

**The 2nd ASRA Practice Advisory on
Neurologic Complications Associated with Regional Anesthesia**

**Joseph M. Neal, MD
Virginia Mason Medical Center
Seattle, WA**

Disclosure:

Dr. Neal has no conflict of interest and does not plan to discuss off-label uses of any drugs or devices.

Learning Objectives:

After participating in this educational activity, participants should be able to:

- Summarize the salient features of the 2nd ASRA practice advisory on neurologic complications associated with regional anesthesia
- List emerging neurological complications of concern that have been associated with regional anesthetic techniques
- Understand the pathophysiology and unique anatomical conditions that place patients at risk for rare neurologic complications

At the spring 2012 meeting in San Diego, ASRA convened its second advisory panel on Neurologic Complications Associated with Regional Anesthesia and Pain Medicine. This panel was charged with the task of assembling and analyzing the existing scientific evidence and expert opinion on the incidence, pathophysiology, diagnosis, treatment, and rehabilitation of neurologic injury associated with regional anesthesia and/or pain medicine practice. Emphasis was placed on that information that was new or updated from the first (2005) advisory panel.

Neurologic injury associated with regional anesthesia and/or pain medicine is a decidedly rare event. The Advisory Panel attempted to describe the anatomical and physiological components of injuries affecting the neuraxis or peripheral nervous system. Whenever possible, recommendations were made on how to prevent these injuries. The Panel included a neurologist who contributed to our understanding of how best to diagnosis or manage anesthesia-related neurological injury, with particular emphasis on the selection and timing of various imaging and neurophysiologic testing modalities. The Panel also included orthopedic surgery colleagues who described the expected neurologic complications associated with elective orthopedic surgeries. The Panel considered several specific and controversial patient management scenarios and strove to offer our best expert opinion regarding the management of patients with pre-existing neurological diseases, patients who are having surgery that itself may damage nerves, or the advisability of performing blocks in asleep or heavily sedated patients. The panel also highlighted emerging areas of concern, including: spinal stenosis, blood pressure control during neuraxial blockade, arachnoiditis, and cauda equina syndrome. Because of the rarity of these injuries, it was virtually impossible to offer definitive, evidence-based recommendations on their prevention. As such, a clear distinction should be made that the information offered herein does

not represent a true consensus of the Panel or those participating in the conference, but rather our best efforts at assembling the available data and expert opinion. The Panel acknowledges that another group of experts analyzing the same information might offer different recommendations. Consistent with past ASRA practice advisories, the Panel tended to err on the side of more conservative recommendations when a clear course was not readily apparent.

Key Concepts

I. Incidence

- a. Neuraxial injury—the incidence of serious neuraxial injuries ranges between 0-4/10,000 depending on the conditions of the reported study and the type of injury
- b. New to the advisory is information specific to elective orthopedic surgery-related nerve injury

II. Diagnosis, management, prognosis

- a. Diagnostic studies
 - i. Neuraxial injury—in most cases, MRI is preferable to CT
 - ii. Electrophysiologic testing—nerve conduction studies and electromyography are the mainstay of testing
 - iii. Electrophysiology testing yields its best results 14-21 days after an injury. However, it should be considered immediately if there is question of pre-existing injury. Consideration should be given to bilateral testing.
- b. Management
 - i. Neuraxial injury—suspicion of spinal cord compression demands immediate neurosurgical consultation and decompression within 8-12 hours.
 - ii. The placement of CSF drainage systems, while not specifically studied in anesthesia-related injuries, has been shown beneficial in trauma and aneurysm surgeries and has low risk
 - iii. The use of corticosteroids is controversial. While they may have some benefit for traumatic cord injury, such as from needle or catheter injury, they have the potential for direct and hyperglycemia-related harm in ischemic injury.
 - iv. ASRA recommends consultation with neurologic colleagues prior to CSF drainage or corticosteroid use.
- c. Prognosis
 - i. The majority of peripheral nerve injuries resolve within weeks; over 99% resolve within a year
 - ii. Stretch and compressive injuries tend to have a better prognosis than injuries that mechanically disrupt the axon
 - iii. Prognosis for spinal cord injury, more proximal nerve injury, or cauda equina syndrome is guarded

