Scottish Paediatric Retrieval Service (Edinburgh)

www.paedsretrieval.com

Clinical Guideline – SEPSIS

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<td>Paediatric Sepsis 6</td>
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Aims
• To outline management of paediatric sepsis and septic shock

Background
• Sepsis is a common life-threatening condition
• Early recognition and prompt goal-directed therapy improves outcome
• Mortality in children with sepsis is associated with severe hypovolaemia and low cardiac output (mortality doubles for every hour that a child remains in shock).

Application
• Retrieval team, referring hospital paediatric emergency teams

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**Management of Sepsis ACTION CHART**

**Assessment & Recognition**
If a child with suspected or proven infection AND has at least 2 of the following:
- Core temperature < 36°C or > 38.5°C
- Inappropriate tachycardia (Refer to local PEWS / APLS Guidance)
- Altered mental state (including: sleepiness / irritability / lethargy / floppiness)

Reduction in peripheral perfusion / prolonged capillary refill

**Initial Resuscitation**
20ml/kg 0.9% saline boluses up to and over 60ml/kg as required until perfusion improves or signs of heart failure (crackles, gallop rhythm, hepatomegaly) appear

**Correct Hypoglycaemia**
Give 2ml/kg 10% dextrose boluses as required with follow-on infusion

**Inotropic Support**
Commence peripherally or via IO needle initially
Adrenaline (0.01-1mcg/kg/min) – use PICU drug calculator ([www.paedsretrieval.com](http://www.paedsretrieval.com)) and 2-person check

**Intubation**
High-risk procedure
Ensure adequate volume and inotropes running pre-RSI
Have emergency drugs to hand

**COLD SHOCK**
Central adrenaline

**WARM SHOCK**
Central adrenaline + noradrenaline

**Catecholamine resistant shock**
Continue volume resuscitation
Hydrocortisone (1mg/kg qds)
Calcium (0.5ml/kg 10% calcium gluconate)
Consider bicarbonate correction

**Ventilation**
Lung-protective 4-7ml/kg TV with PEEP ≥ 5
Sedate & paralyse with drugs as per PICU drug calculator

**Coagulopathy**
Correct early with FFP, platelets, cryoprecipitate as required
Give blood if Hb < 10g/dl

Start Paediatric Sepsis Six Bundle (appendix)

Consider 5% albumin as alternative to saline

Consult with PICU Consultant if not before now

Re-assess clinical state frequently

Move patient to a high dependency environment
ASSESSMENT & RECOGNITION (early recognition encourages prompt treatment)

**SIRS** – systemic inflammatory response syndrome
- Temp >38.5 or <36
- Abnormal heart rate (inappropriate tachycardia or bradycardia) – referral to PEWS
- Tachypnoea (or pCO2 <4.2kPa)
- WCC >12 or <4 or >10% band forms
- Hyperglycaemia, altered mental status, increased CRT

**Sepsis** – SIRS with a suspected or confirmed bacterial, viral or fungal cause.

**Severe Sepsis** – sepsis with evidence of organ hypoperfusion or dysfunction (eg serum lactate >4)

**Septic Shock** – sepsis with fluid refractory hypotension and signs of hypoperfusion

**Shock** in children can be described as **cold shock** or **warm shock**:

- The majority of children with sepsis who present in a shocked state will require inotropic support in the first 48hrs – the first inotrope of choice is **adrenaline**.
- Most of these children will demonstrate a **cold** shock picture
  - *Cold Shock* refers to a normal / low cardiac output (CO) and high systemic vascular resistance (SVR) – i.e. cold peripheries, mottled skin.
  - *Warm Shock* is less common and is characterized by a normal / high CO and low SVR – i.e. warm peripheries, flash CRT.

