

- For regional technique, assess any possibility of AVMs in the neuraxial region prior to performing the technique.

#### Monitoring

- Avoid or use with great caution TEE, gastric suctioning or esophageal stethoscope if esophageal varices or AVMs are present, and avoid nasal temperature probes.

#### Airway

- If oropharyngeal AVMs are present, there is a high risk of airway bleeding.
- Nasal intubation contraindicated if nasal telangiectasias are present.
- Well-lubricated smaller size ETT to prevent any tissue trauma.

#### Maintenance

- When there is a risk of high-output heart failure and liver failure, modify anesthetic management.
- Pulm AVMs could be large enough to lead to heart failure and polycythemia.
- Key aspects of anesthetic management are interventions to maintain nml hemodynamic parameters and to prevent bleeding and the formation of emboli.

#### Postoperative Period

- Avoid immobilization for prolonged periods of time to avoid thromboembolism to CNS.

#### Adjuvants

- Watch for incompatible drugs in IVs or peripheral veins to avoid particulate matter precipitation and embolization to the brain.
- Broad-spectrum antibiotic prophylaxis to decrease risk of CNS infections.
- NSAIDs may precipitate GI or mucosal bleeding and impair renal function.

#### Anticipated Problems/Concerns

- Anemia due to recurrent bleeding; most commonly epistaxis.
- Transfusion is complicated: Low Hct may increase the risk of high-output CHF by increasing extent of arteriovenous shunting (decreasing viscosity effect), but a high Hct may increase risk of thromboembolism.
- Coagulopathy: Multiple hemostatic defects, including low-grade DIC, reduced plt aggregation, and

factor XI deficiency, may aggravate bleeding caused by local vessel wall pathology.

- Paradoxical embolism: Owing to pulm AVMs, peripheral microemboli (air, bland, or septic) bypass nml pulm capillary filtering and embolize, causing transient or permanent neurologic defects or brain abscess.
- Special attention should be paid to pregnant women with the diagnosis of HHT. In the rare instances, deterioration of preconception AVMs and the development of new AVMs will present with clinically silent but potentially life threatening complications of the disorder. These are most commonly located in the pulm vasculature, followed in frequency by the cerebral, GI, and spinal circulation. With CV and hormonally induced enlargement of certain AVMs, there is concurrent risk of rupture, as well as shunt-induced high cardiac output failure and systemic embolism.

## Herniated Nucleus Pulposus

Christine Peeters-Asdourian | Efrain I. Cubillo

#### Risk

- Incidence of symptomatic disc herniation is 1–2% in the general population.
- Most common age of presentation is during third and fourth decades of life.
- Smoking leads to reduced O<sub>2</sub> tension secondary to vasoconstriction, significant inhibition of cell proliferation and extracellular matrix synthesis, and increased abnormal type I collagen versus type II collagen overall, leading to disc degeneration.
- Chronic stress (e.g., chronic coughing, sitting without lumbar support, heavy lifting) increases strain on disc.
- Poor posture combined with poor body mechanics places stress on the lumbar spine and affects the distribution of body weight.
- Obesity and largely sedentary lifestyle.

#### Overview

- Structurally the lumbar disc has three components: the annulus fibrosus, forming the circumferential rim of the disc; the nucleus pulposus, composing its central core; and the cartilaginous end plates on the adjacent vertebral bodies.
- The intervertebral disc is the largest avascular structure in the body.
- The nucleus pulposus is composed of H<sub>2</sub>O, collagen, and PGs. PG molecules are important because they attract and retain H<sub>2</sub>O, constituting a hydrated gel-like matter that resists compression. The amount of H<sub>2</sub>O in the nucleus varies throughout the day, depending on activity. It decreases with age, leading to degenerative disc disease.
- The annulus fibrosus is an annular structure composed of concentric sheets of collagen fibers connected to the vertebral end plates. The sheets are oriented at various angles and enclose the nucleus pulposus.
- Disc herniation occurs when the annulus fibrosus breaks open or cracks, allowing the nucleus pulposus to escape. This is called a HNP or herniated disc. Escaping material initiates an inflammatory reaction.
- Disc herniation typically gives rise to radicular pain, which is pain in the distribution of the nerve root affected by the herniation. This pain has strong inflammatory and neuropathic components

with or without neurologic change. If radicular changes take place, the presentation is that of a radiculopathy.

