Post Operative Vision Loss
Ischemic Optic Neuritis

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Post Operative Vision Loss (POVL)

• What are the types and incidence of POVL?
• What are the patient and operative risk factors?
• What can decrease the risk of POVL?
• What can I do if my patient develops POVL?

Definition

• Complete or partial impairment of vision
  • Following an anesthetic requiring procedure
  • Non-ocular surgery
  • Decreased visual acuity
  • Visual field defect
  • Complete loss of vision
• Uncommon
• Most commonly associated with spine surgery, CABG, & head and neck
• The most common cause of POVL is ischemic optic neuritis (ION).

Ischemic Optic Neuropathy

• **Posterior Ischemic Optic Neuropathy (PION)**
  – Most common form
  – Infarction of the intra-orbital (posterior) portion of the optic nerve
  – Infarction due to decreased oxygen delivery presumably to any number of peri-operative hemodynamic derangements
  – Symptoms upon awakening in 59% of those affected. Within 24 hours in an additional 29%

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Posterior Ischemic Optic Neuropathy

- Sudden painless loss of vision
- Unilateral or bilateral
- It may or may not have associated afferent pupillary defect.
- Normal fundoscopic exam
  - Optic atrophy develops over subsequent weeks to months.
  - MRI frequently shows no abnormalities
- Nonspecific visual field abnormality
- In the absence of an afferent pupil defect may need negative neuro-imaging to confirm the diagnosis

Posterior Ischemic Optic Neuropathy

- Delay in diagnosis because:
  - The bedside objective exam will be normal.
  - Patients may attribute changes in their vision to a “recovering from anesthesia”.
  - May have other post-operative issues that overshadow these symptoms.
  - Particularly in sedated patients who remained mechanically ventilated after operation

Anterior Ischemic Optic Neuropathy (AION)

- Anterior ischemic optic neuropathy (AION)
  - Two types: arteritic and non-arteritic AION.
  - More common after cardiac surgery
  - Ischemic lesion on the anterior portion of the optic nerve
  - Better vascular supply which could explain lower incidence in spine surgery
  - Bilateral involvement is more common in AION
  - Develops 48 hours to one week after surgery
**AION**  
**Anterior Ischemic Optic Neuropathy**

- Edematous disc + peri-papillary flame-shaped hemorrhages
- Relative afferent pupillary defect or reduced pupillary light reflex
- Visual field deficit may be present.

**CRAO**  
**Central Retinal Artery Occlusion**

- Retinal circulation: internal carotid artery → ophthalmic artery → via the central retinal artery.
- Visual loss due to loss of blood supply to the inner layer of the retina
  - Retinal cells become irreversibly damaged after the vessel is occluded for more than 45 minutes.
  - Ischemia possibly as short as 25 minutes may lead to vision loss.
- Patients with a central retinal artery occlusion can usually only see shapes and movement.
- Only 5% to 10% of patients recover “some useful” vision.
- The majority of patients recover some side vision, but do not regain central vision.

**PION vs. AION Exam**

- **PION: Normal optic disc**
  - A. Normal Optic Disc or PION (early)

- **AION: Arrows pointing to blurred optic disc margins**

**Central Retinal Artery Occlusion (CRAO)**  
**Fundoscopic**

- Macular retinal edema and pale whitish color
- Cherry red spot: Macula receives its blood supply from the choroid, supplied by the posterior ciliary arteries, while the surrounding retina is pale due to retinal artery infarction.
- Attenuated retinal vessels
**Incidence of POVL**

*SPINE* 2008; 33 (13):1491–1496

<table>
<thead>
<tr>
<th>Type of Spine Surgery</th>
<th>Total No. Cases</th>
<th>Percent of Patients With Visual Loss</th>
<th>Percent of Patients With IOI</th>
<th>Percent of Patients With CRAO</th>
</tr>
</thead>
<tbody>
<tr>
<td>All spine cases</td>
<td>4720058</td>
<td>0.037</td>
<td>0.006</td>
<td>0.001</td>
</tr>
<tr>
<td>Posterior lumbar fusion</td>
<td>518580</td>
<td>0.136</td>
<td>0.017</td>
<td>0.001</td>
</tr>
<tr>
<td>Anterior lumbar fusion</td>
<td>484937</td>
<td>0.044</td>
<td>0.009</td>
<td>0.002</td>
</tr>
<tr>
<td>Lateral fusion</td>
<td>523794</td>
<td>0.032</td>
<td>0.002</td>
<td>0.002</td>
</tr>
<tr>
<td>Spinal fusion scoliosis</td>
<td>39476</td>
<td>0.202</td>
<td>0.020</td>
<td>0.000</td>
</tr>
<tr>
<td>Scoliosis anterior-only fusion</td>
<td>6206</td>
<td>0.17</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Scoliosis posterior-only fusion</td>
<td>26653</td>
<td>0.29</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

IOI indicates ischemic optic neuropathy; CRAO, Central retinal artery occlusion.

