Course #

712

The Importance of Pupil Testing
Objectives

- The students should leave with a better understanding of the value of Pupillary testing.

Objectives

Auto-Biometry™ — One-touch measurements

Nine documented, objective anterior chamber parameters can be displayed by pressing one button.
Interactive Pachymetry

The Interactive Pachymetry tool provides adjustable calipers for measuring across and within the cornea.

Cranial Nerves

1. Olfactory
2. Optic
3. Oculomotor
4. Trochlear
5. Trigeminal
6. Abducens
7. Facial
8. Vestibulocochlear
9. Glossopharyngeal
10. Vagus
11. Accessory
12. Hypoglossal

Which cranial nerve controls the superior oblique muscle?

Oculomotor Nerve

- It supplies all the Intrinsic Ocular Muscles and all Extrinsic Ocular Muscles except for the Lateral Rectus and Superior Oblique. The ParaSympathetic Fibers from this Nerve innervate the Ciliary Muscle of the Lens and the Sphincter Muscle of the Pupil.

Pupil Response

- The pupillary response is the iris dilator muscle’s response to a variety of different stimuli that varies the size of the pupil of the eye. Changing light conditions, changing focus, drug use, or a variety of other factors can cause this response. Changes in external lighting are among the most common causes of the pupillary response, as many organisms tend to experience a variety of different light conditions over the course of a day.

Continue

- The pupil tends to become smaller when more ambient light is available and larger when there is less available light. This relates to the pupil’s purpose of receiving external light — the pupillary response moderates the amount of light the pupil receives in order to bring about the best conditions for vision.

Continue...

- Constriction or dilation of the pupils in response to differing light conditions is a form of pupillary response known as the pupillary light reflex. The reflex involves a variety of different neurons that sense incoming light and trigger the action of the iris dilator muscle.
Continue

- This reflex is highly important in medicine, particularly for diagnostic purposes. If the eyes do not experience the proper pupillary response to direct light, it’s possible there is something wrong with the eyes or brain stem, or that the subject has taken depressant drugs of some sort.

Pupillary Response

- Pupil size is determined by the interaction of the parasympathetic and the sympathetic nervous system. The parasympathetic system conducts the light reaction with its major center in the dorsal midbrain.

Continue

- To diagnose normal pupillary function, pupils need to be isocoric and react bilaterally equally to light. Anisocoria indicates a problem of the efferent pupillary pathway. Pupillary disorders may involve the afferent pathways (relative afferent pupillary defect) or the efferent pathways.

Afferent vs Efferent

- The meaning of afferent is carrying sensory information such as nerve impulse toward a central organ or a part like brain from the periphery of the body.

- Efferent neurons (also known as motor neurons) are found inside the central nervous systems (in the gray matter of spinal cord and medulla oblongata) that are responsible for receiving information from other neurons and transmitting nerve impulse to the periphery of the body such as muscles, glands etc.

Anisocoria

- Physiological anisocoria is a harmless condition that has to be distinguished from Horner’s syndrome. In this case pharmacological testing with cocaine eye-drops is helpful. Disorders of the parasympathetic system will impair the light response. They include dorsal midbrain syndrome, third-nerve palsy, and tonic pupil.

Adie Syndrome

- Adie syndrome (ˈeɪdi/), sometimes known as Holmes–Adie syndrome or Adie’s tonic pupil, is a neurological disorder characterized by a tonically dilated pupil that reacts slowly to light but shows a more definite response to accommodation (i.e., light-near dissociation). It is frequently seen in females with absent knee or ankle jerks and impaired sweating.
Tonic Pupil

- The tonic pupil, sometimes called Adie’s tonic pupil or simply the Adie pupil, is the term used to denote a pupil with parasympathetic denervation that constricts poorly to light but reacts better to accommodation (near response).

Pupil Testing

- Explain test
- Proper lighting
- Perform direct and consensual
- Swinging flashlight
- Test speed
- Evaluate near response
- Recording accuracy

What does PERRLA stand for?
Horner Syndrome

- Horner syndrome is a combination of signs and symptoms caused by the disruption of a nerve pathway from the brain to the face and eye on one side of the body.
- Typically, Horner syndrome results in a decreased pupil size, a drooping eyelid and decreased sweating on the affected side of your face.
- Horner syndrome is the result of another medical problem, such as a stroke, tumor or spinal cord injury.

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- Classically, the pupillary pathway is considered as a simple reflex arc comprising retinal ganglion cells, midbrain interneurons, oculomotor nerve and short ciliary nerves. However, there are some specialties in the construction of the pupillary pathways that have to be kept in mind when dealing with diseases involving pupillary disorders. This may help to localise lesions. Additionally, studies in patients with lesions of the retrogenticulate pathways have shown that pupillary disorders are possible even with lesions not involving the classical reflex arc. The pupil is therefore not only controlled subcortically, some components are influenced by the visual cortex. The aim of this article is to clarify various findings and terms such as relative afferent pupillary defect and pupillary hemihypokinesia.

