

Assessment Points

System	Effect	Assessment by Hx	PE	Test
HEENT	Vision deficits, nystagmus, strabismus	History of abnormal vision, blindness, vision correction surgeries	HEENT exam	Evaluation by ophthalmologist
ENDO	Hypothalamus/pituitary abnormalities	Growth delay, precocious or delayed puberty, excessive thirst, excessive hunger, heat or cold intolerance, fatigue, constipation, weakness, history of treatment for known abnormalities	Vitals, puffy face, weakness	Endocrine hormones (TSH, T ₃ /T ₄ , GH, cortisol or cortisol stim test, glucose, IGF-1, IGFBP-3, LH, FSH)
CNS	Cognitive delay, autistic spectrum disorder, behavioral disorder, epilepsy, sleep disorder, abnormal temperature regulation, hyperphagia or hypophagia, polydipsia	Stereotypical behaviors, not meeting developmental milestones, speech delay, seizures, abnormal sleep/wake cycles, temperature instability (unexplained fevers or frequent hospitalizations to rule out sepsis), insatiable appetite or food aversion, water-seeking behavior	General appearance, neuro-psych exam	MRI, CT
MS	Weakness, spasms, motor delay, limb deformities	Not meeting developmental milestones, frequent falls, clumsiness	MSK exam NEURO exam	X-ray, CT, and/or MRI

Key References: Borchert M: Reappraisal of the optic nerve hypoplasia syndrome, *J Neuroophthalmol* 32(1):58–67, 2012; Sherlock DA, McNicol LR: Anaesthesia and septo-optic dysplasia: implications of missed diagnosis in the peri-operative period, *Anaesthesia* 42(12):1302–1305, 1987.

Perioperative Implications

Preoperative Preparation

- Evaluation and treatment of endocrine abnormalities (especially thyroid, ACTH, GH and deficiencies)
- Consider ONH if neonatal history of jaundice, hypoglycemia, and nystagmus/visual deficits
- Consider premedication for pts with cognitive delay.

Monitoring

- Standard monitors
- Neuromuscular (TOF) for recovery from muscle relaxants

Induction

- Consider avoiding succinylcholine in pts with severe weakness or immobility.

- Consider avoiding etomidate in pts with untreated secondary adrenal insufficiency.

Airway

- No special difficulty

Intraoperative Considerations

- Intraoperative CBG if history of hypoglycemia.
- Consider stress-dose steroids if secondary adrenal insufficiency.

Extubation

- No special difficulty but may need support for agitated pts

Postoperative Period

- Consider stress-dose steroids for secondary adrenal insufficiency.

- May have increased risk of postop delirium given vision/cognitive impairment.

Anticipated Problems or Concerns

- Abnormal temperature regulation may be difficult to differentiate from postop infection. Multidisciplinary supportive services may be needed postop.

Deep Vein Thrombosis

Sophia T. Cisler | Lee A. Fleisher

Risk

- Incidence in USA: 170,000–200,000 new cases; 90,000–100,000 recurrent cases.
- VTE is the third most frequent acute cardiovascular syndrome after MI and CVA.
- Half of all episodes are associated with recent surgery or hospitalization.
- VTE is recognized as the leading cause of preventable death in hospitalized pts.

Perioperative Risks

- Modified Caprini risk model can be used to predict risk in general surgical pts.
- Without prophylaxis, DVT develops in close to 30% of general surgical pts.
- With chemical prophylaxis, risk can be reduced to 8% for general surgical pts.
- Incidence of fatal PE: 0.1 (general surgery)–5% (total knee replacement).

Worry About

- Pulm embolism
 - Cardiac arrest, electromechanical dissociation

- Increased A-a gradient, increased dead space, potentially leading to respiratory acidosis
- Increased bleeding risk, safety of regional anesthesia in anticoagulated pts
- Risks and benefits of discontinuing anticoagulation for surgery

Overview

- Classic symptoms of DVT: swelling, pain, and erythema of the involved extremity.
- GA associated with increase in tissue factor, vWF, tissue plasminogen activator, resulting in hypercoagulable/hypofibrinolytic state.
- Dx.
 - Contrast venography (gold standard); requires IV contrast exposure; 2–3% incidence of inducing thrombosis.
 - Compression/duplex ultrasonography of femoral/popliteal veins has sens/spec of 97% in symptomatic pts (less sens for more distal [calf] veins).
 - IP, also more sensitive in proximal (90%) than distal.
 - D dimer has high negative predictive value useful to rule out VTE).
- See also Pulmonary Embolism.

