RUPTURED GLOBE REPAIR

Surgical Specialty:	Ophthalmology
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Background:

- General Considerations
  - Open-globe injuries are rare and account for only 2% of all ocular trauma cases with an incidence of 3-6 per 100,000[1]
  - This can lead to severe visual impairment, blindness, and lifelong sequelae
  - Ocular injuries are classified by mechanism, extent of injury, and location
    - Open globes injury involves full-thickness injury to the cornea or sclera
  - Cutting or piercing is the most common mechanism of injury in young children while blunt trauma is more common in teenagers[2]
  - Patients will sometimes present with concomitant injuries such as facial or orbital fractures or traumatic injuries to other areas of the body
  - Intraocular pressure (IOP)
    - Normal pressure 10-22 mmHg
    - < 3 months: < 8 mmHg
    - 6 – 9 months: < 12 mmHg
    - Thereafter: + 1 mmHg /year up to 10-12 years when it becomes similar to adults.
      - Varies over the course of the day (highest in the morning)
    - Physiologic factors that increase IOP[3]
      - Obstruction of aqueous humor flow
      - Intraocular hemorrhage
      - Rise in central venous pressure
      - Rise in arterial blood pressure
      - Hypercarbia or hypoxia
      - Valsalva maneuver
      - Pain
      - Coughing, bucking
- Patient Considerations
  - Almost always an emergency unless surgery has little to no chance of saving vision
  - Delay should be carefully weighed against preventing further injury, endophthalmitis, or extrusion of intraocular content.
  - Patients are frequently full stomach.
- Associated Comorbidities/Syndromes
  - Not usually associated with specific syndromes or comorbidities

Anesthetic Planning:

- Pre-Anesthetic Evaluation
  - A thorough history and physical exam including identification and optimization of comorbid conditions if possible due to the emergent nature of the surgery
  - Assess for multi-trauma and pay special attention to facial or airway injuries.
  - Discuss the Risks/Benefits/Alternatives to proceeding with parents and surgeon.
  - Additional labs/tests indicated during work-up
    - A CT scan may help identify the presence of a foreign body and its location.
    - Other imaging studies or lab work may be required in the presence of other traumatic injuries.
  - The traumatic nature of the experience and environment in addition to separation from parents increases anxiety.
    - Most patients will benefit from benzodiazepine premedication such as midazolam.
- Specific or Unique Room Set-up Requirements
  - Airway
    - Usually, no advanced airway equipment is needed unless there is evidence of facial trauma or possible difficult intubation.
    - Consider an oral RAE endotracheal tube.
  - Drugs/Infusions
    - Anesthetic medications and their effects on IOP[4]

Inhaled Anesthetics	**Intraocular Pressure**
Volatiles (sevoflurane, isoflurane, desflurane)	Decrease
Nitrous oxide	No significant changes
Intravenous Anesthetics	
Ketamine	Increase (with doses > 5mg/kg)
Propofol	Decrease
Benzodiazepines	Decrease
Opioids	No changes
Succinylcholine	Increase by 5-10 mmHg
Non-depolarizing muscle relaxant	No changes
Anticholinergics (glycopyrrolate and atropine)	Topical increases IOP however systemic does not

  - Monitors
    - Standard ASA monitors
  - Blood Availability (if indicated)
    - Usually not required unless the patient has other traumatic injuries
  - PICU Bed Availability (if indicated)
    - Usually not required unless the patient has a complex medical history or other traumatic injuries

Intraoperative Considerations:

- General
  - In adults, most eye surgeries are performed with local anesthetics and sedation however in children general anesthesia is preferred.
- Induction
  - Premedication with benzodiazepines, opioids, or both is essential to decrease anxiety and pain which in turn can lead to lower IOP
  - RSI in patients with full stomach
    - Avoid succinylcholine due to the transient increase in IOP
    - 1.2 mg/kg of rocuronium is preferred
    - In patients with obvious facial trauma, consider the risk of difficult intubation vs. aspiration.
    - Have a difficult airway cart or video laryngoscope
    - Have suction readily available
- Positioning
  - Supine with the bed turned 90 degrees
- Maintenance
  - Combination of inhaled anesthetics, opioids, and muscle relaxants
- Hemodynamic/Physiologic goals
  - Avoid aspiration
  - Obtain a deep plane of anesthesia with opioids, 1mg/kg IV lidocaine, and muscle relaxation prior to laryngoscopy to minimize IOP rise
  - Minimize increases in IOP (prevent extrusion of vitreous humor)
- Surgical Considerations
  - Oculocardiac reflex (OCR)
    - Stimulation of the eyeball (traction, pressure)
    - Afferent: cranial nerve V1 (Trigeminal)
    - Efferent: cranial nerve X (Vagus)
    - More pronounced in children and decreases with age
    - Lead to dysrhythmias: bradycardia (most common), AV block, bigeminy, PVC, asystole
    - This reflex is not suppressed by general anesthesia
    - Prophylaxis with anticholinergics (glycopyrrolate, atropine), or retrobulbar block
    - Fast-acting opioids like fentanyl, remifentanil, sufentanil, and dexmedetomidine will potentiate OCR[5,6]
- Emergence/Disposition
  - Patients who are a full stomach should be extubated awake
  - Deep extubation is an option in appropriately NPO patients
- PONV prophylaxis
  - Steroids
    - Dexamethasone 0.15mg/kg
  - 5-HT3 antagonist
    - Ondansetron 0.1-0.15mg/kg
  - Avoid nitrous oxide
  - Adequate fluid resuscitation
  - Limiting opioids

Post-Operative Considerations

- Pain management
  - Opioids: Avoid if possible due to increased risk for PONV
  - Acetaminophen
  - NSAIDS: Discouraged due to their platelet inhibiting properties which can lead to intraocular hemorrhage

Case-Specific Complications/Pitfalls

- Emesis and aspiration on induction
  - Position the patient head down and tilt to the side
  - Post induction, suction oropharyngeal and gastric content and intubate
  - Suction down the endotracheal tube once a definitive airway is established and before ventilating
  - If a large amount is aspirated, consider bronchoscopy
- Increased IOP
  - Increase the depth of anesthesia with opioids, inhaled anesthetics, and ensure complete paralysis.
- Bradycardia (oculocardiac reflex)
  - Ask the surgeon to stop manipulating the eye until bradycardia resolves
  - IV glycopyrrolate 4-8 mcg/kg, 10mcg/kg atropine, or 1mcg/kg epinephrine if bradycardia is severe and not responsive
- Difficult airway due to facial trauma
  - Weigh aspiration risk with current medical condition
  - Consider inhaled induction and keeping the patient spontaneously breathing
  - Have a difficult airway cart with video laryngoscope and fiberoptic bronchoscope
  - Contact an otolaryngologist early if rigid bronchoscopy or tracheotomy is needed to secure the airway

References

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