**

In addition to a thorough H&P by a pediatrician, urine catecholamine testing should be undertaken.
A

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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It implies one cannot rely on HA testing to differentiate between pre- and post-ganglionic Horner’s in children. Because of this, drop testing cannot be relied upon to rule out neuroblastoma.

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?
In addition to a thorough H&P by a pediatrician, urine catecholamine (VMA, etc) testing should be undertaken.
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?

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Absent a clear trauma history, how should one work up a Horner’s acquired in infancy/early childhood?
In addition to a thorough H&P by a pediatrician, urine catecholamine (VMA, etc) testing should be undertaken.

What does VMA stand for in this context? Hint: It’s not ‘Video Music Awards.’
(Good one Dr Flynn!)
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?

What implications does this hold for managing Horner syndrome in children?
It implies one cannot rely on HA testing to differentiate between pre- and post-ganglionic Horner’s in children. Because of this, drop testing cannot be relied upon to rule out neuroblastoma.

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In addition to a thorough H&P by a pediatrician, urine catecholamine (VMA, etc) testing should be undertaken.

What does VMA stand for in this context? Hint: It’s not ‘Video Music Awards.’ (Good one Dr Flynn!)
Vanillylmandelic acid (VMA) is a catecholamine metabolite. Its measurement in urine is used for screening children for catecholamine-secreting tumors such as 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

Why will HA drop testing be non-localizing if the Horner syndrome is secondary to a history of neck trauma from forceps delivery?

What implications does this hold for managing Horner syndrome in children?
It implies one cannot rely on HA testing to differentiate between pre- and post-ganglionic Horner's in children. Because of this, drop testing cannot be relied upon to rule out neuroblastoma.

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?
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 as well.
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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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?
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

- Wallenberg syndrome: Central
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What about a congenital Horner’s—how should that be worked up?
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 about a congenital Horner’s—how should that be worked up?
There is less consensus on this score. If other stigmata of birth trauma are present (eg, brachial plexus injury), a workup is unnecessary.
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?

What implications does this hold for managing Horner syndrome in children?
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Absent a clear trauma history, how should one work up a Horner’s acquired in infancy/early childhood?
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What about a congenital Horner’s—how should that be worked up?
There is less consensus on this score. If other stigmata of birth trauma are present (eg, brachial plexus injury), a workup is unnecessary. Absent such a history, relatively low-cost and low-risk maneuvers such as a thorough H&P and urine catecholamine testing are reasonable to undertake.
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 about a congenital Horner’s—how should that be worked up?

There is less consensus on this score. If other stigmata of birth trauma are present (eg, brachial plexus injury), a workup is unnecessary. Absent such a history, relatively low-cost and low-risk maneuvers such as a thorough H&P and urine catecholamine testing are reasonable to undertake. It is less certain that imaging of the entire sympathetic chain is warranted.
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.
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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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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- Internal carotid dissection: post-ganglionic
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- 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

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

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**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

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?**
An ocular hypotensive, it is used to blunt perioperative pressure spikes

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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

**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?**
An ocular hypotensive, it is used to blunt perioperative pressure spikes.

**What is its mechanism of action?**

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.
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
- 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.

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 selective α-agonist.

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.
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? An ocular hypotensive, it is used to blunt perioperative pressure spikes.

What is its mechanism of action? It is a selective \( \alpha \)-adrenergic agonist.

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

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?
An ocular hypotensive, it is used to blunt perioperative pressure spikes

What is its mechanism of action?
It is a selective $\alpha$-adrenergic agonist

Which alpha receptors are involved in pupil dilation?

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.

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
- Internal carotid dissection: Post-ganglionic
- Pancoast tumor: Pre-ganglionic
- Cluster HA: Post-ganglionic
- Forceps delivery: Pre- or post-ganglionic

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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?
Apraclonidine (Iopidine) 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 selective $\alpha$-adrenergic agonist

Which alpha receptors are involved in pupil dilation?
$\alpha_1$

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
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 (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 pupillary dilation?
α₁

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

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
- 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**

What is apraclonidine commonly used for?

*Apraclonidine used in diagnosing Horner syndrome?*
It is instilled in both eyes. If the anisocoria reverses, the Horner's is confirmed.

For each pre- and post-ganglionic Horner's

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.

A. Before drops administered (suspected left Horner syndrome).

Apraclonidine testing
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.

- 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 actually, 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

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? **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.

What drop test can be performed in their stead? **Apraclonidine (Iopidine) testing**

Apraclonidine is used to diagnose Horner syndrome by instilling it in both eyes. If the anisocoria reverses, the Horner's syndrome is confirmed.

Apraclonidine is a nonselective alpha-adrenergic agonist commonly used for ocular hypotensive therapy—blunting perioperative pressure spikes. It is contraindicated in patients with uncontrolled hypertension, as it may cause a severe vasodilatory reaction leading to a profound drop in blood pressure. It is also contraindicated in patients with significant coronary artery disease, as it may cause myocardial ischemia.
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**

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.**

Which α receptors are involved in pupil dilation?
α₁

How is apraclonidine used to differentiate between a pre- and post-ganglionic Horner's?

How long after the Horner-inciting injury to the sympathetic pathway does it take for denervation supersensitivity to develop?

What is the physiological basis of anisocoria reversal in response to apraclonidine in Horner syndrome?
Denervation supersensitivity. Horner syndrome results in upregulation of α₁ receptors on the pupillary dilator muscle of the affected eye; therefore, this eye will exhibit a stronger response to apraclonidine instillation compared to the healthy eye, thereby reversing the anisocoria.

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.

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**

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 is confirmed.

Which alpha receptors are involved in pupil dilation?
\( \alpha_1 \)

How is apraclonidine used to differentiate between a pre- and post-ganglionic Horner?

What drop test can be performed in their stead?
**Apraclonidine (Iopidine) testing**

How is apraclonidine used in diagnosing Horner syndrome?
It is instilled in both eyes. If the anisocoria reverses, the Horner is confirmed.

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)

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 compared to the dilator muscle of the fellow eye.
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**

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.

Which α receptors are involved in pupil dilation?

What is the physiological basis of anisocoria reversal in response to apraclonidine in Horner syndrome? **Denervation supersensitivity**. Horner syndrome results in upregulation of α₁ 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
- 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**

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.

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.

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.

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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 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?
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.

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.

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 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.

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?
An ocular hypotensive, it is used to blunt perioperative pressure spikes.

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?

Which alpha receptor are involved in pupil dilation?
α₁
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**

What is apraclonidine commonly used for? An ocular hypotensive, it is used to blunt perioperative pressure spikes.

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 cephalopreps 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

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?

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.

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
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 α₂ receptor, it still provides some stimulation of the α₁ receptors of the dilator muscles. In contrast, bromonidine is a highly-selective α₂ agonist, and as such provides little to no α₁ 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 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

Which drop test differentiates between a pre-ganglionic and central Horners? **None.** A central Horner's is usually apparent by the company it keeps, or by history.
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 company it keeps**, or by history.

What sorts of findings would be associated with a central Horners?
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 (i.e., a Wallenberg-type scenario).
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 history would be associated with a central Horner's?

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
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**.

Associated history could include significant intracranial events (CVA, tumor, meningitis, a bleed) or a history of significant high C-spine trauma (fracture, dislocation).
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

uppermost level needing imaging
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
- Neck
- Upper chest
- ...with attention to the:
  - Skull base
  - ...next level needing imaging
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**