

Critical Care & Shock

Dr. Asem Qandah

Asst. Prof of Plastic & Reconstructive Surgery (Hashemite University)



Introduction :

1. MONITORING OF THE CRITICALLY ILL PATIENT
2. RESPIRATORY FAILURE
3. CIRCULATORY FAILURE: SHOCK
4. SEPSIS
5. UPPER GASTROINTESTINAL HEMORRHAGE PROPHYLAXIS
6. ANEMIA
7. BLOOD GLUCOSE CONTROL

the most of the ICU admission due to

1) circulatory failure (shock)

2) respiratory failure

3) renal failure

4) sepsis



1. MONITORING OF THE CRITICALLY ILL PATIENT

At least every 4 hours

The accurate way to measure the temperatures through rectum, but it is not convenient for the patients, that's why we go usually for oral as an alternative.

A. Temperature Monitoring

B. Electrocardiographic (ECG) Monitoring

C. Arterial Pressure Monitoring

1. Indirect

The indirect method is by using a sphygmomanometer, a blood pressure should be measured at least every hour.

2. Direct

- ◆ Direct → arterial line (continuous, invasive).
- ◆ Indirect → cuff BP (non-invasive, intermittent).

D. Central Venous Pressure (CVP) Monitoring

CVP, SCvO₂, vasoactive medications, TPN

for cardiac surgery patients , they should have arterial pressure monitoring, usually through radial artery. But before insertion the radial catheter, we have to do Allen test just to check that there's a continuous blood supply to the hand. If there's any signs of ischemia, we have to remove the catheter as soon as possible.(this is the direct)

1. MONITORING OF THE CRITICALLY ILL PATIENT

E. Pulmonary artery (PA) *a difficult thing to insert with a high complication rate, that's why we usually don't go for it in hemodynamically unstable patients*

CVP, cardiac output (CO), PA pressures, SVR, SvO₂

No mortality improvement in surgical patients.

Complications > Transient right-bundle-branch block

Balloon rupture

PA perforation

Malposition (e.g., coronary sinus)

Right ventricular rupture

Cardiac tamponade.



1. MONITORING OF THE CRITICALLY ILL PATIENT

→ *In cardiac surgery to monitor the cardiac output*

F. Esophageal Doppler and Pulse Contour Analysis

Less invasive > descending aortic blood flow > CO

Pulse contour analysis > arterial pressure waveform > CO

G. Respiratory Monitoring

(The most commonly used)

1. Pulse oximetry

probe on the finger, but it has some disadvantages or drawbacks that it could give also low or even high false results.

for example, CO poisoning, it will give a high false result.

In case of hypothermia it will give low false results.

2. Capnography > Quantitative, continuous assessment of expired CO₂ concentrations

ETCO₂ ↑ > ↓ Alveolar ventilation, ↑ CO₂ production...Sepsis

ETCO₂ ↓ > ↑ Alveolar ventilation or ↑ dead space...ET obs, PE

→ *We usually use it to measure the CO₂ coming out from the airway, which is the end-tidal CO₂.*

↓
Endotracheal tube obstruction



1.MONITORING OF THE CRITICALLY ILL PATIENT

H. Neurologic Monitoring

1. Intracranial pressure monitoring
2. Processed electroencephalogram monitors

it's not usually used, but sometimes we use it for special indications when patients are taking the neuromuscular drugs.



2. RESPIRATORY FAILURE

A. Etiology: Inadequate gas exchange > ventilation/perfusion (V/Q) mismatch

Hypoventilation

Impaired systemic
delivery/extraction

Dead space ventilation > COPD & PE.

B. Diagnosis: Signs or symptoms of respiratory distress > Pulse oximetry
(Using accessory respiratory muscles) and an ABG.

Oxygen saturation <90% impaired tissue oxygenation.

↑ PaCO₂ > (respiratory acidosis)

History, physical examination a chest x-ray, EKG, and chest
CT with PE protocol.



2. RESPIRATORY FAILURE

Treatment

- 1) Inhaled oxygen
- 2) Noninvasive positive pressure ventilation (NIPPV)
- 3) Endotracheal intubation → *BiPAP is a mask, tight and fitting on the mouth and the nose. It will push air and oxygen through the mouth and the nose to give oxygen to the lungs and increase the ventilation. Usually we use it in patients when we try not to be invasive and the patient is expected to improve within a short period of time*
- 4) Chest tube placement → *is an invasive procedure to calculate , monitor and treat patients with respiratory failure*
- 5) Extracorporeal membrane oxygenation (ECMO) → *in case of a tension pneumothorax, hemothorax (extra pulmonary origin)*

ECMO, which is the last resource we could use for a patient with respiratory failure especially patient with ARDS. ECMO simply means that we take a blood from the patient, oxygenate it then the blood is sent back to the patients. There is two types, veno-venous and veno-arterial. Veno-venous will support oxygenation and ventilation, while veno-arterial will support oxygenation and cardiac output.