No Light

Normal Response to Light

Positive RAPD of Right Eye

Drop Instillation

- Clean hands
- Explain procedure
- Remember safety
- Inspect bottle
- Check date

Make sure you check pupils prior to dilating

APD or +MG

- In an afferent pupillary defect there is a decreased direct response caused by decreased visual function in one eye. This can be demonstrated with the swinging flashlight test, in which the light is moved back and forth between the eyes every two to three seconds. The afferent pupillary defect becomes obvious when the flashlight is moved from the normal to the affected eye, and the affected pupil dilates in response to light. Under normal conditions, the pupil constricts in response to light. Brief oscillations of pupillary size called hippus occur normally in response to light which should not be confused with an afferent pupillary defect.

Swinging Flashlight Test

- Direct response (pupil illuminated). The direct response is impaired in lesions of the ipsilateral optic nerve, the pretectal area, the ipsilateral parasympathetics traveling in CN III, or the pupillary constrictor muscle of the iris.
- Consensual response (contralateral pupil illuminated). The consensual response is impaired in lesions of the contralateral optic nerve, the pretectal area, the ipsilateral parasympathetics traveling in CN III, or the pupillary constrictor muscle.
- Accommodation (response to looking at something moving toward the eye). Accommodation is impaired in lesions of the ipsilateral optic nerve, the ipsilateral parasympathetics traveling in CN III, or the pupillary constrictor muscle, or in bilateral lesions of the pathways from the optic tracts to the visual cortex. Accommodation is spared in lesions of the pretectal area.
• 1. Light Response Pupil Test
• The light response pupil test assesses the reflex that controls the size of the pupil in response to light. Your doctor will first dim the lights, then ask you to look at an object in the distance. A light will be shone into your eyes from each side. Your doctor will watch your pupils closely to determine whether or not your pupils constrict in response to the light, making note of the size and shape of your pupils.

• 2. Swinging Flashlight Pupil Test
• The swinging flashlight pupil test is used to compare your pupils’ response to light. The lights in the room will be dimmed, and you will again be asked to look at a distant object. Your doctor will “swing” the light rhythmically from one eye to the other, noting the response of each pupil. Your pupils should constrict or stay the same size when the light is shone on them. Dilating pupils may alert your doctor to a possible optic nerve problem.

Near Response Pupil Test
• The near response pupil test measures the pupil’s response to a near target. This test will be performed in a room with normal lighting. Your doctor will ask you to look at a distant object, then move a small object or card in front of your eyes. As you fixate your eyes on the near object, your doctor will watch your pupils closely to make sure they constrict quickly as your fixation changes from far to near.

Dilate vs Constriction
• The pupil can expand to be become larger (dilate) or contract to become smaller (constrict). Your iris contains muscles that respond to outside stimuli to control the amount of light that reaches your retina. In bright light, the pupil constricts to reduce the amount of light entering the eye. In dark or dim light, the pupil dilates to allow more light into the eye to improve vision. Normal pupil size tends to range between 2.0 and 5.0 mm depending on the lighting. Pupil size is typically larger in younger people.

What can pupil size reveal?
• When your doctor examines your pupils, he or she will first look for anisocoria. Anisocoria is a condition in which your pupil sizes are unequal. Twenty percent of the general population has normal anisocoria and does not signal anything abnormal. In some cases, however, unequal pupil sizes can be a symptom of disease. Your doctor is also looking at the size and shape of the pupil in both bright light and dim light. The speed and quality of pupillary response to stimuli will also be noted.

Pupillary Impact
• Pupil size abnormalities can sometimes signal disease. The following diseases can affect pupil size: Glaucoma: A mid-dilated pupil can be a sign of glaucoma.
• Aneurysm: An aneurysm that pushes on certain blood vessels in the brain can cause a dilated pupil as well as other symptoms.
• Lung cancer: Lung cancer that affects the top part of the lung can impact the pupillary nerve fibers.
• Brain tumor: If a tumor or mass is close to the origin of the pupillary nerve fibers, it can cause problems within the pupil.
Pupillary Impact

- **Recreational drug use:** Certain drugs can cause the pupils to dilate or constrict abnormally.
- **Medications:** Glaucoma and antihistamines can sometimes cause dilated pupils.
- **Head trauma:** Head injury or concussion can cause unequal pupils.
- **Cluster headaches:** Cluster headaches can cause a constricted pupil.
- **Stroke:** Sometimes a stroke can cause changes in the size of the pupil.
- **Syphilis:** Syphilis can cause an Argyll-Robertson pupil. Argyll-Robertson pupils are small, unequal, misshapen pupils that constrict with near focusing but do not react normally to light.

