Hemodynamic Support of Pediatric and Neonatal Shock

Key Article

- *Davis AL, et al. American College of Critical Care Medicine Clinical Practice Parameters for Hemodynamic Support of Pediatric and Neonatal Septic Shock. Crit Care 2017; 45:1061-1093.*

Why Was This Parameter Published?

- To assess the changes made and changes in mortality after the last recommendations.
- Only to make changes if there was new research since 2007

Summary of Key Recommendations / Changes

- Continued emphasis on resuscitation in the first hour
    - In the ED goals focused on heart rate, blood pressure and cap refill; antibiotics and reevaluation for fluid overload after each bolus,
    - In the ICU goals focused on ScvO2 >70% and cardiac index 3.3-6; antibiotics and source control
- New recommendation that hemodynamic support be performed at an institutional level
- New protocols for early recognition and action toward resuscitation, performance bundle to sustain adherence to best practice

Pediatric Physiology

- Pediatric septic shock usually associated with hypovolemia – low cardiac output associated with mortality; decrease in oxygen delivery rather than oxygen extraction can depend on etiology; CVC associated with high cardiac output and low systemic vascular resistance,; community acquired infections usually low cardiac output
- Neonates – transition period with increase in peripheral SVR to start (fluids can increase L→R shunting through PDA)– will need therapies directed at reduction in pulmonary artery pressures; hydrocortisone course can decrease need for inotropes in very low birth weight infants with septic shock, pentoxyfilline – not used at our institution, however has been shown to have favorable outcomes in premature infants with sepsis

ED Resuscitation

- Clinical signs – threshold heart rates associated with increased mortality in critically ill infants are HR<90 or HR >160 and in children HR<70 or HR >150, eucardia – mortality 1%, mortality increases to 33% with hypotension and cap refill >3 sec, cold shock easily misdiagnosed in children

- Big emphasis on recognition bundles and initiating care within the first 60 minutes
    - Trigger tools – vital signs, exam and at risk populations
    - IV or IO access within 5 minutes, fluid resus within 30 minutes, antibiotics within 60 minutes, reassess and starting pressors within 60 minutes
- Fluid resuscitation – crystalloid or colloid, start with 20 mL/kg and reassess for fluid overload, commonly need 40-60 mL/kg, use blood for Hg < 10 g/dL, large volume has not been shown to increase incidence of ARDS or cerebral edema
- Intubation – fluid resuscitation first, if continued hemodynamic compromise consider peripheral epinephrine infusion before intubation, prefer ketamine and atropine (especially in infants)
- Inotropes – dobutamine, low dose dopamine, low dose epinephrine; vasodilators if increased SVR
- Vasopressors – epinephrine or dopamine if low SVR, wide pulse pressure; norepinephrine is recommended alone
- Monitoring hemodynamics, mental status and urine output

ICU Monitoring

- ScvO2 >70 has been shown to reduce mortality in multiple studies, supranormal may show over resuscitation or high CO state
- Lactate may be useful, but studies are small numbers
- Very low birth weight infants
    - Ultrasound SVC blood flow measurements can be useful >40 mL/kg/min
    - ScvO2 can be misleading with L→R shunting through PDA
    - Maintain neonatal circulation.
- Invasive monitoring – Cardiac index, perfusion pressure, MAP-CVP or MAP-IAP