III. Mechanism of injury

- a. Neuraxis

- i. Vascular compromise—direct trauma to spinal cord vasculature, vasospasm
- ii. Ischemia—the final common pathway consequent to space occupying lesions of the epidural or subarachnoid spaces (hematoma, abscess, spinal canal contents such as fat, bone, or tumor)
- iii. Direct trauma to nerve roots or spinal cord—from a needle or catheter; most typically associated with concurrent injection of local anesthetic, with or without adjuvants

IV. Neuraxial catastrophes

- a. Epidural hematoma
 - i. Suspicion of epidural hematoma demands immediate imaging and neurosurgical consultation for possible decompression
 - ii. Specific recommendations regarding neuraxial hematoma and concurrent anticoagulation can be found at www.asra.com
- b. Neuraxial infectious complications
 - i. Infectious complications of regional anesthesia and pain medicine is the topic of the 2nd ASRA Practice Advisory on Infectious Complications
- c. Respiratory depression
 - i. The ASA Closed Claims study points to instances of respiratory depression consequent to neuraxial opioids administered during pain medicine procedures
 - ii. It is incumbent upon interventional pain medicine practitioners who administer neuraxial opioids to establish the same safety protocols that they would use for similar practice in surgical patients
- d. Local anesthetic toxicity
 - i. Application of local anesthetics has been linked to falls and hypotension. Also, accidental intravascular injection has been linked to cases of local anesthetic systemic toxicity (LAST)
 - ii. It is incumbent upon interventional pain medicine practitioners who administer neuraxial local anesthetics to establish the same safety protocols that they would use for the similar practice in surgical patients. This includes immediately available equipment to facilitate treatment of local anesthetic toxicity.

V. Patients with preexisting neurologic disorders

- a. Concept of the double crush injury
- b. In theory, patients with preexisting injury to the neuraxis or periphery may be at increased risk of injury should a secondary injury occur from the anesthetic procedure itself (double crush). A similar concern has been that surgery on a nerve that is blocked by an anesthetic technique may constitute an increased risk for injury (double crush) or at least an injury with unclear etiology (resulting in medicolegal concerns of surgical vs. anesthetic causation)
- c. The literature neither confirms nor refutes the above concerns

- d. Limited retrospective studies do not universally support that patients with preexisting disease are at increased risk for perioperative nerve injury. For instance, several studies from the Mayo Clinic have demonstrated that:
 - i. Patients with stable diabetic or peripheral sensorimotor neuropathy who underwent neuraxial anesthesia experienced a slightly increased rate of new neurologic injury as compared to historic controls
 - ii. Neuraxial block did not increase the risk of exacerbation in patients with preexisting CNS disorders such as multiple sclerosis or post-polio syndrome
 - iii. Patients with peripheral multiple sclerosis or past use of neurotoxic chemotherapeutic agents are likely at increased risk for double crush injury in the setting of peripheral nerve blocks
- e. Definitive studies do not exist

VI. Spinal stenosis

- a. Emerging data from Europe and the Mayo Clinic note an association of neurologic injury after neuraxial blockade in those patients with spinal stenosis
- b. It is unclear if this is association or cause-and-effect
- c. Nevertheless, patients with known moderate to severe spinal stenosis at the level of intended neuraxial procedures should prompt a risk-benefit analysis prior to placement of a neuraxial block

VII. Lower limits of autoregulation during neuraxial anesthesia

- a. Spinal cord blood flow is autoregulated by the same mechanisms as cerebral blood flow, with metabolic needs being the main determinant of flow
- b. The lower limit of spinal cord autoregulation is likely higher within the general population than the classically taught 50 mmHg, and is probably closer to 60-65 mmHg in most patients
- c. A very small subset of patients have a much higher lower limit of autoregulation and are at risk for spinal cord ischemia during neuraxial anesthesia
- d. Because there are few if any compelling reasons to allow patients undergoing neuraxial block to experience blood pressures below 30 to 40% of baseline mean arterial pressure (and especially, to experience lower MAP for a sustained period of time), it is recommended that practitioners maintain blood pressure during neuraxial anesthesia within 20-25% of baseline

