

Management of Shock

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- Different types of shock
- Early detection
- General Management
- Pathophysiology
- Management
- IV fluid



Different types

- Distributive shock
 - Anaphylactic shock
 - Septic shock
- Cardiogenic shock
- Hypovolaemic shock
 - Haemorrhagic shock
 - Fluid loss/ Inadequate intake
- Obstructive shock
 - Valve thrombosis, cardiac tamponade
- Combined



Resuscitation Guidelines 2010

- Prevent Cardiac arrest
 - Recognition of patients at risk of cardiac arrest
 - Use Track & trigger system (Early warning scores)
 - BP, HR,
 - Respiratory rate, O2 saturation
 - Urine output,
 - Conscious level – AVPU
 - Temp
 - Rapid response system (Out reach team)
 - ABCDE approach
 - Use structured communication (SBAR)
 - Situation, Background, Assessment, Recommendation



Early warning Scoring system

- National EWS
- Local (Barnsley)
- Inadequate O2 delivery despite
 - Normotensive
 - Hypertensive



NEWS

PHYSIOLOGICAL PARAMETERS	3	2	1	0	1	2	3
Respiration Rate	≤8		9 - 11	12 - 20		21 - 24	≥25
Oxygen Saturations	≤91	92 - 93	94 - 95	≥96			
Any Supplemental Oxygen		Yes		No			
Temperature	≤35.0		35.1 - 36.0	36.1 - 38.0	38.1 - 39.0	≥39.1	
Systolic BP	≤90	91 - 100	101 - 110	111 - 219			≥220
Heart Rate	≤40		41 - 50	51 - 90	91 - 110	111 - 130	≥131
Level of Consciousness				A			V, P, or U

Barnsley EWS

	3	2	1	0	1	2	3	
HR	<40	41-44	45-59	60-90	91-110	111-129	130	
BP syst		<85	85-95	96-160	161-190	>191		
Resps		<10		10-20	21-25	26-34	35+	
Oxygen Saturation			Less than 94%					
Temp	<35.5			36-38			>38	

Conscious level



NEW scores	Clinical risk
0	Low
Aggregate 1-4	
RED score* (Individual parameter scoring 3)	Medium
Aggregate 5-6	
Aggregate 7 or more	High

NEWS KEY 0 1 2 3		NAME:	D.O.B.	ADMISSION DATE:
DATE TIME				DATE TIME
RESP. RATE	≥25		3	≥25
	21-24		2	21-24
	12-20		1	12-20
	9-11		1	9-11
≤8		3	≤8	
SpO ₂	≥96			≥96
	94-95		1	94-95
	92-93		2	92-93
	≤91		3	≤91
Inspired O ₂ %	%		2	%
TEMP	≥39°		2	≥39°
	38°		1	38°
	37°			37°
	36°		1	36°
	≤35°		3	≤35°
NEW SCORE uses Systolic BP	230		3	230
	220			220
	210			210
	200			200
	190			190
	180			180
	170			170
	160			160
	150			150
	140			140
	130			130
	120			120
	110		1	110
	100		2	100
	90			90
	80			80
70		3	70	
60			60	
50			50	
HEART RATE	>140		3	>140
	130		2	130
	120			120
	110			110
	100		1	100
	90			90
	80			80
	70			70
	60			60
	50		1	50
	40			40
30		3	30	
Level of Consciousness	Alert V / P / U			Alert V / P / U
BLOOD SUGAR				Bld Sugar
TOTAL NEW SCORE				TOTAL SCORE
Additional Parameters	Pain Score			Pain Score
	Urine Output			Urine Output
	Monitoring Frequency			Monitor Freq
	Escalation Plan Y/N/n/a			Escal Plan
Initials				Initials

NEWS SCORE	FREQUENCY OF MONITORING	CLINICAL RESPONSE
0	Minimum 12 hourly	<ul style="list-style-type: none"> Continue routine NEWS monitoring with every set of observations
Total: 1-4	Minimum 4-6 hourly	<ul style="list-style-type: none"> Inform registered nurse who must assess the patient; Registered nurse to decide if increased frequency of monitoring and / or escalation of clinical care is required;
Total: 5 or more or 3 in one parameter	Increased frequency to a minimum of 1 hourly	<ul style="list-style-type: none"> Registered nurse to urgently inform the medical team caring for the patient; Urgent assessment by a clinician with core competencies to assess acutely ill patients; Clinical care in an environment with monitoring facilities;
Total: 7 or more	Continuous monitoring of vital signs	<ul style="list-style-type: none"> Registered nurse to immediately inform the medical team caring for the patient – this should be at least at Specialist Registrar level; Emergency assessment by a clinical team with critical care competencies, which also includes a practitioner/s with advanced airway skills; Consider transfer of Clinical care to a level 2 or 3 care facility, i.e. higher dependency or ITU;

