Vascular Disorders and Vision

2 hours

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Course Description:
Blood flow to the eye and brain have significant impacts on vision. In this course, we will review the vascular neuroanatomy and the clinical implications for the eye in vision. We will utilize a case-based approach to evaluate the many ways that vascular disease can affect ocular health.

Objectives:
- Understand the neuroanatomy of the vascular system pertaining to the eye and brain
- Differentiate the types of stroke and impacts on the visual system
- Evaluate both the afferent and efferent system in patients with suspected vascular disorders

OUTLINE:

1. **Review of Cerebrovascular Anatomy**
   a. **Carotid System- Three main branches – Anterior System**
      i. Middle Cerebral Artery
         1. Frontal Lobe-Motor function, emotions/personality, motor speech
         2. Parietal Lobe-General senses, sensory processing, spatial relationships
         3. Temporal Lobe- Language, memory, intellect
         4. Internal capsule (posterior limb)-motor/general sensory pathways, optic radiations
      ii. Anterior Cerebral Artery
         1. Medial surface of the cortex
         2. Corpus callosum
         3. Internal Capsule (anterior limb)
      iii. Ophthalmic Artery
         1. Ocular structures
   b. **Vertebrobasilar System- Posterior System**
      i. Two vertebral arteries ascend posteriorly to form a single basilar artery that gives off branches to supply the following structures
      ii. Brainstem
         1. Cranial Nerves
         2. Gaze Centers
         3. Vestibular Nuclei

            4. Sensory/Motor pathways
        iii. <u>Cerebellum</u>
            1. Coordination
        iv. <u>Occipital Lobe</u>
            1. Visual cortex
    c. **The Circle of Willis – The connection**
        i. Network that connects the vertebrobasilar and carotid systems at the base of the brain.
        ii. Connects he right and left sides of the carotid and vertebrobasilar systems.
    d. **The Heart – The central source**
        i. Pumps blood to the brain via both systems.
        ii. Inadequate perfusion pressure via the heart can result in global ischemia to the brain.
        iii. Can be a source of multiple emboli

2. <u>Stroke</u>

- a. Blood vessel to the brain is blocked or ruptured creating lack of blood flow to brain tissue
- b. TIA: warning sign
    - i. Typically foreshadow stroke in 15% of patients
    - ii. Temporary blockage of blood vessel
- c. 3 types of stroke:
    - i. Ischemic – most common
        1. Typically from thrombus or embolus
        2. Goal: dislodge blockage within 6 hours to restore blood flow
    - ii. Hemorrhagic
        1. Typically from hypertension but also AVM and aneurysm
        2. Goal: treat blood pressure, control brain swelling, treat blood vessel abnormality if present
    - iii. Cryptogenic
- d. BEFAST acronym
- e. Modifiable and non-modifiable stroke risk factors: 80% are preventable
- f. Ocular clinical correlations:
    - i. Occipital lobe stroke
        1. Area of most congruity = Macular sparing visual field defects
        2. Typically vision is <u>only</u> symptom
            - a. Often complain of vision loss in one eye (eye with temporal field loss)
        3. Homonymous hemianopsia most common but other presentations possible

a. Visual hallucinations
b. Prosopagnosia

ii. **Middle cerebral artery stroke**
1. Contralateral sensory loss of legs, arms and lower 2/3 of face
2. Contralateral motor loss of legs, arms and face
3. Contralateral gaze palsy (frontal cortex – Broadmann area 8)
4. Contralateral homonymous hemianopsia
5. Visual neglect possible in right sided stroke
6. Aphasia

iii. **Wallenberg syndrome**
1. Damage to the lateral aspect of the medulla
2. Common from infarction of posterior inferior cerebellar artery
3. Ocular signs: Horner's syndrome, nystagmus, INO/Skew deviation

iv. **Brainstem stroke:**
1. CN III, IV or VI palsy
2. MLF: INO and/or skew deviation
3. Horner's syndrome
4. Dorsal midbrain syndrome
5. Nystagmus

v. **Posterior communicating artery aneurysm**
1. Connects anterior and posterior system
2. Runs medial to CN III
3. May impact pupillary fibers first
4. MOST COMMON SITE OF ANEURYSMS- 45.9% of all aneurysms with high risk of rupture

