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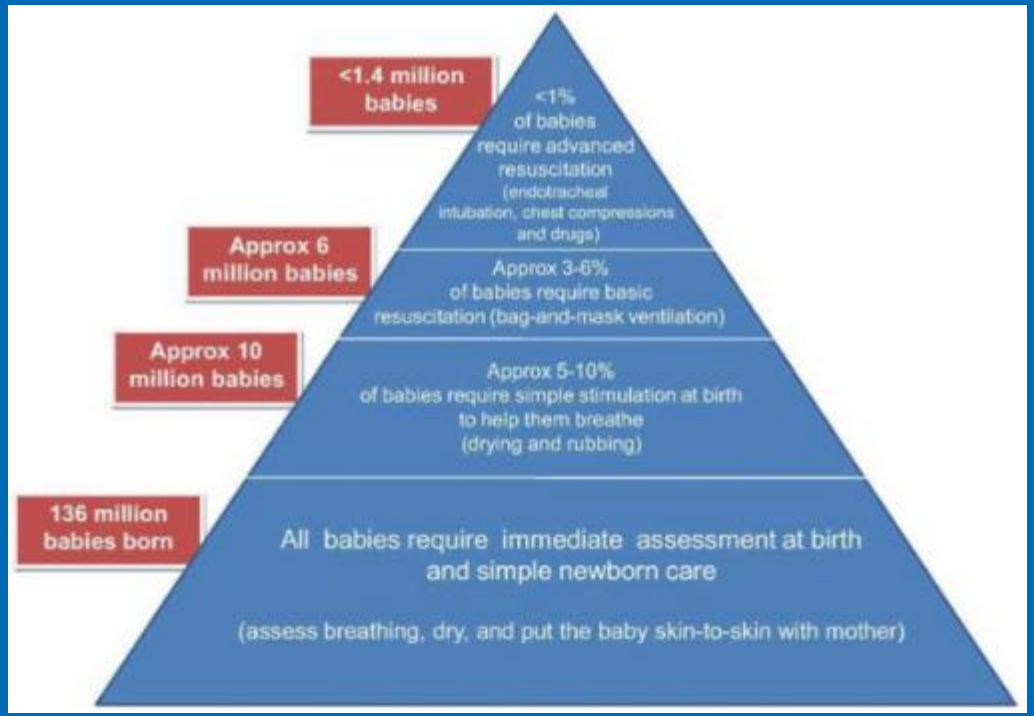
Neonatal Emergencies

Tera N. Carter, BSN, RNC-NIC, CNPT

Children's Hospital Colorado
Here, it's different.™

Neonatal Resuscitation

- The approach to neonatal resuscitation & adult resuscitation is very different
- The focus of neonatal resuscitation is **ventilation, ventilation, ventilation!**



https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2875104/figure/F1/

(Wall et al., 2009)

Delayed Cord Clamping

- Per NRP delay clamping the cord after birth for at least 30 – 60 seconds unless contraindicated (eg. abruption, maternal hemorrhage, cord avulsion)

- Studies have shown that term infants receive approximately 80 ml of blood transferred from the placenta at 1 minute and 100ml at 3 minutes

- Benefits of Delayed Cord Clamping All Infants
  - Increased hemoglobin levels
  - Increased ferritin and HCT at 4 week of age
  - Less fluctuation in HR and Cardiac Output
  - Increased myelin content in the brain at 12 months

- Benefits of Delayed Cord Clamping Premature Infants
  - Decreased mortality prior to discharge
  - Decreased Intraventricular Hemorrhage (IVH)
  - Decreased Necrotizing Enterocolitis (NEC)
  - Decreased hospital stay

http://www.ogpnews.com/2015/11/delaying-umbilical-cord-clamping/13397

(Mercer et al, 2020) (Deepika et al., 2022) (Rabe et al. 2019) (Gupta et al, 2022) (Li et al., 2021) (Weinter & Zaichkin, 2021)

- EFFECTIVE VENTILATION IS THE MOST IMPORATNT INTERVENTION FOR THE APNEIC OR BRADYCARDIC NEONATE

- Give just enough volume to see the chest rise
- If you are having trouble achieving good chest rise use MR. SOPA

  - M = Mask Reposition
  - R = Reposition the Head
  - S = Suction
  - O = Open the Mouth
  - P = Increase the Pressure
  - A = Alternate Airway

