Protocol for management of patients with SEPTIC SHOCK

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DEFINITIONS

Systemic Inflammatory Response Syndrome

Two or more of the following manifests the response to a variety of insults:

Temperature >38’C or <36’C
Tachycardia
Tachypnoea
WCC >12 or < 4 or >10% immature forms

Sepsis

SIRS resulting from a documented infection

Severe Sepsis

Sepsis associated with organ dysfunction, hypoperfusion or hypotension. Hypoperfusion abnormalities may include, but are not limited to, lactic acidosis, oliguria or an acute alteration in mental state.

Septic Shock

Severe sepsis with hypotension in the absence of other causes for hypotension despite adequate fluid resuscitation.

Refractory Shock

Shock unresponsive to conventional therapy (intravenous fluids and inotropic/ vasoactive agents) within one hour.

Warm Shock: septic shock with peripheral vasodilatation, flash capillary refill, bounding pulses.

Cold Shock: Septic shock with cool extremities. Capillary refill >2 secs, diminished pulses, mottled extremities.

ASSESSMENT and TREATMENT

Aggressive fluid resuscitation should be instigated before PICU

Make the diagnosis:

N.B Be aware of child's environment e.g. may have cool peripheries if completely exposed in A&E.

Decreased mental status
Increased PR and RR
Reduced BP
Urine Output < 0.5mls/kg/hr
Capillary Refill Time > 3secs
Difference between core and peripheral temperature (normally @ 0.5'C)

In the first hour:

Goals:
- Improve mental status
- Normalisation of HR and MAP
- Urine Output > 0.5–1 ml/kg/hr
- CVP (if present) 8-12 mmHg
- Improvement of oxygenation: sats >90% or PaO2> 10 kPa

1) Intravenous Access

2 large bore peripheral cannulae are satisfactory in the first instance but may require central and arterial line placement

Intraosseous needle if not able to get iv line. **DO NOT REMOVE** once placed.

2) Fluid Resuscitation

Crystalloid/ Colloid what actual fluid you give depends where you are: N/Saline, Hartmann's, HAS 4.5%

- 20 or 10mls/kg respectively as a bolus
- Repeat as necessary to gain normal physiological parameters, up to 50mls/kg.
- After this inotropes/vasopressors may need to be started, in addition to further fluid resuscitation
- Consider patient for elective ventilation, contact PICU if not already done so.

Reassess after every fluid bolus

3) <u>Monitoring</u>

Standard: ECG
Blood Pressure
Temperature (peripheral and central)
Oxygen Saturation
Respiratory and pulse rate
Level of Consciousness: GCS or AVPU
Pupil size and reactivity
Urinary catheter: hourly monitoring

Invasive May be needed from the start, certainly will be needed if no response to 50mls/kg if fluids. Most patients will need to be intubated for these procedures.

Central and arterial lines (Ultrasound may be required)

4) <u>Intubation, Ventilation and Sedation</u>

There are many reasons for intubating these patients:

- Not able to protect airway due to reduced mental status
- Hypoxia despite non-invasive oxygen therapy
- Pulmonary oedema, aggressive fluid replacement
- Line placement

Usually these patients are very sick and therefore it is important to try and resuscitate them as much as possible. There is also a high risk that the patient will have a cardiac arrest on induction therefore prepare for the worst!

→ RAPID SEQUENCE INTUBATION

Consider cuffed ET tube

<u>Drugs to use</u>:

Ketamine 1-4.5 mg/kg iv (N.B. raised ICP) or
Etomidate 0.2-0.3 mg/kg iv **plus**

Suxamethonium 1-2 mg/kg iv (caution if high potassium but benefits outweigh risks) or rocuronium 0.6 mg/kg iv

