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
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<td>V, P, or U</td>
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<td>NEWS SCORE</td>
<td>FREQUENCY OF MONITORING</td>
<td>CLINICAL RESPONSE</td>
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<td>0</td>
<td>Minimum 12 hourly</td>
<td>• Continue routine NEWS monitoring with every set of observations</td>
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<td><strong>Total: 1-4</strong></td>
<td>Minimum 4-6 hourly</td>
<td>• Inform registered nurse who must assess the patient;</td>
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<td>• Registered nurse to decide if increased frequency of monitoring and/or escalation of clinical care is required;</td>
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<td><strong>Total: 5 or more</strong></td>
<td>Increased frequency to a minimum of 1 hourly</td>
<td>• Registered nurse to urgently inform the medical team caring for the patient;</td>
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<td>or</td>
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<td>• Urgent assessment by a clinician with core competencies to assess acutely ill patients;</td>
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<td>3 in one parameter</td>
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<td>• Clinical care in an environment with monitoring facilities;</td>
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<td><strong>Total: 7 or more</strong></td>
<td>Continuous monitoring of vital signs</td>
<td>• Registered nurse to <em>immediately</em> inform the medical team caring for the patient – this should be at least at Specialist Registrar level;</td>
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<td>• Emergency assessment by a clinical team with critical care competencies, which also includes a practitioner(s) with advanced airway skills;</td>
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<td>• Consider transfer of Clinical care to a level 2 or 3 care facility, i.e. higher dependency or ITU;</td>
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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

- **Catecolamine 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 < 2.2L/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 haemodynamics, 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
• Adrenaline - 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 - hypothenar eminence
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 ° C)
  - More bleeding
    - Affect clotting factors
    - Platelet dysfunction
    - sequestration in liver & spleen
- Acidosis
  - Reduce cardiac output (contractility)
  - Dysrhythmia
  - 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 Vasopressors**
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 g/dl
- A strong indication - Hb < 7 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 > 90g/L
- ICS - maintained > 80-90 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 chloaemic 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

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<td>&gt; 131</td>
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<td>Resp rate</td>
<td>≤ 8</td>
<td>9-14</td>
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<td>≥ 30</td>
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<td>Temp</td>
<td>≤ 35.0</td>
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<td>38.1-38.5</td>
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<td>CNS level</td>
<td>Unresp</td>
<td>Pain</td>
<td>Voice</td>
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Alert Plan of Assessment

Immediate Assessment, Monitoring and Treatment
A-B-C-D-E

Remember:
- airway adjuncts, oxygen, bag-valve-mask ventilation, fluids, recovery position, blood glucose, monitoring
- Call for help?

Full Patient Assessment
- Review patient notes and charts
- Obtain patient history
- Perform a systematic examination
- Review results of routine investigations
- Call for help?

Decisions and Planning
- Is the patient improving?

Yes
- Do you have a diagnosis?
  - Yes
    - Call for help?
  - No
    - Re-assess ABCs
      - Call for help

No/Unsure
- Special Investigations?
  - Call for help
  - DEFINITIVE CARE

No
- MANAGEMENT PLAN