Anaphylaxis

- Risk factors for severe anaphylaxis
 - Asthma
 - Medication
 - β blocker (May need Glucagon 1 mg IV)
 - Angiotensin converting enzyme inhibitors, NSAID
 - Acute respiratory infection
 - Mastocytosis
 - Alcohol, emotional stress, fever



Anaphylactic shock

- Call for help
 - Atypical presentation during anaesthesia
- Check A, B , C
- High flow O₂ (100% O₂)
- CPR if required
- Stop giving the triggering drug
 - Latex, Food, blood products



Anaphylactic shock

- Adrenaline
 - As early as possible
 - 0.5- 1 mg IM (repeat 5 minutes)
 - or 300 mcg IM self inject
 - 50-200 mcg IV increments
- IV fluid
- Legs elevated, or recovery position



Anaphylactic shock

- Second line treatment
 - Antihistamine
 - Chlorphenamine 10 mg IV or IM
 - Hydrocortisone 200 mg IV
 - Bronchodilator
- Catecholamine infusion
- Check Arterial blood gases
- Check airway oedema



Anaphylactic shock

- Bronchospasm
 - Salbutamol (nebulizer or IV)
 - Ipratropium
 - IV Aminophylline or Magnesium sulphate
- Observe for delayed problems (Bi-phasic)
- Oral antihistamine & corticosteroid 3 days
- Arrhythmias,
- Coronary spasm, ACS
- Further investigation (allergy diagnosis)
- Incident reporting



General Investigations

- Bedside
 - ECG
 - Haemoglobin
 - Arterial blood gases,
 - Lactate
 - Ultrasound,
 - Echocardiogram



General Investigations

- Bedside
 - ECG
 - Haemoglobin
 - Arterial blood gases,
 - Lactate
 - Ultrasound,
 - Echocardiogram



General Investigations

- Laboratory
 - Full blood count
 - Coagulation, D dimer
 - U & E
 - LFT
 - Cardiac enzymes
 - Cultures (urine, blood, sputum)
 - Toxicology



General Investigations

- Radiology
 - CXR
 - Abdominal X ray
 - Trauma series radiology
 - CT scan
 - Angiography



General Management of Shock

- Supply Oxygen
- Vascular access
- Volume resuscitation
- Vasoactive drugs
- Manage precipitating illness/ injury
- Monitoring§



Fluid responsiveness

- Static measure
 - Intra cardiac pressure
 - CVP (Limitation)
 - Pulmonary artery occlusion pressure
 - Cardiovascular volume
 - Echo – LVEDV
 - Oesophageal Doppler
 - Corrected Flow time
 - Peak velocity



Fluid responsiveness

- Dynaemic measure
 - Responsive to fluid challenge
 - Passive leg raising test
 - Aortic flow
 - Pulse pressure
 - Response to IPPV
 - Systolic pressure variation
 - Pulse pressure variation
 - Stroke volume variation



CVP

- Frank Starling law
- CVP does NOT indicate volume status
- Normal CVP does not exclude hypovolaemia
- High CVP
 - May need fluid, may respond fluid challenge
- Trend may be useful



Other tools to assess Volume status

- Non-invasive cardiac output
 - Pulse contour analysis
 - Oesophageal doppler
 - Thoracic bio-impedance
- Systemic arterial –venous CO₂ difference
- Ultrasound, Echocardiogram



Cardiogenic shock

- Inadequate blood flow despite adequate intravascular volume
- Sustained hypotension with impaired cardiac function
- Systolic <90 mmHg (> 30 min)
- Cardiac index < 2.2 L/min/ m²
- PAOP >15 mmHg
- Clinical (JVP, basal crackles)
- CXR, ECG, Cardiac enzymes
- Echo (choice)



