PCCL Session: Summary Report and Resources

PCCL session topic: "*Heart of the Matter*"

Date: March 20, 2026

Learning objectives:

1. Review the differential diagnosis of cardiogenic shock in an infant.
2. Formulate a management strategy for undifferentiated cardiogenic shock and discuss this in the context of the ultimate diagnosis.
3. Discuss typical and atypical presentations of aortic coarctation.

Case:

- Care Context:
  - A tertiary hospital with a Pediatric unit but no dedicated PICU beds.
  - Access to ICU for short stays- NICU nurses often cross-cover, adult PICU nurse and physician offers support if needed.
- Patient Demographics:
  - 4.5m old female with unremarkable prenatal course and normal delivery
  - 3 minor UTRIs since birth (siblings attend daycare)
  - Presents to community hospital with 11-day history of cough and fever up to 38.4 T 36.9, HR 146, RR 34, Sats 98%-lungs clear, CVS exam not noted –discharged home.
  - Re-presented 3 days later with vomiting/diarrhea and ongoing fever. T 37.1, HR 202, RR 68, Sats 90%-pale, grunting, chest clear, no murmur, pulses not mentioned, CRT 1 sec.
- Initial Management (small community hospital at 2115):
  - O2 via face mask and changed to HFO2 as per transport advisor.
  - NS bolus 10ml/kg x2 then D5NS at 100% maintenance.
  - Ceftriaxone 100mg/Kg x1, Azithromycin 10mg/Kg x1
  - HR 152, RR 68, sats 100%, BP 102/58, cap refill "good", "no wheeze or stridor"
- Investigations (at community hospital):
  - CBC- WBC 33.6 (predominantly neutrophils), Hb 97, plt 717. Lytes, urea, CR normal. CRP 26.1. Blood cultures and viral swabs sent-was +rhino/enterovirus.
  - Initial gas 7.24/45/19/-8 **lactate 4.9** (venous). Repeat gas after HFO2 7.40/24/18/-7 lactate 2.1.
  - Chest Xray- opacification of LLL, leftward shift of the heart which is mildly prominent. Heart size is difficult to assess given technique and concurrent suspected LLL opacity.
- Initial Presentation (at larger center):
  - Vitals- T 37.5, HR 175, RR 68, sats 97%, BP 120/72, HFO2 10L, room air
  - CNS- Irritable when awake, no abnormal movements
  - Resp- Moderate to severe WOB when awake, mild to moderate when settled. Markedly decreased air entry to left side, no crackles, no wheezes
  - CVS- CRT brisk 1sec, femoral pulses easily palpable, no murmur, significant pallor
  - Abd- liver 1-2 cm BCM

- Ongoing Management:
  - Initiated nasal CPAP +5 for increased WOB
  - Subsequently changed to BIPAP 14/7, Rate 30, fiO2 21%.
  - Vancomycin added
  - PTN notified again to arrange transport given ongoing instability and unclear diagnosis
- Ongoing Investigations:
  - Cap gas 7.41/27/17/-8 **Lactate 3.0**, troponin 908 (<18 normal).
  - ECHO- Severe LV dilation and dysfunction. No obvious outflow tract obstructions. Elevated LA pressure with bulging of atrial septum rightward (into RA). Cannot rule out coronary anomaly based on these images.
  - Discussed findings with BCH CICU attending with plan for urgent transfer to PICU. Advice to intubation if safe, inotropic support, IV diuretic. ECMO alert.
- Ongoing Management while Awaiting Transport
  - Anesthesia intubated patient and obtained additional Access (only had scalp IV)
  - Support with BCCH PICU on video.
  - Epinephrine infusion prepared pre intubation. RSI with **Ketamine 0.5mg/Kg**, **rocuronium 1mg/Kg**. 4.0 cuffed ETT. Hypotensive post intubation so epi infusion started.
  - Precedex infusion for sedation
  - Resp- PRVC with volumes 6ml/Kg, PEEP 8. 30% fiO2, was over breathing.
  - CVS- IO inserted into rt tibia (second attempt as first needle too short). Milrinone infusion started once BP stabilized. Epi infusion continued to maintain BP. Art line attempted but not successful.
  - GI- NPO, NG tube.
  - Fluids - 50% maintenance D5NS. Lasix x 1 given. CaCl x1 given for low ionized Ca. Sodium bicarb x1 given for acidosis.
- Definitive Management: Admitted to BCCH PICU with **confirmed diagnosis of severe coarctation of the aorta with dilated left ventricle with severe left ventricular dysfunction.**

