What Do You Mean It's Not the Heart?
Respiratory Causes of Respiratory Failure

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Disclosures

- No disclosures
Respiratory Management in the CVICU

- Goal - Early extubation

- Minimizes the need for postoperative sedation

- Eliminates the risk of ventilator-associated pneumonia

- Decreases ICU LOS

Respiratory Causes of Respiratory Failure

**Infectious Causes:**
- Respiratory tract infections
- PNA
- Tracheitis

**Mechanical Causes:**
- Diaphragm paralysis
- Vocal cord paralysis
- Tracheobronchomalacia
- Bronchial compression
- Barotrauma/Volumtrauma

**Noninfectious Causes:**
- Pleural Effusions
- Reactive airway disease
- Atelectasis
- Pulmonary edema
- Pneumothorax
Mechanical Causes

Diaphragm Paralysis - due to phrenic nerve injury

- Incidence 0.3-12.8%
- Respiratory complication resulting in respiratory insufficiency, lung infections, prolonged mechanical ventilation prolonged hospital stay

Healy, F. et al, 2012
Diaphragm paralysis

Post-op cases with higher incidence:

• Norwood with BT shut
• Arterial switch
• Tetralogy of Fallot
• VSD closure w/pulmonary reconstruction
• Fontan
Extubation Attempt #1

7.10/83/53/25/-7.4/69.9

LA 5.4
Extubation Attempt #2

7.05/60/65/16/-16/81

LA 10.6
Diaphragm paralysis

• **Treatment**
  - **Time**
  - Diaphragm plication
Mechanical Causes

Vocal Cord Paralysis

- Voice dysfunction
- Swallowing difficulties

Most commonly seen after:
- PDA ligation
- Norwood operation
- Incidence 4-70%
- Aortic Arch reconstruction

Implications:
- Aspiration
  - Silent aspiration in infants
- Tube feeding requirements
- Longer length of hospital stay

Long-term follow-up of vocal fold movement and feeding after cardiac surgery

Fig. 1. (A) Follow-up of patients with normal vocal fold mobility, n = 77. (B) Follow-up of patients with VFMI, n = 17.

Amy Li Richter, Julina Ongkasuwan, Elena C. Ocampo
Long-term follow-up of vocal fold movement impairment and feeding after neonatal cardiac surgery
http://dx.doi.org/10.1016/j.ijporl.2016.02.014
Vocal Cord Paralysis

- **Things to consider:**
  - Awake flexible fiberoptic laryngoscopy to document vocal cord motion after successful extubation in patients who have undergone aortic arch reconstruction
  - Modified barium swallow study
Vocal Cord Paralysis

- **Treatment**
  - Speech evaluation
  - Ongoing speech therapy
  - Possible NG tube or G-tube feedings
Mechanical Causes

Tracheobronchomalacia

Clinical manifestations:
- Wheeze
- Increased work of breathing
- Cyanotic spells
- Extubation failure

*may remain silent until the postoperative period when it manifests by difficulty in ventilation or unexpected requirement for prolonged ventilation

Implications:
- Longer postoperative ventilation
- Longer ICU stay
- Tracheostomy
- Higher mortality

Tracheobronchomalasia

Pulmonary Function and Long-Term Follow-Up of Children With Tracheobronchomalacia

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- 19 children followed to a median 9.4 years

- Concluded based on clinical symptom profiles and pulmonary function tests persistent functional mechanical abnormalities of the large and small airway still exist
Mechanical Causes

Bronchial Compression

- Vascular Ring & Sling
- Aorta / Pulmonary compression
- Incidence 1-1.6% of all CHD
Bronchial Compression
Mechanical Causes

Mechanical Ventilation

- Barotrauma vs Volutrauma

Use low TV 6-8ml/kg
Mechanical Causes
Infectious Causes

- Respiratory viruses
  - Respiratory syncytial virus (RSV)
  - Human metapneumovirus
  - Influenza

- Nosocomial Pneumonia
  - Incidence 9-21% in children following cardiac surgery
  - Pseudomonas aeruginosa
  - Klebsiella pneumoniae

Longer ICU LOS
Longer MV
PHT

Healy, F. et al. 2012
Noninfectious Causes

Pleural Effusions

- Chylous
  - Thoracic duct injury
  - Elevated central venous pressure

Clinical implications:

- Loss of lymphocytes, immunoglobulins, & proteins
  - Leads to poor nutrition & potential infectious complications

- Loss of clotting factors (protein C, S, ATIII)
  - Increased risk of thrombosis

Chylothorax
Management Algorithms for Post-Operative Chylothorax

COA CVICU Postoperative Chylothorax Protocol

- **Diagnosis of Chylothorax**
  - >75% lymphocytes in fluid
  - >110 mg/dl triglycerides in fluid

- **Low Volume** (<15 ml/kg/day)
  - No Diet Change
  - Eval. Upper veins for thrombus/obstruction with ultrasound +/- venogram
  - Observe Drainage 2 days
  - Resolved
  - Persistent Drainage (not decreased by 50%)

- **High Volume** (>15 ml/kg/day)
  - Replace 3% albumin
  - >25 ml/kg/day – consider FFP replacement at 0.5 ml/ml

- **Medium Chain Fatty Acid Diet**
  - Observe for up to 4 days
  - Persistent Drainage (not decreased by 50%)
  - Start Octreotide 10 mcg/kg/min
  - Observe drainage for 2 days

- **Non-occlusive Thrombus**
  - Systemic anticoagulation
  - Cardiac catheterization with angioplasty followed by systemic anticoagulation

- **Resolulion**
  - If CT output >25 ml/kg/day for >7 days, check zinc, calcium, and selenium levels. Replace if needed

- **Adjunctive management during chylothorax**
  - Increase Diuresis
  - Maintenance Labs
  - Renal Function Panel and Complete Blood Count qam
  - ICG, fibrinogen, INR, AT3 qM/Th
  - Replacement
  - Albumin 25% when albumin level < 2.8
  - IVIG when level < 800
  - Replace AT3 < 80
  - FFP if INR > 1.0, cryofibrinogen < 100
  - Start fluconazole prophylaxis when AUC < 1000

- **Other Considerations**
  - Chest Tube Replacement
  - No octreotide if history of NEC or coagulation repair
  - Inotrope if CVL or PICC

Noninfectious Causes

Reactive Airway Disease

Asthma

Bronchospasm

The prevalence of asthma or airway hyperresponsiveness (AHR) in patients with congenital heart disease is unknown.
Noninfectious Causes
Summary

Why is my patient in respiratory distress?
Why has the patient failed extubation twice?

What am I going to do different in planning for the next extubation?
Do I need to investigate further?
What is the patient’s clinical exam telling me?

Differential Diagnosis box:
* Mechanical Causes
* Infectious Causes
* Non Infectious Causes
References


