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.

Etiology

- Autoimmune disease of the NM junction mediated by reduction in number of acetylcholine receptors at the NM junction.

Usual Treatment

- Anticholinesterase medications (pyridostigmine, Mestinon)
- Immunosuppression: Steroids, azathioprine
- Plasmapheresis
- IVIG
- Thymectomy

Assessment Points

System	Effect	Assessment by Hx	PE	Test
NM	Peripheral muscle weakness	Easy fatigability	Arm adduction times <1 min	Repetitive nerve stimulation
RESP				
(Airway)	Bulbar weakness	Difficulty swallowing	Head lift <5 s	Formal swallowing evaluation
(Ventilation)	Inspiratory muscle weakness	Orthopnea, breathlessness	Paradoxical insp motion	NIF <30 cm H_2O FVC <1000 mL
(Ventilatory drive secretion clearance)	CO_2 retention Weak cough	Morning headache Recurrent pneumonia	Reduced ventilation of bases	ABG CXR

Key References: Borel CO, Hanley DF: Muscular paralysis—myasthenia gravis and polyneuritis. In Parrillo JE, Bone RC (eds): *Critical care medicine: principles of diagnosis and management.* Philadelphia, 1994, Mosby Year Book, pp 1193–1215; Sungur Z, Sentürk M: Anaesthesia for thymectomy in adult and juvenile myasthenic patients, *Curr Opin Anaesthesiol* 29(1):14–19, 2016.

Perioperative Implications

Preoperative Preparation

- Anticholinesterase medications:
  - Hold 2–4 h preop
  - Postop: IV neostigmine may be used to replace pyridostigmine, PO 1 mg IV/60 mg PO or start IV neostigmine 1 h before emergence at 1/30–1/60 the daily pyridostigmine dose infused over 24 h.
- Steroid maintenance.

Monitoring

- Routine.
- TOF twitch monitor if short-active nondepolarizers are used.
- NM recovery at the adductor pollicis muscle may not reflect the recovery of all muscles.

Induction/Intubation

- Consider inhalational anesthetic breathe-down techniques
- Consider intubation without muscle relaxation using propofol/remifentanil maintenance.
- Minimize or avoid the use of muscle relaxants.
- Total IV analgesia or inhalational anesthesia.

Extubation

- Consider sugammadex if muscle relaxants are given.
- Check NIF (>30 cm H_2O), head lift, cough, gag reflex; ensure full return of twitch.

Adjuvants

- Avoid or minimize use of nondepolarizing muscle relaxants.
- Depolarizing relaxants may have increased or decreased efficacy.
- Consider epidural analgesic, particularly for thymectomy.

Anticipated Problems/Concerns

- Postop ventilatory failure, pneumonia, aspiration
- Cholinergic crisis if excess anticholinesterase medications are given

Mycoplasma pneumoniae Infection

Carlos A. Puyo

Risk

- Endemic/pandemic worldwide every 3–5 y.
  - Outbreaks likely during summer and early fall.
  - Affects persons of all ages.
  - Long incubation periods of 1–3 wk.
  - Transmitted person to person via aerosols.
  - Frequent in closed and semiclosed communities.
- Common cause of upper and lower respiratory infections.
  - Up to 40% of community-acquired pneumonias, "walking pneumonia."
  - Up to 5% of bronchiolitis in children.
  - 3–10% of adults may develop bronchopneumonia.
  - Clinical manifestations similar to *Chlamydophila pneumonia, Streptococcus pneumonia,* and respiratory viruses.
  - Fulminant pneumonia may occur in children with sickle cell disease (functional asplenism), Down syndrome, and immunosuppressive conditions.
- Extrapulmonary complications in 25% of pts infected with *Mycoplasma pneumoniae.*

Perioperative Risks

- No periop risk data; hemolytic anemia, DIC, and cross-reacting cold agglutinins are of concern, especially if CPB is required.
- Hyper-reactive airway disease.

Worry About

- Multisystem organ dysfunction

Overview

- Clinical manifestations of respiratory involvement are mediated by activity of cytoadherence on the airway epithelium and include
  - Sore throat, hoarseness, fever, cough (pertussis-like).
  - May play a role in asthma, COPD.
  - Conjunctivitis, headache, chills, coryza, myalgias, earache, and generalized malaise are common.
- Extrapulmonary manifestations are the result of direct invasion or immune reactivity.
- Dx:
  - Hx and clinical manifestations: Unspecific upper respiratory symptoms.
  - CXR: Diffuse reticular infiltrates in perihilar and lower lobe regions; bilateral in 20% of cases.
  - Pathology: Ulceration, edema, ciliary loss, bronchioalveolar inflammatory cell infiltration.
  - Culture: Incubation period of several wk; sensitivity around 60%; not practical for routine diagnosis.
  - Serology: Current or recent infection likely if antibody titer increase ≥fourfold.
  - Cold agglutinins: IgM within 1–2 wk after initial infection; titers ≥1:32 correlate with severity of lung involvement.
  - PCR: RNA-amplification techniques are highly sensitive and indicate viable bacterium.

Etiology

- *M. pneumoniae*: Slow-growing bacterium; requires human host for survival

Usual Treatment

- Antibiotic treatment will shorten respiratory symptoms.
- Macrolides, tetracyclines, and fluoroquinolones. Macrolide resistance has been reported.