



SHOCK AND EPIDEMIOLOGY IN NIGERIA VS RUSSIA

Anesthesiology

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ABSTRACT

Oxygen has always been known to be one of the major gases needed by the human body (cells and tissues) for survival. Unfortunately, in shock of all types the lack of enough oxygen supply (hypoxia) to the cells and tissues is the main problem. There is either a reduction or an increased demand in supply of oxygen to the cells and tissues which causes mainly circulatory collapse and could occur in different ways, which is the aim of our study: this study is focused on differentiating the mechanisms behind the different forms of shock, how to manage it and how to prevent it from leading to an irreversible shock state in the easiest way possible. It gives a straight to the point view on each type of shock.

Materials and Methods: This study is based on general researches, experiences and updated guidelines and meta-analysis.

Aim of study : A lot of people don't know the etiology of shock and the different variants of shock are possible. By the end of this, article the reader should be able to:

- know the basic classifications of shock;
- understand the pathogenesis of the different variants of shock;
- know the clinical manifestations of shock;
- know the different ways of management and treatment of each type of shock.

KEYWORDS

Shock, hypotension, hypoxia, and sicknesses associated management and treatment, mechanism, mortality.

INTRODUCTION

Firstly, we need to define shock which is known as a clinical state in which there is inadequate tissue perfusion due to decreased circulating blood volume, leading to reduced oxygen supply to the vital organs, which if not treated could lead to irreversible multiple organ failure. Therefore, we could say it is a life threatening situation in which circulatory failure occurs. It is progressive and should be treated promptly, as it could be fatal without timely and prompt intervention. When we say progressive, it means that the decreased oxygen supply to the cells and tissues leads to: hypoxia, ischemia, necrosis and multiple organ failure. There are different causes and factors that could lead to shock which will be discussed in this article.

Overall there are two main causes of shock which are:

- decreased cardiac output
- Widespread peripheral vasodilatation

They both occur in different forms of diseases. In this sense, shock can be seen as a complication of such diseases.

During shock there are general symptoms such as: thirst, palpitations, sweating, restlessness, confusion and signs such as Pallor, Tachycardia, increased pulse of more than 90 bpm and most importantly, hypotension (decreased arterial blood pressure) with systolic blood pressure less than 90mmHg or diastolic blood pressure less than 65mmHg. We will see each type of shock alongside their management and treatment methods, but one should keep in mind that treating a patient in a state of shock should be aimed at:

- reversing the shock
- securing airway, breathing and circulation
- preventing complications and irreversible damages such as multiple organ failure
- Preventing death

Stages

Shock occurs in three stages:

- **Early or non** - progressive stage (compensatory stage):- here the body tries to compensate by increasing heart rate, increasing peripheral resistance and maintaining organ perfusion. When there is decrease in blood pressure and tissue perfusion, compensatory mechanisms are activated to maintain perfusion to the heart and brain. As a result of activation of compensatory mechanisms, during decreased blood flow to the kidney, renin-angiotensin-aldosterone system is activated, which eventually leads to an increased blood volume and venous return. As a result of these compensatory mechanisms, cardiac output and tissue perfusion are maintained.
- **Progressive stage:** - this stage of shock begins as a result of failure of compensatory mechanisms to maintain cardiac output. It is

characterized by tissue hypo perfusion, metabolic acidosis due to lactic acidemia and circulatory imbalance. This acidosis state depresses myocardial function. Tissues hypo perfusion also promotes the release of endothelial mediators such as histamine, prostaglandin and others, which lead to venous pooling and increased capillary permeability. In this stage of shock, the risk of DIC syndrome increases due to sluggish blood flow.

- **Irreversible (refractory) stage:** - in this stage, compensatory mechanisms can no longer maintain cardiac output and as a result, permanent organ damage occurs. Eventually, circulatory and respiratory failure occurs. The damages are so severe that survival is no longer possible and death is inevitable because brain damage and cell death will occur.