Cardiogenic shock

Causes

- Acute MI
 - Pump failure
- Mechanical complications
 - MR, VSD, Tamponade
- Others
 - Cardiomyopathy
 - Myocarditis
 - Cardiac contusion
 - Septic shock
 - Subarachnoid haemorrhage
 - Massive PE



- **Systolic dysfunction**
 - SV, Cardiac Output reduced
 - Hypotension
 - Reduced coronary perfusion pressure
 - Ischaemia
- **Diastolic dysfunction**
 - Pulmonary congestion
 - Hypoxaemia- Ischaemia
- **RV infarct- Give Fluid (needs high filling pressure)**



Cardiogenic shock Management

- Urgent echocardiogram
- Restore haemodynaemics, oxygenation
 - Avoid arrhythmias
- Without significant pulmonary oedema
 - O₂
 - Fluid challenge
 - Vasopressor
- With pulmonary oedema
 - O₂, CPAP (NIV)
 - Inotropes (Noradrenaline, Dobutamine)



Cardiogenic shock Management

- Vasopressin
- Phosphodiesterase inhibitors (Milrinone)
 - RV infarct
- Levosimendan ?? (calcium sensitizer)
 - Coronary vasodilatation
- Mechanical therapy
 - Intra aortic balloon pump
- Revascularization
 - Thrombolyse, PCI, CABG



Cardiogenic shock

Pathophysiology- Microcirculation

- Microcirculatory function deteriorated during shock
 - Disturb flow to heart & brain
 - Vital organs
- Multi-organ failure
- Monitor
 - Cardiovascular MRI
 - Hand held video microscopy – sublingual microcirculation



Cardiogenic shock

Pathophysiology-

- Persistent inflammatory response (SIRS) in severe heart failure
- Increased vascular permeability
- Increased blood viscosity
- Hypercoagulopathy (platelet activation)
- Endothelial dysfunction (reduced NO)



Vasoactive agents

- Angiotensin II inhibitors
 - Improve microcirculation
- Intravenous Nitroglycerin
- Adrelin- reduce microcirculatory flow
 - Ischaemic vital organs



Fluid resuscitation- Cardiogenic shock

- Fluid loading
- Risk- tissue oedema
- Fluid guided by
 - CVP (No value)
 - Sublingual flow
 - Oxygen extraction ratio- hypothermia



Heart rescue (ACS)

- Coronary revascularization
 - Fibrinolytic therapy
 - PCI (within 90 min)
 - CABG
- Cardiac surgery (VSD, Acute MR)
- Mechanical circulatory support
 - Intra –aortic balloon pump
- LMWH
- Antiplatelets



Post cardiac arrest

- Therapeutic hypothermia
 - 12-24 hours
 - 32-34 degree C
 - Adverse Microcirculatory effect
 - 36 d C (NEJM, December 2013)



Hypovolaemic shock

- Trauma
- Non trauma
 - Medical
 - Obstetrics



Trauma (without head injury)

- C (control bleeding) - ABC
- Damage controlled resuscitation
 - Hypotensive resuscitation
 - Damage controlled surgery
 - Control haemorrhage & contamination
 - Definitive repair later
 - Haemostatic resuscitation
 - Correct coagulopathy (early), hypothermia, acidosis in ICU



Hypotensive resuscitation

- Permissive hypotension
 - End point of resuscitation 70-80mmHg
 - (Cannon & Fraser, JAMA 1918)
 - Systolic BP 90 mmHg (80-100 mmHg),
 - except head injury-Systolic 120mmHg
 - Palpable radial pulse
- IV cannula (Intra-osseous route)
- Minimal IV fluid
 - Hypertonic saline



IV fluid

- Isotonic crystalloids
 - Ischaemia, reperfusion injury
 - **Abdominal hypertension, Abdominal compartment syndrome**
 - ARDS, Multi-organ failure
 - Coagulopathy



Haemostatic resuscitation

- **Acute Traumatic Coagulopathy (TIC)**
- **Early use of Tranexamic acid**
- (CRASH 2 trial, Lancet 2010)
 - Within 3 hours
 - 1g over 10 min
 - 1 g over 8 hours
 - Cost effective



IV fluid -Hypertonic saline

- Rapid restoration of intravascular volume
- Reduce intracranial pressure
- Reverse endothelial swelling (microcirculation)
- Immunomodulation-
 - Less cytokines
- Lower ARDS, Renal failure, coagulopathy
- Meta-analysis- Increased survival



Lethal triad (bloody vicious cycle)

- Hypothermia (keep $>35^{\circ}\text{C}$)
 - More bleeding
 - Affect clotting factors
 - Platelet dysfunction
 - sequestration in liver & spleen
- Acidosis
 - Reduce cardiac output (contractility)
 - Dysarrhythmia
 - bleeding
- Coagulopathy



Haemostatic resuscitation

- High FFP: RBC ratio (early)
- Platelets
- Cryoprecipitate
- Calcium
 - Keep >1.15 mmol/L
- Activated Factor 7
- Prothrombin complex ?