Etiology

- Pt-specific risk factors: age >40 y, immobility, obesity, malignancy, smoking, history of VTE, lower limb injury, inherited hypercoagulability
- Risk increased significantly by major surgery or critical illness
- Without prophylaxis, incidence is approximately 14% in gynecologic surgery, 22% in neurosurgery, 26% in abdominal surgery, and 45–60% in hip/knee surgery
- Risk decreased with regional anesthesia versus general, especially in LE orthopedic surgery

Usual Treatment

- Anticoagulation (UF heparin, LMW heparin, warfarin, or direct oral anticoagulants such as factor IIa or Xa inhibitors)
- Thrombolytics
- Thrombectomy, catheter or open surgical
- IVC filter for PE prevention in high-risk pts or if anticoagulation is contraindicated

Assessment Points

System	Effect	Assessment by Hx	PE	Test
CV			Tachycardia, RV strain	ECG, TTE/ TEE
RESP	PE	Chest pain, dyspnea, hemoptysis	Tachypnea, wheezing, hypoxemia	SpO ₂ , ABGs, ETCO ₂
HEME				PT, APTT, Ptt, Hgb, D dimer
DERM		Fever	Unilateral edema, erythema, warmth	
MS		Limb pain	Tenderness, Homans sign	Ultrasound, venography

Key References: Streiff MB, Agnelli G, Connors JM, et al: Guidance for the treatment of deep vein thrombosis and pulmonary embolism, *J Thromb Thrombolysis* 41(1):32–67, 2016; Krishnan KN: Deep vein thrombosis and pulmonary embolism—prevention, management, and anaesthetic considerations, *Indian J Anaesth* 54(1):8–17, 2010.

Perioperative Implications

Preoperative Preparation

- Consider preoperative placement of an IVC filter in high-risk pts.
- In high-risk procedure (e.g., hip surgery), neuraxial anesthetic may decrease DVT risk versus GA.
- For pts taking anticoagulant/antiplatelet drugs preoperatively:
 - Note the name, type, dosage, duration, and most recent dose.
 - Consider PT, PTT, and platelet count on day of surgery.
 - Confirm adequate blood product availability.
 - Explain risk and benefits of discontinuing medications perioperatively.
 - Consider and discuss with surgeon the role of reversal agents for urgent surgery or life-threatening bleeding.

Monitoring

- Noninvasive BP, ECG, SpO₂, ETCO₂.
- In high-risk pts, consider arterial line for serial ABGs, central line for CVP.
- Consider availability of TEE in high-risk pts or cases of suspected PE.

Airway

- None

Preinduction and Induction

- SCDs prevent venous stasis; may activate fibrinolytic system.
- When possible, administer SQ heparin before incision.

Adjuvants

- Depends on etiology; examine specific etiology (e.g., hypercoagulability).
- Heparin, warfarin, direct oral anticoagulants, and thrombolytics all increase perioperative bleeding diathesis. These agents may have effects on the

pharmacokinetics of other drugs (verify specific effects).

Postoperative Period

- In high-risk pts, consider full anticoagulation postoperative as prophylaxis.
- If using SQ heparin, it should be administered every 8 h if possible.
- Continue SCDs, stockings until pt is ambulatory, but do not start in pts suspected of having DVT.

Anticipated Problems/Concerns

- PE represents life-threatening complication of DVT.
- Postthrombotic syndrome with chronic venous stasis, skin and wound effects.

