

Perioperative Implications

Preoperative Preparation

- Present for multitude of procedures including myelomeningocele closure, cerebral spinal fluid shunt placement, shunt revision, brainstem decompression, and scoliosis correction.
- Assess for latex allergy (increased risk in pts with myelomeningocele).
- Preoperative evaluation including assessment of concurrent comorbidities and active medications, as well as a focused physical exam to assess level of consciousness, motor and sensory function, cranial nerves, and ICP.
- Laboratory evaluation including hemoglobin, type and cross, and electrolytes.
- Review of relevant imaging studies, including CT scans, ECG, and chest plain films.

Monitoring

- Standard ASA monitors with invasive arterial blood pressure.
- Monitor urinary output.
- If central venous access deemed necessary due to pt disease or limited peripheral IV access, avoid neck veins to decrease risk of altering cerebral blood flow or venous drainage.

- Consider TIVA to facilitate neurophysiologic monitoring when applicable.

Airway

- Endotracheal intubation required (naso, oro, or tracheostomy)
- Limit neck flexion during intubation in pts with brainstem compression

Preinduction/Induction

- Use opioids carefully because of their respiratory depressant effects and possible deleterious effects on ICP.
- Sedatives including midazolam appear safe under the direct supervision of the anesthesiologist.
- IV induction with propofol preferred over inhalational induction.
- Avoid hypoxia, hypercarbia, and coughing to limit further increases in ICP when elevated.
- Position pts with myelomeningocele carefully to avoid direct pressure on neural tube defect.

Maintenance

- General anesthesia with controlled ventilation.
- Consider TIVA for benefits of improved neurophysiologic monitoring and favorable effects on cerebral blood flow, cerebral metabolic rate, and ICP.

- When in the prone position, pt's head is rigidly fixed with pins or placed in a cerebellar head frame when pinning contraindicated. Avoid excess neck flexion.
- Carefully evaluate blood loss and management of IV fluid administration, and attempt to limit cerebral edema while maintaining hemodynamic stability.
- Carefully manage known exaggerated heat loss secondary to the disproportionately large head of the neonate.

Extubation

- Prepare for the need for postop mechanical ventilation.
- During emergence and extubation, carefully avoid large fluctuations in ICP and blood pressure.

Postoperative Period

- 24-h monitoring in ICU

Anticipated Problems/Concerns

- Problems related to surgery including hemorrhage, infection, vascular injury, nerve injury, and persistent symptoms of brainstem compression
- Apnea or airway obstruction due to respiratory center or cranial nerve damage
- Secondary cervical instability or kyphosis following cervical laminectomy
- Venous air embolism

Aspiration, Perioperative

Onur Demirci | Paula A. Craig

Risk

- Risk of aspiration: Approximately 3 per 10,000 anesthetics, 11 per 10,000 emergency and/or after-hours cases, and 29 per 10,000 emergency cases in ASA IV and V pts
- Loss of protective reflexes and sphincter function
- Obstructed or abnormal GI motility
- Increased gastric fluid volume; decreased pH
- Inadequate anesthesia leading to coughing and straining during airway manipulation or induction
- Trauma, emergency/night surgery, pregnancy, difficult airway, advanced age, long-standing diabetes mellitus, pain, analgesics, and ASA status >2
- Obesity: not an independent risk factor

Perioperative Risks

- Mortality after aspiration: 5%; higher if ASA >2 or if mechanical ventilation required for >24 h after the aspiration event

Worry About

- Of pts who aspirated, 20% had no risk factor: of these, 66% had difficult intubation
- Rapid-sequence induction may have deleterious effects on heart rate and blood pressure
- Clinical worsening may be delayed up to 24 h after the inciting aspiration event

Overview

- Prevention of aspiration best because there is no definitive treatment.
- Vast majority of pts with risk factor(s) do not aspirate.
- Consider aspiration in differential diagnosis of bronchospasm with hypoxemia.

