ANTERIOR MEDIASTINAL MASS BIOPSY/RESECTION

Surgical Specialty:	General Surgery
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Background:

- General Considerations
  - Anterior mediastinal masses are a heterogeneous group of tumors of the lung, pleura, and mediastinum.[1]
  - Tumors may be primary or metastatic.
- Patient Considerations
  - Children may present with a spectrum of cardiorespiratory symptoms: dyspnea at rest or exertion, orthopnea, stridor, cough, chest pain, syncope, and upper body edema.
  - Respiratory decompensation is caused by mechanical compression of the trachea or main bronchi and is exacerbated by position changes or the induction of general anesthesia.
  - Hemodynamic compromise occurs if the heart or great vessels are surrounded or infiltrated by the mass.
  - Alteration in mental status occurs from sludging of blasts in the cerebral microvasculature in hyperleukocytosis (leukemia/lymphoma). The anesthesiologist may be called to assist with airway management for airway protection.
  - While caring for patients with an anterior mediastinal mass, the presence of any of the following findings necessitates additional precautions taken in the perioperative period due to an increased risk of anesthetic complications.[1-7]
    - Three or more symptoms of respiratory distress.
    - Upper body edema.
    - Inability to lie flat.
    - Orthopnea.
    - Tracheal involvement with cross-sectional area < 50%.
    - Mediastinal mass ratio > 0.45% indicating large tumor burden.
    - Great artery involvement.
    - Evidence of pericardial tamponade or ventricular dysfunction.
    - Evidence of pneumonia.
- Associated Comorbidities/Syndromes
  - Associated with Hodgkin's or non-Hodgkin's lymphoma, acute lymphoblastic leukemia, vascular malformations, neurogenic tumors, teratomas, and other germ cell tumors and cysts

Anesthetic Planning:

- Pre-Anesthetic Evaluation
    - Multidisciplinary planning that includes pediatric anesthesiology, pediatric surgery, pediatric cardiovascular surgery, pediatric otolaryngology, hematology/oncology, critical care, radiology, and perfusion is necessary to manage these patients perioperatively.
        - Location of procedure should be discussed: Interventional radiology vs. operating room (OR).
    - A thorough pre-anesthetic evaluation including identification and optimization of the patient's comorbidities should be performed.
        - The optimal rescue position that alleviates the patient's symptoms should be identified prior to sedation or induction of general anesthesia.
    - Assess the risk for airway collapse, respiratory compromise, or hemodynamic instability due to mass characteristics.
    - Discuss the risks/benefits/alternatives to proceeding with the patient and their parents.
        - Proceeding with general anesthesia in a patient with an anterior mediastinal mass can potentially lead to fatal respiratory and cardiovascular compromise.
        - Biopsy under local anesthesia or sedation should be strongly considered if airway or cardiovascular obstruction is likely. This is particularly challenging in the pediatric populations.
        - If a patient appears to be particularly high risk and is unable to complete procedure without general anesthesia, discuss with oncology the risks and benefits of proceeding with treatment without a tissue diagnosis.
    - Additional labs/tests may be indicated during the work-up
        - Complete blood count, electrolytes, uric acid, LDH, coagulation studies, B-HCG, alpha-fetoprotein, flow cytometry, type and screen, lumbar puncture, bone marrow biopsy, chest x-ray[7]
        - If an anterior mediastinal mass is suspected by history or if the chest x-ray shows a widened mediastinum, a computerized tomography scan should be obtained to evaluate the size and location of the mass and compression of the airway or cardiovascular structures.[7]
        - Transthoracic echocardiography may reveal pericardial effusions or compression of heart or great vessels.[7]
        - Pulmonary function tests (if feasible).[7]
    - Discussions to have with surgeon/family
        - Code status
        - Extracorporeal membrane oxygenation (ECMO) candidate determination
        - Need for possible postoperative invasive or noninvasive mechanical ventilation
        - Need for possible blood transfusion
    - Airway
        - Difficult airway equipment should be available including laryngeal mask airway, rigid bronchoscope, and tracheostomy equipment.
    - Drugs/Infusions
        - Corticosteroids/chemotherapy/chest radiation pretreatment[1,5]

- Can effectively shrink the tumor and reduce symptoms prior to biopsy or definitive surgery
- However, some patients may be at risk for tumor lysis syndrome.
- Requires discussion with oncology team prior to administration.

