Clinical Guideline

Severe Sepsis and Septic shock

Definitions

Systemic Inflammatory Response Syndrome

Must show two of the following four criteria, one of which must be either abnormal temperature or White Cell Count (WCC)

- Core temperature >38.5 °C or <36 °C
- Abnormal WCC for age (high or low) or greater than 10% immature neutrophils
- Tachycardia (or bradycardia in infants)
- Raised respiratory rate or requiring ventilatory support

Sepsis

The presence of SIRS plus infection (suspected by clinical parameters or proven by culture of invasive organism in normally sterile tissue).

Severe Sepsis

Sepsis with evidence of any of the following organ dysfunction

- Cardiovascular organ dysfunction (*see Septic Shock*)
- Acute Respiratory Distress Syndrome (ARDS)
- Two or more other organ dysfunctions
    - Respiratory (need for FiO_2 >50% to maintain SpO_2 >92%, need for ventilation)
    - Neurological (GCS <11/15 or a decrease >3 points from baseline)
    - Haematology (Platelet count <80,000/mm^3, INR >2 normal)
    - Renal (creatinine >2 times upper normal or X2 baseline value)
    - Hepatic (total bilirubin >4 mg/dL or ALT X2 normal value)

Septic shock

Sepsis with cardiovascular organ dysfunction. Cardiovascular organ dysfunction demonstrated by

- hypotension despite fluid resuscitation of 40 ml/kg in 1 hour

- need for inotropes (greater than 5mcg/Kg/min dopamine or any dose Adrenaline, NorAdrenaline or Dobutamine)
- unexplained metabolic acidosis (elevated base deficit >5 mEq/L)
- serum lactate >2 times normal upper limit
- prolonged capillary refill time >5 sec
- oliguria (<0.5mls/Kg/hour urine output)

Assessment

The immediate assessment of a child with suspected sepsis must follow ABC principles aiming to answer two key questions:

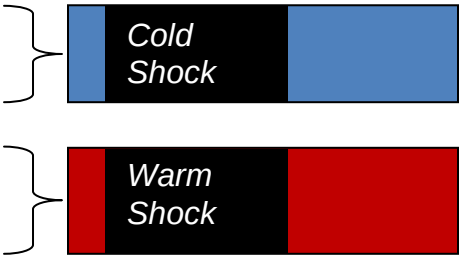
1. **Is the child in shock?**

   Consider a clinical diagnosis of septic shock with the following:
   a. Suspected infection manifested by hyperthermia or hypothermia AND
   b. Clinical signs of inadequate tissue perfusion manifested by any of the following
      i. Decreased or altered mental status

      ii. Prolonged capillary refill time (>2 secs)
      iii. Diminished peripheral pulses
      iv. Mottled cold peripheries

      v. Flash capillary refill time
      vi. Bounding peripheral pulses
      vii. Wide pulse pressure

      viii. Decreased urine output (<1ml/Kg/Hour)



Note that hypotension is not required to make the diagnosis of septic shock; however, its presence is confirmatory.

2. **Is there evidence of organ dysfunction?**

Any child who is in shock and/or has organ dysfunction should be discussed with a consultant paediatric intensivist in PICU, RBHSC

Immediate management

Airway/Breathing

Aims

- Ensure airway patent (call senior anaesthetist EARLY)
- Give high flow oxygen (10-15 L/min via a non-rebreathing mask)

Indications for intubation

- Depressed conscious level (GCS ≤ 8, AVPU ≤P)
- Increased work of breathing
- 40 mls/kg fluid resuscitation given (likely to develop pulmonary oedema)
- Impending cardiorespiratory collapse

Note that up to 40% of Cardiac output is used for work of breathing and intubation/ventilation will help reverse shock

Induction of anaesthesia presents a significant risk in a haemodynamically unstable patient with sepsis. This should be anticipated to allow adequate preparation of drugs and equipment. Some points to consider include:-

1. The most experienced person you can find (e.g. local consultant anaesthetist).
2. Aggressive volume replacement before and during intubation.
3. Adrenaline bolus prepared (0.05-0.1 ml/kg of 1 in 10,000) and available.
4. Pre-oxygenation.
5. IV atropine 10-20 µg/kg pre-induction.
6. Range of ETT sizes prepared (a good fit will be necessary to ensure adequate ventilation in the face of pulmonary oedema. Consider a cuffed ETT if available).
7. Use of optimal drugs for induction. Ketamine and fentanyl are more cardiostable than other IV induction agents. Etomidate in patients with sepsis is not recommended due to an observed increase in mortality after even single dose, possibly due to adrenal suppression.
8. Rapid sequence induction may be necessary.
9. Initially oral intubation may be quicker and safer. Nasal intubation may prove more difficult and be associated with significant bleeding in a coagulopathic patient.

Circulation

Aims

- Obtain secure vascular access. If the child is shocked do not persist with attempting venous access for more than 90 seconds. Proceed to insertion of an intra-osseous needle (e.g. in anterior tibia) for resuscitation.
- Immediate fluid resuscitation with 20 mls/Kg fluid boluses (isotonic saline or colloid) over 5 minutes. Re-assessment after each bolus to ascertain if signs of shock have resolved, or if signs of fluid overload (hepatomegaly, pulmonary crackles) develop. Multiple boluses may be required (commonly 40-60 mls/Kg, but can be as much as 200 mls/Kg).
- In the presence of fluid refractory shock (ongoing shock despite 40-60 mls/Kg fluid), inotropic support should be initiated. Initially consider a peripheral inotrope whilst obtaining central venous access i.e. Dopamine up to 10 µg/kg/min.
- If shock persists despite fluid therapy and dopamine consider adding adrenaline 0.1-1.0 µg/kg/min for cold shock or noradrenaline 0.1-1.0 µg/kg/min for warm shock. Both agents may used together. Administer adrenaline and noradrenaline via IO needle if no central access is immediately available.
- Discuss with PICU consultant if inotropic support is escalating rapidly. Consider using milrinone or vasopressin infusions (consult PICU for doses).
- Consider IV hydrocortisone 1-2mg/kg 6 hourly if at risk for absolute adrenal insufficiency. At risk groups include purpura fulminans, congenital adrenal hyperplasia, prior recent steroid therapy and/or hypothalamic/pituitary axis abnormality. Draw blood for a baseline cortisol level but do not wait for analysis.

Antibiotics

- Community acquired child > 1 month - cefotaxime
- Hospital acquired child > 1month – amikacin and Tazocin or meropenem
- Abdominal source – amikacin/metronidazole/benzylpenicillin
- Neonate < 1 month – benzylpenicillin, amikacin/gentamicin + acyclovir

Ceftriaxone should be avoided as a first line antibiotic in septic patients likely to receive calcium corrections due to the risk of severe precipitation.

Further management following intubation

- Commence sedation
    - Morphine
    - Midazolam
    - Ketamine
- Ensure ETT is well secured.
- Use low tidal volume (4-7ml/kg) ventilation with PEEP and low PIP.
- Ensure adequate central venous and arterial access. First choice site for CVL is the femoral vein. Neck lines carry an increased risk of complications in the presence of coagulopathy; insertion should therefore be under ultrasound guidance.
- Correct laboratory findings
    - Treat any coagulopathy/ thrombocytopaenia
    - Treat hypo/hyperkalaemia, hypoglycaemia and hypocalcaemia
    - Consider sodium bicarbonate for intractable acidosis

Transport considerations

- Prepare fluid boluses and adrenaline before journey
- Prepare and connect appropriate inotropes ready to commence immediately if necessary.
- If cardiovascular collapse is imminent, the patient should also be discussed with the ECMO team.