



Shock

Sept 2014

Circulatory insufficiency - imbalance between O₂ supply/demand - decr tissue perfusion - anaerobic metabolism

Causes

Hypovolaemic > cardiogenic (likely if HR <30 / >150)

Obstructive (eg. tension pneumothorax)

Redistributive (eg. septic, neurogenic, anaphylaxis)

Effects

CV Incr HR, peri vasoconstriction, incr myocardial contractility, intracellular vol depletion, generalised vasodilation from endothelial production of NO - myocardial depression; incr renin/aldosterone/ADH/ACTH

RS Shift curve to R (let go of O₂); incr RR

GI Decr motility, splanchnic vasoC, ischaemia

GU Decr renal blood flow if O₂ delivery <50% normal; incr GFR; incr Na and H₂O reabsorption; ATN

Autoimmune Decr WBC function

Haem Microvascular thrombosis, incr coagulation (decr if T <32), incr plt adhesion, haemoconcentration, hyperK, hypoNa, hyper/hypoG, incr lactate

Classification

- I** Blood loss <750ml; % loss <15
HR <100, BP Normal, CRT Normal, RR 14-20, UO >30ml/hr
Fluid responsive
- II** Blood loss 750-1500; % loss 15-30%
HR >100, BP Normal, CRT Incr, RR 20-30, UO 20-30ml/hr
Fluid responsive
- III** Blood loss 1500-2000ml; % loss 30-40%
HR >120, BP Decr, CRT Incr, RR 30-40, UO 5-15ml/hr
Transient fluid responsiveness
- IV** Blood loss >2000ml; % loss >40%
HR >140, BP V low, CRT V incr, RR >35, UO <5ml/hr
Incomplete fluid responsiveness

Assessment

BP Radial = SBP 80; femoral = 70; carotid = 60

SBP <110 - incr risk of mortality (5% for every 10 below 110 - 25% mortality at SBP 60)

Postural BP - normal = incr HR 7-13, decr SBP 4, incr DBP 5

Incr HR >30 (97% sens, 98% spec for 1L blood loss); decr SBP >20 (30% sens/80% spec for hypovolaemia)

HR >100

CRT >2secs

Dry MM 75% sens, 65% spec for hypovolaemia; skin turgor useless

ECG eg. Pericardial tamponade, PE; R wave amplitude in II correlates with hypovolaemia

CXR eg. pneumoT, aortic dissection

USS eg. AAA

IVC: measured 1-2cm from RA on end-exp and insp; IVC may be larger in athletes

normal = 15-20mm, 5mm decr during insp (from 16mm)

hypovolaemia = <15mm, with >40% collapse on inspiration

hypervolaemia = >20mm, without any insp collapse

Echo PE, valves, dyskinesia, tamponade

Bloods Lactic acidosis; FBC, AGMA, DIC, beta-hCG, BSL



Management

Endpoints (in septic shock)

UO >0.5ml/kg/hr

CVP 8-12

MAP 65-90

ScvO₂ >70

Treat cause eg. MI, arrhythmia, blood loss, pneumothorax

A

Be careful with PEEP/IPPV, sedatives

Consider vol resus before RSI

B

Aim SaO₂ >93%, paCO₂ 35-40

Aim to decr WOB

C

Raise legs - if works, IVF bolus

IVF

20ml/kg IV bolus crystalloid - repeat at 15 mins if no response

Aim UO 0.5ml/kg/hr (1ml/kg/hr in children, 2ml/kg/hr in infants)

Watch for signs of CCF (eg. If CVP rise >3, then R heart non-compliant and no benefit from more IVF)

Don't give if uncontrolled haemorrhage/CCF/non-compliant RV

Prehospital IVF not found to be useful if transport times <20mins

Vaspressors

Use if inadequate response to IVF or IVF CI'ed

Esp important in elderly with significant CAD/CVD to prevent complications of low BP

Blood transfusion

Aim Hb >10 to improve O₂ carrying capacity of blood

Immediate OT

If haemothorax >1500ml, IVC expiratory diameter <7mm in trauma, large amount FF on FAST in trauma, IVC incr <3mm post-fluid resus in trauma, leaking AAA, ectopic pregnancy

Hypotensive resuscitation

For uncontrolled haemorrhage (not self-limiting without OT) = penetrating, sometimes blunt, coagulopathy, no response to initial IVF bolus (eg. leaking AAA, thoracic aortic dissection, penetrating, epistaxis; ??in ectopic, APH, PPH, GI haem, some blunt) and early intervention to control bleeding possible

Aim SBP 60-80, MAP 40 (higher in old, pregnant, HI)

Pros

Incr BP - incr perfusion to bleeding site, dislodgement of thrombus, loss of vascular spasm

Infusion of blood components - cellular damage, poor O₂ carriage, poor clotting

Cons

Renal failure, myocardial/mesenteric/cerebral/fetal ischaemia

Unclear effects on long term mortality and organ failure

Nearly all trials young patients with penetrating injury

Contraindications

Controlled haemorrhage

Evidence of severe end organ hypoperfusion (eg. MI, ARF)

HI

Causes of 'unresponsive shock' (shock not responding to fluids)

1. Adrenal crisis

2. Neurogenic shock

3. Toxicological