SHOCK-Basic Concept & Updated Management

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Definition :

- Syndrome in which tissue perfusion is inadequate for it's metabolic requirement

- Essential for prompt recognition of hypotension or hypoperfusion for timely treatment and improved outcome

- Hypoperfusion may be present in absence of hypotension

- Clinical evidence of hypoperfusion are altered mental status, oliguria, lactic acidosis – MODS - death

Classification /Type:

- On the basis of pathophysiology:
  - Hypovolemic shock
  - Distributive shock
    - *Septic shock*
    - *Neurogenic shock*
    - *Anaphylactic shock*
    - *Endocrine shock- eg,Adrenal crisis*
  - Cardiogenic shock
  - Obstructive shock

1.Hypovolumic shock :

Hypovolumic shock is a life threatening condition occurs due to critical loss in the effective circulating blood volume (>15 %) with systemic hypoperfusion.

2.Distributive shock :

Also known as vasodilatory shock,refers to systemic vasodilation and decreased blood flow to the viscera & vital organs such as the brain,heart & kidneys.

Types:

- Septic shock
- Anaphylactic shock
- Neurogenic shock
- Endocrine shock

3.Cardiogenic shock :

Another name is cardiac shock,happens due to intracardiac causes leading to decreased cardiac output and systemic hypoperfusion.Different subtypes of etiologies contributing to cardiogenic shock include,

*Cardiomyopathies - include acute myocardial infarction

*Arrhythmias - both tachy and bradyarrhythmias

*Mechanical – severe aortic/mitral insufficiency,rupture of papillary muscle

4.Obstructive shock :

Mostly occurs due to extra cardiac causes leading to a decrease in the left ventricular cardiac output.Conditions may lead -

*Pulmonary vascular – impaired blood flow from the right to left heart.e.g. pulmonary embolism,severe pulmonary hypertension

*Mechanical – impaired filling of right heart or decreased venous return.e.g. tension pneumothorax,pericardial tamponade

Hypovolumic shock

- **Essentials of diagnosis:**
  - Tachycardia
  - Hypotension
  - Cool & frequently cyanotic periphery
  - Altered mental status-confusion,delirium,agitation,psychosis
  - Collapsed neck vein
  - Oliguria/ Anuria
  - Rapidly corrected on volume infusion

Causes :

1.Trauma/ surgery:

- Due to blunt or penetrating injury
  - External hemorrhage
  - Internal hemorrhage
- Due to inadvertent surgical loss

2.Sequestration of fluid/blood:

- Within abdominal viscera, peritoneal cavity or muscle space

3.Excess fluid loss from GI or urinary tract: eg,

- Diarrhorea/vomitting
- Diabetes insipidus

4.Excess fluid loss from skin: eg,

- Burn,TEN,Steven-johnson syndrome

5.Blood loss in obstetric cases

- Placenta previa
- Placental abruption
- Inadvertent surgical hemorrhage
- Postpartum hemorrhage
    - Placenta acreta
    - Cervical laceration
    - Vaginal laceration

6.Blood loss in Medical cases:

- Hematemesis
  - Rupture of esophageal varices e.g, Hepatic failure
  - Ulcer in Upper GI tract
  - Acute hemorrhagic pancreatitis
- Malena
  - PUD
  - Upper GI carcinoma

Classification of hypovolemic shock :

1.**Mild hypovolemia:** <20% blood loss

- Pathophysiology:
  - Decreased perfusion to extrimities
  - Can tolerate ischemia

- Features:
  - Cold feeling, cold clammy skin
  - Postural hypotension
  - Flat neck vein
  - Concentrated urine

2.Moderate hypovolemia: 20-40% blood loss

- Pathophysiology:
  - Decreased perfusion to pancrease, spleen & kidney
  - Can withstand ischemia

- Features:
  - Tachycardia
  - Low BP
  - Thirst
  - Oliguria

3.Severe Hypovolemia: > 40% blood loss

- Pathophysiology:
  - Decreased perfusion to brain, heart
- Features:
  - CNS - Restless, Agitated, Confused, Obtunded
  - CVS- Low BP,Rapid thready pulse
  - Resp. system- Increased R/R
  - Renal system - Anuria

- ***If progresses- Cardiac arrest !***

Laboratory findings :

1.HCT:

- If rapid blood loss & assessed at early stage before capillary refill - Normal
- If slow blood loss or slow fluid resuscitation - Low
- If non-sanguineous fluid loss e.g. vomiting, diarrhea, fistula – High

