Multiple Sclerosis

Sabry Khalil | Armin Schubert

Risk

- Affects more than a half million people in USA, with almost 10,000 new cases every year.

Perioperative Risks

- Worsening of symptoms due to stress or infection
- Aspiration related to bulbar involvement
- Postop mechanical ventilation

Worry About

- Hyperkalemia related to succinylcholine.
- Fever that could exacerbate the disease.
- Pt may come to surgery medically unoptimized.

Overview

- A chronic progressive inflammatory T-cell–mediated demyelinating disease that affects the CNS, with periods of remission and exacerbation.
- Commonly affects more women than men (ratio of >2:1) and peaks between ages 20–40; however, it can also affect children (<0.5%) and the elderly.

Etiology

- Pathogenesis is not fully clear; immunologic, viral (EBV, HHV-6), and environmental factors are involved. The disease is more common in areas away from the equator. Sun exposure and vitamin D may play a role. MS is more common in white than black Americans. HLA associations are present (e.g., A3, B7).

Usual Treatment

- Disease-modifying agents: Interferon beta, glatiramer acetate, natalizumab, fingolimod hydrochloride, dimethylfumarate, and teriflunomide. Flu-like symptoms, elevated liver enzymes, neutropenia, and cardiac arrhythmias (fingolimod) are common side effects.
- Immunosuppressive agents: Mitoxantrone can be cardiotoxic. Other agents include cyclophosphamide, corticosteroids, and IV immunoglobulins.
- Symptomatic treatment: For spasticity, depression, neuropathic pain. This includes baclofen, SSRIs, and gabapentin. Continue all these medications.

Assessment Points

System	Effect	Assessment by Hx	PE	Test
HEENT	Lhermitte sign	Visual disturbances due to optic neuritis	Neck flexion induces electrical sensation	
CNS	Neurologic sequelae	Neurologic symptoms	Uhthoff sign (worsening symptoms by increased body temperature, e.g., with exercise)	MRI CSF analysis
PSYCH	Depression			

Key References: Makris A, Peperopoulos A, Karmaniolou I: Multiple sclerosis: basic knowledge and new insights in perioperative management, *J Anesth* 28(2):267–278, 2014; Dorotta IR, Schubert A: Multiple sclerosis and anesthetic implications, *Curr Opin Anaesthesiol* 15(3):365–370, 2002.

Perioperative Implications

Preoperative Preparation

- Ask pt if symptoms are stable and when he or she last visited the neurologist. Pay special attention to any bulbar symptoms and respiratory system. Inform pt of possible postop mechanical ventilation if significant respiratory compromise is evident.
- Carefully review list of medications and their possible side effects and drug interactions.
- Avoid stressors that exacerbate the disease. This includes pain, anxiety, infection, and hyperthermia.
- Premedicate with midazolam, as it decreases stress. It is believed also to decrease core body temperature through inhibition of tonic thermoregulatory vasoconstriction.
- For unknown reasons, MS is stable during pregnancy but worsens postpartum.
- Consider aspiration prophylaxis.

Monitoring

- Depends on other comorbidities and the risk of surgery. Pay special attention to temperature.

Airway

- Consider RSI to avoid aspiration or awake fiberoptic intubation for difficult airway.

Preinduction/Induction

- Titrate medications slowly on induction, as there could be an element of autonomic dysfunction.
- If RSI is needed, it is advisable to avoid succinylcholine for possible myopathy-induced hyperkalemia. For ECT, sugammadex can reverse rocuronium very rapidly.
- Spinal anesthesia may exacerbate the disease; better to avoid it. Epidural is safe; however, it is prudent to avoid higher concentrations of local anesthetics. Avoid epinephrine-containing local anesthetics for peripheral nerve blocks to avoid potential vasoconstriction-induced neuropathy.
- IV lidocaine can worsen MS, especially eye symptoms.
- Use multimodal analgesia, especially for pts with pain issues. There is increased risk of OSA and less commonly central apnea ("Ondine's curse").
- Consider stress dose of steroids if pt chronically uses high doses.

Maintenance

- Stress on normothermia.
- Inhalational anesthetics and NO are safe to use.
- Careful padding of extremities to avoid exacerbation of peripheral neuropathies.
- Response to muscle relaxant is variable. Titrate to TOF.