→ SEDATION POST INTUBATION

Morphine	1 x wt (kg) = no. of mg to be added to 5 or 10% Dextrose to make a volume of 50mls. 1ml/hr = 20mcg/kg/hr run at 10-40 mcg/kg/hr
Midazolam	6 x wt (kg) = no. of mg to be added to 5 or 10% Dextrose to make a total volume of 50mls. 1ml/hr = 2mcg/kg/hr run at 1-6 mcg/kg/min
Muscle relaxants (if necessary):	atracurium 10mg/ml (neat) run at 0.5-1 mg/kg/hr
→ VENTILATION	Tidal volume 5-7 ml/kg PEEP 5 to start with, may need to be a lot higher PaCO2 4-4.5 kPa but allow permissive hypercapnia if requiring high pressures to achieve normocapnia avoid extreme respiratory acidosis

5) Investigations

Blood: FBC, U&E, CRP, Ca/Mg/PO4, Glucose, LFT's, Clotting, amylase, G&S, ABG and lactate.

Need to repeat U&E's, FBC and clotting every 6hrs if not more frequently

Micro: Cultures from-
- blood (ideally line and peripheral)
- urine
- ET secretions
- think about- NPA, stool (virology as well)
- PCR

NOT FOR LUMBAR PUNCTURE

XR: chest

6) Inotropes

These should be initiated if no response in parameters after adequate fluid resuscitation. Patients may only need one inotrope but do not be surprised if they need two (or more).

Ideally they should all be run centrally but in a crisis are given by whatever access you have.

WARM SHOCK: **1st**: Dopamine 2-20 mcg/kg/min (30 x wt in kg = no. mg to be added to 5 or 10% Dextrose to make up to 50mls, 1ml/hr = 10mcg/kg/min).

2nd: Adrenaline 0.05-1 mcg/kg/min (0.3 x wt in kg = no. of mg to be added to 5or 10%Dextrose to make up to 50mls, 1ml/hr = 0.1mcg/kg/min.

or

Noradrenaline 0.05-1 mcg/kg/min (made up as adrenaline).

COLD SHOCK: Dobutamine 2.5-20 mcg/kg/min (made up as dopamine).

If no response to first agent then Adrenaline/ Noradrenaline or both may be added

If unsure start Adrenaline +/- Noradrenaline

CONTINUE FLUID RESUSCITATION

7) Antibiotics

Broad spectrum high doses intravenously, educated guess on most likely cause.
Ideally started after blood cultures taken **but should not be DELAYED**
Review after 48-72hrs

Neonates (less than 6/52): amoxicillin (to cover Listeria) and cefotaxime or gentamicin

-cefotaxime: 50 mg/kg: < 7/7 old 12 hrly; 7-21/7 old 8 hrly; 21-28/7 old 6-8 hrly

-amoxicillin: < 7/7 old 100 mg/kg 12 hrly; 7-28/7 old 100 mg/kg 8 hrly; > 1/12 50 mg/kg 4-6 hrly (max 2 g/4hrs)

-gentamicin: 2.5 mg/kg:
for premature babies: <29/40 - per 24hrs, 29-35/40 - per 18hrs, >35/40 12hrly.
>1/12 – 12yr: 2.5 mg/kg 8hrly

Older children (> 6/52): cefotaxime

- 50mg/kg (max 12g daily) 6hrly

8) Acid-Base and Electrolytes:

Acid-Base: Normally patients will have a metabolic acidosis, correcting this may improve their cardiac function.
If not improving with treatment:
- -pH< 7.15 check chloride level as may be iatrogenic,
- -if chloride level not high then Na Bicarbonate (weight x base deficit x 0.30 mmol). Infuse half this amount over 30mins and then recheck blood gas

If not improving with above treatment may need Renal Replacement Therapy.

