Mediastinal Masses

Mass in the mediastinum (usually the anterior compartment) with the potential to compress vital structures, including tracheobronchial tree, great vessels and the heart

ANESTHETIC CONSIDERATIONS:

- Mass effects:
  - Potential for **catastrophic cardiopulmonary collapse** on induction & inability to ventilate
    - May require pre-induction CPB setup
  - Potential for **airway compression** (upper & lower)
  - Potential for **cardiovascular compression** (SVC, PA, RV)
    - Potential **difficult airway** (SVC edema)
- Co-Morbid / underlying disease:
  - Myasthenia gravis, paraneoplastic syndromes (Eaton-Lambert, hypercalcemia, Cushing's, etc.)
  - Tumor → 4 Ms (mass, metastasis, metabolic, medications)

ANESTHETIC GOALS:

1. Maintain airway patency
   - **Spontaneous ventilation** until ETT past obstruction
   - Awake FOI with **armored** ETT
   - +/- gentle PPV
   - **Assisted expiration** may be lifesaving in near complete obstruction
2. Maintain hemodynamics
   - **Maintain preload** and contractility
   - Careful positioning → may need to alter position to lateral decubitus or prone if cardiovascular collapse
   - Avoid muscle relaxants

HISTORY

- In addition to standard anesthetic history ask about functional capacity, chest pain, SOB, cough, stridor, hemoptysis
- **Assess degree of compression**:
  - Airway compression (high risk of respiratory complications if > 50%) [Bechard]
  - Positional dyspnea or cough
  - Stridor or hoarseness (laryngeal edema or RLN involvement)
- **SVC syndrome:**
  - H/A, change in LOC, swelling and plethora of face, neck and arms
  - Dyspnea
  - Majority are malignant in right paratracheal space or pulmonary hilum
- **RVOT obstruction:**
  - Syncope (worse with Valsalva), positional dyspnea, elevated JVP, hepatosplenomegaly
  - Exacerbated by hypovolemia, reduced contractility and positioning
- **Co-existing disease:**
  - **Myasthenia gravis** (weakness, respiratory or bulbar symptoms, diplopia, natural Hx, treatment)
    - Remember the 4 clinical predictors of increased risk of post-op ventilation after sternotomy
      - Pyridostigmine use in excess of 750 mg/day
      - Vital capacity < 40cc/kg (2.9L)
      - Presence of COPD or chronic lung disease
      - Duration > 6 years
  - **Eaton-Lambert** or myasthenic syndrome (proximal muscle weakness improves with exercise)
  - **Paraneoplastic syndromes** (e.g. see Table below for those associated with thymoma)
    - Most clinically important for thymoma: myasthenia gravis, pure red cell aplasia, and hypogammaglobulinemia (50% incidence)
    - Hyperparathyroidism (adenoma)
    - Hyperthyroidism (goiter)
  - Differential diagnosis of mediastinal mass (see also Table below)
    - Adults (anterior mediastinum)
      - Thymoma
      - Teratoma / GCT (Giant Cell Tumor)
      - Thyroid / Parathyroid tumors
      - T-cell lymphomas
    - Children (posterior mediastinum)
      - Generally neurogenic tumors (e.g. neuroblastomas)
    - Adolescents → lymphomas

Table - Differential Diagnosis of Mediastinal Masses According to Location

Anterior Compartment	Middle Compartment	Posterior Compartment
Thymoma and benign thymic disorders	Germ cell tumors	Neurogenic tumors

Germ cell tumors	Teratoma	Lymphoma
Teratoma	Teratocarcinoma	Non-Hodgkin's lymphoma
Teratocarcinoma	Seminoma	Hiatal hernia
Seminoma	Lymphoma	Meningocele
Thyroid gland and thyroid tumors	Hodgkin's disease	Mediastinal cysts
Lymphoma	Non-Hodgkin's lymphoma	Bronchogenic
Hodgkin's disease	Mediastinal cysts	Enteric
Non-Hodgkin's lymphoma	Bronchogenic	Thoracic duct
Lipoma	Pericardial	Esophageal cancer and diverticula
Soft-tissue tumors	Enteric	Aortic aneurysms and AVMs
Benign tumors	Hiatal hernia	Soft tissue tumors
Sarcomas	Granulomatous diseases	Benign tumors
Pericardial cysts	Aneurysms and AVMs	Sarcomas
LNs enlarged by benign conditions	Lipoma	
Parathyroid tumors		