Extubation

- Fully awake extubation is preferred, with careful attention to clearing secretions.

Adjuvants

- Duration of most NMBs is shortened by phenytoin and carbamazepine.

Postoperative Period

- Adequate pain control; avoid emotional stressors; avoid overheating the pt; consider incentive spirometry for pts with respiratory dysfunction.

Anticipated Problems/Concerns

- Postop mechanical ventilation
- Aspiration

Multisystem Organ Failure, Lung Dysfunction in

Muhammad Azam

Risk

- 200,000 new cases of ARDS occur annually in USA.
- 0.2% of general surgical pts develop ARDS postop.

Perioperative Risks

- Hypoxemia, hypercarbia, hemodynamic instability.
- ARDS hypoxemia requires ventilator management using high PEEP to achieve adequate oxygenation.
- High PEEP may impede right atrial/right ventricular preload.
- Lower RV preload can reduce stroke volume and cardiac output. This can lead to alveolar hypoperfusion, thus inhibiting carbon dioxide elimination and further worsening hypercarbia and respiratory acidosis.
- Mechanical ventilation modes, such as inverse ratio and pressure control, target oxygenation rather than carbon dioxide elimination, resulting in permissive hypercarbia.
- Mechanical ventilation may cause breath stacking, which can also cause hemodynamic instability.
- Acidosis and dysrhythmias worsen hemodynamic instability.

Worry About

- Mortality: 40% among ARDS alone; >90% for MODS, involving three or more organ failures.
- Poor prognostic factors: Advanced age, impaired immunity, poor prior functional status, resistant organisms, MODS despite adequate therapy.
- Severity of ARDS by Berlin criteria as graded by oxygenation ratio (PaO_2/FiO_2): Mild ≤300 mm Hg; moderate ≤200 mm Hg; severe ≤100 mm Hg.

Overview

- Lung dysfunction in MODS is either ARDS or ALI.
- ARDS is more severe than ALI.
- MODS exists when altered organ function in the acutely ill requires medical intervention for homeostasis.

Etiology

- Pulm conditions (pneumonia, lung contusion)
- Nonpulmonary (sepsis, trauma, transfusions, pancreatitis, DIC)

Usual Treatment

- Mechanical ventilation ARDS.net protocol:
  - Mode: Assist control.
  - Tidal volume 6 mL/kg of predicted body weight (length for predicted body weight).
  - Plateau pressure ≤30 cm H_2O.
  - Higher PEEP levels in sepsis-induced moderate/severe ARDS.
  - Link FiO_2 and PEEP levels.
  - Daily awakening and spontaneous breathing trials.
  - Use of bundles to include head-of-bed elevation, oral hygiene.
- Management of severe sepsis and shock:
  - Early recognition and treatment.
  - Microbiology cultures, timely appropriate antibiotics, source control.
  - Fluid boluses with crystalloids.
  - Measure lactate; follow lactate clearance.
- Titrate vasopressor (norepinephrine) to MAP ≥65 mm Hg.

Assessment Points

System	Effect	Assessment by Hx	PE	Test
RESP	Hypoxemia Hypercarbia	Acute respiratory distress	Tachypnea Crackles	ABGs, CXR, lactate, bronchoalveolar lavage, $ScvO_2$
CV	Shock state Dysrhythmias	Hypotension	Tachycardia, S_3 gallop Irregular rhythm	ECG, troponin, brain natriuretic peptide, ECHO
RENAL	Acute injury or failure	Oliguria/anuria	Edema	Basic metabolic panel, fractional excretion of sodium, UA, renal US
HEPAT	Shock liver	Jaundice	Ascites Bruising	INR, bilirubin, LFTs, NH_3, liver US
GI	Ileus	Nausea Vomiting Constipation	Distension Decreased bowel sounds	KUB Abdominal CT Bladder pressures
CNS	Altered mental status	Acute onset	Low score on GCS	CT brain, MRI, LP, ICP monitor, EEG
HEME	Anemia Thrombocytopenia	Bleeding Bruising	Pallor Purpura	CBC, fibrinogen/FDP
ENDO	Hyperglycemia Hypoadrenalism	Increased blood glucose Decreased blood pressure	Polyuria Shock state	Blood glucose Adrenal functional tests

Key References: Blum JM, Stentz MJ, Dechert R, et al.: Preoperative and intraoperative predictors of postoperative acute respiratory distress syndrome in a general surgical population, *Anesthesiology* 118(1):19–29, 2013; Dellinger RP, Levy MM, Rhodes A, et al.: Surviving sepsis campaign: international guidelines for management of severe sepsis and shock: 2012, *Crit Care Med* 41(2):580–637, 2013.