Classification of shock

Shock can be classified based on the mechanisms (causes) behind it which includes:

1. Shock based on reduced and damaged heart function: Cardiogenic shock
2. Shock induced by low fluid volume: Hypovolemic shock.
3. Shock induced by internal or external obstruction: Obstructive shock
4. Shock caused by excessive vasodilatation: Distributive shock (Septic, Anaphylactic and Neurogenic shocks)

Epidemiology

The most common type of shock is distributive shock with Septic shock being the most common type of distributive shock which has a high mortality rate of about 40 - 50 % of all cases of shock and associated with a severe infection. Cardiogenic and Hypovolemic shock are almost always on the same level of occurrence which is about 30 - 40% of cases, and obstructive shock is the least occurring type of shock with 10%.

From different studies carried out in Nigeria and Russia, in various intensive care units, the following results were obtained to be the types of shock with the highest mortality rate.

CASES	NIGERIA	RUSSIA
	Percentage	
<i>Obstetric</i>	Hypovolemic(hemorrhagic)17.4% Septic 15.5%	Hypovolemic(hemorrhagic) 20% Septic 11%
<i>Pediatrics</i>		
<i>Neonatal (0-6 months)</i>	Septic 29%, Hypovolemic(diarrhea and dehydration) 14.2%	Hypovolemic(hemorrhagic)14.3% Septic 11.5%

Childhood (5-17 years)	Septic 14.4% Hypovolemic (diarrhea and dehydration) 9.2%	Hypovolemic (trauma) 6.5% Septic shock 4.4%
Pre-operative	Head injury (hemorrhagic) 68.6% Septic 21%	Cardiogenic 45.7% Head injury (hemorrhagic) 8.7%
Post-operative	Burns (non-hemorrhagic) 84.6% Cardiovascular (Cardiogenic) 63%	Head injury (hemorrhagic) 35.3% Other injuries 19.6%

The studies were carried out from 2015 to 2019. The above table represents the most common types of shock that lead to death in various cases. In obstetric cases both in Nigeria and Russia, hemorrhagic shock came in first place and septic shock in second with 17.4%, 15.5% and 20%, 11% respectively. In pediatric cases, septic shock and Hypovolemic shock are with the highest mortality rate in both Nigeria and Russia. However, it should be noted that in Nigeria, the leading cause of Hypovolemic shock is due to non-hemorrhagic fluid loss mainly diarrhea and dehydration while in Russia, it is caused mainly by increased bleeding.

In the hospitals, unfortunately patients die before operation can be carried out which leads to preoperative death. In Russia, Cardiogenic shock is the leading cause of death in preoperative cases with 45.7% while in Nigeria, hemorrhagic shock 68.6% with most cases being head injury. One can deduce that in both Nigeria and Russia, there is generally a high mortality rate with hemorrhagic shock in preoperative cases.

In Nigeria, the leading cases of mortality due to shock in post operative care is non-hemorrhagic shock (84.6%) and it occurs often in patients presenting with burns of over 50% of the body surface. Cardiogenic shock also has a very high influence on the mortality rate in the ICU, as it came in second place with 63% of cases. In Russia, 35.3% of patients die after operating on their head injuries, which is due to hemorrhagic shock.

Generally, we can gather that in both Nigeria and Russia, most patients with shock die from hemorrhagic, septic and cardiogenic shock.

Let's look at each type of shock, the causes, pathogenesis and treatment.

1. Cardiogenic shock: this occurs due to an injured heart which isn't working like it should. Whenever there is damage to the heart muscle most often from a large myocardial infarction, it makes the heart incapable of pumping out enough blood into circulation, leading to decreased cardiac output and systemic hypo perfusion. So in simple terms, in Cardiogenic shock the heart simply isn't working properly.

What are the common causes of this type of shock? This includes sicknesses that cause injury or damage to the heart such as:

- Acute myocardial infarction (heart attacks)
- Myocarditis
- Valvular stenosis such as aortic, mitral etc
- Arrhythmia (tachycardia, bradycardia)
- Dilated cardiomyopathy
- Congenital heart diseases

During this type of shock, there is a decrease in blood circulation caused by decreased cardiac output which in turn leads to low blood pressure (hypotension) and low tissue perfusion. The body tries to respond to these changes by increasing post capillary wedge pressure, systemic vascular resistance and also increased heart rate. The skin becomes cold due to less blood flow, and this can also be called "cold shock". There could also be metabolic acidosis due to increased lactic acid in the blood.