3. CIRCULATORY FAILURE: SHOCK

- A. Shock is defined by global tissue hypoxia and occurs when the supply of oxygen is insufficient to meet metabolic demands.
- B. Classification and Recognition of Shock.

History, laboratory values, and physical examination are usually sufficient for determining the etiology

1. **Hypovolemic shock** results from loss of circulating blood volume caused by acute hemorrhage, fluid depletion, or dehydration. Patients are peripherally vasoconstricted, tachycardic, and have low jugular venous pressure.

Mainly management is control of bleeding or loss, and also at the same time, resuscitate the patient with IV fluid



It's important to note that in class 1, there is no change in blood pressure, heart rate, CNS symptoms, everything is normal.

It will start to deteriorate as the class is becoming more advanced.

Classification of hemorrhage				
PARAMETER	CLASS			
	I	II	III	IV
Blood loss (mL)	<750	750–1500	1500–2000	>2000
Blood loss (%)	<15	15–30	30–40	>40
Heart rate (bpm)	<100	>100	>120	>140
Blood pressure	Normal	Orthostatic	Hypotension	Severe hypotension
CNS symptoms	Normal	Anxious	Confused	Obtunded

bpm = beats per minute; CNS = central nervous system.



3. CIRCULATORY FAILURE: SHOCK

2. **Distributive shock** is a hyperdynamic state consisting of tachycardia, vasodilation, decreased SVR, and increased CO. The most common causes include sepsis, neurogenic shock, adrenal insufficiency, and liver failure.

3. **Neurogenic shock** results from interruption of the spinal cord at or above the thoracolumbar sympathetic nerve roots, which produces loss of sympathetic tone, causing vasodilation. Patients are peripherally vasodilated and tachycardic. Jugular venous pressure is low.

With the trauma patients, RTA, suspected to have spinal cord injury, especially high cervical (loss of sympathetic tone, hypotension due to vasodilatation, and tachycardia)

In these patients, the treatment is fluid resuscitation like in hypovolemic shock initially.

If this failed, we have to give vasopressors like adrenaline

3. CIRCULATORY FAILURE: SHOCK

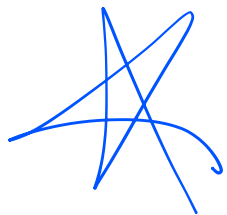
Inadequate cardiac output by external cause

4. **Obstructive shock** results from etiologies that prevent adequate CO but are not intrinsically cardiac in origin. This may be caused by PE, tension pneumothorax, or cardiac tamponade. Jugular venous pressure is elevated while the peripheral tissues demonstrate vasoconstriction

MI , Heart failure

5. **Cardiogenic shock** results from inadequate CO due to intrinsic cardiac failure. Diagnosis may require echocardiography. These patients typically are peripherally vasoconstricted and tachycardic with an elevated jugular venous pressure, *Cold extremities*



**TABLE 7-3****Clinical Parameters in Shock**

Shock Classification	Skin	Jugular Venous Distention	Cardiac Output	Pulmonary Capillary Wedge Pressure	Systemic Vascular Resistance	Mixed Venous Oxygen Content
Hypovolemic	Cool, pale	↓	↓	↓	↑	↓
Cardiogenic	Cool, pale	↑	↓	↑	↑	↓
Septic						
Early	Warm, pink	↑↓	↑	↓	↓	↑
Late	Cool, pale	↓	↓	↓	↑	↑↓
Neurogenic	Warm, pink	↓	↓	↓	↓	↓



3. CIRCULATORY FAILURE: SHOCK

- The goal of therapy is to ensure adequate oxygen delivery. Because oxygen delivery is proportional to SaO_2 , hemoglobin concentration, and CO, each should be optimized.

Specific Therapy:

Hypovolemic shock > Therapy focuses on control of ongoing loss and restoration of intravascular volume.

Neurogenic shock > The initial intervention is volume infusion. A peripheral vasoconstrictor, phenylephrine or norepinephrine, is administered to increase vascular tone if hypotension is refractory to volume infusion.



