Anesthetic Considerations for Pediatric Patients with Anterior Mediastinal Masses (AMM)

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Disclosures

No relevant financial relationships to report
Learning Objectives:

• Identify anatomical and physiological perturbations that occur with mediastinal masses
• Identify perioperative complications likely to occur in these patients and discuss their management
• Discuss pre-operative testing used for anesthetic planning and risk stratification
• Present anesthesia techniques helpful for management of anterior mediastinal mass
Introduction

Perioperative complications are estimated to occur during 9% to 20% of anesthetic procedures.$^1,^2$

The differences between adult and pediatric populations relate to the **histology**, **location**, and **symptomatology** of the mediastinal masses.$^3$
Most masses in the pediatric population are found in the anterior compartment, which are associated with **increased** perioperative risks. 4-6
# Mediastinal Masses

<table>
<thead>
<tr>
<th>Anterior</th>
<th>Middle</th>
<th>Posterior</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Benign</strong></td>
<td><strong>Malignant</strong></td>
<td><strong>Benign</strong></td>
</tr>
<tr>
<td>*Thymoma</td>
<td>Thyroid carcinoma</td>
<td>*Lymphoma</td>
</tr>
<tr>
<td>Thyroid</td>
<td>Thyroid carcinoma</td>
<td>Esophageal Cancer</td>
</tr>
<tr>
<td>Cystic hygroma</td>
<td>Seminoma</td>
<td>Thyroid carcinoma</td>
</tr>
<tr>
<td>Thymic cyst</td>
<td>Mixed Germ Cell</td>
<td>Vascular structures</td>
</tr>
<tr>
<td>Thymic hyperplasia</td>
<td>Lymphoma</td>
<td>Hiatus hernia</td>
</tr>
<tr>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
Anterior Mediastinal Mass (AMM)

<table>
<thead>
<tr>
<th></th>
<th>Children (%)</th>
<th>Adults (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lymphomas</td>
<td>45</td>
<td>23</td>
</tr>
<tr>
<td>Germ cell tumors</td>
<td>24</td>
<td>14</td>
</tr>
<tr>
<td>Thymomas</td>
<td>16</td>
<td>47</td>
</tr>
<tr>
<td>Others</td>
<td>15</td>
<td>16</td>
</tr>
</tbody>
</table>

T-cell lymphoblastic leukemia, non-Hodgkin’s lymphoma, and neurogenic tumors have an increased incidence, as well as, increased risk of perioperative complications in children.\(^4,7,12\)
Physiology

Cardiopulmonary symptoms can be explained by compression of airway, cardiac, or major vessels by the mass.
Physiology

Hemodynamic compromise

Mass Compression

Superior Vena Cava

Right Cardiac Chambers

Pulmonary Arteries

Pulmonary Veins

Left Ventricular Preload

Cardiac Output
Physiology

Hypoxemia

Mass Compression

Superior Vena Cava

Right Cardiac Chambers

Pulmonary Arteries

Pulmonary Veins

Pulmonary Perfusion

RV Failure

Hypoxemia
Physiology

Hypoxemia

Mass Compression

Superior Vena Cava
Right Cardiac Chambers
Pulmonary Arteries
Pulmonary Veins

Cardiac Output

Pulmonary Edema

Hypoxemia
Physiology

Gravity

Worsening V/Q mismatch

Increased Intrathoracic Pressure

Airway Collapse

Supine position
# Signs and Symptoms

<table>
<thead>
<tr>
<th>Airway</th>
<th>Cardiovascular</th>
<th>Constitutional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shortness of breath</td>
<td>Cyanosis</td>
<td>Weight loss</td>
</tr>
<tr>
<td>Stridor</td>
<td>Syncope</td>
<td>Fever</td>
</tr>
<tr>
<td>Pleural effusion</td>
<td>Tachycardia</td>
<td>Night sweats</td>
</tr>
<tr>
<td>Accessory muscle use</td>
<td>SVC syndrome</td>
<td></td>
</tr>
<tr>
<td>Orthopnea</td>
<td>Upper body edema</td>
<td></td>
</tr>
<tr>
<td>Cough</td>
<td>Jugular venous distension</td>
<td></td>
</tr>
<tr>
<td>Dyspnea</td>
<td>arrhythmias</td>
<td></td>
</tr>
<tr>
<td>Hoarseness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hx of respiratory arrest</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Dependent on size, location, and the rate of growth**

- **Systemic effects of the tumor**
- **Thyroid function abnormalities**
- **Myasthenic Crisis**
Signs and Symptoms

