Neuraxial anesthesia in patients with pre-existing neurological deficit

Rayyan Neil – Vaes Bart
Dr. Lauweryns
Case 1: Multiple Sclerosis

- 30-year old pregnant woman
- Scheduled for an elective caesarean section
- 38 weeks in gestation at the moment of caesarean section
- Remitting-relapsing multiple sclerosis:
  - 2 relapses in the past
  - at the moment of admission: neurologically asymptomatic
  - Most recent MRI-scan revealed white matter lesions at T8 and T10

What is your anesthetic plan?
Case 2: Spinal stenosis

- 75-year old male
- Severe spinal stenosis in the lumbar spine region
- Medical history
  - Chronic low back pain
  - Right sided lumbar radicular pain since 2002
  - Type-2 diabetes
  - Atrial fibrillation (R/ Warfarin)

- Scheduled for a laparoscopic right hemicolecctomy (colon carcinoma)

What is your anesthetic plan?
Overview

• I. Multiple sclerosis
• II. Amyotrophic lateral sclerosis
• III. Myopathies
• IV. Myasthenia gravis
• V. Guillain-Barré syndrome
• VI. Scoliosis
• VII. Spinal stenosis
• VIII. Intracranial pathologies
**EXACERBATION OF PRE-EXISTING NEUROLOGIC DISEASE AFTER SPINAL ANESTHESIA**

**LERoy D. Vandam, M.D.† and Robert D. Dripps, M.D.‡**
Boston and Philadelphia

**TABLE 1. Antecedent Neurologic Disease and Postoperative Neurologic Sequelae.**

<table>
<thead>
<tr>
<th>CASE No.</th>
<th>Neurologic Disease</th>
<th>AGE</th>
<th>SEX</th>
<th>OPERATION</th>
<th>Lumbar Puncture</th>
<th>Anesthetic</th>
<th>Postoperative Sequelae</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Undiagnosed spinal-cord meningioma</td>
<td>42</td>
<td>F</td>
<td>Diaphragmatic herniorrhaphy</td>
<td>Paresthesia of left leg; cerebrospinal fluid clear.</td>
<td>Pontocaine; glucose.</td>
<td>Progressive sensory &amp; muscular changes; cure by lumpectomy.</td>
</tr>
<tr>
<td>2</td>
<td>Undiagnosed herpes zoster</td>
<td>25</td>
<td>F</td>
<td>Appendectomy</td>
<td>Atraumatic; cerebrospinal fluid clear.</td>
<td>Pontocaine; glucose.</td>
<td>Transient sensory &amp; muscular defects of leg</td>
</tr>
<tr>
<td>3</td>
<td>History of mumps encephalitis</td>
<td>36</td>
<td>F</td>
<td>Cholecystectomy</td>
<td>Atraumatic; cerebrospinal fluid clear.</td>
<td>Pontocaine; glucose; epinephrine.</td>
<td>Headache; recurrence of weakness of leg; recovery.</td>
</tr>
<tr>
<td>4</td>
<td>History of cerebrovascular accident; leg pain; hemiparesis; bladder weakness.</td>
<td>59</td>
<td>F</td>
<td>Diagnostic spinal anesthesia</td>
<td>Multiple spinal taps</td>
<td>0.2% procaine</td>
<td>Exacerbation of leg pain &amp; bladder weakness</td>
</tr>
<tr>
<td>5</td>
<td>History of sciatic pain</td>
<td>59</td>
<td>M</td>
<td>Suprapubic prostatectomy</td>
<td>Atraumatic; cerebrospinal fluid clear.</td>
<td>Pontocaine; glucose.</td>
<td>Reappearance of leg pain; recovery.</td>
</tr>
<tr>
<td>6</td>
<td>History of sciatic pain</td>
<td>53</td>
<td>M</td>
<td>Appendectomy; excision of</td>
<td>Atraumatic; cerebrospinal fluid clear.</td>
<td>Pontocaine; glucose.</td>
<td>Reappearance of pain; lumpectomy; disk removed.</td>
</tr>
<tr>
<td>9</td>
<td>Metastatic melanoma</td>
<td>50</td>
<td>M</td>
<td>Abdominal exploration</td>
<td>Atraumatic; cerebrospinal fluid clear.</td>
<td>Pontocaine; glucose; epinephrine.</td>
<td>Delayed onset of back &amp; leg pain; urinary incontinence.</td>
</tr>
<tr>
<td>10</td>
<td>Diabetes; anemia; arteriosclerosis.</td>
<td>68</td>
<td>M</td>
<td>Suprapubic prostatectomy</td>
<td>3 taps; cerebrospinal fluid clear.</td>
<td>Pontocaine; glucose.</td>
<td>Leg weakness; sensory changes.</td>
</tr>
<tr>
<td>11</td>
<td>Diabetic neuropathy</td>
<td>75</td>
<td>M</td>
<td>Suprapubic prostatectomy</td>
<td>Atraumatic; cerebrospinal fluid clear.</td>
<td>Pontocaine; glucose.</td>
<td>?Foot drop; absent vibratory sense.</td>
</tr>
<tr>
<td>12</td>
<td>Acute otitis media</td>
<td>12</td>
<td>M</td>
<td>Diagnostic spinal anesthesia</td>
<td>Atraumatic; cerebrospinal fluid clear.</td>
<td>Procaine (5%)</td>
<td>Menigitis or meningitis 12 days postoperatively</td>
</tr>
</tbody>
</table>

"Avoid RA in patients with pre-existing neurological disorders"
“The Double Crush Theory”

I. MULTIPLE SCLEROSIS (MS)

- Auto-immune inflammatory disorder of the CNS
- Characterized by focal demyelination in the spinal cord or the brain
- Presentation is divers and defined by the specific damaged nerve fibers
- Etiology is unclear. Genetic factors and environmental factors play a role
- Affecting 1/400 especially younger women
- 3 types: 90% Intermittent Relapsing Remitting
- Relapse episodes are mostly unpredictable, although multiple risk factors exist
• Risk factors: infections, delivery and the postpartum period, surgery, stressful life events, emotional stress, smoking, fatigue, fever.

