Pulmonary Hemorrhage – Massive Hemoptysis

Emergency situation often requiring immediate resuscitation & diagnosis with potential for complete upper or lower airway obstruction and asphyxiation with refractory hypoxemia.

ANESTHETIC CONSIDERATIONS:

- Emergency situation
- Potential for life threatening refractory hypoxemia and ventilatory failure due to alveolar flooding and severe V/Q mismatch
- Potential for hemodynamic collapse secondary to hemorrhage
- Absolute indication for lung isolation
    - Double lumen tube
    - Bronchial blocker
    - Endobronchial intubation
- Considerations of underlying disease and etiology
    - TB
    - Bronchiectasis (CF, end stage COPD)
    - Vasculitis/inflammatory
    - Cancer

ANESTHETIC GOALS:

1. Optimize V/Q matching
    a. If lung isolation not yet achieved:
        i. 'bad lung' down
    b. If lung isolation is achieved:
        i. 'bad lung' up
2. Early lung isolation and prevention of contralateral lung contamination
3. Correct any coagulation defects
4. Maintain hemodynamic stability

HISTORY

- AMPLE history if emergency
- Diagnosis, onset, progression and treatment
- Which side is involved
- What is the etiology? (DDx for hemoptysis):
    - Extra-pulmonary (GI / nasopharyngeal)
    - Airway
        - Neoplasia
        - Inflammation / infection
        - Trauma / foreign body
    - Parenchymal disease
        - Infectious (TB, bronchiectasis, aspergillosis)
        - Inflammatory/vasculitis (Goodpastures, Wegeners, PAN, SLE etc)
        - Coagulopathy (Pre-existing?)
        - Drugs (crack cocaine, NF, amiodarone)
    - Pulmonary Vascular Disease
        - PE
        - Pulmonary AVM
        - Increased PCWP (LV failure, Mitral Stenosis)
        - PAC
    - NOTE that the three most common causes for massive hemoptysis are **TB, bronchiectasis and neoplasia**
- History of co-morbidities (liver failure)
- Recent invasive procedures (bronchoscopy, biopsy)
- Amount of bleeding and resuscitation
- Routine anesthetic history

PHYSICAL

- **GENERAL** – Overall assessment and vital signs
- **HEENT** - Airway exam
- **RESP** - Evidence of airway obstruction, strong cough & ability to protect airway, bilateral breath sounds
- **CVS** - Volume status and IV sites

INVESTIGATIONS

- **Labs**
    - CBC, **PTT / INR**, **ABG & crossmatch**
    - Electrolytes, BUN and Cr
- **Imaging**
    - CXR, CT to localize
    - EKG - Evidence of pulmonary HTN
- **Special**
    - Old PFTs if available
    - Thoracic surgery consult if not already immediately involved
        - Bronchoscopy - rigid if bleeding now (better suction and clot removal), flexible if not bleeding now

- Radiology for possible embolization if the patient won't tolerate surgery, the lesion is not resectable, or the patient has CF (may preserve more lung tissue in a diffuse disease)
    - Embolization may not be an option if the bronchial system shows collaterals to the spine
- Also, consider respirology consult

OPTIMIZATION

- Avoid sedation
- Consider early bronchial artery embolization in patients who are not surgical candidates
    - Contraindications to surgery include inoperable carcinoma of the lung, an inability to localize the bleeding site, and the presence of severe bilateral pulmonary disease and systemic disease (debilitation)
- Ensure hemodynamics and oxygenation optimized:
    - Patient sitting or in semi-Fowlers with 100% O_2 by FM
        - Consider placing patient with bleeding lung in dependent position (if tolerated)
    - Intermittent PPV and vigorous suction
    - Coughing may worsen bleeding but be life-saving in non-intubated patient therefore avoid suppression until intubated and suctioning can take over
    - Consider early lung separation with DLT, endobronchial SLT, bronchial blocker
- Ensure plan with surgeon discussed
- Correct coagulopathy if present
- Antibiotics if indicated & anti-TB medications in patients with TB

ANESTHETIC OPTIONS

- General anesthesia before or after bronchoscopy
- May require AFOI vs. awake laryngoscopy + intubation
- Need for cricoid pressure if RSI performed

ANESTHETIC SETUP

- **Drugs**
    - Blood products immediately available (pRBCs, platelets, FFP)
    - Vasopressors / vasoconstrictors (ephedrine, epinephrine & phenylephrine) and other emergency drugs
    - Consider ketamine for induction of hemodynamically unstable patient
- **Equipment**
    - Airway:
        - Two suctions tested and ready
        - Difficult airway cart including tube exchangers and FOB
        - Selection of small uncut SLTs, DLTs & bronchial blockers
            - Advantages of DLT- separation of two lungs, improves surgical exposure, can add CPAP to bleeding lung, inflation of the operative lung to aid with surgery
            - Disadvantages of the DLT- difficult placement in a bloody trachea of an hypoxic patient, may not be able to ventilate patient with OLV if soiling has occurred
        - Thoracic surgeon and rigid bronchoscope in OR
        - Jet ventilator available
    - Monitors:
        - Usual CAS monitors + art line + CVC (but don't delay case)
        - Several large bore IVs (14g or 6-7F), fluid warmers and level 1 infuser
        - Foley catheter
        - If PAC in-situ and likely cause of injury then keep inflated
    - Special:
        - Cold saline, saline with EPI
        - Fogarty catheter with balloon tip (blocker)