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How does pupil size affect Lasik eye surgery?

- People with very large pupils are generally bad candidates for Lasik and other refractive procedures. Having naturally large pupils or pupils that dilate heavily in dim light may increase the occurrence of glare and halos following Lasik. Measuring pupil size is an important step in deciding if Lasik is right for you.

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Performing the Exam

- When performing a pupillary exam, it sometimes helps to illuminate pupils indirectly from the side, so you can actually see what is happening.
- Observe the pupil size and shape at rest, looking for Anisocoria (one pupil larger than the other)
- Observe the direct response (constriction of the illuminated pupil)
- Observe the consensual response (constriction of the opposite pupil)
- Repeat with the opposite pupil
- Check for accommodation (constriction of pupil when viewing a close object)

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Anisocoria

- Refers to the asymmetric sizes of pupils
- Physiologic Anisocoria can is very common and a normal variant in up to 20% of the population. The variation should be no more than 1mm and both eyes should react to light normally.
- Can be dangerous if a manifestation of Horner’s syndrome (e.g. carotid dissection) or from damage to the third nerve (e.g. aneurysmal expansion)
  
  — Consider further workup such as imaging if Anisocoria is suspected to be from a pathologic process

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Relative Afferent Pupillary Defect (RAPD, Marcus Gunn Pupil)

- An RAPD is a defect in the direct response. It is due to damage in optic nerve or severe retinal disease.
- It is important to be able to differentiate whether a patient is complaining of decreased vision from an ocular problem such as cataract or from a defect of the optic nerve. If an optic nerve lesion is present the affected pupil will not constrict to light when light is shone in the that pupil during the swinging flashlight test. However, it will constrict if light is shone in the other eye (consensual response). The swinging flashlight test is helpful in separating these two etiologies as only patients with optic nerve damage will have a positive RAPD.

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Swinging Flashlight Test:

- Swing a light back and forth in front of the two pupils and compare the reaction to stimulation in both eyes.
- When light reaches a pupil there should be a normal direct and consensual response.
- An RAPD is diagnosed by observing paradoxical dilatation when light is directly shone in the affected pupil after being shown in the healthy pupil.
Some causes of a RAPD include:
- optic neuritis
- ischemic optic disease or retinal disease
- severe glaucoma causing trauma to optic nerve
- direct optic nerve damage (trauma, radiation, tumor)
- retinal detachment
- very severe macular degeneration
- retinal infection (CMV, herpes)

Adie's (Tonic) Pupil
- Common in women in the 3rd/4th decade of life (but also can be present in men)
- Either no or sluggish response to light (both direct and consensual responses)
- Thought to be caused from denervation in the postganglionic parasympathetic nerve
- Associated with Holmes-Adie syndrome described with Adie's pupil and absent deep tendon reflexes
- Overall, this is a benign process (including Holmes-Adie syndrome)

Argyll Robertson Pupil
- This lesion is a hallmark of tertiary neurosyphilis
- Pupils will NOT constrict to light but they WILL constrict with accommodation
- Pupils are small at baseline and usually both involved (although degree may be asymmetrical)

Horner's Syndrome
- Loss of sympathetic innervation causing the clinical triad of:
  - Ptosis (drooping eyelid): The superior tarsal muscle requires sympathetic innervation to keep the eyelid retracted
  - Miosis (pupillary constriction): A loss of sympathetic input causes unopposed parasympathetic stimulation which leads to pupillary constriction. This degree of miosis may be subtle and require a dark room.
  - Anhidrosis (decreased sweating): Also caused by a loss of sympathetic activity. The pattern of anhidrosis may help identify the lesion. Anhidrosis of the entire face is often associated with a lesion at the level of the carotid artery. Partial anhidrosis involving only the medial aspect of the forehead ipsilateral side of the nose is associated with a lesion distal to the carotid bulb.

Causes of Horner's Syndrome include:
- carotid artery dissection
- pancoast tumors, nasopharyngeal tumors
- lymphoproliferative disorders
- brachial plexus injury
- cavernous sinus thrombosis
- fibromuscular dysplasia

From an anatomical point of view, a normal, non-pathological eye is known as an emmetropic eye, and has been studied very little until now in comparison with myopic and hypermetropic eyes. The results show that healthy emmetropic women have a wider pupil diameter than men.

http://www.sciencedaily.com/releases/2012/04/120426104953.htm
Pay Attention

Arcus Senilis

Marfan’s

TRAUMATIC IRIDECTOMY

What is the minimal information needed to order contacts?

Thank You

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