## Perioperative Implications

### Preoperative Preparation

- PFTs for BOS staging and resp status and bronchoscopy for biopsy and culture.
- Treat active infections aggressively.
- Evaluate renal functions and adjust periop medications where appropriate.
- Continue anti-infective and immunosuppressive therapy during the periop period and adjust dosing to keep within the indicated therapeutic range.
- Strict aseptic techniques due to immunosuppression.
- Premedication useful due to excessive secretions, but avoid excessive resp depression.
- Reflux prophylaxis.
- Corticosteroids supplementation especially for long, invasive, and stressful procedures.
- Watch for increased sensitivity to opioids, hypercarbia, resp acidosis, bronchial hyperresponsiveness (bronchoconstriction), V/Q mismatch, GE reflux, hyperkalemia, and hypomagnesemia.
- Most common side effect of immunosuppressive drugs: Cyclosporine and tacrolimus (Htn, diabetes, neurotoxicity, and renal failure), glucocorticoids (hyperglycemia, weight gain, osteoporosis, and adrenal insufficiency), and azathioprine (anemia and thrombocytopenia).

### Monitoring

- Routine.
- Consider arterial line placement if hypoxic, acidotic, or $O_2$ saturation is inadequate: invasive monitoring must be carefully weighed against the possibility of infection from intravascular catheters.
- TEE or other continuous CO monitoring systems may be helpful in assessing cardiac function in post heart-lung transplant pts, and when there is evidence of pulm edema and pulm Htn.
- CVP insertion recommended (when necessary) on side of native lung (one-lung transplant).

### Airway

- ETT cuff placement should avoid tracheal anastomosis.
- Oral intubation is preferred over nasal intubation (due to infection and thrombocytopenia).
- Anticipate difficult intubation if on chronic corticosteroids due to Cushingoid (moon face) features and limited atlanto-occipital joint mobility.
- Use aseptic tracheal suction technique.

### Induction

- Short-acting agents preferred; adjust doses to pt status and to avoid prolonged CV depression.

### Maintenance

- Avoid fluid overload; renal dysfunction due to immunosuppressants and disruption of lymphatic drainage in posttransplant pts can lead to pulm edema with fluid overload.
- Significant reductions of cyclosporine or tacrolimus blood levels can be caused by dilution with IV fluids.
- Adjust neuromuscular blocking dosage due to interactions with immunosuppressive agents and adjust dosage if renal impairment. (Cyclosporine enhances the effect of muscle relaxants producing a prolonged block.)
- NSAIDs can cause further renal toxicity in addition to immunosuppressants.
- Prevent additional mechanical obstruction (ventilator-induced disease and excessive tidal volumes) and employ ventilator with capability for variable inspiratory and expiratory ratios.
- Lateral decubitus position may aggravate V/Q mismatch.
- Hyperventilation during mechanical ventilation should be avoided because seizure threshold in pts taking immunosuppressive agents may be lowered.
- Use shorter-acting agents to avoid prolonged CNS, CV, and resp depression to facilitate a swift recovery of functions and timely extubation.

### Extubation

- Delay until adequate ventilation is assured (sustained tetanus on monitoring).
- The lack of cough reflex below the tracheal anastomosis makes pts unable to clear secretions, unless they are awake, increasing the risk of silent aspiration.

### Adjuvants

- Consider regional technique because it allows opioid sparing, but dense intercostal blockade can delay extubation in pts with poor respiratory reserve.

### Postoperative Period

- Monitor for and aggressively treat resp depression, infection, and fluid overload.

## Anticipated Problems/Concerns

- Many pts with resting hypoxia and marginal compensated lung functions come to OR for diagnostic lung biopsy. A thoracoscopic technique may be impossible owing to adhesions post heart/lung transplantation or pt's inability to tolerate one-lung ventilation.
- Anticipate further perioperative resp decompensation after open-lung biopsy.
- Arrange postop disposition (monitored bed and ventilator support) depending on preop functional status and the potential for periop complications.