Trauma with head injury

- ABC (O₂ +Cervical spine)
 - Prevent secondary injury
- Maintain cerebral perfusion pressure 60-70 mmHg
 - Keep systolic >90 mmHg
 - Assume ICP of 20 mmHg in unconscious
- Role of hypertonic saline
 - More effective than Mannitol
- Early use of Vassopressors



Tolerance to anaemia

- Do not use 10/30 rule
- Restrictive transfusion strategy
- Clinical risk factors (decrease tolerance)
 - CAD
 - Impaired myocardial contractility/ Failure



Microvascular bleeding

- PT/ APTT >1.5 – give FFP
- Platelets $<50-100$ – give platelets
- Fibrinogen <1.5 g/L – give Cryoprecipitate
 - <2 g/L in Obstetric
 - One adult dose raise Fibrinogen by 1 g/L
 - Consider Fibrinogen concentrate
- Dying from bleeding (Activated Factor 7)



Bleeding patient

- To reverse Warfarin
 - Vit K +/- Prothrombin Complex Concentrate
 - FFP when PCC is unavailable
- Give Platelets
 - Expect platelet <50 after 2 blood volume replacement
 - Give Platelets when count is <50
 - Adult dose raise platelets by 20



Massive Blood Transfusion

- Replacement of > 1 blood volume (5L) in <24 hr.
- 50% blood volume lost in 3 hours
- Loss 150 ml/min
- Pathophysiology
 - Dilution / consumption
 - DIC
 - Systemic fibrinolysis
 - Platelet dysfunction



Therapeutic goals

- Maintain tissue perfusion & oxygenation
 - Restore blood volume & Hb
- Stop bleeding (source)
 - Ultrasound, CT scan
- Correct coagulopathy
- Shock pack box
 - 2 Units of blood + 2 units FFP
- Fresh blood (< 14 days old)



Management

- C – ABC
 - O₂, 2 IV cannulae
- Inform
 - Blood bank
 - Haematology laboratory
 - Haematologist,
 - Surgeons
 - ICU consultants/ Anaesthetists



Accept hypotension

- Multiple trauma with active bleeding
- Penetration injury
- Major vessel or cardiac injury
- Do not give large volume of fluid
- Can feel a palpable pulse?



Management

- Colloid/ **crystalloid**
- Blood transfusion
- Keep the patient warm
 - Avoid exacerbating coagulation problems
- Investigations



Investigations

- FBC
 - Haematocrit
 - Platelet count
- Coagulation screen
- U & E
- Request blood & blood products
- Arterial Blood Gases



Blood Transfusion Guidelines

- Should not transfuse if Hb is $> 10\text{g/dl}$
- A strong indication - Hb $< 7\text{ g/dl}$
- Hb between 8 -10 g/dl is safe even for those with cardiorespiratory disease
- Symptomatic patients should be transfused

Recent British guidelines (2012) Critically Ill patients

- Transfusion threshold 70g/L
 - trigger not > 90 g/L
 - Target 70-90 g/L
- Traumatic brain injury - Target 70-90 g/L
- Single unit transfusions- recommended (especially in non-bleeding patients)



Recent British guidelines (2012) Critically Ill patients

- Subarachnoid Haemorrhage - 80-100 g/L
- Ischaemic stroke- maintained $> 90\text{g/L}$
- ICS - maintained $>80-90\text{ g/L}$



Summary

- Initial resuscitation & prevention of further bleeding
- Diagnosis & monitoring of bleeding
- Rapid control of bleeding
- Management of bleeding & coagulation
- Tissue oxygenation, fluid & hypothermia



Summary

- Damage controlled resuscitation
- Permissive hypotension
- Haemostatic resuscitation
 - Massive blood transfusion