Degenerative Disk Disease

John E. Tetzlaff

Risk

- Risk factors determined by spinal level
- Cervical spine: C3 and C4 most common; 10% of degenerative disk disease
- Thoracic: uncommon; can be related to trauma or tumor; 0.2–1.8% of disk disease
- Lumbar; very common; 85–90% of disk disease; third most common cause of chronic pain in USA

Perioperative Risks

- Difficult airway
- Spinal cord injury from airway manipulation or positioning
- Positioning injury from prone position
- Ischemic optic neuropathy

Worry About

- Cervical spine instability, nerve root entrapment, or chronic subluxation.

- Difficulty with intubation.
- Injury to the spinal cord, nerve roots.
- Pressure injuries or ventilatory difficulty with the prone position.
- Brachial plexus injury with the prone position.
- Optimum perfusion to the head. Ischemia, neck position, or venous congestion may contribute to ischemic optic neuropathy.
- Airway edema at the conclusion of surgery.

Overview

- Pain from herniation of an intervertebral disk with nerve root compression is the third most common chronic disease in USA and the most common indication for elective spine surgery.
- Incidence varies among spinal segments, being absent in sacral area; most common in lumbar area, next in cervical region, and uncommon in thoracic region.

Etiology

- Osteoarthritis
- Trauma
- Connective tissue diseases, such as rheumatoid arthritis or ankylosing spondylitis

Usual Treatment

- Conservative measures, including rest, exercise, physical therapy, heat, and traction.
- Symptoms are treated with analgesics and NSAIDs.
- During the acute phase, disk herniation can be treated with epidural steroid injection.
- Nonsurgical intervention, such as IDET.
- Surgery is performed to relieve compression on the spinal cord or specific nerve roots and to expand the space for nerve root exit from the spinal column.

Assessment Points

System	Effect	Assessment by Hx	PE	Test
HEENT	Difficult airway Visual acuity	Neck pain Patient report	Decreased ROM Patient report	Flexion/extension x-ray to detect instability Eye examination
RESP	Lung tumor can mimic symptoms of thoracic disk disease	Chest pain with chest excursion	Abnormal pulmonary auscultation	CXR, MRI
GI	GI malignancy can mimic symptoms of thoracic or lumbar disk disease	Truncal pain, abdominal pain	Abdominal mass	CT, MRI
RENAL	Pyelonephritis, cancer of prostate can mimic symptoms of lumbar disk disease	Lumbar pain, muscle spasm, fever/chills	Costovertebral angle tenderness to percussion	Urinalysis, prostate-specific antigen, lumbar spine x-ray, MRI, bone scan
CNS	Myelopathy, anterior spinal cord syndrome	Radiating pain, incontinence, sexual dysfunction, paraplegia	Long tract signs, abnormal reflexes, paresthesia, Babinski reflex	X-ray, MRI
PNS	Radiculopathy, absent deep tendon reflexes, peripheral nerve deficits	Sciatica, numbness, weakness of the extremities	Sciatic pain with ROM, motor deficits, Patchy sensory deficits	Electromyography
MS	Pain, decreased ROM, calcification	Pain, night pain, disability from work	Decreased ROM in spine	Spine x-ray, MRI

Key References: Rothman RA, Simeone FA: *The spine*, ed 54, Philadelphia, PA, 2011, Elsevier (Chapters 36–54); Popitz MD: Anesthetic implications of chronic disease of the cervical spine, *Anesth Analg* 84(3):672–683, 1997.

Perioperative Implications

Preoperative Assessment

- Evaluate coagulation if heavy aspirin or NSAID use, anticoagulants, or symptoms of bleeding.
- Airway assessment. If signs of cervical instability or other indicators of difficult airway management, flexion-extension x-ray of cervical spine.
- Antisialagogue if awake intubation.

- If spinal or epidural anesthesia planned, lumbar x-rays may be needed.
- Planned regional anesthesia may reduce minor complications, such as pain and nausea; intraop bleeding may be reduced.

Monitoring

- Potential for air embolism, greater with sitting position for posterior approach to cervical spine.

- Consider multilumen right atrial catheter; precordial Doppler if sitting position for cervical spine procedure.
- If large blood loss estimated, arterial line becomes indicated.

Airway

- If cervical spine not involved, then routine.
- If abnormal, choices include awake fiber optic intubation, asleep fiber optic intubation, inhalation