MANAGEMENT OF ANESTHESIA

- **Induction**
    - Initially, place bleeding lung in dependent position and then move to non-dependent once lung isolation achieved
    - Will depend on state of patient – two scenarios (see also Management Algorithm from Miller below):
        - Acute airway obstruction or treatable cause → rigid bronchoscope
            - Topical iced saline and vasoconstrictors can be administered through the bronchoscope to control bleeding, provided bleeding is not so massive that visualization not possible
            - May insert bronchial blocker in main bronchus of bleeding lung
            - Gauze packing
            - Nd:YAG laser or spraying of fibrin precursors
        - Massive hemoptysis that likely not treatable with rigid bronchoscope (e.g. PA rupture) → rapid lung isolation
    - Consider AFOI or just awake intubation during massive active bleeding to prevent the hazard of obstructed laryngoscopy in a paralyzed patient
        - Topicalization and direct laryngoscopy
        - Fibreoptic bronchoscope
        - Intubation in the semi-upright position may minimize coughing from presence of blood in the upper airway and provide a clearer field of vision
        - Ability to jet ventilate
    - If the patient is to be anesthetized, aspiration prophylaxis must be used:
        - RSI with cricoid pressure
        - Use small dose of short acting barbiturate or ketamine or etomidate (may be hypovolemic) followed in rapid sequence by relaxation (SCh / rocuronium / mivacurium)

        - Insertion of a DLT is preferable to insertion of a SLT / univent / blocker (soiled lung is strong indication for lung separation as it will empty when placed in non-dependent position)
- **Maintenance**
    - Maintain lung isolation
    - Consider CPAP to non-dependent lung
    - TIVA vs. volatile + intermittent SCh
    - Maintain paralysis
- **Emergence**
    - Delayed
    - ETT should be left in place and patient should be mechanically ventilated
        - Likely to have impaired gas exchange (preoperative lung disease, soiling of non-bleeding lung & physiologic consequence of GA / surgery)

DISPOSITION & MONITORING

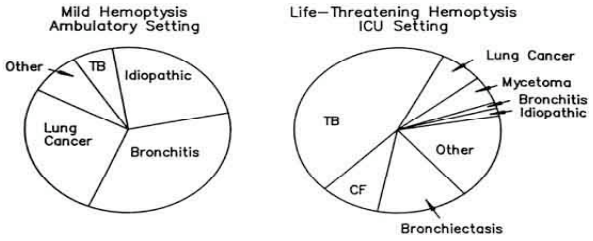
- ICU
- Transition to SLT over tube exchanger when stable

COMPLICATIONS

- Refractory hypoxemia
- High airway pressures:
    - Etiology
        - Massive airway clot
        - Tension pneumothorax
        - Patient fighting ventilator
    - Treatment
        - Increase FiO_2 to 100%
        - Switch to manual ventilation, assess compliance with and without connection to ETT
        - Auscultate chest (endobronchial ETT, bronchospasm, edema & pneumothorax)
        - Exclude obstruction
    - Pass suction catheter with cuff inflated and deflated
    - Consider bronchoscope to assess DLT or bronchial blocker position
    - If blood clots problematic consider conversion to rigid bronchoscopy to facilitate suctioning
        - Assess surgical field

PATHOPHYSIOLOGY

- Massive hemoptysis is the expectoration of 200-600mL over 24-48 hrs (>250mLs in a single event)
- May be more clinically relevant to define as hemoptysis leading to potential airway obstruction / asphyxia or severe enough to require blood transfusion or compromise organ perfusion



- Causes:
    - Infectious (90%): Tuberculosis, bronchiectasis, abscess & pneumonia
    - Neoplasm: Bronchogenic Ca, metastasis & mediastinal tumors
    - Pulmonary: Infarction, AVM, PAC complications
    - CVS: Pulmonary hypertension, mitral stenosis
    - Vascular: SLE, Vasculitis, Goodpastures & Wegeners → treat with steroids, plasmapheresis
    - Miscellaneous: Coagulopathy, trauma, post-op thoracic surgery & CF
- Management:
    - Stable vs unstable
    - If stable: consider medical therapy (inhaled epinephrine and vasoconstrictor therapy), therapeutic bronchoscopy with selective intubation/lung isolation
    - If unstable:
        - Resuscitate according to ABCs
        - Intubation (preferably with lung isolation)
        - Ventilation with 100% FiO2
        - Volume challenge
        - Trauma Labs and X match
        - Proceed for emergency (rigid or flexible) bronchoscopy
            - NdYAG laser, fibrin seal, iced saline, epi saline lavage, balloon catheter tamponade
            - Consider angiographic embolization
            - Consider surgical management

REFERENCES

- Miller 6th Edition – Chapter 49 – Emergency Thoracic Procedures – p1923
- Gaba, DM et al. – Crisis Management in Anesthesiology – Massive Hemoptysis – p135