TYMPANOPLASTY

Surgical Specialty:	Otolaryngology
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Background:

- General Considerations [1]
  - Tympanoplasty is the surgical repair of a perforated tympanic membrane, with or without reconstruction of the ossicles.
  - The aim is to restore hearing ability.
  - Tympanoplasty and mastoidectomy are two of the most common major ear surgeries in children.
  - Indications include:
    - Chronic suppurative otitis media.
    - Progressive and resistant middle ear infection that leads to persistent otorrhea.
    - Tympanic membrane perforation and conductive hearing loss.
  - The most common surgical approach is through a post-auricular incision but the surgery can also be performed through the ear canal. [1]
  - The patient's bed is often turned 180 degrees from the anesthesia machine.
- Patient Considerations
  - Frequently performed in children greater than 5 years old.
  - Typically failed multiple ventilation tube insertion (VTI) attempts, which is often the first-line therapy.
  - About 30% of patients undergoing tympanoplasty have had an earlier VTI. [2]
  - Risk factors for disease progression are malnutrition, antibiotic resistance, and poor access to health care.
- Associated Comorbidities/Syndromes
  - No specific associated comorbidities/syndromes.

Anesthetic Planning:

- Pre-Anesthetic Evaluation
  - A thorough pre-anesthetic evaluation including identification and optimization of comorbid conditions.
    - Meticulous airway assessment should include any history of difficult airway and a complete airway evaluation should be performed, including baseline neck mobility which is particularly important in trisomy 21 patients.[3]
    - Commonly, a tympanoplasty has been preceded by previous airway surgeries. Review the previous anesthetic records for a history of difficult bag mask ventilation or tracheal intubation.

  - Discuss the risks/benefits/alternatives to proceeding with the parents and surgeon.
    - Increased risk of post-operative nausea and vomiting (PONV) should be discussed with the patient and parents/caregivers.
    - A great auricular nerve block versus local anesthetic infiltration as indicated for post-operative pain and has been shown to decrease nausea and vomiting. [6]
  - No additional labs/tests are typically indicated unless warranted by medical history.

- Specific or Unique Room Set-Up Requirements
  - Airway
    - Extreme degrees of neck rotation are often needed to allow visualization of the middle ear. Lateral rotation of the OR table might assist with surgical visualization.
    - The anesthesiologist and surgeon must be vigilant to ensure that the patient is not injured during positioning, particularly trisomy 21 patients with ligamentous laxity of the cervical spine. [5]
    - Consider using an oral-RAE endotracheal tube (ETT) or standard ETT taped to the contralateral side if unilateral repair is being performed.
    - A long breathing circuit is often helpful with most surgeries done with the operating room bed rotated 180 degrees from the anesthesia machine.
  - Drugs/Infusions
    - Avoid neuromuscular blocking agents – electromyography is used to monitor and prevent facial nerve injury.
    - PONV prophylaxis – These patients are at a higher risk for PONV. Consider using at least two anti-emetic agents for PONV prophylaxis.
      - Ondansetron (0.1-0.15mg/kg) – max 4mg.
      - Dexamethasone (0.1 mg/kg) – max 8 mg.
        - Higher doses are not indicated unless airway edema is expected.
      - Consider total intravenous anesthesia (TIVA) with propofol.
      - Consider liberal intra-operative IV hydration with isotonic crystalloid, minimum 20 mL/kg.
    - Emergence delirium prophylaxis
      - Dexmedetomidine infusion of 0.3 - 0.7 mcg/kg/hour has been suggested to reduce the anesthetic consumption, offer smooth extubating conditions, and reduce the post-operative narcotic requirement. [4]
    - Many options/combinations may be used for maintenance of general anesthesia and institutional practices vary.
      - Inhalational
        - Consider alternative with a patient or family history of PONV.
      - TIVA– consider infusions of:
        - Propofol – has anti-emetic properties.
        - ~~o~~ Remifentanil – relative hypotension.
        - Dexmedetomidine
  - Monitors
    - Standard ASA monitors.
  - Blood Availability (if indicated)
    - Usually not required.

