

## ASRA practice advisory on neurologic complications associated with regional anesthesia

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### 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 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 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 information that was new or updated from the first (2005) advisory panel.

Neurologic injuries associated with regional anesthesia and/or pain medicine are decidedly rare events. 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 and/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 controversial patient management scenarios, and strove to offer its best opinion regarding the management of patients with pre-existing neurological diseases, patients 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 and 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 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, steroids 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; well over 99% resolve within a year
      1. Stretch and compressive injuries tend to have a better prognosis than injuries that mechanically disrupt the axon
    - ii. 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](http://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. 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 treat local anesthetic systemic toxicity.
- V. Patients with preexisting neurologic disorders
- a. Concept of the double crush injury
    - i. 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)
    - ii. The literature neither confirms nor refutes the above concerns
  - b. 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 may be at increased risk for double crush injury in the setting of peripheral nerve blocks
- iv. 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 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 unanesthetized patients
- c. A small subset of patients have a much higher lower limit of autoregulation and may be at risk for spinal cord ischemia during neuraxial anesthesia
- d. Because there are few compelling reasons to allow patients undergoing neuraxial block to experience blood pressures 30 to 40% below 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 and if blood pressure approaches those levels that it not be allowed to persist

#### 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. 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 or 40-60mg for intrathecal 2-chloroprocaine

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

- a. The ability to perceive a painful paresthesia and the linkage of that experience to peripheral or neuraxial injury is poorly understood. Case studies point to inconsistency between the experience of a painful paresthesia and subsequent nerve injury.

- 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.

- i. 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.

- 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

- i. 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, adult 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. d. Definitive studies do not exist

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