**AIMS / GOALS OF INITIAL TREATMENT** (target is within 1 hour of recognition)

To restore:
1. normal perfusion
2. normal HR, RR and BP for age
3. normal mental status (unless meningitis)
4. urine output >1ml/kg/hr
5. serum lactate <2mmol/L
6. serum Hb >10g/dl
7. Take samples for culture and give antibiotics

Actions:
- High flow O2, secure and maintain airway as required for poor responsiveness (P or U on AVPU scale)
• Follow ABCDE principles – don’t forget BM measurement (hypoglycaemia is more common in children with septic shock).
• Establish IV access – don’t waste time trying peripheral IV access – go for IO if no success within a few minutes.
• Fluid resuscitation – 20ml/kg 0.9% saline as a rapid IV bolus over 5-10 mins, repeated up to 60ml/kg until perfusion improves or signs of cardiac failure develop (repeat clinical assessment is very important in children).
• Correct hypoglycaemia – use 2ml/kg boluses of 10% dextrose repeated if needed to normalise BM, followed by a continuous infusion.
• Give antibiotics after taking blood for culture
  o Lothian policy is cefotaxime 50mg/kg if under 3 months and ceftriaxone 80mg/kg if older than 3 months. Consider adding clindamycin for suspected streptococcal infection.

If shock is not reversed after the above initial actions:
• Prepare inotropes for peripheral IV / IO infusion (see below)
• Call local anaesthetic team to prepare for intubation & ventilation
• Call PICU Edinburgh to mobilise retrieval team and for ongoing clinical advice

INOTROPIC SUPPORT

 o Do not delay starting inotropes in the child with fluid-refractory shock – mortality increases for every hour spent in the shocked state.
 o Use the paediatric drug calculator found via the retrieval service website to help with dosing and correct composition of inotropic medication.
   • http://www.snprs-wordpress.scot.nhs.uk/?page_id=152
 o Adrenaline is recommended first-line for both types of shock and can be given peripherally:
   • Intra-osseous access can be used as central access until a definitive central venous catheter has been inserted
   • Adrenaline - best inotrope for cold shock
     o Dose: 0.01-1mcg/kg/min
     o Monitor the IV site closely for any sign of extravasation if started peripherally
     o Intra-osseous access can be used as central access until more definitive central venous access is obtained.
   • Noradrenaline
     o Best inotrope for warm shock
     o Can be added to adrenaline if shock still present despite adequate volume loading and adrenaline dosing
     o Dose: 0.01-1mcg/kg/min
     o Must be run via central venous access
INTUBATION / VENTILATION

- Correct timing of intubation & ventilation can be difficult. Unless the airway is at imminent risk, this should be delayed until adequate resuscitation including inotropic support has been administered.
- Intubation & ventilation should be performed by rapid sequence induction (RSI) by appropriately trained staff. **In the haemodynamically unstable child this is a high-risk intervention** – have inotropic medication (adrenaline) running prior to induction of anaesthesia. Use a checklist if available with due consideration to non-technical skills – communicate with your team and have a plan B. This must include anticipation of cardiovascular collapse on induction and failed intubation.
- Administer CPAP via a T-piece circuit to enhance pre-oxygenation.
- Recommended drugs for RSI in this setting:
  - Ketamine 0.5-2mg/kg
  - Suxamethonium 2mg/kg
  - Atropine 20mcg/kg (to hand)
  - Avoid cardiovascular depressant drugs such as propofol, thiopentone and inhalational volatile anaesthetic agents
- Ventilation
  - Mechanical ventilation reduces the work of breathing and can improve cardiac output by reducing LV afterload (beware excessive tidal volumes / PIP which can impair cardiac filling)
  - EtCO2 monitoring is essential
  - Secure ETT with tape
  - Check ETT position on CXR (aim for tip at T2/3 level)
  - Low-tidal volume strategy is recommended due to risk of ARDS
    - 4-7ml/kg
    - PEEP at least 5cmH2O
  - Sedate & paralyse with morphine / midazolam / rocuronium as appropriate

CENTRAL VENOUS & ARTERIAL CATHETER INSERTION

- CVC should take precedence to allow safe & accurate titration of inotropes
- Femoral access is easiest – use ultrasound guidance if available
  - Triple lumen lines are preferable
- Measure the central venous pressure (CVP) and aim for **10-14mmHg**
  - <10 – give more volume
  - >14 – increase inotropic medication
COAGULOPATHY

- Common in sepsis
- Ensure blood for cross-matching is taken at presentation
- Consider activating the Major Haemorrhage Protocol if significant volumes of blood products are needed and the child remains critically ill
- FFP is first-line for immediate treatment of prolonged PT / APTT and is also a good fluid for volume resuscitation. Vitamin K can also be given (delayed response however)
- Use platelets for low platelet count
- Liaise early with a haematologist to advise on correct blood product use

STEROIDS

- Hydrocortisone by preference
- Indicated for catecholamine-resistant severe septic shock
- Dose is 1mg/kg every 6 hours (max 100mg per dose)
- NB. This guidance does not cover that for steroid therapy in prevention of hearing loss in meningitis.

