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Posterior Fossa Craniotomy for Chiari Malformation

Surgical Specialty:	Neurosurgery
Authors:	Micaela Bethel, M.D., Angela Saettele, M.D. Washington University, St. Louis, MO

Background:

- General Considerations
    - Chiari malformation - displacement of the cerebellar structures with or without the medulla into the spinal canal due to an anatomic abnormality of the craniocervical junction
        - Common subtypes:
            - Chiari type I - abnormally shaped cerebellar tonsils that are displaced below the foramen magnum, may be associated with a syrinx
            - Chiari type II - hydrocephalus due to cerebral spinal fluid outflow obstruction with associated herniation of cerebellar structures and malformation of midbrain causing beaked appearance on imaging, associated with myelomeningocele
    - A posterior fossa decompression - performed to decompress the craniocervical junction and restore the flow of cerebral spinal fluid
        - Approach
            - Suboccipital craniectomy
            - C1 laminectomy
            - Extradural versus intradural with duraplasty - increased complexity
- Patient Considerations
        - Spine or skull abnormalities may impact airway management
            - Syringomyelia - fluid-filled cyst within the spinal cord
            - Myelomeningocele - extrusion of CSF and neural elements
            - Klippel-Feil syndrome - fusion of two or more cervical vertebrae
            - Atlas assimilation - fusion of atlas to occiput
            - Atlantoaxial dissociation - dissociation of the atlas and axis
            - Basilar impression - odontoid process extending through the foramen magnum
            - Lacunar skull - fenestration of fetal skull due to ossification disorder
        - Neurological deficits or increased intracranial pressure

Anesthetic Planning:

- Pre-Anesthetic Evaluation
  - Detailed history and physical including
    - Neurological assessment and comorbid conditions
      - The posterior fossa contains cranial nerves, III through XII, the cerebellum, midbrain, pons, and medulla – ass for symptoms related to compression of these structures.
      - Review MRI for other intracranial or spine abnormalities and obstruction of CSF flow causing hydrocephalus
  - Discussions to have with surgeon/family
    - Neuromonitoring - discuss the necessity with the surgical team
    - Pain management postoperatively
    - Need for possible post-operative ventilation – in the setting of preexisting laryngeal or pharyngeal dysfunction
    - Blood transfusion - rare though possible anytime the dura is incised
- Specific or Unique Room Set-Up Requirements
  - Airway
    - Endotracheal intubation
    - Consider video or other indirect methods of intubation to avoid brain stem compression
  - Drugs/Infusions
    - Inhaled anesthetic
    - Total intravenous anesthetic if neuromonitoring is requested, propofol and opioid infusions are commonly used
    - Vasoactive infusions are rarely needed
    - PONV Prophylaxis
      - Ondansetron
      - Dexamethasone
    - Antibiotics
      - Cefazolin
  - Monitors
    - Standard ASA monitors
    - Consider arterial line for intradural approach
    - Two peripheral IVs
  - Blood Availability
    - Type and screen if intradural

Intraoperative Considerations:

- Premedication - use of benzodiazepines with caution if signs of laryngeal/pharyngeal dysfunction or respiratory symptoms such as sleep apnea or disordered breathing
- Induction: standard induction - inhalation or intravenous
  - Ventilation prior to intubating to avoid hypercarbia
  - Consider reverse Trendelenburg to reduce ICP
- Positioning
  - Prone position
  - Mayfield pins are often used
    - Consider scalp blocks
    - Administer additional anesthesia and analgesia for the placement of pins
    - Immobility while in pins is essential to avoid neck and spinal cord injury

- Maintenance
    - Inhaled anesthetics or TIVA
- Hemodynamic/Physiologic goals
    - Normotension
        - Avoid hypertension/coughing at extubation
    - Maintenance of cerebral perfusion pressure
- Surgical Considerations
    - Extradural versus intradural approach
- Emergence/Disposition
    - Avoidance of coughing or straining and hypertension
    - Floor versus ICU
    - Extubation may be delayed until the ICU due to:
        - Preoperative neurological deficits such as cranial nerve dysfunction or respiratory disorders
        - Surgical complications

Post-operative Pain Management

- Incisional - acetaminophen, NSAIDs, and opioids
- Muscle spasms - benzodiazepines, methocarbamol, or cyclobenzaprine

Case-Specific Complications/Pitfalls

- Bleeding
    - Particularly if intradural
- Bradycardia or asystole can occur from traction on cranial nerves causing a vagal response
- Venous air embolism (VAE)

References

1. Litman, R, et al. (2017). Neurosurgery. In *Basics of Pediatric Anesthesia* (2nd ed. Pp. 215-226). Philadelphia, PA: William Korchek Projects.
2. Nag, D., et al. (2019). Intracranial pressure monitoring: Gold standard and recent innovations. *World Journal of Clinical Cases,* 7: 1535-1553. Doi: 10.12998/wjcc.v7.i13.1535. PubMed Link

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Reviewed by:

Reviewer #1: Madeline Miano, MD, Children's Hospital of Philadelphia

Reviewer #2: Samuel Hunter, M.D., Children's Hospital of Philadelphia

Reviewer #3: Marc Parris, M.D., MPH, Children's Hospital of Philadelphia

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Created: August 2022; Last revised: May 2023