• Most studies almost exclusive in obstetric population.

• Pregnancy: decrease in disease relapse.

• The post-partum period: significant increase in relapse first 3 months.
• **Confavreux et al (2006):** Prospective cohort study

Epidural anesthesia does not contribute to a higher risk of relapse compared with patients not receiving neuraxial techniques.

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**Table 3. Rate of Relapse among Women with Multiple Sclerosis in Relation to the Use or Nonuse of Epidural Analgesia and Whether or Not the Women Breast-Fed Their Infants.**

<table>
<thead>
<tr>
<th>Period</th>
<th>Epidural Analgesia</th>
<th>Breast-Feeding</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes (N=42)</td>
<td>No (N=180)</td>
</tr>
<tr>
<td></td>
<td>Yes (N=122)</td>
<td>No (N=87)</td>
</tr>
<tr>
<td>Year before pregnancy</td>
<td>0.7 (0.4–1.0)</td>
<td>0.6 (0.5–0.7)</td>
</tr>
<tr>
<td></td>
<td>0.5 (0.3–0.8)</td>
<td>0.6 (0.5–1.0)</td>
</tr>
<tr>
<td>Pregnancy</td>
<td>0.4 (0.3–0.7)</td>
<td>0.3 (0.2–0.4)</td>
</tr>
<tr>
<td>Year after pregnancy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Months 1–3</td>
<td>1.6 (0.9–2.3)</td>
<td>1.2 (0.9–1.4)</td>
</tr>
<tr>
<td></td>
<td>1.2 (0.9–1.4)</td>
<td>1.3 (1.0–1.6)</td>
</tr>
<tr>
<td>Months 4–6</td>
<td>1.0 (0.1–2.0)</td>
<td>0.9 (0.6–1.1)</td>
</tr>
<tr>
<td></td>
<td>0.9 (0.6–1.1)</td>
<td>1.0 (0.7–1.3)</td>
</tr>
<tr>
<td>Months 7–9</td>
<td>0.7 (0.3–1.2)</td>
<td>0.8 (0.6–1.1)</td>
</tr>
<tr>
<td></td>
<td>0.8 (0.6–1.1)</td>
<td>1.0 (0.7–1.3)</td>
</tr>
<tr>
<td>Months 10–12</td>
<td>0.7 (0.2–1.1)</td>
<td>0.6 (0.4–0.8)</td>
</tr>
<tr>
<td></td>
<td>0.6 (0.4–0.8)</td>
<td>0.8 (0.5–1.0)</td>
</tr>
</tbody>
</table>


- Hebl et al (2006, retrospective cohort): no correlation between neuraxial anesthesia and worsening of NMD (MS, ALS) in a broad spectrum of surgeries.

→ Current data: **No contra-indication** for neuraxial anesthesia in patients with NMD

→ Decision whether or not to administer regional anesthesia is based on an individual risk-to-benefit ratio and on a case-by-case basis
• Choice of neuraxial anesthesia technique?

→ epidural > spinal anesthesia:
  • Lower dose LA intrathecal
  • MS: possible BBB disorder
  • MS: more hypotension per-operative
  • MS: Less effect vasopression while hypotensive
  • More evidence for epidural
II. AMYOTROPHIC LATERAL SCLEROSIS (ALS)

- Degeneration of motor-neurons in spinal cord
- Fast progressive muscle weakness
- Adult onset
- 2/100,000
- Death from respiratory failure within a few years
• ALS does not form a contra-indication for neuraxial anesthesia

• Epidural > spinal anesthesia

• Regardless of the anesthetic technique, postoperative respiratory or neurologic deterioration is high

• Avoiding airway manipulation could be a benefit in the high-risk patient population

• Choice of anesthesia is based on an individual risk-to-benefit ratio and on a case-by-case basis
III. MYOPATHIES

= Muscle disorders without neurological component

1. Muscular dystrophy: Duchenne- & Becker`s disease
2. Myotonic disorders: Myotonic dystrophy
1. Duchenne Muscle Dystrophy (DMD)

- X-linked recessive disorder
- Mutation in the gene for dystrophin
- 1/3300
- Progressive muscle weakness
- Involves the heart and breathing muscles in later stages
- Life expectancy: 25
- Death from respiratory failure or cardiac insufficiency
- Becker’s muscle dystrophy: semi-functional dystrophin, milder form of DMD.
Affected systems

- **Respiratory**: - restrictive lung disease due to scoliosis,  
  - respiratory muscle weakness

- **Cardiac**: dilated cardiomyopathy, cardiac arrhythmias

- **Metabolic**: anesthesia induced rhabdomyolysis (AIR)

- **Airway**: macroglossia
Neuraxial anesthesia and DMD?