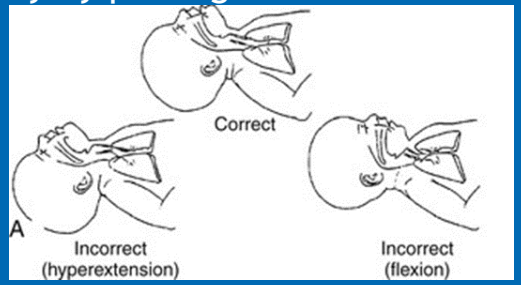
Rate is 40 – 60 Breaths per minute

(Weiner & Zaichkin, 2021)

https://www.moscmm.org/uploads/userfiles/Neonatal resustitation.pdf

PPV and Advanced Airway

- Open airway by placing infant in the sniffing position



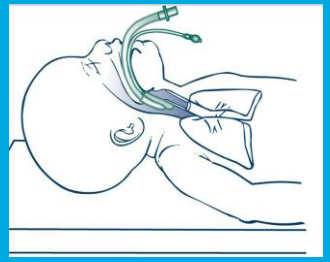
- Make sure it's the right size mask when creating a seal with the mask. Ensure that you are not occluding the soft tissue of the neck

Supraglottic Devices

IGEL Size 1
(2 - 5kg)

https://www.flemingmedical.ie/airways/

LMA Size 1
(< 5kg)



https://www.tomwademd.net/neonatal-resuscitation-program-use-of-the-laryngeal-mask-airway/

Air-Qsp3G
Size 0 (<2kg) Size 0.5 (2-4 kg)

Oxygen in the Delivery Room

What Fio2 should you start resuscitation in?

- Full Term Infant: Fio2 21%
- Premature Infant (<35 weeks): Fio2 21% – 30%

Targeted Preductal Spo_2 After Birth	
1 min	60%-65%
2 min	65%-70%
3 min	70%-75%
4 min	75%-80%
5 min	80%-85%
10 min	85%-95%

(Weiner & Zaichkin, 2021)

http://www.emdocs.net/em-cases-neonatal-resuscitation/

Premature Delivery

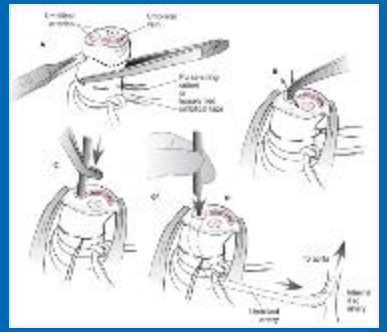
- Infant less than 32 weeks

Extra Supplies:

- Plastic Bag
- Extra Warming Equipment

UVC / Peripheral IV / IO Access

- Umbilical Venous Access
  - Low lying UVC placement
  - Catheter inserted to a depth of ~5cm
  - Ensure blood return



https://obgynkey.com/umbilical-vessel-catheterization/

https://emedicine.medscape.com/article/1348863-technique

- Peripheral IV Access:
  - 24g or 22g catheter
  - Can place a peripheral IV anywhere you can see a vein
  - Vessels ae very shallow – don't always get a flash back

- Intraosseous
  - Proximal Tibia placement
  - Manual Placement vs IO drill may be more successful
  - Only attempt in full term infants

Post-Resuscitation Care

Manage Hypothermia

- **Goal Temp: 36.5 – 37.5 Degrees Celsius**

- What does an infant do to conserve heat?
  - Vasoconstrict
  - Metabolize brown fat
  - Increase tone