2.Lactic acid level: Increased

- Gradual decline of lactic acid level indicates proper fluid resuscitation

3.ABG:

- Decreased HCO_3
- Increased Negative Base excess - metabolic acidosis

Monitoring :

A.Clinical monitoring:

- Pulse
- Blood pressure
- Skin turgor
- Capillary refill time
- Central venous pressure (CVP)
- Capnography - $ETCO_2$

B.Lab monitoring:

- Urea, creatinine
- Electrolytes
- Blood sugar

Treatment :

1.General principle:

- CPR - CAB
- 16 G IV catheter - at least 2 channels
- Central venous line
- Quick search & stop the source of bleeding

*If external bleeding – direct pressure over the site of bleeding (go through ATLS guidelines)

2.Fluid resuscitation:

A.Crystalloid solution-

- Isotonic fluid -
  - Distributes in the body as extracellular water content, 1/3rd remains in vascular space

B. Colloid fluid-

- Albumin
- HES
- Dextran 40, 70

3.Assessment:

- Restoration of urine output
- Gradual decrease of heart rate
- Increase in Blood pressure
- Restoration of mental status
- Restoration of skin turgor
- Restoration of capillary refill

Some Definitions

* Sepsis :

Patient with suspected infection who have 2 or more of:

Hypotension-Systolic BP < 100 mmHg
Altered mental status-GCS ≤14
Tachypnea-respiratory rate ≥ 22 br/min

Sepsis can also be diagnosed by suspected infection & an increase of ≥ 2 points on the Sequential Organ Failure Assessment (SOFA) score.

Sequential [Sepsis-Related] Organ Failure Assessment (SOFA) Score

System	0	1	2	3	4
Respiration PaO2/FiO2, mmHg (kPa)	≥400 (53.3)	<400 (53.3)	<300 (40)	<200 (26.7) with respiratory support	<100 (13.3) with respiratory support
Coagulation Platelets, x10^3/uL	≥150	<150	<100	<50	<20
Liver Bilirubin, mg/dL (umol/L)	<1.2 (20)	1.2 - 1.9 (20 - 32)	2.0 - 5.9 (33 - 101)	6.0 - 11.9 (102 - 204)	>12.0 (204)
Cardiovascular	MAP ≥70mmHg	MAP <70mmHg	Dopamine <5 or Dobutamine (any dose)	Dopamine 5.1 - 15 or Epinephrine ≤0.1 or Norepinephrine ≤0.1	Dopamine >15 or Epinephrine >0.1 or Norepinephrine >0.1
CNS GCS Score	15	13 - 14	10 -12	6 - 9	<6
Renal Creatinine, mg/dL (umol/L) Urine Output, mL/d	<1.2 (110)	1.2 - 1.9 (110 - 170)	2.0 - 3.4 (171 - 299)	3.5 - 4.9 (300 - 440) <500	>5.0 (440) <200

*Catecholamine Doses = ug/kg/min for at least 1hr

Sepsis: *qSOFA Score*

Altered Mental Status

GCS < 15

Tachypnoea

RR ≥22

Hypotension

SBP ≤100 mmHg

Not high risk

0 *or* 1 Points

Continue management as appropriate

2 *or* 3 Points

High risk of poor outcome

Assess for evidence of organ dysfunction

*Septic Shock :

A subset of sepsis with underlying circulatory or cellular/metabolic abnormalities associated with a substantially increased mortality:

Sepsis and both of (after fluid resuscitation)

Persistent hypotension requiring vasopressors to maintain a MAP > 65 mmHg

Serum lactate > 2 mmol/l (18 mg/dl)

Management of Septic shock

1.Take care of Airway and Breathing :

- Proper airway care and if needed assisted ventilation should be promptly initiated in all patients with septic shock,that decreases the oxygen consumption by respiratory muscles and enables better perfusion of vital organs.

2.Recognize Sepsis and Septic Shock :

- Categorizing patients into sepsis and septic shock helps in triaging,prognostication and choosing appropriate therapy.

3.Initial Resuscitation :

- Fluid resuscitation is of utmost importance in initial management of patients with sepsis induced tissue hypoperfusion or septic shock.

- Administer initial fluid challenge

  Crystalloids (normal saline or Ringer lactate) 30ml/kg over 3 hours.