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**Pathology CRAO**

- **Retinal vascular occlusion: mechanisms**
- **External compression**
  - Retinal ischaemia
  - Anterior chamber ischaemia
  - Extracocular muscles ischaemic
  - Reperfusion
  - Swelling increased ➔ Retinal hypoperfusion
  - Further increases in compartment pressure ➔ Retinal reperfusion injury ➔ Propotosis ➔ Extracocular muscle damage ➔ Chemosis ➔ Corneal injury ➔ Retinal cell loss

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**ASA Registry**

*Anesthesiology* 2006;105:652-9

- 1990s: concern lead to desire for data base
- 1999 ASA POVL Registry
  - All cases in registry developed POVL within 7 days of surgery
- Multi-institutional
- Collected data on 131 cases (93 spine surgery)
ASA Registry

Anesthesiology 2006;105:652-9

Surgical Characteristics Associated With ION
Anesthesiology 2006;105:652-9

Table 3. ASA POVL Registry: Surgical Characteristics in Spine Cases with ION (n = 83)

<table>
<thead>
<tr>
<th>Surgical Variable</th>
<th>n (% of 83 cases)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fusion/instrumentation</td>
<td>74 (89)</td>
</tr>
<tr>
<td>Previous spine surgery</td>
<td>32 (39)</td>
</tr>
<tr>
<td>Number of vertebral levels</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>9 (11)</td>
</tr>
<tr>
<td>2</td>
<td>19 (23)</td>
</tr>
<tr>
<td>3</td>
<td>15 (18)</td>
</tr>
<tr>
<td>&gt; 4</td>
<td>33 (40)</td>
</tr>
<tr>
<td>Unknown number of levels</td>
<td>10 (12)</td>
</tr>
<tr>
<td>Vertebral location</td>
<td></td>
</tr>
<tr>
<td>Cervical/ cervic thoracic</td>
<td>4 (5)</td>
</tr>
<tr>
<td>Thoracic/thoracolumbar</td>
<td>11 (13)</td>
</tr>
<tr>
<td>Lumbar</td>
<td>22 (27)</td>
</tr>
<tr>
<td>Lumbosacral/sacral</td>
<td>35 (42)</td>
</tr>
<tr>
<td>Thoracolumbosacral</td>
<td>5 (6)</td>
</tr>
<tr>
<td>Unknown location</td>
<td>8 (10)</td>
</tr>
</tbody>
</table>

ASA = American Society of Anesthesiologists; ION = ischemic optic neuropathy; POVL = Postoperative Visual Loss.

Comparison ION CRAO
Anesthesiology 2006;105:652-9

Table 5. Comparison of ION and CRAO Cases from the ASA POVL Registry (n = 93)

<table>
<thead>
<tr>
<th></th>
<th>ION (n = 83)</th>
<th>CRAO (n = 10)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD), yr</td>
<td>50 (14)</td>
<td>46 (13)</td>
<td>0.34*</td>
</tr>
<tr>
<td>Anesthetic duration, mean (SD), h</td>
<td>9.8 (3.1)</td>
<td>6.5 (2.2)</td>
<td>0.003*</td>
</tr>
<tr>
<td>Estimated blood loss, mean (range), %</td>
<td>2.3 (0.1-25)</td>
<td>0.75 (0.3-1.8)</td>
<td>0.001*</td>
</tr>
<tr>
<td>Crystalloid infusion, mean (SD), L</td>
<td>9.7 (4.7)</td>
<td>4.6 (1.7)</td>
<td>0.001*</td>
</tr>
<tr>
<td>Lowest hematocrit, mean (SD)</td>
<td>29 (6)</td>
<td>31 (6)</td>
<td>0.073*</td>
</tr>
<tr>
<td>Bilateral disease, number of cases (% of column)</td>
<td>55 (56)</td>
<td>0 (0)</td>
<td>0.0012</td>
</tr>
<tr>
<td>Any visual recovery, number of cases (% of column)</td>
<td>20 (40)</td>
<td>2 (20)</td>
<td>0.11</td>
</tr>
<tr>
<td>Mayfield pins, number of cases (% of column)</td>
<td>16 (16)</td>
<td>0 (0)</td>
<td>0.0011</td>
</tr>
<tr>
<td>Isolated percutaneous trauma, number of cases (% of column)</td>
<td>1 (1)</td>
<td>7 (7)</td>
<td>0.0012</td>
</tr>
</tbody>
</table>

*1 test, **2 test

ASA = American Society of Anesthesiologists; CRAO = central retinal artery occlusion; ION = ischemic optic neuropathy; POVL = Postoperative Visual Loss.