VIII. Cauda equina syndrome

- a. Spinal stenosis has emerged as an independent risk factor for the development of cauda equina syndrome
- b. However, the bulk of CES occurs in patients who underwent completely unremarkable neuraxial anesthetics. The etiology of these occurrences is unclear, but believed to be an unpredictable form of inflammation and/or extreme sensitivity to local anesthetic neurotoxicity
- c. Nevertheless, practitioners are advised not to re-dose spinal anesthetics in excess of the maximal recommended dose. Some experts recommend not exceeding 60mg for intrathecal lidocaine

IX. Performing pain management techniques in asleep or heavily sedated patients

- a. The ability to perceive a painful paresthesia (presumably from intrafascicular injection) and the linkage of that experience to peripheral or neuraxial injury is poorly understood. Furthermore, case studies point to inconsistency between the experience of a painful paresthesia and subsequent nerve injury. Few data refute or confirm this theory.
- b. The panel continues to take the conservative stance that regional anesthetics or pain medicine procedures not routinely be performed in anesthetized or heavily sedated adults
- c. The panel recognized the unique goals of placing regional blocks in asleep vs. awake children (assurance of no movement). Practitioners are advised to consider the risks (particularly with thoracic and high lumbar epidurals) vs. the benefits of this practice on an individual basis
- d. Since the 2005 panel, the ASA Closed Claims project has published its experience with cervical spinal cord injury during interventional pain medicine procedures. The rate of injury was markedly higher in those patients who were heavily sedated or asleep.
- e. New data from pediatric registries support the concept that doing regional anesthesia in anesthetized children does not appear to increase their risk for injury higher than historic controls. Nevertheless, reports of devastating injury to the neuraxis continue to emerge in children who were under general anesthesia at the time of thoracic epidural placement
- f. Definitive studies do not exist

References

1. Brull R, Hadzic A, Reina MA, Barrington MJ. Pathophysiology and etiology of nerve injury following peripheral nerve blockade. *Reg Anesth Pain Med.* 2015;40:479-490.
2. Dwyer T, Henry PDG, Cholvisudhi P, et al. Neurological complications related to elective orthopedic surgery. Part 1: Common shoulder and elbow procedures. *Reg Anesth Pain Med.* 2015;40:431-442.
3. Dwyer T, Drexler M, Chan VWS, Whelan DB, Brull R. Neurological complications related to elective orthopedic surgery. Part 2: Common hip and knee procedures. *Reg Anesth Pain Med.* 2015;40:443-454.
4. Kopp SL, Jacob AK, Hebl JR. Regional anesthesia in patients with pre-existing neurologic disease. *Reg Anesth Pain Med.* 2015;40:467-478.
5. Kopp SL, Peters SM, Rose PS, Hebl JR, Horlocker TT. Worsening of neurologic symptoms after spinal anesthesia in two patients with spinal stenosis. *Reg Anesth Pain Med.* 2015;40:502-505.
6. Neal JM, Kopp SL, Lanier WL, Pasternak JJ, Rathmell JP. Anatomy and pathophysiology of spinal cord injury associated with regional anesthesia and pain medicine: 2015 update. *Reg Anesth Pain Med.* 2015;40:506-525.
7. Neal JM, Barrington MJ, Brull R, et al. The second ASRA practice advisory on neurologic complications associated with regional anesthesia and pain medicine: Executive summary, 2015. *Reg Anesth Pain Med.* 2015;40:401-430.

8. Veljkovic A, Dwyer T, Lau J, et al. Neurological complications related to elective orthopedic surgery. Part 3: Common foot and ankle procedures. *Reg Anesth Pain Med.* 2015;40:455-466.
9. Watson JC, Huntoon MA. Neurologic evaluation and management of perioperative nerve injury. *Reg Anesth Pain Med.* 2015;40:491-501.