- Goal during first 6 hour of resuscitation-
  - ✓ MAP 65 mm Hg
  - ✓ Urine output .5ml/kg/hr

4.Send Initial Investigations :

- As the patient is being resuscitated send blood for
  - ✓ Complete blood count
  - ✓ Blood cultures (2 sets-both aerobic and anaerobic,with at least 1 drawn percutaneously and 1 drawn through vascular access device) obtained before antimicrobial therapy.
  - ✓ Other cultures depending on clinical situation
  - ✓ Urea
  - ✓ Creatinine
  - ✓ Electrolytes
  - ✓ Liver function test
  - ✓ ECG
  - ✓ Chest X-ray

- Send arterial blood for arterial blood gas and lactate analysis.Raised lactate is a feature of global hypoperfusion.

- If lactate is not available,base deficit(metabolic acidosis) in absence of renal failure can be taken as surrogate marker of lactic acidosis.

- Biomarkers of sepsis-Procalcitonin,CRP

5.Start Antimicrobial agent :

- Appropriate broad-spectrum antibiotics as per hospital protocol should be started preferably within 1 hour of presentation of septic shock.

- Selection of antimicrobial is one of the key determinants of outcome in septic shock.thus one or more agents active against likely bacterial/fungal or viral pathogens and with good penetration into presumed source should be selected.

- Dosing of antibiotics should be based on PK/PD principles and specific properties of antibiotic being used.

- Duration of therapy is typically 7-10 days,longer duration may be needed.

- In patients with risk factor for invasive Candida infections such as immuno-compromised status,prolonged invasive vascular catheters,TPN,recent major surgery,prolonged hospital/ICU admission empirical antifungal therapy should be started.

- Antiviral therapy should be initiated as early as possible in patients with severe sepsis or septic shock of viral origin.

6.Source control :

- Source control should be done as soon as within 6-12 hours.

- Efforts should be specifically considered for drainage of an abscess,debridement of infected necrotic tissue,removal of infected device.

- Central lines and other intravascular device should be promptly removed after establishing other vascular access.

7.Fluid therapy :

- Crystalloids are the fluids of choice in septic shock.
- 5% Albumin may be considered for volume replacement when patient require large volume of crystalloids to maintain perfusion.

8.Optimize Vasopressor use :

- Vasopressor(norepinephrine) is the first choice,needs to start to keep MAP >65mmHg
- Vasopressin @ 0.03unit/min is given if patient remains hypotensive on catecholamine.
- Epinephrine is alternative agent that is poorly responsive to norepinephrine.

- Dopamine may be used as alternative of noradrenaline in highly selected patient.
- Dobutamine @20microgram/kg/min be administered or added to vasopressor in presence of myocardial dysfunction.

- De-escalation of fluids and vasopressors should be done for the patients who demonstrate response to therapy.
- Try to maintain neutral fluid balance.

9.Corticosteroids :

- Septic shock which does not respond to fluids and vasopressors should be considered for IV Hydrocortisone.

- A dose of 200mg/day ,over 24 hours or 50mg/6 hour I.V. is preferred to restore MAP.

- It may be continued till the patient is on vasopressor and gradually tapered off over a week.

10.Glycemic control :

- Frequent monitoring of blood glucose needs to be done.

- Commencing insulin infusion when two consecutive blood glucose levels are equal to or more than 180 mg/dl.

- Blood sugar level should be kept between 140-180 mg/dl ,preferably with IV insulin infusion.

11.Other Adjuncts :

a.Blood product transfusion-

- PRBC when Hb% <7gm/dl,target Hb% 7-9 gm/dl in adult.

b.Lung protective mechanical ventilation –

- Tidal volume : 6ml/kg
- Plateau pressure : less than or equal 30 cm H2O
- High PEEP
- Recruitment maneuvers in severe refractory hypoxaemia

c.Sedation :

- Sedation should be minimized and intermittent doses are preferable as compared to continuous dose.

d.Renal replacement therapy :

- Continuous Renal Replacement Therapy(CRRT) or Slow Extended daily Dialysis are equivalent here if needed.

e.DVT prophylaxis :

- LMWH daily
- Intermittent pneumatic compression device ,compression stocking etc.

f.Nutrition :

- Administer oral or enteral feeding as tolerated.
- Avoid mandatory full calorie feeding in first week.
- Use iv glucose and enteral nutrition rather than TPN.

g.Stress ulcer prophylaxis :

- H2 blocker or PPI


Thank
You