- PICU Bed Availability (if indicated)
  - Usually not required.
- Other Indicated Resources
  - None.

Intraoperative Considerations:

- General
  - The facial nerve is in close proximity to the surgical field and preservation is critical.
  - Electrical stimulation is used to identify the nerve and neuromuscular blocking agents are usually avoided.
  - Vasoconstriction of the tympanic membrane is often achieved with topical epinephrine solution (1:10,000) or oxymetazoline 0.05%. Max dose of topical epinephrine is 10 mcg/kg per 30 minutes.[5]
  - Nitrous oxide (N_2O) should be avoided since the middle ear and sinuses are non-distensible, air-filled cavities and N_2O is 34 times more soluble than nitrogen [5].
  - N_2O has also been linked to increased PONV and can displace the tympanic graft.
- Induction
  - Rapid sequence induction is not typically indicated since the elective status of the surgery allows for proper NPO precautions.
- Positioning
  - Supine with the patient's bed turned 180º from the anesthesia machine.
  - Extreme lateral head rotation is common; however, caution must be used in patients with trisomy 21, where 20% of patients may have an underlying atlantoaxial subluxation. [3]
- Maintenance
  - Drugs as above.
- Hemodynamic/Physiologic Goals
  - Avoid coughing or bucking with stimulation.
  - Bleeding must be minimized for adequate surgical exposure.
  - Relative hypotension is often employed to minimize bleeding (i.e. mean arterial pressure 10-25% below baseline) [6]
- Emergence/Disposition
  - A smooth, quiet extubation without coughing is highly recommended to avoid disruption and pressure buildup in the middle ear cavity.
  - Consider a deep extubation.
- Post-op Care
  - PONV is more common and should be aggressively treated.
  - Multimodal pain control with a combination of NSAIDs, IV acetaminophen 15 mg/kg, and posterior auricular nerve infiltration have been shown to reduce post-operative opioid requirements. [1]

Case-Specific Complications/Pitfalls:

- PONV
  - Most common post-operative complication requiring unscheduled hospital admission.
  - At least 2 anti-emetics should be given; consider TIVA with a propofol infusion.
  - Consider placing a Foley catheter for longer procedures to allow adequate IV hydration.
- Accidental extubation
  - The airway is positioned 180º from the anesthesia machine and under drapes with frequent head turning.

    - Make certain all airway connections are tight, and the circuit is long enough for movement.
- Bleeding
    - Minimal bleeding in the middle ear can obscure the view and disrupt the surgery.
    - Difficult to control bleeding from open bony surfaces.
    - Bleeding can be decreased with topical vasoconstrictor use and controlled hypotension.
    - Lowering the mean arterial pressure below 80% of the baseline or further extreme hypotensive anesthesia has no additional surgical benefit for the aim of a bloodless surgical field. [6]
    - Blood products are rarely required. [6]
- Facial nerve injury
    - The facial nerve is in close proximity to the surgical field and facial nerve monitoring may be used.
    - Neuromuscular blocking drugs should be avoided.

References

1. Gregory's Pediatric Anesthesia. (2019). United Kingdom: Wiley, pages 857-880.
2. Wang MC, Chu CH, Wang YP. Epidemiology of common otologic surgical procedures in pediatric patients: A population-based birth cohort study. Int J Pediatr Otorhinolaryngol. 2019;127:109644. PubMed Link
3. Ali FE, Al-Bustan MA, Al-Busairi WA, Al-Mulla FA, Esbaita EY. Cervical spine abnormalities associated with Down syndrome. Int Orthop. 2006 A30(4):284-9. PubMed Link
4. Gupta K, Bansal M, Gupta PK, Pandey M, Agarwal S. Dexmedetomidine infusion during middle ear surgery under general anaesthesia to provide oligaemic surgical field: A prospective study. Indian J Anaesth. 2015 ;59(1):26-30. PubMed Link
5. Cote, C. J. (2018). A Practice of Anesthesia for Infants and Children. Chapter 33. United States: Elsevier Health Sciences.
6. Pairaudeau C, Mendonca C. Anaesthesia for major middle ear surgery. BJA Educ. 2019;19(5):136-143. PubMed Link

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