Electrolytes: all abnormalities should be corrected
reassess after correction and repeat U&E's

Some of the more common ones:

Magnesium: treat if < 0.75 mmol/l target >0.75 mmol/l
50% $MgSO_4$ in 2 ml ampoule. 1 ml=2 mmol Mg
0.2 ml/kg over 30 mins
max 10 ml

Calcium: if total Ca < 2 or ionised Ca < 1.0 mmol/l
target - total Ca > 2 or ionised Ca > 1.0 mmol/l

1. Calcium Gluconate 10% (1 ml = 0.22 mmol Ca)

   0.3 ml/kg over 30 mins
   max 20 mls

2. Calcium Chloride 10% (1 ml = 0.7 mmol Ca)

   0.1 ml/kg over 30 mins
   max 10 mls

Potassium: treat if < 3.5 mmol/l target > 3.5 mmol/l
15% solution of KCl (1 ml=2 mmol Potassium and 2 mmol Chloride)
0.4 mmol/kg/dose over 1 hour
maximum infusion rate is **10 mmol/hr**
dilute ampoule with N/Saline or 5% Dextrose to a concentration of 0.5mmol K/ml

Hypoglycaemia: treat glucose < 3 mmol/l
5 ml/kg 10% Dextrose bolus, then dextrose infusion at 80% of maintenance requirements over 24 hrs

10) Clotting abnormalities:

Need to know the fibrinogen value, may need advice from the on-call haematologist.

INR: correction needed if > 2.0
FFP 10 mls/kg **BUT**
if fibrinogen low (< 1.0) give cryoprecipitate 5 mls/kg

APPT: Correction if > 50, FFP as above

Platelets: Corrected if < 50*, platelets 10 mls/kg
MUST NEVER be given as a bolus

*may need to correct if higher if need to perform invasive procedures, but if not actively bleeding may decide to monitor.

Vitamin K 0.3 mg/kg iv for 3 – 5 days

10) Feeding:

Insert NG tube
Aim to start feed as soon as possible
Ranitidine to be prescribed 1mg/kg iv tds (reduce dose in renal failure)

11) Other therapies started either on PICU or with their advice:

Glucose levels: may have elevated glucose levels due to inotropes
aim to keep level ~8mmol/l, monitor every 30-60mins until stabilised then every 4hrs
Actrapid 50 units in 50 mls N/saline, run 0.05 – 0.1 unit/kg/hr

Raised ICP decreasing or fluctuating level of consciousness
Hypertension and relative bradycardia
Unequal, dilated or poorly reacting pupils
Focal neurological signs
Abnormal posturing or seizures
Papilloedema (late sign)

Mannitol 0.25 g/kg bolus followed by frusemide 1 mg/kg

30 degree head elevation, midline position

Seizures as per hospital protocol

Steroids: consider if either unresponsive, or a poor response to inotropes
Hydrocortisone 2mg/kg qds

Renal Replacement: may be required for correction of pH/ Potassium/ Fluid Balance
Consultant decision, can cause a further deterioration in patient

Vasopressin: also used to improve mean arterial pressures if already on maximum inotrope concentrations
0.001 u/kg/min

Fasciotomies: if concern about Compartment Syndrome and ischaemia contact Vascular Surgeons

12) Family and patient prophylaxis

May need antibiotic cover: close contacts who have had prolonged contact in a household type setting during the 7 days before onset of illness
e.g. living and sleeping in same household (including extended household)
pupils in the same dorm

Rifampicin and Ceftriaxone can be used if pregnant or breastfeeding

Rifampicin (PO)

Neonate-1yr: 5mg/kg bd for 2 days
1-12yrs: 10mg/kg (max 600mg) bd for 2 days
12-18yrs: 600mg bd for 2 days

Advice needed re: side effects,
staining of contact lenses and nappies,
if on OCP or Progesterone only Pill- extra precautions

Ciprofloxacin (PO)

5-12yrs: 250mg single dose
12-18yrs: 500mg single dose

Ceftriaxone (IM)

12-18yrs: 250mg single dose reconstitute with 2mls 1% lidocaine.

Infection Control and Public Health need to be informed.

REASSESS, REASSESS, REASSESS

If in doubt ask for senior advice

References:

Early management of meningococcal disease: Meningitis Research foundation

Clinical practice parameters for haemodynamic support of paediatric and neonatal patients in septic shock: Crit Care Med 2002 Vol 30, No 6: 1365-1377

Surviving Sepsis Campaign guidelines for management of severe sepsis and septic shock: Crit Care Med 2004 Vol 32, No 3: 858-873

Health Protection Agency: www.hpa.org.uk