



Pediatric
Critical Care
Learning



PCCL Session: Summary Report and Resources

PCCL session topic: “Take My Breath Away – Intubation in Severe Asthma”

Date: May 16, 2025

Learning objectives:

1. Discuss atypical presentation of asthma in pediatric patients
2. Optimization of ventilation in hypoxemic respiratory failure/asthma
3. Sedation strategies in pediatric patients

Case:

- 6-year-old fully vaccinated with 2 previous admissions for “lung infections”, one being a prolonged admission at 6 months in another province. No previous formal diagnosis according to parents. Presented with 4-day history of vomiting, cough and tactile fever. On presentation noted to be hypoxic with mild WOB. Patient was admitted to the ward on LFNP. CXR showed RLL opacity. Patient started on ceftriaxone and metronidazole (for pneumonia vs possible aspiration).
- Labs: Normal CBC, CRP 17, Swab: Positive for Metapneumovirus and Non-COVID Coronavirus
- Progression: Oxygen was weaned off overnight. A significant coughing when eating breakfast, and acute desaturation event 30 minutes after with marked work of breathing. HR 137 RR 60 Sats 80-82% on room air. Supported with BVM holding 5 of PEEP with 15L O2 Sats improved to low 90's. CODE PINK called patient transferred to local adult ICU.
- Course in ICU: Persistent hypoxia but normal cap gas (7.36/37). Proceeded to intubation by local Pediatric Anaesthesia for hypoxia after BIPAP not tolerated High FiO2 requirements while ventilated; improved with PRN Rocuronium and Increased PEEP (PRVC PEEP 10 TV 6 ml/kg, PIP's 16-20, FiO2 50-60%)
 - Arterial gas post intubation- 7.25/46/80- Adjusted Tidal Volumes
 - NG and foley placed. Continued Ceftriaxone and added Vancomycin for possible bacterial pneumonia/Aspiration
 - Sedation: Bolus Ketamine and Propofol given while Morphine and Midazolam being titrated reaching max of 40 mcg/kg/hr Morphine and 220 mcg/kg/hr of midazolam. Intermittent Rocuronium used when overriding the Vent
 - Throughout resuscitation air entry noted to be decreased, coarse breath sounds, inconsistent reports of wheezing. Post intubation trial of in line Ventolin with no improvement in FiO2 needs
- BCCH in Brief: Respiratory status remained difficult to manage with multifocal atelectasis and fluctuating FiO2. Respiriology consult ultimately recommended a trial of asthma protocol with



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Regular Ventolin and Methylpred in addition to management of atelectasis and possible mucus plug. Extubated after 7 days. Diagnosis of “Secretory Asthma”. Sent home in Regular ICS with planned follow up, but has been lost to follow up in the community

Learnings:

Atypical Presentation of Asthma

- This was a challenging case and other potential diagnosis remained on the differential beyond asthma. An atypical pediatric asthma presentation is challenging to recognize, especially in the hospital setting. These presentations can deviate from wheezing, shortness of breath, and coughing. Some key atypical presentations seen in children:
 - Chronic cough as sole or dominant symptom
 - Recurrent pneumonia or bronchitis
 - Chest tightness without wheeze
 - Anxiety or behavioural changes
 - “Silent Asthma” – little to no air movement
 - GI symptoms from diaphragmatic fatigue
- Key Point: A child with a history of prior intubation for asthma (even a single episode) should be considered at high risk for rapid deterioration.**
 - Take all symptoms seriously, even if they seem mild.
 - Monitor closely for early signs of decompensation.
 - Have a lower threshold for initiating aggressive therapy and ICU consultation.
 - These patients may not wheeze if airflow is severely limited—“silent chest” is a warning sign.

PRAM Scoring

The PRAM score (Pediatric Respiratory Assessment Measure) is a clinical tool used to assess the severity of asthma exacerbations in children, particularly in emergency or acute care settings. It helps guide treatment decisions and monitor response to therapy. A score of 4-7 classifies as moderate asthma, and 8-12 classifies as severe. For more information on PRAM scoring, the management of moderate and severe asthma see in a hurry section [asthma](#).

Severity Classification	PRAM Clinical Score
Mild	0-3
Moderate	4-7
Severe	8-12
Impending Respiratory Failure	Regardless of score, presence of lethargy, cyanosis, decreasing respiratory effort, and/or rising CO ₂

Optimization of Ventilation

- Ventilating a child with severe asthma—especially if intubated—requires a delicate balance to prevent worsening air trapping, barotrauma, or hemodynamic compromise. This approach is very different from the strategies used in conditions like ARDS.