Obstructive shock

- Support (ABC)
- Treat the cause (Urgent)
 - Cardiac tamponade
 - PE
 - Thrombolysis
 - Anticoagulation
 - Thrombectomy



Septic shock

- Hypovolaemia- from fluid loss
- Maldistribution- from vasodilatation
 - Reduce peripheral vascular resistance
- Increased permeability- tissue oedema
- Reduced Contractility- Myocardial depressant factors
 - Ischaemia
- Late- mitochondrial failure
 - Fluid fail to improve microcirculation



Septic Shock

- Surviving sepsis campaign (2012)
- Early goal directed therapy (Rivers 2001NEJM)
 - First 6 hours
 - Fluid challenge
 - MAP >65 mmHg (vasopressors)
 - Noradrenaline
 - CVP goal 8-12 mmHg (Limited Value)
 - Central venous O₂ saturation
 - keep >70%
 - Fluid, (Blood transfusion), Dobutamine
- Sepsis bundle
- Haemoglobin 7-9g/dl

Septic Shock

- Early recognition
- 2 or > blood culture
- Early & adequate antibiotic therapy (within 1 hour)
 - De-escalation therapy
- Source control
- Early hemodynamic resuscitation support



Septic Shock

- Corticosteroids
 - Hydrocortisone 50 mg IV 6 hourly
- Metabolic support
 - Glycaemic control – 8-10 mmol/L
 - NICE SUGAR study NEJM
 - SSC – Maintain below 10 mmol/L
 - Early enteral nutrition
 - Immuno nutrition



Septic Shock

- Respiratory support
 - Tidal volume 6 ml/Kg
 - Limit pressure <30 cm H₂O
 - Permissive hypercarbia
 - Adequate PEEP
 - Consider Prone -ARDS
 - 30-45 d head up
- Renal support
- Stress Ulcer prophylaxis
- DVT prophylaxis (daily assessment)

Management of septic shock

- AB (Correct low SaO₂ - High flow O₂)
- C- Circulation
 - correct hypovolaemia (colloid, crystalloid)
 - correct pump failure
 - early goal directed therapy
 - correct coagulopathy
- Specific (antibiotics)
- Supportive measures



Sepsis Six- FABULOS sticker (Audit)

- F- Fluid
- A – Antibiotics
- B- Blood culture (before antibiotic)
- U- Urine
- L – Lactate
- O – Oxygen
- S – Sepsis Six



Central Venous O₂ Saturation

- Global tissue hypoxia may persist after resuscitation
- Normal mixed venous O₂ saturation (Sv O₂ 65-75%)
- Low SvO₂ = Low O₂ delivery or demand exceed the supply



Noradrenaline

- Improve MAP
- Increase GFR
- Improve renal function

- Adrenaline use should be limited



Vasopressin

- Relative deficiency
- V1a receptors
- Vasopressin 0.01- 0.04 units/min
- Terlipressin every 6 hr



Dobutamine

- Combined with N-Adrenaline
- 5 -20 mcg/kg/min (septic shock)



Adrenaline

- Alone
- combinations





IV Fluid

- Use fluid as a drug
- NICE guidelines (December 2013)
- Crystalloids vs colloid
- Normal Saline
- Balanced salt solution
 - Hartmann
- Colloid
 - HES
 - Albumin



Normal Saline

- Abnormal
- Hyper chloraemic acidosis
 - Renal vasoconstriction
- Hypernatraemia
- More cytokines released
- Risk of renal failure



Balanced salt solution

- More physiological
- Choice



Colloid

- Avoid HES (Renal failure)
- Albumin
 - Do not use in head injury



De-resuscitation

- Fluid overload- worse outcome
- Ebb Phase
- Persistent Ebb phase
 - Impaired fluid mobilization
- Flow Phase
 - Conservation fluid
 - Diuretics
 - Renal replacement therapy (CVVH)- Negative balance



An Early Warning System

Score	3	2	1	0	1	2	3
Pulse		< 40	41-50	51-100	101-110	111-130	> 131
Resp rate		≤ 8		9-14	15-20	21-29	≥ 30
Temp		≤ 35.0	35.1-36	36.1-38	38.1-38.5	≥ 38.6	
CNS level	Unresp	Pain	Voice	Alert	New confusion		
Urine output	<10ml/hr	<0.5ml/kg/hr					
BP	<70	71-80	81-100	101-199		>200	

Alert Plan of Assessment