- Current data is limited to case reports
  → shows no correlation between worsening of neurologic onset and neuraxial anesthesia
  → no contra-indication for neuraxial anesthesia anesthesia in patients with NMD

- Given the potential risk for per- and post-operative cardio-pulmonary complications and AIR, the ability to avoid general anesthesia could be a benefit in the high risk population if possible.
2. Myotonic dystrophy (Steinert)

- Autosomal dominant genetic disorder
- Gradually worsening muscle loss and weakness
- DSM 1 & DSM 2
- Life expectancy: +53
- 1/10 000
- Death from respiratory failure or cardiac insufficiency
Affected systems

• **Endocrine**: hypo-gonadisme, thyroid disorders and insulin resistance

• **Respiratory**: respiratory muscle weakness, OSAS, hypoventilation

• **Cardiac**: brady- and supra ventricular arrhythmia`s, LVHT, dilated CMP

• **Gastro-intestinal**: dysphagia
Neuraxial anesthesia and MD?

- Current data is limited to case reports
  → shows no correlation between worsening of neurologic onset and neuraxial anesthesia
  → no contra-indication for neuraxial anesthesia in patients with NMD

- Given the potential significant cardiorespiratory co-morbidities, it could be wise to avoid general anesthesia in the high risk MD-population
IV. MYASTHENIA GRAVIS

- Antibodies bind postsynaptic acetylcholine receptors blocking neuromuscular transmission
- Muscle weakness, worse with muscle exercise, improves with cholinesterase inhibition.
- Associated with thymoma
- Epidemiology: <40 and >60
  - 1/5000
- R/ Cholinesterase-inhibition
- Cave Myastenic crisis

Myasthenic crisis

- Exacerbation MG

- Multiple risk factors => always try to avoid these
  - Emotional stress
  - Pain, surgery
  - Respiratory infections,
  - Fatigue

- Higher risk in severe disease

- R/ causal, cholinesterase-inhibition

- DD cholinergic crisis
  - Due to overdosing cholinesterase-inhibitors
  - R/ temporary stop Ach-chol.-inh. +- atropine

- Beware of certain medication (e.g. aminoglycosides and Beta-blockers)
Neuraxial anesthesia

- Considered safe and preferred above GA when possible
- Eliminates the need for intraoperative neuromuscular blockade & opioids
- Only if respiratory problems GA, avoid NMBAs

→ elevated risk of postoperative respiratory failure that *may* be decreased through regional anesthesia and avoidance of opioids and paralytics
MG & Delivery

• In stable disease: vaginal delivery

• NAA preferred for both cesarean and vaginal delivery

• Epidural > spinal anesthesia

• Avoid ester-LA

• Early epidural anesthesia: circumventing fatigue, stress and pain

• Delivery should be carefully planned
  – Stable disease
  – Multidisciplinary

• Beware of neonatal myastheny

• Evaluation and documentation of the patient’s baseline neurological status

V. GUILLAIN-BARRE SYNDROME (GBS)

- Acute inflammatory, demyelinating polyradiculoneuropathy
- History of upper respiratory tract infection or gastroenteritis
- Progressive motor weakness, areflexia, and ascending paralysis => respiratory failure
- Autonomic instability and upregulation postsynaptic acetylcholine receptor
- R/ Supportive, plasmapheresis and IV Ig

- Fear of GBS/worsening of symptoms after epidural anesthesia

Use of epidural analgesia without problems

- Prevalence/symptoms increased postpartum and after surgery irrespective of any intervention

Worsening of Neurologic Symptoms After Epidural Anesthesia for Labor in a Guillain-Barré Patient

Sandrine Wiertlewski, MD*,†, Armelle Magot, MD*, Sophie Drapier, MD†, Jean-Marc Malinovsky, MD, PhD‡, and Yann Péréon, MD, PhD*

From the *Laboratoire d’Explorations Fonctionnelles, the †Clinique Neurologique, and the ‡Département d’Anesthésie et Réanimation Chirurgicale, University Hospital, Nantes, France

Mechanism:
- incidental immunologic changes associated with pregnancy
- anesthetic toxicity.

Combined Spinal and Epidural Anesthesia for Labor and Cesarean Delivery in a Patient With Guillain-Barre Syndrome

Dmitri V. Vassiliev, M.D., Elisabet U.M. Nystrom, M.D., Ph.D., and Craig H. Leicht, M.D., M.P.H.
Development of GBS (new onset) => No direct link between neuraxial anesthesia and GBS can be confirmed.