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- **Ventilation strategy in Asthma**
 - Mode: Choose a ventilator mode with a decelerating flow pattern, pressure- limited ventilation that provide a lower peak airway pressure and a higher mean airway pressure. No evidence to support one mode of ventilation is better over another
 - Respiratory Rate (RR): Choose lower respiratory rate to allow longer expiratory time
 - Lung protective strategy: Pplat < 30 cmH₂O and Permissive hypercapnia
- PEEP settings in Asthma:
 - Higher PEEP (6–8 cm H₂O) may be considered only if needed to:
 - Prevent alveolar collapse
 - Match intrinsic PEEP (auto-PEEP)
 - Caution: Excessive PEEP can worsen air trapping, raise intrathoracic pressure, and reduce venous return → leading to hypotension or pneumothorax.
- Always monitor for:
 - Air trapping (increased plateau pressures, rising CO₂)
 - Pulsus paradoxus
 - Hemodynamic instability

- Pediatric ARDS Ventilation guide Pediatric ARDS Ventilation guide

Pediatric Acute Respiratory Distress Syndrome (PARDS) Ventilation Guideline

Ventilation Goals

VT: 6-8 ml/kg
(consider 4-6 ml/kg if $\geq$ PIP or DP limits)

Pplat: $\leq$ 28cmH2O
($\leq$ 32cmH2O with reduced chest wall compliance)

DP: $\leq$ 15 cmH2O

PEEP: $\geq$ ARDSNet Lower PEEP/fiO2 Table*

(titrate to oxygenation needs & hemodynamics)
*PEEP strategy discussion warranted in unilateral lung disease

ABG Goals & Calculations

- pH > 7.20 with permissive hypercapnea
- SpO2: 92-97% (mild/mod PARDS)
88-92% (severe PARDS)
- Calculate & monitor OI/OSI
- Calculate and monitor AVDSf
- Follow "Prevention of VAE Guideline"
- Consider ECLS if unable to maintain protective lung strategy

Pulmonary-Specific Ancillary Treatment

- Consider proning with rotation every 6-12 hrs
- Careful recruitment maneuvers via slow incremental and decremental PEEP steps (sustained inflation maneuvers not recommended)
- Minimize FiO2 to prevent oxygen toxicity and nitrogen washout
- Use of iNO recommended in select populations only
- Consider use of corticosteroids in select populations only
- No routine use of surfactant therapy
- No routine use of bicarbonate supplementation

Non-Pulmonary Treatment

- Daily pain, sedation and delirium scoring
- Minimize the use of midazolam
- Daily discussion for early mobilization
- Rehabilitation discussion by 72 hrs
- 24 hr fluid balance goals of neutral/negative
- Early diuretics

- Early enteral feeds (< 72 hrs)
- Protein ≥ 1.5 g/kg/day
- NJ feeds if ventilated > 5 days
- Consider transfusion of pRBC for Hgb < 70 g/L

Monitoring

- Continuous monitoring of vitals & ETCO2
- Monitor intrinsic PEEP, flow & pressure loops/waveforms
- Monitor patient's respiratory effort to avoid P-SILI (use objective measures such as EBM or P0.1, if available)
- In severe PARDS where SpO2 $< 92\%$, consider monitoring central venous oxygenation
- Hemodynamic monitoring to evaluate the impact of ventilation and disease on right & left cardiac function
- Perform daily wean screen

VT: Tidal Volume
Pplat: Plateau Pressure
DP: Driving Pressure (Pplat - PEEP)
PEEP: Positive End-Expiratory Pressure
OI/OSI: Oxygenation Index/Oxygenation Saturation Index
AVDSf: End-Tidal Alveolar Deadspace Fraction
ETCO2: End-Tidal CO2
VAE: Ventilator Associated Events
ECLS: Extra-Corporeal Life Support
P-SILI: Patient Self-Induced Lung Injury
BRM: Esophageal Balloon Manometry

FiO2	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7
PEEP	5	5	8	8	10	10	10	12

