Incidence of POVL

- Rare: 1/60,000 to 1/125,000 anesthetic procedures
- Increased incidence < 18 and > 65 yrs
- US Nationwide Inpatient Sample Data
  - Cardiac Surgery 8.64 per 10,000
  - Spine 3.09 per 10,000
  - Appendectomy 0.12 per 10,000
- Excludes obstetrics and gynecology cases
- Shen et al., Anesth Analg, 2009
POVL: Primary Cause is Ischemia

- Optic Nerve = Ischemic optic neuropathy (ION)
  - Anterior ION
  - Posterior ION

- Retina = Retinal Artery Occlusion
  - Branch retinal artery occlusion (BRAO)
  - Central retinal artery occlusion (CRAO)

- Ischemic ocular compartment syndrome

- Angle-closure glaucoma

Ischemic optic neuropathy (ION)

- “Stroke of optic nerve”
- PION more common than AION
- Painless vision loss on awaking
- Late onset 24-48 hrs
- MRI normal
- ASA Postoperative Visual Loss Registry
  - Cardiothoracic>spinal fusion>head/neck sx>sinus surgery

Ischemic optic neuropathy (ION): Signs & Symptoms

- AION: papilledema, hemorrhages
- PION: normal eye findings early
  - late optic nerve atrophy weeks to months later

- Ophthalmological exam only way to diagnose
- Poor vision, as bad as no light perception
- Pupils demonstrate afferent defect or is nonreactive
- Color vision decreased or absent
- Visual field testing shows altitudinal defect

Risk Factors for ION

- Prone positioning
- Lengthy surgery: complex spine surgeries
- Changes in arterial and venous hemodynamics
  - Anemia
  - Hypotension
  - Hemodilution
  - Vascular risk factors: hypertension, diabetes, hyperlipidemia, smoking, atherosclerosis, sleep-apnea, hypercoagulability
  - Changes in eye pressure: external and internal

- Anything that leads to decreased oxygen delivery to the optic nerve sufficient to cause ischemic injury

Anatomic Correlate of Retinal Artery Occlusion
Retinal Artery Occlusion

- Central Retinal Artery Occlusion (CRAO)
- Branch Retinal Artery Occlusion (BRAO)
- Perioperative period
  - Improper head positioning
  - External compression of eye
  - Retinal microemboli
    - Open-heart surgery, endoscopic nasal surgery
  - Hypotension, rare cause

Retinal Artery Occlusion: Signs & Symptoms

- Painless, unilateral vision loss, can be no light perception
- Improper head positioning or head movement in horseshoe
- Afferent pupil defect
- Eye findings
  - Retinal edema
  - “Cherry red spot”
  - Retinal arterial attenuation
- Secondary external signs of compression
  - Proptosis, chemosis, ptosis, loss of eye movement

PERIOPERATIVE ANGLE-CLOSURE GLAUCOMA ASSOCIATED WITH GENERAL ANESTHESIA

1957-2008: 30 cases of unilateral angle-closure (7 bilateral)

PERIOPERATIVE ANGLE-CLOSURE GLAUCOMA ASSOCIATED WITH GENERAL ANESTHESIA

- RISK FACTORS
  - Effect of gravity with prone position shifts the lens/iris diaphragm
  - Patient at risk: Asians, small eyes, far-sighted patients
  - Usually unilateral but can be bilateral
  - Intense pain, mid-dilated pupils, nausea, emesis
  - Must differentiate from corneal abrasion (topical anesthesia)
  - Anesthetics and medications used during surgery:
    - Ephedrine
    - Anticholinergic agents (atropine sulfate, scopolamine)
    - Neuromuscular blocking drugs (succinylcholine)