As compared to adults, children experience more signs and symptoms

• AMM tend to be more central
• More likely to compress on the softer airway and vascular structures
• More likely to be malignant and grow/infiltrate at a faster rate
• Smaller intrathoracic volumes may not be able to accommodate the mass as easily
Pre-operative testing

I. Anatomic Testing

• Anterior-posterior and lateral chest X-rays
• CT scan
• MRI
• Positron Emission tomography
• Angiography
• Echocardiography
Pre-operative testing

II. Physiologic Testing

- Complete blood count, electrolytes
- Pulmonary function tests
- Transthoracic echocardiography (ECHO)
- Thyroid scan
Pre-operative testing

III. Tumor markers

• Uric acid, LDH, β-HCG, α-fetoprotein, thyroid function test
• Flow cytometry
• Lumbar puncture
• Bone marrow aspirate and biopsy
Computed tomography Scan

It is imperative that patients undergo a CT scan to further delineate the exact location of the mass, as well as the degree of airway and cardiovascular structure compression.
Transthoracic echocardiography

ECHO done in the **supine position** will evaluate cardiovascular compression, reduction of pulmonary blood flow, cardiac output, and pericardial tamponade physiology.
## Risk Stratification

<table>
<thead>
<tr>
<th></th>
<th>Low Risk</th>
<th>Intermediate Risk</th>
<th>High Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Signs</strong></td>
<td>No airway, cardiac, or vascular compression</td>
<td>Mild tracheal compression (&lt;70%)</td>
<td>Tracheal compression (&gt;70%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No bronchial compression</td>
<td>Bronchial compression</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Great vessel compression</td>
<td>Great vessel compression</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tamponade physiology</td>
<td>Tamponade physiology</td>
</tr>
<tr>
<td><strong>Symptoms</strong></td>
<td>None</td>
<td>Mild to moderate Postural</td>
<td>Orthopnea Stridor Cyanosis</td>
</tr>
</tbody>
</table>
Anesthetic Management

Multidisciplinary team

Surgery

Oncology

Radiology

Critical Care

Anesthesiology

Consider referring to a high-level pediatric surgery center
Anesthesia Type

Local Anesthesia +/- Sedation

General Anesthesia

Procedures

Extrathoracic lymph node biopsy

Percutaneous needle aspiration of mass, pericardial fluid, or pleural fluid

Open biopsy or resection of the mass

Thoracoscopic biopsy of the mass
Undiagnosed mediastinal mass
Consult pediatrics, hematology/oncology, anesthesiology, PICU, radiation oncology, pediatric surgery

CBC, LP, bone marrow biopsy/aspiration
Chest X-ray, CT scan, ECHO

Airway or cardiovascular obstruction
Biopsy under local anesthesia
Tracheostomy, CPB available

No Airway or cardiovascular obstruction
Biopsy under local anesthesia NOT feasible

Biopsy under local anesthesia
Radiation therapy*

Biopsy
Local Anesthetic OR General Anesthesia

*If radiation therapy is NOT available, proceed with multidisciplinary operative plan
Anesthesia Techniques

- Volatile Agents
  - Ketamine
  - Dexmedetomidine
  - Propofol
- Positive pressure ventilation?
- Muscle relaxation?
Airway management

**Posture**
- Induce in sitting position
- Change supine position to lateral or prone

**Spontaneous Respiration**
- Inhalational induction
- Intravenous induction
- Awake fiberoptic intubation

**Airway Stenting**
- Long ETT
- Double-lumen ETT
- Rigid bronchoscope
- Insertion of tracheobronchial stents

**CPB**
- Commenced under local anesthesia before induction
- Vessels prepared under local anesthesia ➔ GA
It is prudent to place a large bore intravenous cannula in the lower body, preferably in the femoral vein, to facilitate transfusion if the SVC is breached surgically.
Intraoperative Considerations

- Large-bore IV X 2
  (SVC Syndrome: place in the lower limbs)
- Blood in OR
- Arterial line (left radial artery)
- +/- CVP/PA
Managing Intraoperative Complications

- Rescue position
- Rigid bronchoscopy
- Cardiopulmonary bypass
- Emergent sternotomy
Postoperative Considerations

Pain management

Parenteral opioids

+/- Epidural catheter

+/- Peripheral nerve block
Conclusion

Location  
Timing  
Type

Patient Safety

H&P  
CT Scan  
ECHO

Patient, Family

Multidisciplinary team

GA vs. Local +/- sedation
References:


References:


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