FiO2	0.7	0.8	0.9	0.9	0.9	1.0
PEEP	14	14	14	16	18	18-24

PICU

Sedation and Analgesia for the Intubated Pediatric Patient

Drug	Dose	Comments
Morphine	10 – 40 mcg/kg/hr	Analgesic Active metabolites = pruritus, N/V, constipation, urinary retention
Midazolam	30 – 200 mcg/kg/hr	Sedative, anxiolytic and amnesic Respiratory depression, hypotension, paradoxical reaction
Dexmedetomidine (Precedex)	0.1 – 1.2 mcg/kg/hr	Alpha agonist. Sedative, anxiolytic and analgesic Minimal respiratory depression May cause bradycardia and hypotension (esp. loading dose)
Ketamine	5 – 20 mcg/kg/min	Dissociative, amnesic and analgesic (anti-epileptic) Mobilizes endogenous catecholamines = increased HR/BP (transient) bronchodilation, bronchorrhea, tachyphylaxis
Propofol	20-160 mcg/kg/min (GA dosing)	Sedative, anxiolytic and amnesic (anti-epileptic) Short term sedation ONLY in hemodynamically stable older patients Propofol-related infusion syndrome risk ****

First-Line Therapy: Preferred Combination: *Dexmedetomidine (Precedex) + Opioid*

- Offers effective sedation and analgesia.
- Ketamine may be a beneficial first-line agent in asthmatic patients due to bronchodilator effects; however, it poses risks of rapid tachyphylaxis and bronchorrhea with prolonged use, which can worsen respiratory status.

Second-Line Therapy: Midazolam + Opioid

- Now used less frequently as benzodiazepines (e.g., midazolam) are increasingly recognized as contributors to pediatric delirium. Caution in younger or neurodiverse children, as paradoxical reactions can occur. You could also add the midazolam infusion to the first line therapy of dexmedetomidine and morphine if additional sedation is required

Short-Term Sedation:

- Propofol may be considered for brief sedation periods only with an experienced provider.
 - Risks: Propofol Infusion Syndrome—marked by lactic acidosis, rhabdomyolysis, lipemia, hyperkalemia, arrhythmias, and potentially fatal multi-organ failure.

SBS: State Behaviour Scale:

- Developed and validated for children intubated and mechanically ventilated (derived from adult scales adapted for developmental variations in pediatrics)
- The scale assigns a score from -3 to +2, with lower scores indicating a more sedated state and higher scores indicating agitation
- A score of -1 or 0 might indicate a patient who is asleep or awake and calm, while a score of 1 or greater might indicate a patient who is awake and distressed.



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Resources:

- [Pedmed](#) – dosing of pediatric drugs
- [Sedation and Analgesia](#)
- [Weight based dosing of medications](#) – in a hurry section of website
- [Continuous infusion guidelines for pediatrics](#)
- [Virtual Support Pathways](#)
- [Asthma Guidelines](#)
- [PRAM scoring](#)
- [Asthma Lanyard Card](#)

Here's how to bookmark the [Pediatric Critical Care Resources Website](#) as a shortcut on your smartphone home screen, depending on your device and browser:



For iPhone (Safari Browser):

1. **Open Safari** and go to the website you want to save.
2. Tap the **Share icon** (square with an arrow pointing up) at the bottom of the screen.
3. Scroll down and tap **"Add to Home Screen."**
4. You can edit the name if you like, then tap **Add**.
5. The shortcut will appear on your **Home Screen** like an app icon.



Only Safari supports this on iPhone (not Chrome or Firefox).



For Android (Chrome Browser):

1. Open **Google Chrome** and go to the website.
2. Tap the **three-dot menu** in the upper-right corner.
3. Tap **"Add to Home screen."**
4. Edit the name if desired, then tap **Add**.
5. Confirm by tapping **Add automatically** or drag it to your preferred location.



Works with most Android devices using Chrome. Firefox has a similar option under its menu.

The resources shared throughout this session are for reference purposes only. Please consult your health authority leaders for guidance on adoption and use of these resources within your local context. The advice provided during the PCCL sessions is not intended to replace the clinical judgment of the healthcare providers who are with the patient. While PCCL sessions may suggest recommendations, the final decisions regarding a child's care and treatment should always rest with the healthcare professionals involved in their care at both the referring and receiving centres. If you need additional in the moment support refer to the Provincial Real Time Virtual Support Pathways: If you need additional in the moment support refer to the Provincial Pediatric Virtual Support Pathways: <https://childhealthbc.ca/pcc/provincial-pediatric-virtual-support-pathways>