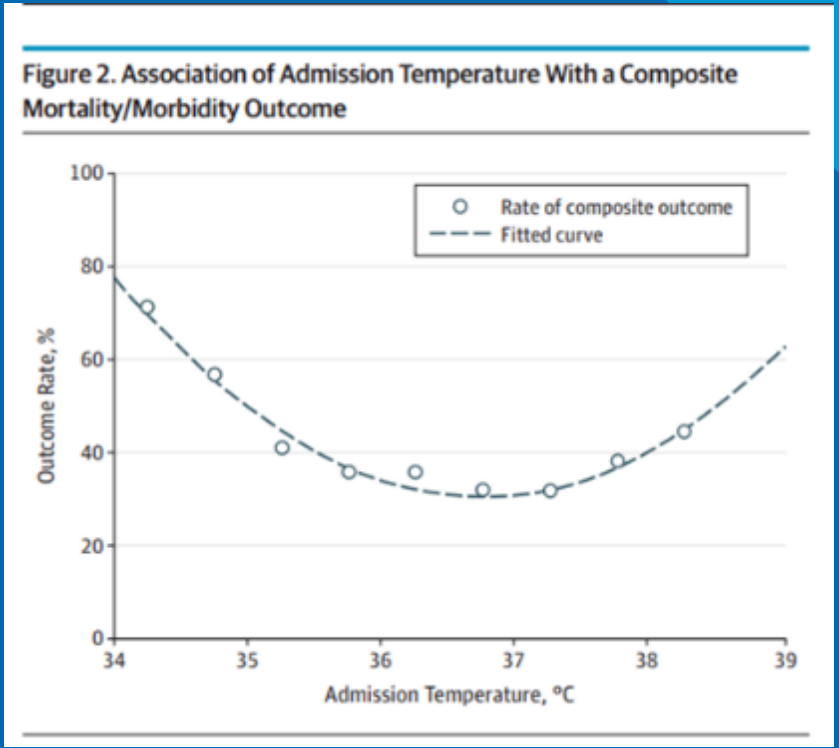
- Detrimental Effects of Hypothermia
  - Bradycardia
  - Apnea
  - Lethargy
  - Acrocyanosis
  - Metabolic acidosis

Impaired Immune function
Impaired surfactant production
Impaired coagulation

Post-Resuscitation Care

Why is managing temperature important?

- A 2015 study demonstrated a U-shaped relationship between outcomes and temperature
- Lowest rates of mortality and morbidity outcomes associated with temps between 36.5 – 37.2 degrees Celsius



Lyu, et al, 2015

Post-Resuscitation Care

Managing Hypothermia

- What can you do to prevent hypothermia?
  - Increase the temperature of delivery room
  - Provide warm blankets
  - Place hat on infant shortly after birth
  - If infant is stable – place skin to skin with mom

BE CAREFUL USING ITEMS THAT ARE NOT TEMPERATURE CONTROLLED!

Post-Resuscitation Care

Hypoglycemia

- Defined as a blood glucose <50mg/dl
- Most infants can maintain their blood glucose for a period of time after birth

Post-Resuscitation Care

Hypoglycemia

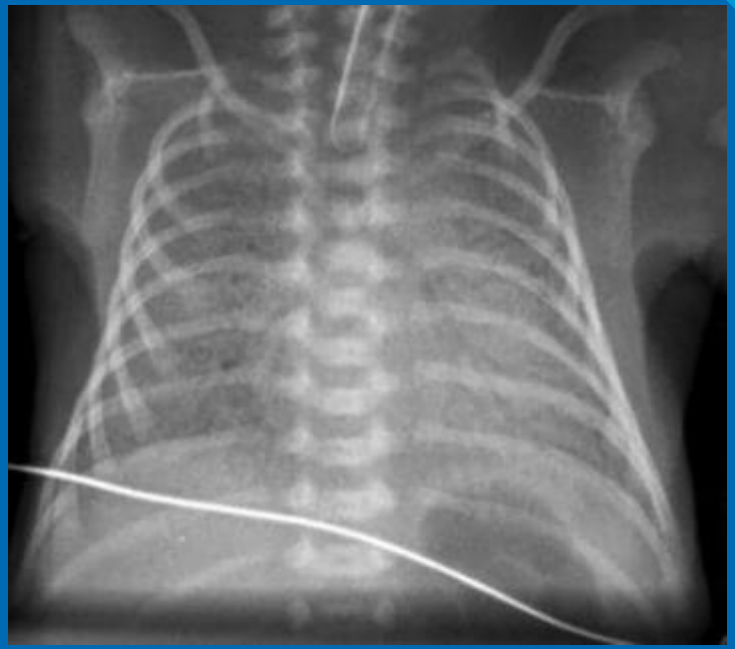
- Infants at risk for hypoglycemia:
  - Infants with Inadequate Glycogen Stores
    - Premature
    - Small for Gestational Age
  - Infants with Hyperinsulinemia
    - Infants of diabetic mothers (IDM)
  - Infants with Increased Glucose Utilization
    - Sick infants
    - Respiratory Distress
    - Hypothermia
    - Infection
- Treatment:
  - D10 – 2ml/kg (rate 1ml/minute) – recheck in 15 minutes.
  - D10 infusion at 80ml/kg/day