<table>
<thead>
<tr>
<th>Case subject</th>
<th>Author (reference)</th>
<th>Age/sex</th>
<th>Initial Infection</th>
<th>Procedure</th>
<th>First symptom</th>
<th>Time between epidural and first neurological symptoms</th>
<th>Treatment</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Steiner et al.</td>
<td>29/F</td>
<td>—</td>
<td>Spontaneous delivery using epidural anesthesia</td>
<td>Acroparestheis, weakness in the arms and legs, constipation, urgency and frequency, dysphagia</td>
<td>1 wk postpartum</td>
<td>Steroid treatment; discontinued after 3 mo</td>
<td>Recovery was slow. One and a half years later, patient was medication free and asymptomatic</td>
</tr>
<tr>
<td>2</td>
<td>Steiner et al.</td>
<td>60/M</td>
<td>—</td>
<td>Inguinal herniorrhaphy</td>
<td>Weakness of the legs and paresthesias</td>
<td>2 wk postoperatively</td>
<td>Steroid treatment</td>
<td>Patient was discharged after 25 d free of neurological abnormalities but global areflexia persisted</td>
</tr>
<tr>
<td>3</td>
<td>Steiner et al.</td>
<td>70/M</td>
<td>—</td>
<td>Inguinal hernia repair</td>
<td>Weakness of the legs and paresthesias</td>
<td>10 d postoperatively</td>
<td>Steroid treatment</td>
<td>Discharged after 1 mo asymptomatic</td>
</tr>
<tr>
<td>4</td>
<td>Steiner et al.</td>
<td>25/M</td>
<td>—</td>
<td>Acute prolapse of hemorrhoids</td>
<td>Weakness of the legs and paresthesias of soles and hands, dysphagia, dyspnea, and bifacial weakness</td>
<td>1 wk postoperatively</td>
<td>Steroid treatment</td>
<td>Regained strength within 2 wk</td>
</tr>
<tr>
<td>5</td>
<td>Rosenberg and Stacey</td>
<td>58/M</td>
<td>—</td>
<td>Bronchoscopy, esophagoscopy, transabdominal Nissen fundoplication, and thoracotomy</td>
<td>Dull low back pain. Motor reflexes in legs lost, and a left facial droop was noted.</td>
<td>9 d postoperatively</td>
<td>Treated with plasmapheresis and methylprednisolone</td>
<td>Improvement was noted 1 mo later</td>
</tr>
<tr>
<td>6</td>
<td>Bamborger and Thye</td>
<td>63/M</td>
<td>—</td>
<td>Exploratory laparotomy, open partial pancreatectomy, splenectomy</td>
<td>Weakness, flaccid paralysis, loss of sensation and reflexes of the right upper extremity</td>
<td>2 h postoperatively</td>
<td>Methylprednisolone</td>
<td>Patient discharged home on postoperative day 11 with slow and steady progress. Complete recovery from paralysis after 6 mo.</td>
</tr>
<tr>
<td>7</td>
<td>Yun et al.</td>
<td>26/M</td>
<td>Diarrhea 10 d before hospital visit</td>
<td>Radiating pain to the right lower limb; lumbar herniated intervertebral disc</td>
<td>Powerlessness in both lower limbs with increasing weakness</td>
<td>4 d after epidural block</td>
<td>Immunoglobulin for 5 d</td>
<td>Patient discharged after 10 d of treatment after showing improvement in gait and ambulation</td>
</tr>
<tr>
<td>8</td>
<td>Gautier et al.</td>
<td>20/F</td>
<td>—</td>
<td>Obstetrical epidural anesthetic for labor</td>
<td>Left facial palsy and acroparesthesias; global weakness of all 4 limbs</td>
<td>24 h postpartum</td>
<td>Plasmapheresis</td>
<td>Patient regained strength and could walk within 2 wk. Patient was discharged 25 d later.</td>
</tr>
</tbody>
</table>
Conclusion GBS

- No guidelines
- No contra-indication for RA
  - Avoidance of succinylcholine (risk of hyperkalemia)
  - Decreased dose of local anesthetic (risk of high block)
- Careful evaluation and documentation of the patient's baseline neurological status
- Risk-benefit analysis
- Informed consent
  - Risk of worsening symptoms
  - Limited experience

VI. SCOLIOSIS

- Lateral curvature of the spine
- Degree of curvature (‘cobb angle’) > 10°
- Congenital vs ideopathic vs neuromuscular
- Contra-indication for neuraxial anesthesia?
  - Increased risk of neurological complications?
- Challenge!
  - Landmarks, scar formation, instrumentation, bone grafts, false loss-of-resistance
Literature overview

• Crosby et al, 1989: Epidural obstetric analgesia in patients with previous Harrington rod instrumentation (HRI) for correction of idiopathic scoliosis: **50% successful** (10 patients)
  • Complications: failure to identify the epidural space, blood vessel trauma, dural puncture, failure to obtain analgesia

• Daley et al, 1990: Successful epidural analgesia in only **50%** of parturients with previous spine surgery (21 patients)
  • Complications: low back pain due to multiple attempts

• Villevieille et al, 2003: Only **18% failure** in 31 parturients with epidural analgesia (9% technical failure, 9% analgesic)

• Smith et al, 2003: Focus on continuous spinal anesthesia (CSA): **63 % catheters successfully** inserted with good analgesia or anaesthesia for vaginal or operative delivery (19 patients).
  • Only one case of Post-dural puncture headache (PDPH) due to epidural scar tissue

=> Between 44-92% required "**multiple attempts**" to successfully insert the epidural catheter
• Ko et al, 2009 (review):

⇒ Neuraxial success ratio of 79% (uncorrected) and 69% (corrected)

⇒ Complications: 1 case of PDPH (continuous spinal group) and 2 cases of persistent low back pain (epidural group)

Bauchat et al, 2015: prospective study:
41 women with scoliosis correction vs 41 controls

- Successfull analgesia in 88% with scoliosis correction (newer surgical techniques ?)
- Longer time to complete neuraxial technique
- Greater number of needle redirections, attempted interspaces and switch to more experienced anesthesiologist
- Lower final spinal level of in the spinal group
- Complications: 1 dural tap

