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# SPINAL CORD DETETHERING

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| **Surgical Specialty:** | Neurosurgery |
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## Background:

- **General considerations**
  - A tethered cord occurs when the spinal cord is abnormally attached to other spinal structures, thus limiting the movement within the spinal column
  - The abnormal attachment can occur due to a variety of pathologies (myelomeningocele, fatty filum terminale, prior surgeries, etc.)
  - The attachment causes repeated traction injuries to the spinal cord, which can result in permanent neurological deficits.
- **Patient considerations**
  - The patient may have neurologic symptoms (lower extremity weakness and urinary retention) depending on the duration and severity of tethering.
  - Outcomes are generally better with earlier repair; therefore, the defect is usually repaired in the first year of life.[1]
  - Surgery is most effective at relieving pain; however, it also stabilizes neurologic function in 80-90% of patients.[1]
  - Tethered cord is often an isolated finding but can be seen as a component of VACTERL association.[2]

## Anesthetic Planning:

- **Pre-Anesthetic Evaluation**
  - There is typically minimal blood loss; Type and cross is usually not indicated.
  - If there is concern for VACTERL association, transthoracic echocardiography is indicated to rule out cardiac anomalies.
  - Discuss prone positioning and risk for ocular injury/facial edema with family
- **Specific or Unique Room Set-Up Requirements**
  - **Airway:** age-appropriate endotracheal tube, standard airway supplies.
  - **Drugs/Infusions:** an opioid adjunct is often helpful, especially for older patients. If total intravenous anesthesia (TIVA) is used for neuromonitoring purposes, consider propofol and opioid ± ketamine, as well as a dedicated peripheral intravenous (PIV) catheter for infusions.
  - **Monitors:** standard American Society of Anesthesiologists monitors; an arterial line is usually not indicated.

- **Other indicated resources:** donut pillow or gel pillow is useful for prone positioning; if the patient is school age or older, consider the use of Proneview cushion or a related system.

## Intraoperative Considerations:

- **General**: main considerations are
  - Careful attention to positioning.
  - Immobility without the use of neuromuscular blockade.
  - Judicious fluid administration to minimize facial edema.
  - As the patients undergoing repair are often infants, the standard considerations for infant anesthesia apply (close glucose monitoring, avoidance of hypothermia, etc.).
- **Induction:**
  - Inhalational induction is usually pursued unless PIV is *in situ* or inhalational induction is otherwise contraindicated.
  - Deep intubation vs intubation with a non-depolarizing agent followed by reversal are both viable strategies.
  - There is a theoretical risk of hyperkalemia from succinylcholine administration if there is significant denervation.
- **Positioning:**
  - Prone positioning, usually with head turned to the side and arms up.
  - Pay careful attention to pressure points as the surgery typically takes 3-4 hours.
- **Maintenance:**
  - Volatile ± opioid infusion
  - Avoidance of neuromuscular blockade
  - If intraoperative neuromonitoring is used, consider TIVA.
  - The initial dissection is stimulating (manage with opioids/volatile/propofol); the actual detethering is minimally stimulating (may need to reduce anesthetic depth).
- **Hemodynamic/physiologic goals:**
  - Standard; consider permissive hypertension for cord perfusion
- **Surgical considerations:**
  - Neuromonitoring per surgeon preference (typically electromyography (EMG) ± motor evoked potentials (MEPs) ± somatosensory evoked potentials (SSEPs).
  - Lengthy microsurgical component; patient immobility is critical.
  - Valsalva is often requested to assess dural closure.
- **Emergence/disposition:**
  - A postoperative neurologic exam is typically performed; avoid agents that will cloud the exam in the peri-emergence period, if possible.
  - Post anesthesia care unit to the floor.
- **Post-op pain:**
  - Minimal; usually managed with acetaminophen/opioids
  - Ketorolac is may be avoided if requested by the surgeon
  - If remifentanil is used intraoperatively, ensure adequate analgesia with other agents.

## Case-Specific Complications/Pitfalls

- **Airway complications:** Deep intubation is associated with higher rates of laryngospasm and other airway complications relative to intubation with paralytic; treat as per usual with positive pressure, deepening of anesthetic, and/or paralytic.[3]
- **Patient movement:** significant changes in surgical stimulus throughout the procedure with the inability to paralyze present challenges in terms of ensuring immobility. Ensure

appropriate anesthetic depth prior to incision and consider opioid infusion as per above. If the patient moves, rapidly deepen the anesthetic with propofol and/or volatile agent.

- **Cord perfusion/loss of signals:** though rare, spinal cord injury can occur during detethering, presenting as decreased MEP/SSEP amplitude and increased MEP/SSEP latency. Treat with 100% oxygen, BP elevation, reduction of volatile agent, and consider transfusion and steroid administration. A wake-up test may be necessary if signals fail to improve.
- **Positioning complications:** prolonged prone position can lead to pressure injuries and neuropraxia. Careful attention to padding, arm position, and head position is critical.
- **Facial edema:** excessive fluid administration can lead to significant facial edema. This is typically cosmetic and rarely precludes extubation; however, careful attention to fluid administration can minimize the risk of this complication.

## References


1. Lew SM, Kothbauer KF. Tethered Cord Syndrome: An Updated Review. Pediatr Neurosurg. 2007;43(3):236-248. PubMed Link
2. Solomon BD. VACTERL/VATER Association. Orphanet J Rare Dis 6, 56 (2011). PubMed Link
3. Garcia-Marcinkiewicz AG, Adams HD, Gurnaney H, et al. A Retrospective Analysis of Neuromuscular Blocking Drug Use and Ventilation Technique on Complications in the Pediatric Difficult Intubation Registry Using Propensity Score Matching. Anesthesia & Analgesia. 2020;131(2):469-479. PubMed Link


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