Neonatal Emergencies

Respiratory Emergencies

Respiratory Distress Syndrome

- Causes of Respiratory Distress Syndrome:
  - Surfactant Deficiency in premature lungs
  - Surfactant Deactivation
    - Meconium Aspiration
    - Blood Aspiration
    - Amniotic Fluid Aspiration
    - Pulmonary Hemorrhage
  - Genetic Causes:
    - Surfactant Protein B Deficiency
- Most commonly seen in preterm or late preterm infants



https://emedicine.medscape.com/article/409409-overview

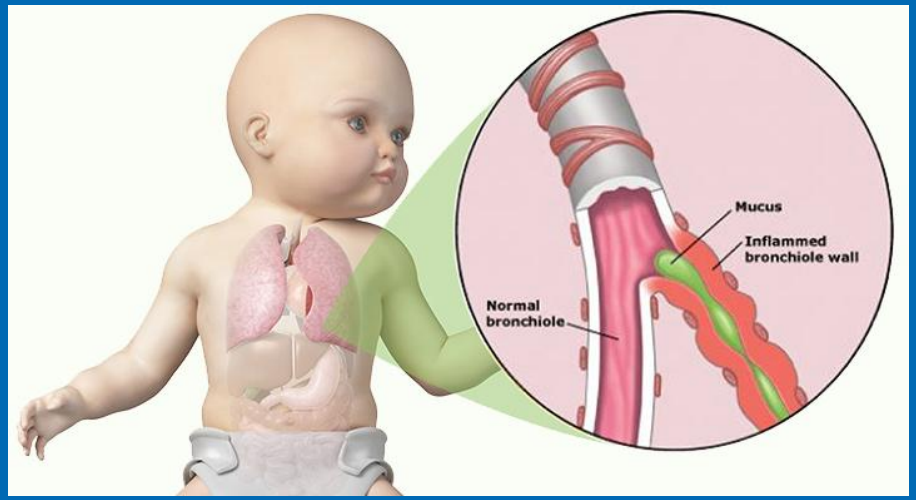
Respiratory Distress Syndrome

- Symptoms
  - Onset is shortly after birth
  - Tachypnea, Retractions, and Grunting
  - Decreased oxygen saturation
  - X-ray with granular opacities with or without air bronchograms

- Treatment
  - Support Breathing
  - CPAP
  - Intubation, if severe
  - Surfactant administration

Bronchiolitis

- Usually caused by RSV
- Symptoms:
  - 1-3 days of cough, nasal discharge/congestion
  - Apnea
  - Tachypnea
  - Coarse breath sounds
  - Retractions
  - May have hypoxia
  - Decreased PO intake
- Treatment:
  - Suction, if needed
  - Respiratory support, if needed
  - NS Bolus and fluids, if hypovolemic



Neonatal Shock

Shock

https://personcenteredtech.com/2016/06/06/electronic-records-revelations-jay-ostrowski/baby_shocked_featuredsize/

What is Shock?

Inadequate oxygen delivery to the tissues

Compensated vs Uncompensated Shock

- Compensated shock: Body is able to maintain adequate
- blood pressure.
- Uncompensated shock: Compensatory mechanisms are unable maintain adequate perfusion – progression to hypotensive state.

Karlsen, 2013

Shock Physical Exam

Breathing:

- Tachypnea
- Increased WOB
- Apnea

Circulation:

- Tachycardia (HR > 180)
- Pale or cyanotic
- Mottled
- Poor perfusion
    - Delayed capillary refill
    - Mottled and/or cool skin
- Chest X-ray
    - Heart Size
- Urine output

https://www.paediatricemergencies.com/collapsed-neonate/

Types of Neonatal Shock

Hypovolemic

↓ Circulating Blood Volume

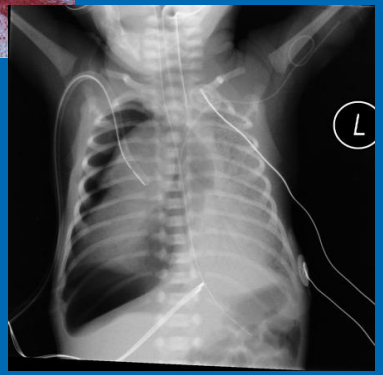
Causes:

- Intrapartum Blood Loss
- Postnatal Blood Loss
- Obstruction
- Dehydration

Treatment:

- Volume
  - NS 10ml/kg/dose
  - PRBC 10 ml/kg/dose

https://doctorlib.info/pediatric/visual-diagnosis-treatment-pediatrics/2.html



https://radiopaedia.org/articles/neonatal-pneumothorax

Types of Neonatal Shock

Cardiogenic

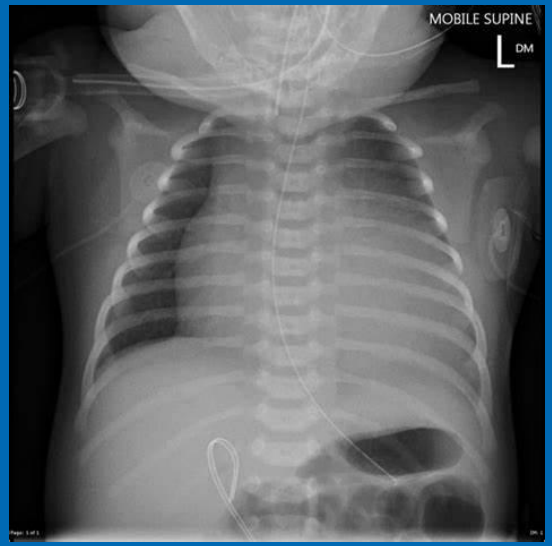
- Myocardial Dysfunction / Heart Failure

Causes:

- Birth Asphyxia
- Infection
- Hypoglycemia
- Infection
- Arrythmias
- Congenital defect

Treatment:

- Treat underlying cause
- Consider Inotropes



https://radiopaedia.org/cases/neonatal-cardiomyopathy

Karlsen, 2013
Bhat & Plakkal, 2015

https://hellodoctor.com.ph/parenting/baby/premature-babies/neonatal-sepsis/

Types of Neonatal Shock

Septic

- Loss of vascular integrity and profound hypotension

Causes:

- Bacterial or Viral Infection

Treatment:

- Antibiotics if bacterial
- Volume replacement – NS Bolus
- Vasopressors

Karlsen, 2013
Bhat & Plakkal, 2015

Neurological Emergencies

Seizures

- Neonatal seizures can be very subtle since their cortical development is not complete

- Signs and Symptoms:
  - Eye deviation
  - Lip Smacking
  - Abnormal tongue movements
  - Pedaling
  - Apnea
- Treatment:
  - Lorazepam IV (0.05mg/kg – 0.1mg/kg)
  - Midazolam IV or IN (0.05 – 0.1mg/kg)
  - Check Electrolytes and Glucose

BRUE – Brief Resolved Unexplained Event

- Occurs in infants < 1 year old

- Symptoms include at least 1 of the following:
  - Color change to cyanosis or pallor
  - Apnea or irregular breathing
  - Change in tone (either hypertonic or hypotonic)
  - Altered level of consciousness

- Lasts < 1 min, usually 20-30 seconds

- Infant needs to be evaluated
  - Physical Exam
  - CHECK GLUCOSE
  - Rule out other causes
  - Infant should be monitored with EKG and pulse ox

(previously called ALTE)

< 1 year old

B R U E

B	R	U	E
Brief	*Resolved*	*Unexplained*	*Event*
< 1 min usually 20-30 s	*Normal physical exam*	*Diagnosis of exclusion*	*Altered Colour* (pale / cyanosed) *Breathing* (altered/apnoea) *Response* (decreased) *or Tone* (hypo or hypertonia)

Must meet ALL criteria to diagnose BRUE

LOW RISK

No red flags
Well child

Serious pathology or recurrence unlikely

Observe 1-4 hours

Consider BM, ECG and pertussis PCR

Shared decision making - consider home with early OP follow up (< 24 hrs) if parents confident

HIGH RISK

Any red flag

Needs further assessment and investigation

Admit

Treat any identified illness

Consider BM, ECG and pertussis PCR

Differentials

Include airway obstruction, laryngospasm, reflux, congenital heart disease, arrhythmia, infection, sepsis, hypoglycaemia, metabolic disorder, toxins, or NAI.