- Lumbar region L4–L5 is most common site (59%), followed by L5–S1 (30%) and L3–L4 (9%).
- Natural history of disease is favorable.
- Most pts have substantial improvement of symptoms within a few mo.

#### Etiology

- Ability of the nucleus pulposus to retain H<sub>2</sub>O declines progressively with age.
- Displacement of nuclear material initiates a robust inflammatory response, eliciting known inflammatory mediators such as IL-1, IL-8, IL-17 and TNF  $\alpha$  in addition to several recently identified contributing mediators including NGE, IFN $\gamma$ , and Th1 lymphocyte activation.
- The inflammatory response results in migration and activation of macrophages, leading to scar production and an increase in substance P.
- Symptoms do not always correlate with herniation size (asymptomatic herniation is frequent).

#### Disease Presentation

- May begin either suddenly, with physical activity, or slowly.
- Frequently presents with a combination of back pain and radicular symptoms; neurologic signs such as weakness or sensory deficits are possible. Isolated low back pain may also be the sole presentation.
- Pts often describe a popping sensation prior to onset of radicular symptom.
- Neural impingement is responsible for dysfunction. Compression of a motor nerve results in weakness in less than 50% of pts; compression of a sensory nerve results in numbness.
- Radicular pain is caused by inflammation of the nerve (which can explain the lack of correlation between the size of a herniation and symptoms of pain).
- Ideal imaging modality is MRI, although CT may also be helpful, EMG/NCS can help to identify the nerve root involved. However, there is not always a correlation between findings on imaging studies and clinical presentation.

- Maneuvers that increase intrathecal pressure (coughing, sneezing, prolonged sitting) can aggravate pain.

#### Usual Treatment

- Conservative therapies:
  - NSAIDs are supported by the literature.
  - Systemic corticosteroids have not been shown to be superior to placebo.
  - Opioids, muscle relaxants, neuropathic agents (empirical data, limited EBM data)
  - Contrary to prior belief, activity is now preferred over bed rest.
  - Physical therapy.
  - Several other modalities, poorly supported by the literature, include bracing, traction, acupuncture, chiropractic manipulation, behavioral therapy, and biofeedback.
  - Favorable outcomes are more common among better-educated pts and those who are self-motivated. A second neurologic examination within 12 wk is suggested. nml psychological profile, and absence of a workers compensation claim or litigation
- Injection therapy:
  - Epidural injections utilizing fluoroscopy are the standard of care as fluoroscopy is one modality that may reduce catastrophic neurologic injuries, including stroke and spinal cord injury
  - Interlaminar epidural steroid injections are commonly performed.
  - Transforaminal epidural steroid injections target a given area more precisely (commonly performed in the lumbar region but controversial in the cervical region).
  - Investigational studies have shown evidence for lumbar intradiscal PRP.
- Percutaneous discectomy:
  - Does not directly remove the herniated portion but rather removes only the nucleus pulposus in the hope that the herniation portion will regress (limited studies showed a success rate of about 30%).
  - Nucleoplasty.
  - Laser disc decompression.
  - Endoscopic discectomy.

- These techniques may be performed in ambulatory surgery or even office settings with moderate sedation or monitored anesthesia.
- Surgical intervention:
  - Most common procedure for a herniated or ruptured intervertebral disc is a microdiscectomy.
- Lumbar discectomy is the most commonly performed spinal surgery in USA, with over 300,000 discectomies performed annually.
- Cauda equina syndrome or a high degree of motor dysfunction is a surgical emergency.
- Most recently a randomized controlled trial comparing surgery with prolonged conservative treatment at 5 y demonstrated no significant differences in either disability scores and VAS for leg and back pain.

Assessment Points				
System	Effect	Assessment by Hx	PE	Test
MS	Decreased ROM, pain	Lumbar sprain: Stiffness, decreased ROM	Muscle tenderness	MRI
		Annular tear: Axial pain, difficulties sitting	Decreased ROM referred dermatomal pain	MRI/CT EMG/NCS
		HNP: Numbness, weakness or simply pain Cauda equina	Decreased reflexes, sensory loss "Saddle anesthesia"	Surgical emergency
NEURO	Decreased reflexes or increased reflexes with severe spinal stenosis			
PSYCH	Anxiety, chronic opioid intake, litigation issues	Medications preop	If opioid abruptly stopped, may present with withdrawal	Need for multimodal analgesia

**Key References:** Ropper AH, Zafonte RD: Sciatica, *N Engl J Med* 372(13):1240-1248, 2015; Dunn LK, Durieux ME, Nemergut EC: Non-opioid analgesics: novel approaches to perioperative analgesia for major spine surgery, *Best Pract Res Clin Anaesthesiol* 30(1):79-89, 2016.