<table>
<thead>
<tr>
<th>Table 4. Evaluation of Neuraxial Placement in Paired Spinal Instrumentation and Control Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neuraxial technique (n)</td>
</tr>
<tr>
<td>------------------------</td>
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<td></td>
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<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td>Time to placement of neuraxial catheter (min)</td>
</tr>
<tr>
<td>interspaces attempted (n)</td>
</tr>
<tr>
<td>Estimated initial level of neuraxial technique attempt (n)</td>
</tr>
<tr>
<td>Lumbar 2-3</td>
</tr>
<tr>
<td>Lumbar 4-5</td>
</tr>
<tr>
<td>Lumbar 5-sacral 1</td>
</tr>
<tr>
<td>Estimated final level of neuraxial technique (n)</td>
</tr>
<tr>
<td>Lumbar 2-3</td>
</tr>
<tr>
<td>Lumbar 4-5</td>
</tr>
<tr>
<td>Lumbar 5-sacral 1</td>
</tr>
<tr>
<td>Procedure taken over by more senior anesthesiologist (n)</td>
</tr>
<tr>
<td>Experience level of anesthesiologist initiating/completing procedure (n)</td>
</tr>
<tr>
<td>Resident clinical anesthesia year 1</td>
</tr>
<tr>
<td>Resident clinical anesthesia year 2</td>
</tr>
<tr>
<td>Resident clinical anesthesia year 3</td>
</tr>
<tr>
<td>Obstetric anesthesia fellow</td>
</tr>
<tr>
<td>Attending anesthesiologist</td>
</tr>
</tbody>
</table>

Data presented as median (interquartile range) or n (%).
CSE = combined spinal epidural; T = intrathecal; CA2 = clinical anesthesia year 2; CA3 = clinical anesthesia year 3.
*Time from local anesthetic injection to administration of epidural test dose, point estimates presented as median (interquartile range), difference as median difference (95% confidence interval of the median based on 10,000 bootstrapped samples).
Procedure initiated by resident anesthesiologist and completed by fellow or attending anesthesiologist.

• Approach

**Figure 2.** The neuraxial needle should be oriented toward the convexity of the scoliotic curve as it is advanced from the interspinous space toward the midpoint of the posterior epidural space (see arrow). Reproduced with permission from Crosby ET. Disorders of the vertebral column. In: Gambling DR, Douglas MJ, McKay RSF, eds. Obstetric anesthesia and uncommon disorders. 2nd ed. Cambridge: Cambridge University Press, 2008:139.

**Figure 3.** Transverse computed tomogram demonstrating L2 vertebral body rotation and pathway for paramedian approach to the epidural space.


Ultrasound imaging facilitates spinal anesthesia in adults with difficult surface anatomic landmarks.

- 120 patients
- Obesity, lumbar scoliosis, or lumbar spinal surgery
- US: added 6 min to the procedure time but reduced the number of passes

**Fig. 1.** In the paramedian sagittal oblique view, each lumbar interlaminar space is centered in turn on the ultrasound screen (A). A corresponding skin mark is made at the midpoint of the probe’s long edge (B). The probe is then turned 90 degrees to obtain the transverse view (C). The midline is centered on the ultrasound screen, and skin marks are made at the midpoint of the probe’s long and short edges (D). The intersection of these two marks provides an appropriate needle insertion point for a midline approach to the epidural or intrathecal space at that level. (From Ultrasound Imaging for Regional Anesthesia: A Practical Guide Booklet, 3rd edition, Ultrasound for Regional Anesthesia. Used with permission from the publisher.)
Conclusion scoliosis

• High rates of successfull analgesia possible
• Multiple attempts!
• Complications: PDPH - low back pain
• Check radiographs and surgical reports
• Needle insertion can only be accomplished at unfused segments
• Try neuraxial placement in the lower lumbar segments
• Informed consent (technical difficult and analgesia failure)
• Use of Ultrasound (experience!, less attempts)
VII. SPINAL STENOSIS

- Narrowing of the spinal canal and neural foramina produced by age-associated changes in the disks and facet joints
- “Neurogenic claudication”
- Pain, paraesthesia or cramping of one or both legs, brought on when walking/standing and relieved in sitting (posture!)
- Symptoms exacerbate when the spine is extended (upright, when standing or walking) and eased when the spine is flexed (stooping forwards or sitting).
Spinal stenosis

- Relative contra-indication for neuraxial anesthesia
- Increased risk of neurologic complications
- Worsening of the condition

- Epidural infiltrations with corticosteroids to treat chronic back pain …
• Yuen et al, 1997: Neurologic complications of lumbar epidural anesthesia and analgesia.
  – 2/12 patients with more severe polyradiculopathy had severe lumbar spinal stenosis on MRI.

  • Of 127 complications, 33 were spinal haematomas and 32 were cauda equina syndromes; 14 of the latter group had spinal stenosis, of which only one case was known preoperatively
  • frequency of cauda equina syndrome and spinal hematoma increased with age

Table 5. Spinal Hematoma, Spinal Stenosis, and Cauda Equina Syndrome Related to Age

<table>
<thead>
<tr>
<th>Patient age</th>
<th>≤50</th>
<th>50–59</th>
<th>60–69</th>
<th>70–79</th>
<th>≥80</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spinal hematoma</td>
<td>4 (1/3)*</td>
<td>4 (3/1)</td>
<td>4 (2/2)</td>
<td>11 (3/8)</td>
<td>10 (0/10)</td>
<td>33 (9/24)</td>
</tr>
<tr>
<td>Paraparesis and spinal stenosis</td>
<td>1 (0/1)†</td>
<td>1 (0/1)‡</td>
<td>–</td>
<td>1 (1/0)</td>
<td>1 (1/0)</td>
<td>4 (2/2)</td>
</tr>
<tr>
<td>Cauda equina syndrome, all cases</td>
<td>8 (4/4)</td>
<td>8 (7/1)</td>
<td>3 (2/1)</td>
<td>7 (2/5)</td>
<td>6 (3/3)</td>
<td>32 (18/14)</td>
</tr>
<tr>
<td>Pre-existing spinal stenosis</td>
<td>–</td>
<td>–</td>
<td>2 (1/1)</td>
<td>5 (0/5)</td>
<td>2 (1/1)</td>
<td>9 (2/7)</td>
</tr>
<tr>
<td>Local anesthetic neuronal toxicity</td>
<td>8 (4/4)</td>
<td>8 (7/1)</td>
<td>1 (1/0)</td>
<td>2 (2/0)</td>
<td>4 (2/2)</td>
<td>23 (16/7)</td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
<td>13</td>
<td>7</td>
<td>19</td>
<td>17</td>
<td>69</td>
</tr>
</tbody>
</table>