Etiology

- Loss of protective reflexes: Sedation, neuromuscular disorders/relaxants, and altered mental status

- Obstructed or abnormal motility: Achalasia, gastroparesis, pain, and opioids
- Increased GI contents: Bleeding, obstruction, and feeds

Usual Treatment

- Suctioning or bronchoscopy if obstructing particles present
- Lavage and steroids not helpful; surfactant investigational
- Empiric antibiotics: Consider if pt is compromised, with fulminant course, or suspected high bacterial load due to bowel obstruction

Assessment Points

| System | Effect | Assessment by History | Physical Examination | Test |
|--------|---------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|--------------------------------------|-----------------------------------------|
| HEENT | Awake intubation in difficult airway; cricoid pressure may distort anatomy and obstruct ventilation | Hx difficult airway, head and neck surgery/radiation | Airway exam | X-ray, CT scan, OR records as available |
| CV | Rapid-sequence intubation may lead to ischemia with tachycardia, hypertension/hypotension, or myocardial depression | Anginal Sx, exercise intolerance, Hx CHF, CAD age, sex, risk factors | S3, rales; displaced PMI | ECG and ECHO in selected patients |
| RESP | Rapid-sequence intubation may lead to bronchospasm | Hx pulm disease, wheezing with URI, smoking | Wheezing; prolonged expiratory phase | CXR, continuous pulse oximetry |
| GI | Abnormal sphincters, motility, acidity | Hx peptic ulcer disease, reflux Sx, diabetes, scleroderma, bowel obstruction | Abdominal exam for distention | |
| NEURO | Increased ICP leads to vomiting; depressed protective reflexes; muscle weakness | | Neurologic exam | |

Key References: Marik P: Aspiration pneumonitis and aspiration pneumonia, *N Engl J Med* 344(9):665–671, 2001; Tasch MD, Langeron O: Aspiration prevention and prophylaxis: preoperative considerations. In Hagberg CA, editor: *Benumof and Hagberg's airway management*, ed 3, Philadelphia, 2013, Elsevier, pp 265–279.

Perioperative Implications**Preoperative Preparation**

- NPO status:
 - Adults: 6-8 h for solids depending on fat content and 2 h for clear liquids
 - Infants: 6 h for formula, 4 h for breast milk, and 2 h for clear liquids
- Pharmacologic prophylaxis in selected pts:
 - Increase gastric pH: Nonparticulate antacid, H₂ blockers, and proton pump inhibition
 - Decrease GI contents: prokinetics
 - Increase lower esophageal sphincter pressure: β -antagonists and metoclopramide
- Preinduction gastric emptying:
 - Preexisting orogastric or nasogastric tube to wall suction; might not remove particulate matter but will empty liquid contents
 - Proven not to cause/worsen gastroesophageal reflux

Monitoring

- Routine

Airway

- Protect airway with cuffed ETT or maintain protective reflexes.
- Awake intubation in difficult airway.
- LMA not protective against aspiration.

Preinduction/Induction

- Regional anesthesia can result in aspiration if seizures or hypotension decrease alertness.
- GA: Risk at induction and extubation.
- Denitrogenation with 100% O₂.
- Check optimal pt position, table height, drugs and tools available, and suction at hand.
- Rapid-sequence induction; cricoid pressure until ETT placement assured by ET_{CO}₂.

Maintenance

- Care with depth of sedation during sedation/regional cases

Extubation

- Return of muscular strength/coordination/consciousness adequate to protect airway if emesis occurs.
- If emesis occurs, position pt with head-down or right-side tilt and thoroughly suction the oropharynx and trachea.

Postoperative Period

- If no symptoms in 2 h, significant aspiration extremely unlikely.
- If pneumonitis occurs, initial postop CXR may be normal, proceeding to white-out in a few to 24 h.
- PEEP redistributes lung water and improves oxygenation; higher PEEP may decrease cardiac output and ventilation.
- Maintaining low cardiac filling pressures may limit lung fluid accumulation but may worsen negative effects of PEEP.

Adjuvants

- Muscle relaxants must be dependably rapid acting.
- Regional anesthesia in high-risk pts: Avoid oversedation (loss of protective airway reflexes) hypotension (can cause nausea and vomiting).
- Drug interactions between anesthetic drugs and 1 or 2 doses of aspiration prophylaxis not significant.