Paraneoplastic Syndromes Associated with Thymoma†

Autoimmune
- Systemic lupus erythematosus
- Polymyositis
- Myocarditis
- Sjogren's syndrome
- Ulcerative colitis
- Hashimoto's thyroiditis
- Rheumatoid arthritis
- Sarcoidosis
- Scleroderma

Endocrine disorders
- Addison's disease
- Hyperthyroidism
- Hyperparathyroidism
- Panhypopituitarism

Hematologic disorders
- Red cell aplasia
- Hypogammaglobulinemia
- T-cell dificiency syndrome
- Pancytopenia
- Erythrocytosis
- Megakaryocytopenia

Neuromuscular syndromes
- Myasthenia gravis
- Eaton Lambert syndrome
- Myotonic dystrophy
- Myositis

Miscellaneous
- Hypertrophic pulmonary osteoarthropathy
- Nephrotic syndrome
- Minimal change nephropathy
- Pemphigus
- Chronic mucocutaneous candidiasis

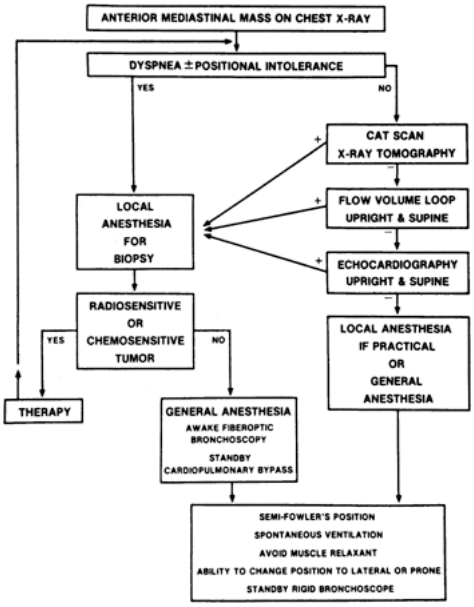
† From Cameron, RB, et al. Neoplasms of the Mediastinum. In: Principles and Practice of Oncology 6th ed (DeVita, Hellman, Rosenberg, Eds); 2000. p 1024.

PHYSICAL

- **VITALS**
- **AIR**: careful airway exam (edema from SVC syndrome)
- **HEENT**: facial plethora / edema, dilated upper extremity veins, JVD
- **CVS**: postural BP, syncope with Valsalva (ominous sign), quiet heart sounds and JVD (pericardial effusion), pulsus paradoxus, hTN (compression of PA or heart)
- **RESP**: palpation of trachea, wheeze, stridor, localized decreased air entry
- **MSK**: assessment of muscle strength with repeated contractions
- **CNS**: swallowing, compression of RLN, parasthesias

INVESTIGATIONS

- **Labs**
  - CBC (polycythemia, lymphoma), lytes, BUN, Cr
  - Ca^{++}, PTH, TSH
  - ABG – hypoxia? hypercarbia?
- **Imaging**
  - **ECG** – Assess signs of strain and failure
  - **CXR**
    - PA and lateral (ID's 97% of mediastinal tumors)
    - Broadly outlines mass, elicits lung parenchymal collapse
  - **CT chest**
    - **Imperative for delineation of tissue and airway involvement****
    - CT tracheal airway reduction >50% predicts perioperative airway obstruction
  - **ECHO –** Outlines cardiac performance and extent of PA involvement and cardiac compression
  - **MRI** – May distinguish soft tissues from vascular structures better than CT
- **Special**
  - **PFTs / Flow-Volume Loops**
    - Does not predict airway morbidity
    - Classically has variable intrathoracic obstruction with flattening of expiratory loop on spirogram
    - Majority of cases have spirogram consistent with fixed lesions or predominantly inspiratory impairment
  - **Tissue diagnosis** – Will dictate effectiveness of radio / chemo / steroids
  - **Consults** – Thoracic surgery, respiratory medicine, neurology