• De Sèze et al, 2007: Severe and Long-Lasting Complications of the Nerve Root and Spinal Cord After Central Neuraxial Blockade
  • 12 severe complications (cauda equina) occurring after central neuraxial blockade, five of which had spinal stenosis
Case-reports and studies

• Increased risk of neurological complications
  – Motor weakness, sensory deficits, cauda equina, spinal/epidural hematoma
  – Mostly postoperatively diagnosis of spinal stenosis

• Mechanism of action (synergistic)
  – Ischemic (increase in intraspinal/epidural pressure due to volume, elderly!)
  – Mechanical trauma
  – Local anesthetic toxicity
  – Positioning
  – Tourniquet ischemia

=> Double crush syndrome
**1 Large review (2010)**

- **Indications:** surgical anesthesia, labor analgesia, postoperative analgesia
- **Technique:** Epidural (38%), Spinal (58%), continuous spinal (3%), CSE (1%)

---

**Table 1. Neurologic History of Patients with Spinal Stenosis or Lumbar Disk Disease**

<table>
<thead>
<tr>
<th>Neurologic feature</th>
<th>Number of patients (N = 937)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neurologic diagnosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spinal stenosis</td>
<td>387</td>
<td>41</td>
</tr>
<tr>
<td>Compressive radiculopathy</td>
<td>530</td>
<td>57</td>
</tr>
<tr>
<td>Disk herniation (without radiculopathy)</td>
<td>40</td>
<td>4</td>
</tr>
<tr>
<td>Peripheral neuropathy</td>
<td>210</td>
<td>22</td>
</tr>
<tr>
<td>Multiple (&gt;1) diagnoses</td>
<td>180</td>
<td>19</td>
</tr>
<tr>
<td>Neurologic history</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor deficits</td>
<td>473</td>
<td>51</td>
</tr>
<tr>
<td>Sensory deficits</td>
<td>568</td>
<td>61</td>
</tr>
<tr>
<td>Pain/paresthesia</td>
<td>582</td>
<td>62</td>
</tr>
<tr>
<td>Hypalgesia</td>
<td>74</td>
<td>8</td>
</tr>
<tr>
<td>History of prior spinal surgery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>s/p Laminectomy</td>
<td>193</td>
<td>21</td>
</tr>
<tr>
<td>s/p Discectomy</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>s/p Spinal fusion or other</td>
<td>5</td>
<td>0.5</td>
</tr>
<tr>
<td>Disease status at time of block placement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acute exacerbation (~&lt;30 days)</td>
<td>32</td>
<td>3</td>
</tr>
<tr>
<td>Subacute exacerbation (<del>1</del>6 months)</td>
<td>69</td>
<td>7</td>
</tr>
<tr>
<td>Chronic/stable (&gt;6 months)</td>
<td>829</td>
<td>91</td>
</tr>
<tr>
<td>Unknown</td>
<td>8</td>
<td>—</td>
</tr>
<tr>
<td>Disease progression within last 12 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>153</td>
<td>16</td>
</tr>
<tr>
<td>No</td>
<td>832</td>
<td>88</td>
</tr>
<tr>
<td>Unknown</td>
<td>152</td>
<td>—</td>
</tr>
<tr>
<td>Active symptoms at time of neuraxial block</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>335</td>
<td>36</td>
</tr>
<tr>
<td>No</td>
<td>323</td>
<td>35</td>
</tr>
<tr>
<td>Unknown</td>
<td>279</td>
<td>—</td>
</tr>
</tbody>
</table>

*Percentages based upon those patients with available data.

s/p = status post (previous condition).

---

**Table 3. Outcomes of Neuraxial Blockade in Patients with Spinal Stenosis or Lumbar Disk Disease with or without Prior Spinal Surgery**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Patients without prior history of spine surgery</th>
<th>Patients with prior history of spine surgery</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block efficacy</td>
<td>730</td>
<td>207</td>
<td>0.72</td>
</tr>
<tr>
<td>Satisfactory</td>
<td>709</td>
<td>202</td>
<td>0.72</td>
</tr>
<tr>
<td>Unilateral</td>
<td>0</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>Patchy or segmental</td>
<td>9</td>
<td>4</td>
<td>0.5</td>
</tr>
<tr>
<td>No block (block failure)</td>
<td>12</td>
<td>4</td>
<td>0.5</td>
</tr>
<tr>
<td>Technical complications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Epidural</td>
<td>285</td>
<td>73</td>
<td>0.88</td>
</tr>
<tr>
<td>Unable to reach epidural space</td>
<td>5</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Unable to advance catheter</td>
<td>14</td>
<td>3</td>
<td>0.5</td>
</tr>
<tr>
<td>Unplanned dural puncture</td>
<td>8</td>
<td>2</td>
<td>0.5</td>
</tr>
<tr>
<td>Spinal</td>
<td>439</td>
<td>130</td>
<td>1.0</td>
</tr>
<tr>
<td>Unable to obtain CSF</td>
<td>1</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>Epidural or spinal</td>
<td>19</td>
<td>8</td>
<td>0.91</td>
</tr>
<tr>
<td>Traumatic (blood)</td>
<td>1</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>Unintentional paresthesia</td>
<td>37</td>
<td>9</td>
<td>0.3</td>
</tr>
<tr>
<td>Unintentional high spinal</td>
<td>1</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Neurologic complications</td>
<td></td>
<td></td>
<td>0.54</td>
</tr>
</tbody>
</table>

Results

- 10 patients (1.1%) with new deficits (3) or worsening of preexisting symptoms postoperatively (7)
- 3 complications occurred in patients with history of spinal surgery
- Higher frequency in patients with preop compressive radiculopathy
- Cause:
  - 4 patients: presumed surgical (nerve trauma, tourniquet, positioning)
  - 6 patients: anesthesia related (LA toxicity, ischemic volume effect)
  - Double crush syndrome!