### Perioperative Implications

- Pts may present on high-dose opioids, which may present a challenge intraop and postop.
- Nonopioid therapies have been increasingly used as part of a multimodal analgesic regimen to provide improved pain control while minimizing opioid-related side effects.
  - A single dose of preoperative gabapentin at 1200 mg versus placebo in pts undergoing elective lumbar surgery was associated with a significant reduction in pain up to 4 h after the procedure ( $P < 0.01$ ).
  - Periop pregabalin (300 mg before surgery as well as 150 mg for two postop doses 12 h apart) was

associated with decreased VAS scores in addition to improved functional outcome at 3 mo postop.

- IV acetaminophen administered at 1 g intraop followed by another dose of 1 g every 6 h throughout the first postop day resulted in significantly improved pain scores at 24 h in the treatment group versus the placebo group.
- Dexamethasone versus placebo given intraop in a randomized controlled study involving pts undergoing lumbar discectomy led to a significant improvement in mean pain scores on postop day 1.
- Ketamine administered IV before surgery resulted in reduced postop opioid demands and

24-h postop pain scores. Studies examining continuous IV infusion of ketamine demonstrated decreased opioid demands in 9 of 13 trials, with pts in 2 trials maintaining reduced pain scores for 48 h postop.

- There have been some reports of epidural catheter placement by the surgeon intraop (at the end of the procedure but prior to wound closure) leading to reduced VAS pain scores and morphine PCA consumptions after lumbar microdiscectomy.

## Herpes, Type 1

Daniel C. Sizemore | Travis W. Hammond | Manuel C. Vallejo

### Risk

- 500,000 new cases of HSV-1 each year in USA (prevalence approximately 68%); 58% of people worldwide are seropositive.
- Symptoms are typically minor (malaise, myalgias, and painful vesicular oral lesions) or absent, except in immunocompromised pts.

### Perioperative Risks

- Theoretical risk that spinal anesthesia can spread HSV-1 infection to new dermatomes.
- Association of intrathecal morphine and reactivation of HSV-1 infections in obstetric population.

### Worry About

- Transmission of infection to healthcare workers or other pts
- Reactivation after organ transplantation and initiation of immunosuppression
- Secondary infection of herpetic lesions with bacteria or fungi

### Overview

- Transmission occurs after contact with secretions or mucus.
- Primary infection associated with fever/malaise, with a mean duration of 19 d. Recurrences are milder, with a mean duration of 10 d.
- Lesions recur about once per y (in contrast with four times per y for HSV-2) in immunocompetent pts.
- 27% of the population is seropositive by age 4.
- Oral symptoms include gingivostomatitis/oral ulcers. Genital, ocular, pneumonitis, and additional dermatologic infections may occur.
- Symptoms may last 1–4 wk.
- Can be diagnosed via a viral culture (titer 1000 times nml while active lesions exist) or HSV antibodies.

### Etiology

- Transmission occurs after contact with lesions or body fluids such as saliva or genital secretions. Fifty-eight percent of the world population is seropositive. Transmission can be vertical (transmission to infant

via vaginal tract), which is a TORCH pathogen associated with greater risk of infant death or blindness. Vertical transmission (8-60:100,000 live births) and postpartum transmission is exceedingly rare.

- No animal/insect reservoir or vectors exist for HSV-1.
- Infection is usually mild in pts with an intact immune system.
- Dx is by viral culture, PCR, fluorescent antibody testing, or serology.

### Usual Treatment

- Acyclovir, valacyclovir, and famciclovir are effective as episodic therapy when initiated within 72 h of appearance of symptoms reducing viral shedding, lesion healing time, and symptoms.
- Suppressive therapy (lower dose initiated while asymptomatic) is effective in reducing frequency and severity of recurrences, as well as transmission to an uninfected partner.
- Foscarnet or vidarabine may be used in acyclovir-resistant herpes infections.