Ocular Compartment Syndrome

- Surgery on the nose and paranasal sinuses
- Endoscopic Sinus Surgery (ESS)
  - <1% of direct orbital injury, 16% of retrobulbar hemorrhage
  - Arterial: iatrogenic, acute, abrupt orbital swelling
  - Venous: subacute, traumatic, over hours
- Direct pressure to optic nerve and ophthalmic artery
- Signs & Symptoms
  - Extreme pain, proptosis, diplopia, decreased vision, ophthalmoplegia
  - Tonometric pressures within 20 mm of arterial pressure constitute an emergency

Retrobulbar Hemorrhage during endoscopic sinus surgery

Ocular compression syndrome: Management
• Elevate head
• Remove nasal packing and control epistaxis
• Antiglaucoma eye drops, mannitol, acetazolamide decrease eye pressure
• Lateral canthotomy and cantholysis if all else fails
• Prevention is best medicine (adequate visualization during surgery)

Prone Positioning
• Increased intraocular pressure decreases ocular perfusion
• Can predispose to angle-closure glaucoma in susceptible eyes
• Position head in neutral position at or above level of heart
• Damage to retinal ganglion cells

Length of surgery and hypotension
• POVL associated with longer surgery
• Complex spinal and cardiothoracic sx
• Hypotension and POVL
  • 33% lowest arterial pressure > 90 mmHg
  • 20% lowest arterial pressure < 80 mmHg
  • 57% had decrease of mean arterial pressure by 20-39% below baseline
  • 25% had decrease of 40-49%
  • ASA Postoperative Visual Loss Registry

Risk Factors in POVL
• Prone positioning
• Lengthy surgery: complex spine surgeries
• Changes in arterial and venous hemodynamics
  • Anemia
  • Blood Loss and Hypotension
  • Hemodilution
  • Vascular risk factors: hypertension, diabetes, hyperlipidemia, smoking, atherosclerosis, sleep-apnea, hypercoagulability
• Changes in eye pressure: external and internal
• Anything that leads to decreased oxygen delivery to the eye sufficient to cause ischemic injury

Effect of Steep Trendelenburg on Intraocular Pressure during Robotic Radical Prostatectomy

Blood Loss
• Decreased O₂ to optic nerve & retina
• Unknown variables
  • How long and how low the hematocrit must decrease?
• Spine surgery: POVL correlated with higher intraop blood loss but not lowest Hct
• Cardiac surgery: POVL with lower postop Hg
  • Hg <8.5 g/dl associated 2:1 with ION
• Guidelines do not recommend transfusion if Hg > 8.0
  (ASA, Society of Cardiovascular Anesthesiologists, Society of Thoracic Surgeons)
Hemodilution

- Commonly present in surgical patients
- No human studies but animal studies show that isovolumic hemodilution (30% decrease in Hct) did not affect blood flow to the eye
- Combination of hemodilution and decreased mean arterial pressure (to 50-55 mmHg) affected blood flow to optic nerve the most

Fluid Replacement

- Necessary during long, complex spine surgery
- ASA POVL Registry:
  - Average of 9.7 L crystalloid intraoperatively
  - Increased postop weight gain associated with visual loss after cardiac surgery
- Not an independent risk factor but increases risk when combined with prone positioning

Hypertension, DM, CAD, PVD

- Cited in numerous case reports
- Mild association of PVD and DM with POVL in spine surgery patients
- ION still rare in coronary artery bypass graft patients
- Approach these patients cautiously
- Discontinue erectile dysfunction drugs 1-2 days before surgery

Recommendations of ASA task force on POVL

- Use foam headrest
- Proper eye position and documentation
- Check intermittently (20 minutes)
- Optimize H & H and hemodynamic status
- Significant blood loss: colloids & crystalloids
- Position head level with or higher than heart
- Maintain head in forward neutral
  - i.e. no flexion, extension, rotation, or lateral flexion
- MRI to rule out intracranial causes
- Check vision, pupils, and confrontational visual fields
- Get ophthalmological consult when appropriate

THANK YOU FOR YOUR ATTENTION