Red flags

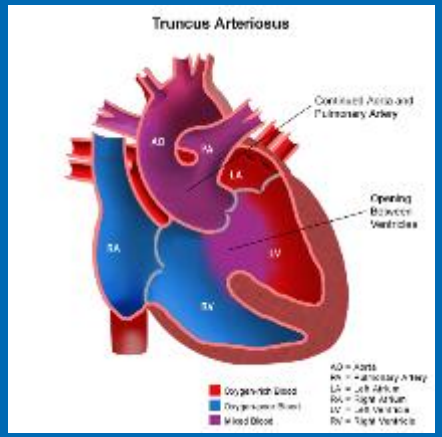
< 60 days old
Born at < 32/40
> 1 episode
Abnormal history or examination
Unwell child
Significant PMH
Feeding difficulties
FH sudden death
Social concerns or NAI

https://pediatrics.aappublications.org/content/137/5/e20160590
https://www.clinicalguidelines.scot.nhs.uk/nhsggc-paediatric-clinical-guidelines/nhsggc-guidelines/emergency-medicine/brief-resolved-unexplained-event-or-brue-alte-guideline-update/

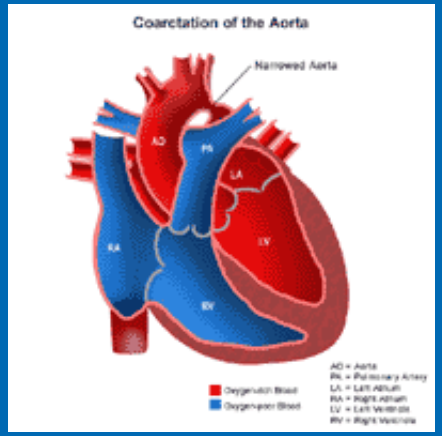
Cardiac Emergencies

Congenital Heart Disease

- Universal Screening for Cardiac Defects
- Congenital heart disease can be used to describe a large number of cardiac structural anomalies or anomalies of the vessels.
- When the cardiac defect is dependent on the ductus to maintain their systemic blood flow, known as obstructive left sided lesions, the infant can present in significant shock.
- When the cardiac defect is dependent on the ductus for pulmonary blood flow, known as obstructive right sided lesions, the infant can present with severe cyanosis.



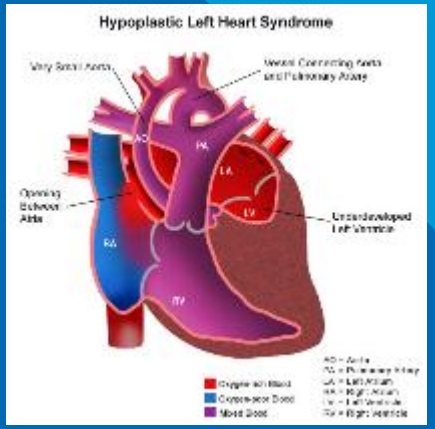
https://www.choc.org/heart/congenital-heart-defects/truncus-arteriosus/



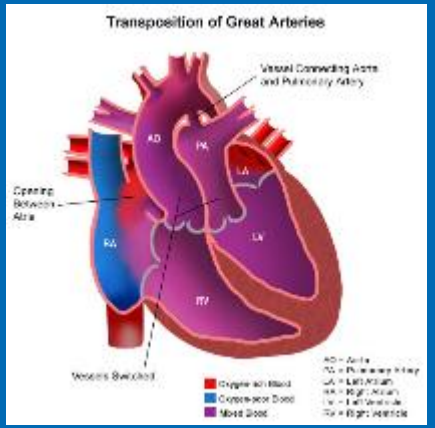
https://www.choc.org/heart/congenital-heart-defects/coarctation-of-the-aorta/

Congenital Heart Disease

- History and Physical Exam findings that Increases Suspicion of CHD:
  - Poor feeding for several days to weeks – fatigue with feeding
  - Absence of temp instability or other signs of sepsis
  - Oxygen desaturation that doesn't respond to O2 therapy – difference between pre/post ductal saturations
  - Difference between brachial and femoral pulses
  - Hepatomegaly
  - Presence of murmur
  - Tachypnea without other signs of distress



https://www.choc.org/heart/congenital-heart-defects/hypoplastic-left-heart-syndrome/



https://www.choc.org/heart/congenital-heart-defects/transposition-of-the-great-arteries/