Higher incidence of neurological complications after neuraxial blockade with preexisting spinal canal pathology
SPECIAL ARTICLE

The Second ASRA Practice Advisory on
Neurologic Complications Associated With Regional
Anesthesia and Pain Medicine
Executive Summary 2015

Joseph M. Neal, MD,* Michael J. Barrington, MBBS, FANZCA, PhD,† Richard Brull, MD,‡
Admir Hadzic, MD,§ James R. Hebl, MD,∥ Terese T. Horlocker, MD,∥∥ Marc A. Huntoon, MD,**
Sandra L. Kopp, MD,∥ James P. Rathmell, MD,†† and James C. Watson, MD∥∥
TABLE 6. Recommendations: Patients With Spinal Stenosis

These recommendations are intended to encourage optimal patient care but cannot ensure the avoidance of adverse outcomes. As with any practice advisory recommendation, these are subject to revision as knowledge advances regarding specific complications.

- Spinal stenosis represents a continuum of spinal canal encroachment by hypertrophied ligamentum flavum, bony overgrowth, and/or degenerative changes such as from osteoporosis or herniated nucleus pulposus. Patients with spinal canal pathology (eg, spinal stenosis, lumbar disk disease) may have clinical or subclinical evidence of a preexisting neurologic deficit because of neural compromise from the disease state. However, even moderately severe spinal stenosis is not always symptomatic; many patients (or their health care providers) are unaware that they have the condition (Class I).

- When neuraxial anesthesia is complicated by the development of mass lesions within the spinal canal (eg, hematoma or abscess), resultant postoperative neurologic complications may be more likely or more severe in patients with spinal stenosis or other obstructive spinal canal pathology, including changes brought on by patient positioning (Class I).

- In patients with known severe spinal stenosis or symptoms suggestive thereof, we recommend that risk-to-benefit be considered before performance of neuraxial anesthesia because of the association of spinal stenosis with neurologic complications in the setting of neuraxial blockade. If neuraxial blockade is performed, we recommend heightened perioperative vigilance for symptoms suggestive of neural compromise (Class II).

- There is no firm linkage to injury if spinal stenosis is at a site distant from the level of neuraxial block placement (Class III).

- If neuraxial anesthesia is planned, the practitioner may consider reducing the total mass (volume × concentration) of local anesthetic in an effort to reduce segmental spread, local anesthetic neurotoxicity (which is related to concentration), and/or facilitate neurologic assessment by earlier block resolution. Although we are unaware of routinely administered volumes of local anesthetic being associated with injury in patients with spinal stenosis, reports have postulated linkage between high volumes and neuraxial injury in the setting of other mass lesions such as epidural lipomatosis (Class III).

- The literature has established an association between spinal stenosis and injury after neuraxial blockade, most often affecting patients in whom the diagnosis of spinal stenosis was made during workup for the injury. There is no clear evidence that spinal stenosis per se caused these injuries (Class II).

- Currently, it is unclear whether the development of new or worsening neurologic symptoms after neuraxial anesthesia or analgesia is caused by surgical factors, the anesthetic technique, the natural progression of spinal pathology, or a combination of these factors (Class II).
VIII. INTRACRANIAL PATHOLOGY

- Brain tumors, vascular malformations, Arnold-Chiari malformation, pseudotumor cerebri
- Increased intracranial pressure and risk of herniation …
- Physiology and anatomy!
- General vs neuraxial anesthesia
- Impact of pregnancy/labor: increased CSF and epidural pressure
- Lack of evidence!!!
  - Expert opinion
  - Case reports
  - Reporting bias
- **Large** but **unknown** brain tumor
- S/ Headache at the time of her initial epidural injection and recurrent headaches during labor
- **Accidental dural puncture**: 3 ml air “loss-of-resistance” testing was injected intrathecal
3 primary intracranial elements:
- Brain tissue
- Cerebrospinal fluid
- Cerebral blood volume

Fig. 4. Schematic of the potential impact of a space-occupying lesion on the three primary intracranial components—brain tissue, cerebrospinal fluid (CSF), and blood—and their respective volumes. The graph to the right depicts the intracranial compliance curve (i.e., the relationship between intracranial pressure [ICP] and intracranial volume). This is attenuated by the ability of CSF and blood to move from the intracranial to the extracranial compartment (dashed arrow) as intracranial volume rises. Once this is exhausted, the curve rises steeply due to the incompressible nature of liquids (solid arrow).
1. Brain tumors

- Glioma, meningioma, neurinoma, glioblastoma, …
- Not every lesion is associated with increased ICP
  - Lack of clinical symptoms/increased ICP on imaging
- Preservation of continuous flow of CSF and absence of pressure difference between intracranial and intraspinal compartments
  - CSF rather than brain tissue displaced to intraspinal after dural tap
- Effect on intracranial compliance/ICP: location, size, rapidity of growth, imaging
  - +: Remote from CSF pathways, small, slowly growing, no ventricular compression => very little risk of herniation after dural tap/epidural-spinal injection well tolerated on ICP
  - -: Obstruction CSF flow, lesion near ventricular system/foramen magnum/fossa posterior => high risk of herniation
2. Arnold-Chiari malformation