OPTIMIZATION

- Does this patient require a general anesthetic?
  - Alternatives to diagnosis → consider lymph node biopsy with **local anesthetic**

- Could this patient be optimized prior to GA?
    - Steroids, radiotherapy or chemo to shrink tumor prior to tissue diagnosis (**Conflict** due to patients often requiring tissue Dx prior to Tx & rendering tissue Dx non-diagnostic)
    - Premedication best limited to antisialogogue
- Airway obstruction → airway stenting, Heliox
- Hemodynamic instability → **volume loading** prior to GA to maintain preload
- **SVC syndrome**
    - Consider placing a **stent pre-operatively**, this can be done transcutaneously
    - Bleeding from both venous and arterial sites can be a major concern, so have blood in the OR
- Some authors recommend **pre-induction bronchodilation**

ANESTHETIC OPTIONS

- Local anesthetic for biopsy
- GA
    - Consider CBP standby

ANESTHETIC SETUP

- **Drugs**
    - Heliox?
    - Resuscitation drugs including pre-mixed inotrope infusions if significant risk of cardiovascular collapse
- **Equipment**
    - 2 Large IVs (one in lower extremity if SVC syndrome)
    - Pre-induction radial artery line
        - Placing on the right (along with pulsox) may be useful to help elucidate inominate artery collapse due to mass or mediastinoscope
    - If PAC is indicated, place femorally
    - ECMO / CPB
        - If > 50% obstruction of the airway at the level of the lower trachea and main bronchi some authors recommend cannulating femorals for ECMO prior to induction
        - Patients with PA or heart compression may need cardiopulmonary bypass
        - Check availability prior to induction with cannulation sites prepped and draped
    - Airway
        - Armored ETT, multiple sizes
            - Long, uncut tubes may be just as effective as armored tubes, they tend to be longer (better a long tube that can be placed distal to the lesion)
        - Ensure variety of difficult airway equipment available (difficult airway cart)
        - Fibreoptic bronchoscope (3.7mm if DLT)
        - Rigid ventilating bronchoscope and proficient personnel in room prior to induction
        - Jet ventilator (+/- high frequency oscillator)
        - Heliox

MANAGEMENT OF ANESTHESIA

- **Induction**
    - If asymptomatic patient with no radiologic evidence of significant airway or cardiac compression → proceed with routine induction and intubation
    - Positioning
        - Airway compression? - Patient may need to be in Semi-Fowlers position
        - PA or heart compression? - Sitting, leaning forward, face down would be optimal
    - "Noli Pontes Ignii Consumere" Don't Burn Your Bridges
        - Consider avoiding GA by using local technique
        - Awake FOI with placement of tube distal to obstruction (if possible)
        - Maintain spontaneous ventilation until ETT distal to obstruction or throughout procedure with volatile
        - Ensure PPV does not lead to airway or cardiac obstruction by gently taking over PPV prior to administering muscle relaxants
            - **NOTE** that muscle relaxants can precipitate airway obstruction and cardiovascular collapse
    - **Resuscitation plan**
        - **Airway obstruction**
            - Inability to ventilate → re-institute spontaneous ventilation
            - Intubate distal to obstruction
            - Rigid bronchoscope
            - Dynamic hyperinflation from obstruction, consider assisted expiration by manual chest compression
        - **Cardiovascular collapse**
            - Volume resuscitation + inotropes
            - Re-position to lateral, prone or semi-erect
            - Wake up patient
            - CPB
- **Maintenance**
    - Allow to spontaneously ventilate through procedure with vapor +/- intravenous infusion
    - Avoid muscle relaxants
        - A patient who suddenly obstructs may need to be turned lateral or prone to relieve symptoms
        - Oxygen (100%) and isoflurane (1-1.5%) or sevoflurane (1.5-2.5%)
        - Avoid N_2O especially during OLV