3. CIRCULATORY FAILURE: SHOCK

Obstructive shock > Tension pneumothorax is treated by needle decompression followed by tube thoracostomy.

Pericardial tamponade is treated by needle decompression, often with catheter placement for drainage.

Cardiogenic shock > Management is directed toward maintaining adequate myocardial perfusion and CO with volume expansion and vasoactive medications



4. SEPSIS

A. Definition: *Systemic Inflammatory Response Syndrome*

Sepsis is defined as SIRS with a documented or presumed infection. ↗ Usually by culture

The clinical definition of SIRS requires two of the following:

Body temperature $>38^{\circ}\text{C}$ or $<36^{\circ}\text{C}$

Heart rate >90 beats/minute

Respiratory rate >20 /minute or $\text{Paco}_2 <32$

WBC count >12 or 10% bands

Severe sepsis is multiple-organ dysfunction or hypoperfusion (septic shock) resulting from infection.



4. SEPSIS

B. Diagnosis: Cultures → *either from the source of infection or from blood (aerobic and anaerobic)*

C. Treatment:

1. Infection

a. Antibiotic therapy → *We have to start the treatment with IV antibiotics, then we have to shift antibiotics according to the culture*

b. Source control

2. Circulatory support

a. Volume resuscitation. → *resuscitation at the same time with IV fluid and with vasopressors if needed.*

b. Vasoactive medications.



5. UPPER GASTROINTESTINAL HEMORRHAGE PROPHYLAXIS.

Patients in the ICU are at increased risk for stress-induced mucosal ulceration and GI hemorrhage.

Risk factors: head injury (Cushing ulcers); burns (Curling ulcers); prolonged mechanical ventilation; history of peptic ulcer disease; NSAIDs or steroids; and the presence of shock, renal failure, portal hypertension, or coagulopathy

H2-receptor antagonist > Proton-pump inhibitors

↓ *Increases the risk of*

Clostridium difficile-associated diarrhea



6. ANEMIA

Transfusing all patients to a hemoglobin of 10 mg/dL either has no effect or may actually decrease survival in the critically ill.

Restrictive transfusion strategy (hemoglobin <7 mg/dl)

*we don't give blood for any patient with more than 7 mg/dL
except when there is associated cardiac insufficiency, like in patients with heart
failure , previous angina or MI*

*in these patients, they have high risk to get cardiac complications or they have
cardiac problems, we need them to have at least 9 mg/dL*



7. BLOOD GLUCOSE CONTROL

Two techniques :

- 1) Tight glucose control (blood glucose goal: 80 to 110 mg/dL)*
- 2) Conventional control (blood glucose goal: 180 to 200 mg/dL)*

In surgical patients > twofold decrease in mortality.



Tight glucose control is better

That's why we usually go for tight, but sometimes you have to be careful in case of tight glucose control because the risk of hypoglycemia.

Hypoglycemia is also something we have to avoid, so usually in practice, the target is, just keep it below 140.

Keeping the blood glucose below 140 is enough, and it will decrease also at the same time the risk of hypoglycemia.



6. A patient who comes into the emergency department with unknown history is hypotensive. Initial physical examination findings are increased jugular venous distention and cool skin. After PA catheter placement you see decreased cardiac output with increased wedge pressure and increased systemic vascular resistance. This patient is most likely suffering from:

- a. Hypovolemic shock.
- b. Neurogenic shock.
- c. Late septic shock.
- d. Early septic shock.
- e. Cardiogenic shock.**

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10. For which of the following patients, currently in the ICU, is blood transfusion indicated?

- a. A 26-year-old male admitted after a motorcycle accident with femur fracture s/p ORIF POD 2 with a hemoglobin of 7.4 mg/dL with low UOP.
- b. A 76-year-old patient with ESRD who underwent brachiocephalic graft placement complicated by a postoperative pneumonia with a hemoglobin of 8.2.
- c. An 84-year-old male POD 2 after a femoral-popliteal bypass complicated by postoperative NSTEMI and a hemoglobin of 7.9 mg/dL.**
- d. A 56-year-old male after left hemicolectomy with the intraoperative course complicated by significant blood loss with a hemoglobin of 8.6 mg/dL and a small norepinephrine requirement.
- e. A 94-year-old female admitted after hepaticojejunal bypass for a mass obstructing the duodenum with a hemoglobin of 8.2 mg/dL.