Learnings:

Cardiogenic vs. Septic Shock: Quick Differentiators

- **Septic**: Often cold shock in young children with poor pulses and perfusion. Infectious focus may not always be prominent in very young children.
- **Cardiogenic:** Disproportionate tachycardia, respiratory distress from pulmonary edema, **hepatomegaly**, cardiomegaly on CXR, lactate/BNP/troponin elevation.
- Salient Clinical Signals (Reinforcing Early Suspicion for Cardiac Etiology)
  - Marked pallor with preserved peripheral perfusion (warm extremities, no prolonged CRT) can still signal serious cardiac pathology.
  - Persistent tachycardia and tachypnea with only “okay” BP → remember BP is a late pediatric sign.

- Repeat presentations with worsening vitals – this should result in automatic escalation and broadened differential (don't anchor on pneumonia/sepsis alone).
- CXR mis-cue: "LLL pneumonia" appearance likely cardiomegaly; treat "mild enlargement" as meaningful in a sick infant.

Targeted Bedside Assessment (Do Early)

- **Pre-/post-ductal SpO_2** (R hand vs foot) for differential cyanosis/shunting.
- **Four-limb BP and femoral pulses**—abnormal gradients support coarctation; normal femorals do not exclude coarctation in older infants.
- Labs: VBG/ABG + lactate; troponin/BNP if available.
- **Imaging: CXR essential** for heart size/pulmonary edema.
- POCUS (if trained): Cardiac dysfunction may be apparent, but interpreting scan in infants and children is challenging; infant myocardium looks different (brighter) and can be tricky. Lung POCUS: a normal scan in a dyspneic infant nudge toward cardiac rather than primary lung disease. POCUS can be used as an extension of physical exam, but not as a confirmatory diagnostic tool in this sort of case. Clinical discernment is key when considering all findings of physical exam, lab and imaging findings.

Management Under Uncertainty: Anticipatory, Physiology Driven Care

1. Fluids

- Avoid large boluses; if used, give small aliquots (5–10 mL/kg) with tight reassessment for pulmonary edema and enlarged liver

2. Vasoactive Medications

- Epinephrine for inotropy/chronotropy in low CO states; monitor for tachycardia.
- Norepinephrine mainly for distributive physiology (warm shock, wide pulse pressure). In fixed outflow obstruction/coarct, raising SVR can worsen afterload—use judiciously.
- Milrinone (inodilator): reasonable in suspected dilated cardiomyopathy/myocarditis/low-output physiology; may reduce SVR/BP—start with monitoring/arterial line if possible.
    - Nuance (from panel): Even with concern for left sided obstruction, milrinone was appropriate given the overall picture leaning DCM/myocarditis; would be more cautious in true left sided obstructive physiology.

3. Airway & Ventilation

- This was a high-risk intubation (hemodynamics), even if not anatomically difficult.
- Plan for hemodynamic control around induction (optimize volume status, vasoactive drips ready, consider gentle induction, minimize swings in preload/afterload).
    - Nuance (from panel): in these situations, I recommend a small pre-induction fluid bolus and a small pre-induction dose of low dose push epinephrine or have the epinephrine infusion running before induction. Don't treat after the fact - try and prevent.

- Balance controlled intubation now at the sending site vs risk of emergent intubation during transport (the latter is usually more dangerous).

4. Vascular Access

- IO before intubation for this case? Reasonable to consider, but in an extremely fragile patient, proceeding directly to airway control was appropriate to avoid additional noxious stimuli pre-intubation.
- Practical IO tip: The smallest "red" 15mm EZIO needle is often too short in infants; for many, **Blue 25 mm, 15gauge is the better first choice to reach the medullary space in infants**

5. Monitoring & Escalation

- Aim for arterial line if feasible after airway.
- Early cardiology/PICU/transport engagement; ECMO alert if deterioration likely.