- Congenital neurological anomaly
- Type I (most often) -> Type IV
- Prolaps of cerebellar tonsils into foramen magnum
- Abnormal CSF flow: hydrocephalus and syringomyelia
- Symptoms: headache, cervical or arm pain, paresthesia of hands and fingers, gait disturbance
- R/ Decompression and duraplasty

Reports and case series (30 patients)
- Successful spinal and epidural analgesia in patients with Chiari malformations (CM)
- (Un)diagnosed and (un)corrected
- Complications:
  - PDPH R/ blood patch
  - PDPH not responsive to blood patch with new diagnosis CM afterwards

Arnold-Chiari malformation

- Literature is limited, no guidelines
- Unknown whether ICP is significantly elevated in cases of CM1
- Corrected => no problem
- Uncorrected => controversy!
- Absence of new-onset symptoms = low risk for neuraxial technique
  - Patients with asymptomatic type I CM and minimal tonsillar descent
- Key points
  - Early technique to decrease uterine contractions
  - Slow titration of bolus through epidural
  - Vacuum assisted delivery to minimize maternal valsalva
  - Maintain stable hemodynamics
  - Multidisciplinary approach
  - Individualized care plan
  - Dural tap: consider early blood patch and neurological consultation
3. Pseudotumor Cerebri

- Benign intracranial hypertension
- Obese women of reproductive age
- **Elevated ICP** (>20 cm H20) with normal CSF composition
- Absence of underlying cause
- Symptoms: headache, neck stiffness, tinnitus, **papilledema**, visual disturbance -> visual loss!
- No obstruction, no pressure difference between intracranial-spinal CSF compartment

=> **No risk** of brain herniation after dural puncture!
- R/ lumbar punctures (20-40 ml CSF), acetazolamide
Pseudotumor Cerebri

- Neuraxial anesthesia = SAFE
- Increased ICP is not always contra-indications
- Goal: minimize increase in ICP
- Epidural and combined spinal-epidural analgesia have been used successfully
- Epidural: smaller incremental dosing
- Spinal catheter
  - Deliver labor analgesia, smaller volumes
    - 6 mL or 7.5mg of isobaric bupivacaine /2,5h
  - Monitoring ICP during labor
    - 22-29 mmHg at rest rising to 43–60 mmHg when pushing
  - CSF drain if ICP increase is associated with symptoms.

4. Aneurysms and AV malformations

• Risk of rupture?
  – GA: risk of hypertension after intubation, pain, PONV, bearing down
    • Increase CBF – ICP – transmural pressure => rupture
  – RA: risk of hypotension after spinal/epidural/dural tap
    • Decrease CSF pressure – increase transmural pressure => rupture

=> MAINTAIN HEMODYNAMIC STABILITY!

• Brain aneurysm:
  – Corrected: no contra-indications for RA
  – Not-corrected: no reports or guidelines
  – Pregnancy, labor or puerperium did not increase risk of aneurysmal subarachnoidal hemorrhage
AV Malformation

- No consensus, only case reports
- **Increased risk** of hemorrhage from AV malformations during pregnancy!
- Therapeutic intervention ideally before pregnancy
- Case-specific multidisciplinary discussion
- Delivery: mostly cesarean sections
- Spinal/epidural/CSE have been successfully used in cesarean and vaginal deliveries
KEY POINTS:
- Multidisciplinary approach
- Individualized care plan
- Neurological symptoms
- Neuro-imaging

Fig. 7. Decision tree summarizing the critical elements for assessing the risks of neurological deterioration from neuraxial anesthesia in patients with intracranial space-occupying lesions. CSF = cerebrospinal fluid.

TAKE HOME MESSAGES

• No absolute contra-indications for neuraxial anesthesia in patients with pre-existing neurological deficits

• Lack of evidence - no strict guidelines

• Recommendations mostly based on case reports and expert opinion

• Individual risk-to-benefit ratio and case-by-case basis

• Evaluation and documentation of the patient’s baseline neurological status

• Informed consent (technical difficult - analgesia failure - worsening of symptoms-complications)

• Reduce volume and concentration of LA

• Heightened perioperative vigilance!
Case 1: Multiple Sclerosis

- 30-year old pregnant woman
- scheduled for an elective caesarean section
- 38 weeks in gestation at the moment of caesarean section
- remitting-relapsing multiple sclerosis:
  - 2 relapses in the past
  - at the moment of admission: neurologically asymptomatic
  - Most recent MRI-scan revealed white matter lesions at T8 and T10

What is your anesthetic plan?
1) Inform and reassure patient
2) A thoroughly pre-operative screening
3) Epidural anesthesia  (>> spinal)
Case 2: Spinal stenosis

- 75-year-old male
- Severe spinal stenosis in the lumbar spine region
- Medical history
  - Chronic low back pain
  - Right sided lumbar radicular pain since 2002
  - Type-2 diabetes
  - Atrial fibrillation (R/ Warfarin)

- Scheduled for a laparoscopic right hemicolecotomy (colon carcinoma)

RISK > BENEFIT
- Higher incidence of neurological complications after neuraxial blockade with spinal canal pathology
  - Higher frequency in patients with preop compressive radiculopathy + higher age
- Atrial fibrillation