## Acknowledgment

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# Bronchitis, Chronic

C. William Hanson III

## Risk

- Incidence in USA: 14 million
- Race with highest prevalence: Caucasian
- M:F ratio 1:2
- Smoking, second-hand smoke, occupational exposure to pulm toxic substances (radon, coal, silicates, and asbestos)

## Perioperative Risks

- Bronchospasm

## Worry About

- Airway stimulation at light levels of anesthesia
- Laryngospasm (due to secretions and hyperreactivity)
- Hypoxia
- Hypercarbia

## Overview

- Chronic productive cough with periodic exacerbations (most d for at least 3 mo and for at least 2 consecutive y)
- Enlargement of the mucus-secreting glands in the airways with excessive sputum production
- Obstruction of expiratory airways
- Derangement in V/Q relationships
- Chronic hypoxia with right heart failure
- Exacerbations with intercurrent bacterial or viral infections

## Etiology

- Acquired, usually due to smoking
- May also be due to asthma or frequent childhood resp infections

## Usual Treatment

- Avoidance of environmental irritants such as cigarette smoke (preferably >8–10 wk before elective surgery)
- Antibiotics for acute exacerbations; inefficacious for prophylactic treatment
- Oral glucocorticoids: appropriate for acute exacerbations but not for maintenance therapy
- Periop stress dose glucocorticoid (methylprednisolone, dexamethasone, and hydrocortisone) administration: may be appropriate in pts on prolonged (>3 wk) high dose (≥20 mg prednisone per day) oral steroids
- Short-acting bronchodilators, such as beta agonists or anticholinergics, for acute exacerbations and long-acting beta agonist bronchodilators plus inhaled steroids for long-term maintenance therapy; pts on inhalers may be treated with preintubation inhalation of a beta agonist

## Assessment Points

| System | Effect | Assessment by Hx | PE | Test |
|---|---|---|---|---|
| HEENT | Short, fat neck | | | |
| CV | Right heart failure | Exercise tolerance | RV heave<br>Dependent edema | ECG<br>ECHO |
| | Pulm Htn | | | PA catheter |
| RESP | Airways obstruction | Smoking Hx (current, recent, emote)<br>Number and severity of recent exacerbations | Cyanosis | PFT, DLCO, ABGs |
| MS | | | Clubbing of fingers | |

**Key References:** Kim V, Criner GJ: Chronic bronchitis and chronic obstructive pulmonary disease, *Am J Respir Crit Care Med* 187: 228–237, 2013; Yamakage M, Iwasaki S, Namiki A: Guideline-oriented perioperative management of patients with bronchial asthma and chronic obstructive pulmonary disease, *J Anesth* 22:412–428, 2008.

### Perioperative Implications

**Preoperative Preparation**
- Smoking cessation
- Antibiotics to decrease sputum production
- Resp conditioning

**Monitoring**
- Consider arterial line to monitor blood gases
- Consider pulm artery catheter for large fluid-shift operations

**Airway**
- Often, truncal obesity (especially with corticosteroids); may have redundant soft tissue in airway or a short, fat neck

**Preinduction/Induction**
- Avoid stimulating the airway while pt is in light levels of anesthesia because it may precipitate bronchospasm (although less likely than with asthma).
- Regional anesthesia may be preferable.

**Maintenance**
- Frequent suctioning of ETT
- Limit narcotic administration (danger of periop $CO_2$ retention)
- Adjuvant regional anesthesia for postop pain management in procedures that affect resp mechanics (e.g., intercostal nerve blocks, epidural analgesia)

**Extubation**
- Administer intratracheal bronchodilator in responsive pts before extubation.
- Consider IV lidocaine before extubation.