ELECTROLYTES

- Calcium
  - Maintain a normal ionised calcium as hypocalcaemia will contribute to persistent shock and cardiac dysfunction. Use 0.5ml/kg of 10% calcium gluconate. Re-assess and repeat if necessary. The ionised calcium is measured via a blood gas analyser.
- Magnesium
  - Maintain a normal magnesium. The correction dose is 0.2mmol/kg titrated to effect (can cause hypotension if given too quickly). 50% MgSO4 solution is equivalent to 2mmol/ml.

CLINICAL SCENARIOS

If you are still not improving adequately.....

- Re-assess and re-examine the child
- Consider other reversible causes for the shocked state and actively rule-out if appropriate (eg echo for cardiogenic shock)
- Discuss early with a PICU Intensivist
- Consider referral to an ECMO centre (Glasgow Yorkhill Hospital is national centre for Scotland)
1. **Cold Shock with normal blood pressure**
   a. Titrate further volume and adrenaline, maintain Hb > 10g/dl
   b. Consider a vasodilator with volume loading (eg. Milrinone)

2. **Cold Shock with low blood pressure**
   a. As for 1a above
   b. If remains hypotensive consider adding noradrenaline
   c. Consider a vasodilator after steps a+b (eg. Milrinone)

3. **Warm shock with low blood pressure**
   a. Titrate further volume, adrenaline and noradrenaline, maintain Hb >10g/dl
   b. If remains hypotensive consider vasopressin

**References**


Dibb-Fuller E, Liversedge T. Management of Paediatric Sepsis – Anaesthesia tutorial of the week 278 (28/1/2013)


Surviving Sepsis Campaign [www.survivingsepsis.org](http://www.survivingsepsis.org) (with reference to special considerations in Paediatrics)

Early Management of Meningococcal Disease in Children. [www.meningitis.org](http://www.meningitis.org)

Paediatric Sepsis 6

Severe sepsis is a CLINICAL EMERGENCY. Early treatment improves outcomes.

Recognition: A child with suspected or proven infection AND at least 2 of the following:
- Core temperature < 36°C or > 38°C (observed or reported in previous 4 hours)
- Inappropriate tachycardia (Refer to National PEWS)
- Altered mental state (including: sleepiness / irritability / lethargy / floppiness)
- Reduced peripheral perfusion / prolonged capillary refill / cool or mottled peripheries

Reduce Threshold:
Some children are at higher risk of sepsis. You may consider treatment with fewer signs than above. These include, but are not restricted to:
- Infants < 3/12
- Immunosuppressed / Immunocompromised / chemotherapy / long term steroids
- Recent surgery
- Indwelling devices / lines
- Complex neurodisability / Long term conditions (may not present with high PEWS but observations may vary from their baseline)
- High index of clinical suspicion (tachypnoea, rash, leg pain, biphasic illness, poor feeding)
- Significant parental concern

Think is this SEPSIS? If yes

Respond with Paediatric Sepsis 6 within 1 hour:
1. Give high flow oxygen
2. Obtain intravenous or intraosseous access and take blood tests:
   - Blood cultures
   - Blood glucose - treat low blood glucose
   - Blood lactate (or gas)
3. Give IV or IO antibiotics: Broad spectrum as per local policy
   If shocked:
4. Consider fluid resuscitation:
   - Titrate 20 ml/kg isotonic fluid over 5 - 10 min and repeat if necessary
   - Aim to reverse shock – trend to normal heart rate, BP and peripheral perfusion
   - assess for fluid overload after ≥ 40 ml/kg fluids.
   - If no signs of fluid overload and remains shocked titrate further 20mls/kg fluid
5. Consider inotropic support early:
   - Adrenaline (reconstitute whilst administering 3rd fluid bolus. 0.5mg/kg in 50mls 5% dextrose. Commence 1ml/hr = 0.1mcg/kg/min).
   - Can be given via peripheral IV or IO access
6. Involve senior clinicians / specialists early:
   - Discuss with PICU if inotropes commenced