        - Short-acting muscle relaxants and opioids are required
- **Emergence**
    - Aim for a very smooth emergence & extubation sequence because excessive coughing and straining can exacerbate airway obstruction and the symptoms of SVC syndrome
    - High risk of post-extubation airway obstruction d/t edema, tracheomalacia
        - **Extubation in OR**
        - **Be prepared to re-intubate**

DISPOSITION & MONITORING

- Monitor in HDU for several hours after extubation to detect and treat delayed airway obstruction
- Postoperative CXR looking for pneumothorax

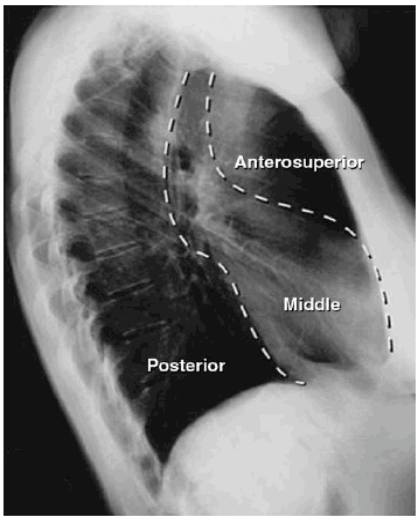
COMPLICATIONS

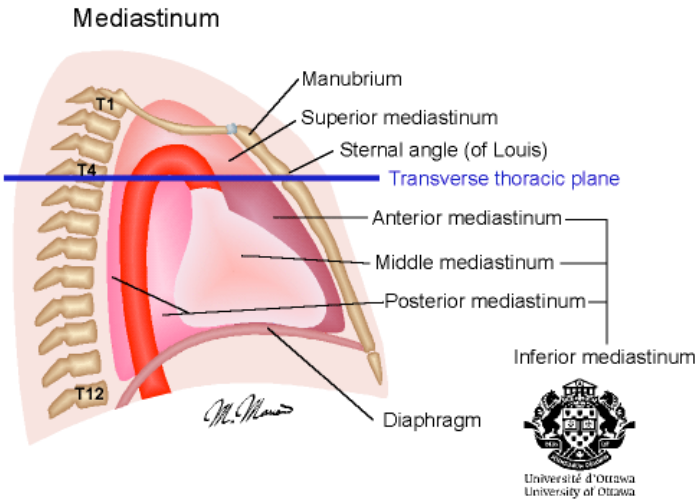
- Airway obstruction, hypotension, and hypoxia are major concerns
- Consider radiation and / or chemotherapy before GA
- If GA required, maintaining spontaneous ventilation preferable
- If GA required, consider inspection of tracheobronchial tree with FOB
- **Management of tracheobronchial tree obstruction:**
    - Awake FOI
    - Maintain spontaneous ventilation
    - Position change if required
    - Ability to intubate distal to the obstruction with long reinforced ETT
    - Availability of surgeon and rigid bronchoscope
    - Consider independent cannulation of each mainstem bronchus
    - Consider CPB standby
- **Management of SVC compression**
    - Elevate head of the bed
    - Consider diuretics and steroids
    - Lower extremity IV access
    - Immediate availability of cross-matched blood
- **Compression of the heart and pulmonary artery**
    - Maintain preload
    - Avoid negative inotropes
    - Ability to position to minimize compression (lateral or even prone)
    - CPB standby

PATHOPHYSIOLOGY (by Slinger in Hensley)

- **Anatomy**:

Area	Boundaries (A=anterior, I=inferior, etc)	Contents	Pathology
Mediastinum	**S:** thoracic inlet, **I:** diaphragm, **A:** sternum, **P:** vertebral column, **lat:** parietal pleura	As below	As below
Antero-superior mediastinum	**S:** thoracic inlet, **I:** diaphragm, **A:** sternum, **P:** vertebral column of first 4 vertebra, then boundary of great vessels, **lat:** parietal pleura	Thymus, occasionally parathyroids, lower trachea, arch of aorta, SVC, azygous vein, lymphatics	• Thymoma • Germ cell tumors • Lymph nodes (due to bronchogenic ca) • Teratoma • Seminoma • Thyroid tumors
Visceral or middle mediastinum	**S:** pericardial reflection, **I:** diaphragm, **A:** sternum, **P:** vertebral column, **lat:** parietal pleura	Heart, carina with mainstem bronchi, pulmonary hila, lymph nodes, lymphatics, upper esophagus	• Germ cell tumors • Teratoma • Lymphoma • Cystic hygroma • bronchogenic
Posterior mediastinum	Posterior to the heart (?)	Segmental nerve roots, intercostals, vagus nerve, sympathetic nerves, esophagus, descending aorta, azygous vein, thoracic duct	• neurogenic tumors • lymphoma • bronchogenic





- Epidemiology
  - 50% of lesions are asymptomatic & 10% of these prove to be malignant
  - Of the other 50% with symptoms, half are malignant (total 1/3 of all lesions are malignant)
- Presentation is of two varieties (besides incidentally on CXR)
  - **Compression** from the lesion
  - **Systemic effect** of the lesion (paraneoplastic syndromes, B-symptoms etc.)
- An area of great concern is the confluence of the middle, anterior and posterior mediastinum - Three devastating complications can arise from the mass at this level
  - **Tracheobronchial tree compression**
  - **Pulmonary artery and / or heart compression** – a rare complication because the pulmonary trunk is protected by the aortic arch.
  - **Superior vena cava syndrome** – 90% are malignant [bronchial Ca (87%), lymphoma (10%), other (3%)]. These lesions tend to be very radio-sensitive. Pathology of the right paratracheal space causes compression. Patients get venous distention, cerebral edema, RL nerve involvement
- **Mediastinoscopy** most commonly is done via a cervical approach with an incision in the suprasternal notch
  - Any structure in the upper chest can be injured during the procedure, including great vessels, pleura (pneumothorax), nerves (recurrent laryngeal), and airways
  - Hemorrhage is the most frequent major complication, particularly due to inadvertent inominate artery or PA biopsy
  - Significant hemorrhage during mediastinoscopy usually can be tamponaded temporarily by the surgeon when resuscitation is required
  - In only a minority of mediastinoscopy hemorrhages is it necessary to proceed to thoracotomy for surgical control of bleeding.
  - A frequent complication of cervical mediastinoscopy is transient compression of the brachiocephalic artery by the mediastinoscope
    - Monitor the circulation in the right arm (pulse oximetry or arterial line or palpation) so that the surgeon can be notified and avoid the risk of cerebral ischemia in patients who may not have good collateral cerebral circulation
- **Tracheomalacia**
  - Softening of tracheal cartilages caused by prolonged compression by thyroid and other tumors
  - Identified early by manual palpation by the surgeon, failure to pass a suction catheter through a withdrawn endotracheal tube in a spontaneously breathing patient, failure to demonstrate a peritubal leak after deflation of endotracheal tube cuff, or by fibreoptic bronchoscopy through a laryngeal mask airway or retracted endotracheal tube at the end of the case
  - Tracheomalacia usually resolves within 48 hours of surgery, and temporary re-intubation may be required during this period
  - Rarely, prolonged tracheal support using stents or cartilage grafts is needed
- **Tracheal and bronchial stenting**
  - Regional narrowing of the trachea or bronchi can be treated temporarily or definitively by placement of tracheal or bronchial stents
  - The only previous options for these lesions were dilation, laser excision, or surgical excision
  - Airway stenting is an option for palliation of patients with mediastinal masses pending other therapy
  - There are two major varieties of stent: metallic and Silastic (Dumon). Both are commonly placed during rigid bronchoscopy, although there is an option to place the self-expanding metallic stents with flexible FOB. The metallic stents are more stable and more resistant to dislocation in the airway but are more difficult (often impossible) to remove once placed.

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