Perioperative Implications

Preoperative Preparation

- Associated risk factors:
  - ASA class 3–5
  - Emergency surgery, multiple anesthetics, renal failure, COPD
  - High Paw and FiO_2
  - High volume of crystalloids

Airway

- Secure and stabilize endotracheal tube/tracheotomy.
- Consider ICU/transport ventilator for mechanically ventilated pt with high PEEP or FiO_2 (10 cm H_2O, 50%) or inhaled agents with nitric oxide.
- Avoid prolonged circuit disconnection, especially with higher levels PEEP, due to risk of rapid and potentially irreversible hypoxemia caused by alveolar derecruitment.
- Severe ARDS hypoxemia may require prone mechanical ventilation.
- Continue inhaled agents and nitric oxide/prostacyclin.

Monitoring

- Invasive lines including arterial lines, central line, PA catheter, hemodialysis lines, PICC lines.
- Verify dose and indications for all infusions.
- Maintain drains and mechanical devices (chest tubes, temporary pacer wires, external pads, extracorporeal membrane oxygenator, intra-aortic balloon pump, ventricular assist devices).

Preinduction/Induction

- Intraop medication challenges:
  - Induction agents may cause hypotension (propofol), tachycardia (ketamine), worsen survival in sepsis (controversially, etomidate).
  - Paralytic agent risks include hyperkalemia (succinylcholine) and prolonged neuromuscular blockade activity. If organ-dependent elimination (consider organ independently eliminated cisatracurium or sugammadex for reversing rocuronium).
  - Antimicrobial choice based on best evidence, local microbiome, specific findings, allergies, and pt status.

Maintenance

- Opiates titrated for analgesia.
- Benzodiazepines may prolong emergence and have been associated with delirium.
- Inhalational anesthetics titrated as indicated.
- Vitals, clinical picture, and labs guide fluids, products, and vasopressors.

Extubation

- Delayed emergence or instability precludes immediate extubation.
- Plan and coordinate with surgical, anesthesia, and ICU team to continue all supportive measures.
- Anticipate repeat surgeries in burns, exploratory laparotomies, vascular injuries, skeletal and spinal trauma, compartment syndromes.
- Avoid hypothermia which delays emergence and in trauma is associated with worse outcome.
- Provide safe transport and comprehensive report.

Adjuvants

- Dexmedetomidine GTT has sedative and analgesic properties and is less likely to cause delirium.

Anticipated Problems/Concerns

- Anticipate worsening of ARDS immediately postop.
- Tracheotomy if low GCS and frequent ongoing surgical procedures.
- Ventilator-associated pneumonia risk increases with duration of mechanical ventilation and in pts emergently intubated.
- Critical illness polyneuropathy, steroids, and neuromuscular blockade unpredictably prolong significant skeletal muscle weakness.
- Extended illness and immobility predispose to DVT, cath-associated urinary tract infections, central line–associated bloodstream infections, intestinal bleeding, malnutrition, delirium, decubitus ulcers, and so forth.

Myasthenia Gravis

Lee A. Fleisher | Cecil O. Borel

Risk

- Prevalence of myasthenia gravis in USA is estimated at 14 to 20 per 100,000 population; there are approximately 36,000–60,000 cases in USA.
- Affects all races.
- Male:female ratio: 2:1.

Perioperative Risks

- Postop NM ventilatory failure
- Postop pneumonia due to poor cough and secretion clearance

Worry About

- Preop optimization of muscle strength
- Anticholinesterase medications, steroids, plasmapheresis
- Inspiratory muscle weakness due to residual paralysis from nondepolarizing NM blocking agents.
- Exacerbation of underlying bulbar (airway) musculature weakness.
- Increased sensitivity to hypoventilation with narcotic analgesics.

Overview

- Characterized by weakness and fatigability of skeletal muscles.
- Muscle strength improves similarly in both myasthenia gravis and nondepolarizing blockade after administration of anticholinesterase drugs.