Anticipated Problems/Concerns

- Must balance concern for aspiration risk against airway quality, cardiopulmonary reserve, and feasibility of regional techniques

Asthma, Acute

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Risk

- Prevalence in USA: 25 million people; nearly 5% for persons age 5-34 y
- Increased prevalence and severity in African Americans, adult females, and atopic individuals

Perioperative Risks

- Risk related to degree of preop control of symptoms and optimization of medication regimen
- Morbidity due to bronchospasm and laryngospasm

Worry About

- Bronchospasm
- Hyperinflation of lungs
- Medication side effects (e.g., β -agonists causing tachycardia and hypokalemia)
- Adrenal insufficiency (chronic corticosteroid use)

Overview

- Characterized by chronic bronchial wall inflammation, reversible expiratory airflow obstruction, airway hyperreactivity, wheezing, dyspnea, and cough.
- Type I exacerbation: "slow-onset, late arrival," slow and progressive obstruction.
 - Inadequate asthma control, treatment, and/or compliance; preventable with better preoperative control (e.g., adding an inhaled corticosteroid).
 - Often overusing bronchodilators, maximally relaxed smooth muscle, inflammation undertreated, and airway edema present.
 - Additional beta-2 agonists not helpful, present with secretions and mucous plugging and eosinophilic infiltration; slower response to treatment.
 - Majority of asthma fatalities.
- Type II exacerbation: "Sudden-onset, fatal asthma," rapid and in response to an allergen.

- Little airway inflammation, predominantly neutrophilic infiltration.
- Reaction is typically in response to a specific allergen.
- Rapidly respond to bronchodilators.
- Respiratory arrest, acidemia, and altered mental status more likely than with type I.
- More likely to improve with appropriate treatment

Etiology

- Pathophysiology is a combination of the release of inflammatory mediators by IgE antibody activation and the abnormal autonomic nervous system regulation of airway function.

Usual Treatment

- Manual bag-mask ventilation, bronchodilators, anti-inflammatories, deepen anesthesia, and alter ventilation settings (I:E ratio).

Assessment Points

| System | Effect | Assessment by Hx | PE | Test |
|--------|----------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| CV | Tachyarrhythmias, possible pulm Htn | Palpitations, HR | Tachycardia, irregular rhythm, loud P ₂ | ECG, ECHO |
| RESP | Airflow obstruction, decreased lung elastance, hyperinflation, hypoxemia, hypercapnia, variations in peak flow | Dyspnea, cough, wheeze, chest tightness, nighttime awakenings, symptoms induced by exercise, allergens | Prolonged I:E, decreased breath sounds, wheezing, pulsus paradoxus | PFT, CXR, ABG |
| ENDO | Steroid-induced hyperglycemia; adrenal insufficiency (prior <1 y steroid users) | Polyuria, polydipsia, weakness | Hypotension in adrenal insufficiency | Glucose, lytes, cortisol, ACTH, stimulation test |
| MS | Steroid myopathy; steroid-paralytic myopathy | Difficulty climbing stairs or rising from chair; difficulty weaning mechanical ventilation | Proximal muscle weakness in steroid myopathy; possible quadriplegia in steroid-paralytic myopathy | Measurement of inspiratory muscle force, CPK, EMG, muscle biopsy |

Key References: Applegate R, Lauer R, Lenart J, et al: The perioperative management of asthma, *J Allerg Ther* S11:007, 2013; Bateman ED, Hurd SS, Barnes PJ, et al: Global strategy for asthma management and prevention: GINA executive summary, *Eur Respir J* 31(1):143-178, 2008.

Perioperative Implications**Preoperative Preparation**

- History: Inquire about Hx and degree of control of asthma symptoms, any recent flare requiring corticosteroids, increased use of β ₂-agonist medication (or continued use through the periop period), emergency room or hospital visit for asthma, allergies, recent URI, history of periop bronchospasm/pulm

complication, and tobacco use or environmental exposure

- Consider rescheduling elective procedures for 2-3 wk after resolution of URI
- Consider course of oral corticosteroids in poorly controlled asthmatic pts before operation
- Physical examination:
 - Lung auscultation may reveal wheezing

- Visual inspection may demonstrate accessory muscle use
- Assess vital signs (hypercapnia, hypoxemia, hypotension, and tachyarrhythmias)
- Testing: Usually unnecessary; consider arterial blood gas, spirometric evaluation, or eosinophilic cationic protein in patients with severe asthma; measure and compare the peak expiratory flow rate to prior data points during an exacerbation