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LASER FOR RETINOPATHY OF PREMATURITY

Surgical Specialty:	Ophthalmology
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Background:

- General Considerations
    - Retinopathy of Prematurity (ROP) is the leading cause of blindness in premature infants.
        - Visual loss occurs when fibrovascular proliferation from retinal vessels into the vitreous humor produces tractional distortion of the macula or traction retinal detachment.
    - Normally, retinal blood vessels grow into the retina from the optic nerve beginning in the fourth month of gestation, reaching the anterior retina at full-term birth.
        - At the time of premature birth, retinal vessels have not yet reached the anterior retina.
        - Therefore, premature infants have an avascular peripheral retina to varying degrees based on the gestational age at birth.
    - ROP occurs because of the effects of retinal ischemia with consequent production of vascular endothelial growth factor (VEGF) in the incompletely vascularized retina.
        - The ROP stages are based on abnormal changes occurring at the junction of the posterior vascularized retina and more peripheral avascular retina.
        - The early administration of oxygen may cause vasoconstriction of the existing vascularized retina.
            - This is due to autoregulation and further adds to retinal ischemia.
            - Neovascularization occurs at the junction of the vascularized and avascular retina.
                - At this point, intervention is recommended.
    - Treatment strategies are evolving, but infrared scatter laser to the peripheral avascular retina remains the mainstay of treatment.[1]
        - In particularly severe cases of posterior ROP, anti-VEGF injections (monoclonal anti-VEGF antibodies) into the vitreous humor may be added to laser therapy.
            - The systemic and long-term effects of anti-VEGF intravitreal injections in premature infants remain unclear.

- Patient Considerations
  - Prematurity is the greatest risk factor for developing ROP.
    - The incidence and severity increase with lower gestational age and birth weight.
  - Additional risk factors include:
    - Respiratory distress
    - Anemia
    - Blood transfusion
    - Exposure to high inspired oxygen concentrations
    - Intraventricular hemorrhage
    - Sepsis
    - Acidosis
    - Hypercarbia
    - Surfactant therapy
    - Vitamin E deficiency
    - Hyperglycemia and insulin therapy[1,2]
  - Associated Comorbidities/ Syndromes:
    - There are no syndromes associated with ROP.
    - Comorbidities primarily related to prematurity include:
      - Postoperative apnea
      - Pulmonary disease
      - Neurodevelopmental disabilities
      - Gastrointestinal disorders
      - Cardiac anomalies

Anesthetic Planning:

- Pre-Anesthesia Evaluation
  - A thorough pre-anesthetic evaluation includes the identification and optimization of comorbid conditions.
    - Discuss the risks/benefits/alternatives to proceeding, including pharmacologic management, with the parents and surgeon.
  - Additional labs/tests indicated during work-up:
    - Pre-operative testing should be directed toward optimizing comorbidities.
    - There are no specific anesthesia-related tests for ROP.
  - Consideration must be given to safe transport to the operating room and back.
- Specific or Unique Room Set-up Requirements
  - Airway
    - Endotracheal intubation is preferable due to the length of the case, patient positioning, and provider access.[3]
      - Some patients may have an endotracheal tube (ETT) in situ.
      - This case can also be performed with a natural airway with sedation.
        - However, this may be challenging as the baby must be still during cryotherapy or laser therapy.
      - Preparations should be made for a potentially difficult airway related to prematurity and low birth weight.
    - Appropriately sized cuffed and uncuffed ETTs and supraglottic airways should be available.
  - Drugs/Infusions
    - There are no specific medication requirements intraoperatively.

        - Antibiotic prophylaxis is usually not required.
    - Monitors
        - Standard American Society of Anesthesiologists monitors
        - Invasive monitoring may be indicted for specific comorbidities.
    - Blood Availability
        - Usually not required
    - PICU Bed Availability (if indicated)
        - Patients are usually from the intensive care (ICU) or intermediate care units.
        - Patients coming from home are more likely to need ICU-level care postoperatively, depending on comorbidities, especially respiratory status. This should be determined on a case-by-case basis.
    - Other Indicated Resources
        - Transport monitors and ventilators

Intraoperative Considerations:

- General
    - The principles for anesthetic management are the same as for neonatal anesthesia.
        - The procedure may be performed at the bedside in the neonatal intensive care unit (NICU) with sedation or general anesthesia.
        - This decision is based on the anesthesiologist and surgeon's comfort level, the availability of equipment, and the extent of the disease.[3]
    - There is ongoing debate regarding the optimal oxygen saturation targets for patients with ROP.
        - Target oxygen saturation levels >90% by pulse oximetry have been suggested.[4]
        - Attempts should be made to maintain oxygen saturations as close to preoperative ranges as possible.
            - The need for additional supplemental oxygen should be discussed between the neonatologist, the surgeon, and the anesthesia team.
- Induction
    - Inhalational induction may be preferable in patients without existing intravenous access.
    - Intravenous induction may be performed, tailored to the patient's co-morbidities.
- Positioning
    - Supine with the bed turned 90°
- Maintenance
    - Inhalational or IV maintenance anesthetic as indicated.
        - Institutional practice may vary.
    - Local anesthetic can be utilized as supplemental analgesia.
        - Topical local anesthetic or a regional ophthalmic block may be used.[5,6]
- Hemodynamic/Physiologic goals
    - Maintain hemodynamics parameters within 20% of baseline for the patient.
    - Specific attention to O_2 saturations, as discussed above.
- Surgical Considerations
    - Scatter laser photocoagulation using the infrared diode laser is the primary treatment.[1]
        - Anti-VEGF intravitreal injections may be added for severe posterior ROP.
    - All operating room personnel should wear protective laser goggles for the infrared wavelength.
- Emergence/Disposition

  - There are no contraindications to extubation specific to the procedure.
  - The proper assessment of patient hemodynamics and comorbidities should guide the decision.
  - Patients who were intubated pre-operatively frequently remain intubated following the procedure.
- Post-op Care
  - The postoperative care is principally in relation to preoperative co-morbidities.
    - These patients are frequently at increased risk of postoperative apnea and should be monitored appropriately in accordance with institutional policies.

Case-Specific Complications/Pitfalls

- Thermal stability in premature infants is challenging.
- Safe transport to and from NICU where applicable.

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References

1. Ricketts K, Valley RD, Bailey AG, Justice LT. Anesthesia for Ophthalmic Surgery. In: *Smith's Anesthesia for Infants and Children* (9th ed., pp 892-912). Philadelphia, PA: Elsevier; 2017.
2. Kim SJ, Port AD, Swan R, Campbell JP, Chan RVP, Chiang MF. Retinopathy of prematurity: a review of risk factors and their clinical significance. Surv Ophthalmol. 2018;63(5):618-637. PubMed Link
3. Klein KS, Aucott S, Donohue P, Repka M. Anesthetic and airway management during laser treatment for retinopathy of prematurity: A survey of US ophthalmologists and neonatologists. J AAPOS. 2013;17(2):221-222. PubMed Link
4. Higgins RD. Oxygen Saturation and Retinopathy of Prematurity. Clin Perinatol. 2019;46(3):593-599. PubMed Link
5. Guise P. Sub-Tenon's anesthesia: An update. Local Reg Anesth. 2012;5(1):35-46. PubMed Link
6. Novitskaya ES, Kostakis V, Broster SC, Allen LE. Pain score assessment in babies undergoing laser treatment for retinopathy of prematurity under sub-tenon anaesthesia. Eye. 2013;27(12):1405-1410. PubMed Link

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