▪ Many options/combinations are available for maintenance of general anesthesia with spontaneous ventilation. Institutional practices may vary.
- Inhalational agents
- Dexmedetomidine
  - Bolus or infusion
- Ketamine
  - 0.5-1mg/kg boluses
- Propofol
  - 100-300 mcg/kg/min titrated to effect

o Monitors
▪ Standard American Society of Anesthesiologists monitors.
▪ Invasive monitoring including arterial line and central venous access.
o Large bore intravenous (IV) access
o Availability of blood products
o Pediatric Intensive Care Unit (PICU) bed availability
o Other Indicated Resources
▪ The availability of rigid bronchoscopy may be lifesaving in the event of airway compromise.
▪ Preemptive ECMO or rescue ECMO may be indicated in high-risk patients or severe deterioration.
- Preemptive ECMO (access prior to induction) carries the challenge of placing ECMO cannulas in children without significant sedation or managing the risks of heavy sedation.
- Using ECMO as a rescue runs the risk of prolonged hypoxia occurring while the circuit is being established.
- Discussion about the site of outflow cannulation if the great vessels are compromised.
- Availability of necessary equipment (i.e., ECMO circuit, perfusionist)

▪ Transesophageal echocardiography (if availability and expertise available)

Intraoperative Considerations:

- General
  - Have additional personnel in the OR in case of complications.
  - Local anesthesia vs general anesthesia
    - If high-risk, biopsy should be performed under local anesthesia if possible. This can be particularly challenging in the pediatric population.
- Induction
  - Inhalational vs. slow IV induction
    - Use induction agents with minimal and favorable effects on hemodynamics (i.e., etomidate, ketamine).
  - If intubation is planned, the anesthesiologist should position the endotracheal tube (ETT) distal to the level of obstruction.
    - Consider using a reinforced ETT or microlayrngoscopy tube (MLT) which is in essence a pediatric-sized standard ETT with an adult length.
  - Possible need for awake fiberoptic intubation
  - Standby rigid bronchoscopy and cardiopulmonary bypass

        - If the patient has >50% tracheal compression, contact the ENT or general surgeon to be present in the OR with rigid bronchoscopy equipment.[3,5]
        - If patient has ejection fraction <35% or pericardial effusion, contact ECMO team.
    - Maintain spontaneous ventilation
    - Avoid positive pressure ventilation and muscle relaxants, if possible.[7]
- Positioning
    - Maintain the patient's position of comfort that provides reliable and consistent gas exchange when lying down (nocturnal sleep position).
        - Keeping the head of the bead elevated may decrease the deleterious effects of supine positioning.
        - Placing the child in partial or full left lateral position may help to maintain airway patency and reduce cardiovascular or tracheal compression.
        - Prone positioning may be needed.
- Maintenance
    - Continuous monitoring of airway patency
    - Volatile agents vs. total intravenous anesthesia vs. combination
- Hemodynamic/Physiologic goals
        - If there is impending respiratory collapse, intubate past the obstruction or maintain patent airway with a rigid bronchoscope.
        - Optimize fluid status with crystalloids or colloids.
        - Availability of inotropes/vasopressors as necessary.
        - Initiate ECMO if there impending cardiovascular collapse.
- Surgical Considerations (such as neuromonitoring, muscle relaxation, anticipated blood loss)
    - Need for towel clips, sternal elevators, and similar devices in case of tracheal or bronchial collapse to lift the sternum and restore patency of the airway.
    - If the mass invades or compresses intrathoracic vascular structures (i.e., superior vena cava obstruction), consider large IV cannulation in the lower extremities to avoid complications related to obstruction of flow from mass effect or surgical resection.[7]
    - Nerves essential to respiration, such as recurrent laryngeal and phrenic nerves, may be involved in the mass and may require resection.
        - May be appropriate to consider elective postoperative invasive mechanical ventilation.
- Emergence/Disposition
    - Awake extubation
        - Elevated risk of glottic edema/post-op stridor: Patients should be extubated fully awake, obeying commands, and after complete recovery of airway reflexes.
    - Place patient in optimal position for extubation and recovery.
    - Admission to PICU for close respiratory and cardiac monitoring.
- Post-op Care
    - Emergency complications
        - Monitoring for hemorrhage at the surgical site, evidence of airway compromise, or hemodynamic instability.
    - Pain management
        - Regional techniques vs. IV/oral pain medication

Case Specific Complications/Pitfalls

- Complete airway obstruction
    - Can occur at any point during the case.
    - Urgently exclude tracheobronchial obstruction with bronchoscope.
    - If intubation distal to the obstruction is not possible, rigid bronchoscopy with a skilled provider should be readily available.
- Cardiovascular collapse/inability to ventilate after induction
    - Can result in profound hypotension and hypoxia.
    - Be prepared to turn the patient lateral or prone to restore cardiac output.
    - Rigid bronchoscopy and tracheostomy available.
    - Cardiopulmonary bypass/ECMO
        - Consider electively establishing prior to induction for high-risk patient.
- Pericardial tamponade
    - Optimize fluid status to maintain preload: fluid resuscitation with isotonic fluids or colloids.
    - Maintain heart rate, systemic vascular resistance, and blood pressure with available vasoactive agents.
- Bleeding
    - Ensure type and crossed blood products are available prior to induction.
- Post-op stridor
    - Edema from surgical manipulation or anterior mediastinal mass itself can cause obstruction.
        - Steroid administration may help but should be discussed with oncology team prior to administration.
        - Racemic epinephrine may be given to decrease edema.
- Infection
    - Patients with an anterior mediastinal mass may be immunocompromised
    - Ensure appropriate perioperative antibiotics are given if necessary.

References

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