3. **<u>Ocular Manifestations of Carotid Circulation Disease</u>**

a. **Transient Monocular Vision Loss**
i. Transient blindness or vision loss usually lasting less than 10 minutes
ii. Involves all or part of the visual field
iii. Usually platelet/fibrin emboli from carotid or heart
iv. 3 year risk of stroke can be as high as 10% when there are certain associated risk factors

b. Artery Occlusions (Branch/Central)
i. Considered to be embolic until proven otherwise
ii. Prevalence of carotid disease and risk of future stroke is presumed comparable to transient monocular vision loss
iii. Needs to be worked up as stroke – sent to ER for evaluation
iv. Different then asymptomatic hollenhorst plaque

c. Ocular Ischemic Syndrome

        i. Hemorrhagic retinopathy (mid-peripheral hemorrhages, attenuated arteries, dilated veins, neovascularization).
        ii. Symptoms include vision loss, TMVL and pain
        iii. Anterior segment signs may be apparent (uveitis, corneal edema, iridoplegia, rubeosis, neovascular glaucoma, dilated episcleral vessels).
        iv. Future stroke risk is not well-defined but thought to be high.
        v. Risk of permanent blindness is great
    d. **Carotid Dissection**
        i. Layers of the carotid artery are mechanically separated
        ii. Can occur extra or intracranially and lead to stroke or hemorrhage
        iii. Can occur with blunt (MVA) or mild trauma (neck manipulations) or in connective tissue disorders
        iv. Horner's syndrome
        v. Symptoms: headache, neck pain and facial pain

4. **<u>Ocular Manifestations of Other Vascular Disorders</u>**
    a. **Arteritic Ischemic Optic Neuropathies**
        i. **Arteritic**
            1. Acute, painful vision loss
            2. Most commonly from **giant cell arteritis**
                a. Granulomatous medium and large vessel vasculitis
                b. Most common vasculitis in the US
                    i. Most common arteries affected:
                        1. Temporal – where we biopsy
                        2. Ophthalmic- choroidal ischemia – AION +CRAP
                        3. Posterior ciliary arteries - AION
                        4. Vertebral arteries – stroke
                c. Systemic features:
                    i. Headache, malaise, scalp tenderness, jaw claudication, fever, fatigue, weight loss, polymyalgia
                d. Visual features: temporary or permanent
                    i. Double vision
                    ii. Amaurosis fugax
                    iii. AION
                    iv. Ophthalmic artery occlusion
            3. Females>males
            4. More common in Caucasian population over 50 years of age
            5. Profound visual loss typically hand motion or worse
            6. Optic disc appearance

a. Chalky disc edema
b. Cotton wool spots
c. May have cilioretinal artery occlusion or choroidal ischemia

7. If suspicion is high send to ER for evaluation and treatment
    a. Clinical diagnosis = treat before diagnosis
    b. Bloodwork:
        i. ESR, CRP, platelets
    c. Imaging – cranial ultrasound
    d. Temporal artery biopsy – gold standward
8. Treatment
    a. Vision loss = IV steroids
    b. No vision loss = oral steroids
    c. Tocilizumab
        i. More effective than prednisone alone at sustaining glucocorticoid-free remission in GCA
9. Risk to fellow eye
    a. 9% on treatment and 20-62% in untreated patients

ii. **Non-arteritic**
1. Acute, painless vision loss
2. More common in Caucasian population
3. Mean age of onset between 57-65
4. Visual acuity is variable but typically hand motion or better
5. Visual field loss follows RNFL with inferior visual field loss being the most common
    a. Segmental (25%) or diffuse (75%) swelling
    b. Hemorrhages and hyperemic disc
    c. Fellow eye: disc at risk
6. Associated risk factors = microvascular compromise
    a. Hypertension, diabetes, hypercholesterolemia, smoking, sleep apnea, nocturnal hypotension, anemia, hypercoaguable states, optic disc drusen, ocular and non-ocular surgery
    b. Ocular equivalent of a lacunar infarction and presents only a low risk of future stroke. It **is NOT considered a direct manifestation of carotid occlusive disease,** however, patients with AION often have increased stroke risk by virtue of having other diseases that increase their risk of stroke
7. Associated medications
    a. Phosphodiesterase type-5 inhibitors

  b. Amiodarone
  c. Semaglutide
  d. Increased risk in both diabetic and overweight/obese cohorts
  e. Typically occurs within the first year
  f. Current research updates
8. No known beneficial treatment
9. Vision typically stabilizes in 2-3 months and may improve up to 3 lines in 43%
10. 5% risk of reoccurrence in the same eye and 15% chance of involvement in fellow eye in 5 years

5. Q&A / Discussion