Teamwork, Roles, and Process Lessons

- Stick to an agreed plan—when more consultants join align quickly and avoid deviations mid-procedure unless safety demands.
- Role clarity: designate a single airway lead, a meds/vasoactive lead, and a nurse/RT lead; assign a scribe for real-time documentation of vitals/meds/events.
- Remote video support (real-time screen sharing during intubation from BCCH) was helpful—created shared mental model, allowed immediate coaching if complications occurred, and reduced delay/phone tag.
- Cognitive load supports: Use Child Health BC "In a Hurry" resources and local checklists/flow cards for shock, high-risk intubation, vasoactive mixing/compatibility, and transport preparation.

Coarctation: Pathophysiology, Screening, and Atypical Timing

- Timing of clinical symptoms depends on ductal physiology. With patent ductus arteriosus (PDA) open, coarct may be "masked;" but when the duct closes the obstruction declares itself. Most PDAs close within 3–5 days in term infants, but some remain open much longer—explaining late/unusual presentations.
- This case: 4–5 months is highly atypical. Hypotheses discussed:
    - PDA remained patent for weeks/months and closed later; or
    - Coexistent primary myocardial disease (DCM/myocarditis) simmered sub clinically and viral illness (rhino/enterovirus) tipped the child into decompensation.
- Screening: Many coarcts are caught by fetal risk identification or newborn CCHD pulse oximetry screening; murmur is a common prompt for outpatient echo—but >50% may have no murmur at presentation.
- Alprostadil (PGE) in older infants: With no PDA, receptor downregulation, and need for very high doses (with more complications), PGE is generally not recommended at this age.

Interpreting This Case's Biomarkers & Course

- Very high troponin (~988) is unusual for a purely slowly progressive obstructive physiology; supports possibility of myocardial injury beyond afterload alone (myocarditis or dual pathology).
- Persistent LV dilation with incomplete recovery on follow-up raises the need to evaluate for underlying cardiomyopathy (family history, metabolic/genetic panels per local pathways) vs. resolved myocarditis vs. mixed pathology.

Practical Checklists You Can Drop into Practice

A) Rapid Cardiac vs Sepsis Screen (Infant with respiratory distress ± infection)

- Pre/post ductal SpO_2, 4 limb BP, femoral pulses
- Hepatomegaly, gallop, pallor, work of breathing
- CXR re-read for heart size and edema
- Lactate, troponin/BNP if available; VBG/ABG
- POCUS (cardiac & lung) if trained; otherwise, don't delay transfer/consultations

B) High-risk Intubation Prep (Hemodynamics)

- Plan: induction agent (consider reduced dose), vasopressor/inotrope strategy (consider starting prior to procedure), postintubation ventilation settings (avoid excessive PEEP in preload dependency)
- Access: secure IV; IO ready (prefer 25 mm needle for many infants)
- Vasoactives: Epi/Norepi/Milrinone mixed, labeled, and ready
- Monitoring: full monitors; Art line if feasible post securing of airway
- Roles: airway lead, meds lead, RT lead, scribe; remote video support if possible
- Transport: secure lines/ETT, confirm drips, backups, documentation for receiving team

Resources:

- Low dose push Epinephrine
- Pediatric Infusion Guide (PGE)
- Intubation
- Intubation checklist
- Intraosseous Insertion
- Virtual Support Pathways
- Critical Care Outreach RN and RT
- Weight based drug sheets

Here's how to download the free ZOOM App on your mobile device:

🤖 **For Android (Chrome Browser):**

1. Open the **Google Play Store**
2. Search **"Zoom Cloud Meetings"**
3. Tap **Install**

4. Open the app
5. **Sign in** or **Join a Meeting**

For iPhone (Safari Browser):

1. Open the **App Store**
2. Search **"Zoom Cloud Meetings"**
3. Tap **Get**
4. Open the app
5. **Sign in** or **Join a Meeting**

Tip: Allow camera and microphone access for full meeting participation.

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