### Anticipated Problems/Concerns
- Postop resp complications (secretions, mucus plugging, atelectasis, pneumonia, and prolonged requirement for mechanical ventilation)

# Bronchopulmonary Dysplasia

Marissa G. Vadi | Ryan E. Lauer

### Risk
- Incidence in USA: 10,000-15,000 infants annually
- Risk increases with decreasing gestational age and birth weight
- Affects at least one-quarter of infants with birth weights <1500 g
- No race or gender predilection

### Perioperative Risks
- Bronchospasm
- Pulm Htn
- Cor pulmonale

### Worry About
- Airway obstruction and hyperreactivity
- Pulm Htn and cor pulmonale
- "BPD spells": Acute cyanotic events caused by increases in central airway resistance
- Tracheomalacia and/or bronchomalacia
- Recurrent pulm infections

### Overview
- Chronic lung disease associated with premature birth and positive pressure mechanical ventilation, the clinical definition of which has evolved over time
  - "Classic BPD": Associated with characteristic radiographic changes and four stages of lung injury: exudative → necrosis → pulm fibrosis → severe cystic changes, and cor pulmonale
  - "New BPD": Seen after introduction of surfactant therapy, antenatal steroid administration, and improved neonatal ventilator strategies; mild respiratory distress syndrome and continued need for supplemental oxygen; and lung development is uniformly arrested, with simplified alveolar structures and dysmorphic capillaries
- Disease severity (mild, moderate, or severe) determined by the gestational age of the infant, oxygen dependency at 36 wk postconceptual age, total duration of oxygen supplementation, and positive pressure requirements
- Chronic airway obstruction and hyperreactivity present in long-term survivors
- High risk of periop morbidity if pulm Htn present

### Etiology
- Multifactorial; arrest of pulm development ± inflammation
- Major risk factors: premature birth, respiratory failure, oxygen supplementation, and mechanical ventilation
- Impaired angiogenesis, which reduces alveolar-capillary gas exchange, leading to hypoxemia and increased PVR

### Usual Treatment
- Supplemental oxygen
- Inhaled bronchodilators (e.g., β-agonists)
- Pulm vasodilator therapies (e.g., sildenafil, calcium channel blockers, bosentan) if pulm Htn present

### Assessment Points

| System | Effect | Assessment by Hx | PE | Test |
|---|---|---|---|---|
| HEENT | Possible tracheomalacia | SOB<br>Stridor | Retractions<br>Audible stridor | Bronchoscopy for severe cases |
| CV | PulmHtn<br>Cor pulmonale | Exertional dyspnea<br>Syncope<br>Cyanosis, esp. during feeds<br>Supplemental $O_2$ dependence | Hypoxia<br>Cyanosis ± clubbing<br>Rales<br>Peripheral edema<br>Elevated JVP | ECG<br>ECHO<br>Cardiac cath |
| RESP | Possible bronchomalacia<br>Decreased tidal volumes<br>Increased airway resistance<br>Decreased dynamic lung compliance<br>Hypoxia<br>Hypercapnia | SOB<br>Cyanotic spells<br>Supplemental $O_2$ dependence<br>Asthmalike symptoms<br>Recurrent respiratory infections | Tachypnea<br>Retractions<br>Cyanosis ± clubbing<br>Expiratory wheezing<br>Rales | CXR<br>ABG |
| GI | Failure to thrive | Poor feeding | Low BMI | Generally not needed |

**Key References:** Jensen EA, Schmidt B: Epidemiology of bronchopulmonary dysplasia, *Birth Defects Res A Clin Mol Teratol* 100(3):145–157, 2014; Lauer R, Vadi M, Mason L: Anaesthetic management of the child with co-existing pulmonary disease, *Br J Anaesth* 109(21):i47–i59, 2012.

### Perioperative Implications

**Preoperative Preparation**
- Determine room-air oxygen saturation and baseline supplemental oxygen requirements.
- Obtain electrolytes (if pt receiving chronic diuretic therapy); ABG (if oxygen requirements recently increased); and ECHO (if clinical markers concerning for pulm Htn).
- Avoid general anesthesia for elective procedures during acute respiratory infection.
- Avoid spinal anesthesia in patients with severe pulm Htn; decreased venous return and bradycardia may precipitate right heart failure.
- Consider preoperative nebulized $\beta_2$ agonist and/or steroid administration.
- Administer premedication cautiously in pts with pulm Htn.

**Monitoring**
- Standard ASA monitors.
  - Monitor pulse oxygen saturation, end-tidal carbon dioxide, and body temperature closely. Abnormalities may worsen pulm Htn.
- Consider arterial cannulation for invasive blood pressure monitoring and central venous line placement for inotrope administration in pts with pulm Htn.