Congenital Heart Disease

Treatment:

- Support Airway, Breathing, Circulation
- Check upper and lower BP’s
- Check Pre/Post Ductal Saturations
- Get ECHO to confirm diagnosis
- Prostaglandin E infusion is needed for ductal dependent lesions

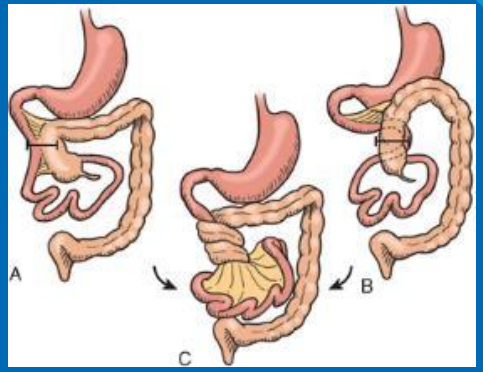
GI Emergencies

GI Emergencies

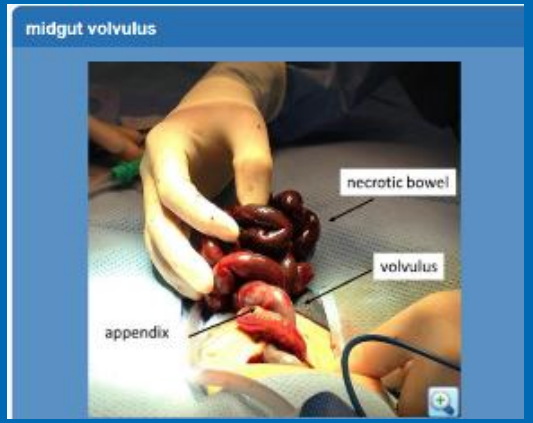
Malrotation with Volvulus

Symptoms
- Bilious Emesis
- Abdominal Distention
- May present in shock if there is bowel ischemia

Treatment
- NPO
- Gastric Decompression
- Transport to a facility that can do an UGI
- Surgery



https://basicmedicalkey.com/malrotation-volvulus-and-bowel-obstruction/



https://www.pedsurglibrary.com/apsa/view/Pediatric-Surgery-NaT/829042/all/Intestinal_Rotational_Abnormalities

Infection

Infection

- Risk Factors
  - Prolonged Rupture of Membranes
  - Maternal Infection
  - Chorioamnionitis
  - Procedures (prior or after birth)

- Symptoms:
  - Poor thermoregulation
  - Any fever in an infant <3 months is concerning
  - Lethargy, irritability, seizures, poor tone
  - Respiratory Distress
  - Tachycardia, hypotension, mottled, poor perfusion
  - Poor feeding
  - Rashes
  - Glucose instability
  - Oomphalitis
  - Monitor for signs of Septic Shock

Infection

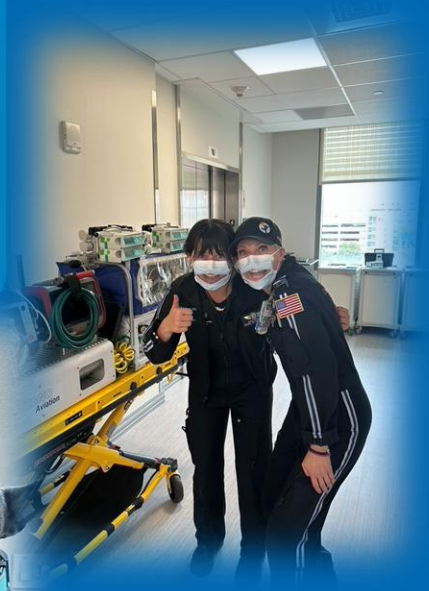
Causes:

- Bacterial, Viral, Fungal

Treatment:

- Provide oxygen to maintain saturations
- Treat hypotension with normal saline
- Treat hypoglycemia
- Stabilize Temperature
- Monitor for signs of septic shock
- Start Antibiotics if bacterial

Questions?



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