Anesthesia Duration in Spine ION Cases (n=83)
**Post Operative Vision Loss Study Group**  
*Anesthesiology 2012; 116: 15-24*

- Multi-institutional case control study
  - 17 academic medical centers
- 80 Patients from ASA POVL Registry with ION were compared to 315 controls without ION
- Patient underwent multi-level surgery
- Compared Pre-existing Conditions and Peri-operative factors
  - The goal was to find risk factors for ION
  - Prior studies were small, lack controls or detailed information

**Estimated Blood Loss in Spine Cases with ION (n=83)**

- Anesthesiology 2006;105:652-9

<table>
<thead>
<tr>
<th>Estimated Blood Loss (ml)</th>
<th>% Spine Cases with ION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-499</td>
<td>0%</td>
</tr>
<tr>
<td>500-999</td>
<td>10%</td>
</tr>
<tr>
<td>1000-1999</td>
<td>30%</td>
</tr>
<tr>
<td>&gt;2000</td>
<td>40%</td>
</tr>
<tr>
<td>Unknown</td>
<td>20%</td>
</tr>
</tbody>
</table>

**Anesthesiology 2006;105:652-9**

Table 6. ASA POVL Registry: Lowest Blood Pressure* in Spine Cases with ION (n = 83)

<table>
<thead>
<tr>
<th>Lowest SBP, mmHg</th>
<th>n (% of 83 cases)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 110</td>
<td>4 (5)</td>
</tr>
<tr>
<td>101-110</td>
<td>7 (8)</td>
</tr>
<tr>
<td>91-100</td>
<td>17 (20)</td>
</tr>
<tr>
<td>81-90</td>
<td>35 (42)</td>
</tr>
<tr>
<td>71-80</td>
<td>12 (14)</td>
</tr>
<tr>
<td>70</td>
<td>5 (6)</td>
</tr>
<tr>
<td>Unknown</td>
<td>3 (4)</td>
</tr>
<tr>
<td>Lowest MAP or SBP as % below baseline, mmHg</td>
<td>n (% of 83 cases)</td>
</tr>
<tr>
<td>&lt; 20%</td>
<td>5 (6)</td>
</tr>
<tr>
<td>20-39%</td>
<td>47 (57)</td>
</tr>
<tr>
<td>40-59%</td>
<td>21 (25)</td>
</tr>
<tr>
<td>50%</td>
<td>7 (8)</td>
</tr>
<tr>
<td>Unknown</td>
<td>3 (4)</td>
</tr>
<tr>
<td>Deliberate hypotension</td>
<td>25 (27)</td>
</tr>
</tbody>
</table>

* Blood pressure ranges were based on 15 min of blood pressure at a given range.  
ASA = American Society of Anesthesiologists; ION = ischemic optic neuropathy; MAP = mean arterial pressure; POVL = Postoperative Visual Loss; SBP = systolic blood pressure
Post Operative Vision Loss Study Group
Anesthesiology 2012; 116: 15-24

• Findings:
  – Risk factors for ION after multivariate analysis:
    • **Male sex** OR 2.53 (95% CI 1.35 - 4.91 P = 0.005)
    • **Obesity** OR 2.83 (95% CI 1.52-5.39 P= 0.001)
    • **Wilson Frame** OR 4.30 (95% CI 2.13 -8.75 P < 0.001)
    • **Anesthesia duration** OR per 1 h = 1.39 (95% CI 1.22-1.58 P < 0.001)
    • **EBL** OR per 1 L =1.34 (95% CI 1.13 -1.61 P = 0.001)
    • **Colloid** as percent of non-blood replacement OR per 5% = 0.67 (95% CI 0.52 -0.82 P < 0.001)

Prognosis

■ Visual recovery
  – Some recovery in approximately 40%
  – Patients with poorer vision initially tended to have less improvement and poorer outcomes
  – 54.9% had a final visual acuity of hand motion or worse

Horseshoe Head-Rest and Eye Protection

Treatment for POVL

• Stat Ophthalmology consult
• Maintain normal blood pressure/correct anemia
• 5% CO2 in oxygen inhaled to enhance dilatation and increase O2 delivery
• Massage of the eye can lower IOP or dislodge an embolus
• I.V. acetazolamide increases retinal blood flow
• Localized hypothermia to affected eye may decrease ischemic injury (animal studies)
• tissue plasminogen activator (tPA)
  – Given via the ophthalmic artery within 6-8 hours
Recommendations

- Avoid Direct Pressure on the globe
- Close attention to Perioperative anemia
- Keep HCT around 30
- Minimize hypotension
- Maintain SBP near baseline
- Reverse Trendelenberg at 10 degrees
- Consider staging long procedures
- Consider arterial catheters to monitor BP
- Consider use of a central venous catheter
- Postop visual exam in high risk patients
- Colloids with crystalloids for volume

References

1. SPINE Visual Loss After Spine Surgery A Population-Based Study Volume 33, Number 13, pp 1491–1496