

POSTERIOR SPINE FUSION: CORD INJURY

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Question

A 13-year-old female undergoing posterior spinal fusion surgery develops intraoperative neurophysiological monitoring changes suggestive of a potential spinal cord injury. Which of the following actions is MOST appropriate to minimize morbidity?

- Hyperventilate the patient to a target ETCO₂ of 25 to 30 mm Hg.
- Request the surgeon to continue to the procedure with urgency.
- Increase MAPs to a goal of 80 mm Hg.
- Request the surgeon to apply chilled saline to the epidural space.

Key Points

- Scoliosis is a lateral and rotational deformity of the vertebral column, present in up to 2-4% of adolescents.
- The most feared neurologic complication of scoliosis repair is paraplegia. Other complications include focal weakness/numbness and bowel/bladder disturbances.
- The areas of the spinal cord most vulnerable to perioperative spinal cord injury (POSCI) are the motor pathways, supplied by a single anterior spinal artery.
- Multimodal intraoperative neuromonitoring is an important tool used for recognition and prompt treatment of suspected POSCI.

Blood Supply

- The blood supply of the spinal cord relies on the pial plexus supplied by a single anterior spinal artery and two posterior spinal arteries
- Anterior spinal artery:
 - Supplies the anterior two thirds of the spinal cord, including the motor pathways.
 - Receives inconsistent contributions from segmental radicular arteries. The largest is the greater radicular artery (Artery of Adamkiewicz), arising between T8 and L4.
- Posterior spinal arteries:
 - Supplies the posterior third of the spinal cord, including the sensory pathways.
 - Receives regular contributions from posterior radicular arteries, posterior and inferior cerebellar arteries, and the vertebral arteries.
- Areas at greatest risk for ischemia are those supplied by the single anterior spinal artery and watershed areas, most notably T4 to T9³.

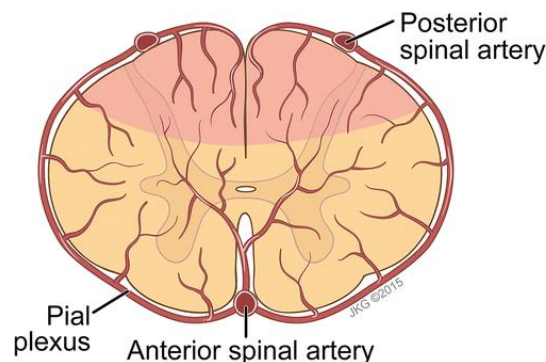


Figure 1: Blood supply of the spinal cord (Reproduced with permission from Jill K. Gregory, MFA, CMI)

Cord Injury

- Four main mechanisms of spinal cord injury during scoliosis repair include¹:
 - Direct contusion during surgical exposure
 - Contusions by hooks, wires, or pedicle screws
 - Distraction by rods or halo traction
 - Reductions in spinal cord blood flow (hypotension, hypocapnia, compression of arterial bloody supply)
- Patients with curves greater than 100 degrees, congenital scoliosis, kyphosis, and post irradiation deformity appear to be at greatest risk¹.
- Signs: Neurophysiologic monitoring changes, abnormal wake-up or ankle clonus test²

Neurophysiologic Monitoring Changes

- Without electrophysiologic monitoring, the incidence of neurologic complications after operating on the vertebral column has been reported to be as high as 3.7-6.9%².
- Evoked potential monitoring relies on a complete neuronal chain. Disruption in any part will produce a change from the preoperative baseline.
 - Animal studies have shown that there is a timeframe of less than 10 minutes from the onset of monitoring changes until permanent damage is done².
- Neurophysiologic Monitoring Changes Requiring Immediate Intervention¹

Somatosensory Evoked Potentials (SSEPs)	10% increase in latency of the first cortical peak (P1) or 50% decrease in the peak-to-peak amplitude (P1N1)
Motor Evoked Potentials (MEPs)	Varies among centers. Options include using same criteria for SSEPs, a 75% decrease in amplitude, or a significant increase in the minimum threshold for producing a response

- Multimodal intraoperative monitoring (combination of SSEP and MEP) has demonstrated improved sensitivity when compared to either modality alone¹.

Anesthetic Treatment Options Minimizing the Effects of POSCI³

- Prompt recognition
- If possible, prompt reversal of offending cause of SCI
- Maintain MAP >80 mm Hg with vasopressors, if necessary
- Maintain euvolemia and correct hematocrit (>30-35%)
- Start methylprednisolone using NACIS III dosing and scheduling⁴
- Systemic or local cooling and CSF drainage are experimental and not routinely used

References

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Answer: **C. Maintain MAPs greater than 80 to 85 mm Hg.** (A) Autoregulation of spinal cord blood flow mimics that of the brain, with hypoventilation resulting in vasoconstriction. (B) It is appropriate to remove or reverse the most recent instrumentation or manipulation, rather than to continue with surgery. (D) Therapeutic hypothermia can be used to minimize oxygen demand of the spinal cord but is not routinely used or offered at most spinal surgical centers.