The treatment of all forms of shock including cardiogenic shock depends mainly on the underlying cause. So therefore, in managing this type of shock,

- Treat the underlying cause for example if the patient has myocardial infarction, angioplasty and thrombolytic should be administered.
- Oxygen therapy which is simply the administration of oxygen,

which helps not just in breathing but in circulation and in turn increases tissue perfusion.

- Vasopressors such as Epinephrine and Dobutamine which leads to vasoconstriction.
- Surgery procedures could also be done such as intra-aortic balloon pump.

2. Hypovolemic shock:

this is generally caused by low fluid levels that is, loss of fluid from the circulation. These fluids could be either blood (hemorrhagic shock) or non-blood (non-hemorrhagic shock). During hemorrhagic shock one experiences bleeding which could be caused by trauma, GI bleeding, postpartum hemorrhage, abdominal aortic aneurysms, hemoptysis due to esophageal varices and so on. Non-hemorrhagic shock occurs due to loss of other bodily fluids and includes cases such as excessive vomiting, diarrhea, 3rd degree burns, bowel obstruction, acute pancreatitis, diabetic ketoacidosis and so on.

However in Hypovolemic shock, the patient present with signs such as cyanosis which presents on places like the lips, tongue or on the fingertips, cold shock (hypothermia). There is also low cardiac output, hypotension (low blood pressure) and compensation reactions by vasoreceptors, causing vasoconstriction which increases systemic vascular resistance and Heart rate (HR). There could be hemo-concentration or low hematocrit.

Treatment

- In order to restore blood volume IV fluids such as normal saline, Ringer's lactate solution, crystalloids should be administered.
- To stabilize oncotic pressure drugs such as Albumin, Hetastarch should be given to the patient.
- To prevent hypothermia for example Midazolam

3. Obstructive shock:

as the name implies, this occurs as a result of some sort of internal or external obstruction, affecting the blood flow out of the heart or into the blood vessels. Some diseases which could lead to this type of shock include:

- Tension pneumothorax (PT) which involves the compression of blood from coming into the heart and also prevents the heart from pumping blood out. Here there is a significant increased jugular venous pressure.
- Pericardial tamponade (PT) where there is an increased fluid in the pericardial cavity, which leads to heart compression resulting in decreased cardiac output. Here a patient presents with increased jugular venous pressure, hypotension, distant heart sounds and so on.
- Pulmonary embolism also leads to this type of shock by the blockage of a pulmonary artery, resulting in reduced arterial blood gases and increased lactic acid in the blood.

Treatment of obstructive shock includes procedures and medications such as:

- Needle compression (TP)
- Pericardial synthesis (PT)
- Embolectomy
- Thrombolytic (heparin)
- Oxygen, isotonic fluids, vasopressors

4. Distributive shock -

this type of shock is generally due to a decreased systemic vascular resistance caused by extremely dilated blood vessels, leading to decreased tissue perfusion. As in Hypovolemic shock, there is also an insufficient intravascular volume of blood. There are 3 subtypes of this shock:

1. Septic shock: endotoxins from infections (mostly gram negative bacteria) directly damage the endothelial cells of the blood vessel causing a release and accumulation of inflammatory agents such as: histamine which brings about vasodilation, very low vascular resistance and increases vascular permeability (edema). Septic shock also includes some elements of cardiogenic shock because the depression action of the toxins on the myocardium occurs. Patients present with fever due to increased blood flow and heat (warm shock), hypotension, increased cardiac output and heart rate. Treatment includes IV broad spectrums antibiotics, IV Fluids, vasopressors.

2. Anaphylactic shock - caused by a severe allergic reaction such as after bee sting, food allergies, drug allergies, IV contrasts which leads

to vasodilatation, bronchoconstriction (bronchial asthma), laryngeal edema, angioedema, itching etc which could either cause the release of inflammatory mediators or could directly degranulate the mast cells and basophils and this dangerously decreases the blood pressure (hypotension). Treatment includes supplemental oxygen, epinephrine, IV antihistamines, Beta-agonists such as Salbutamol (nebulised form), corticosteroids.

3. Neurogenic shock: this occurs due to damage to the nerves causing autonomic blockade, which occurs usually in diseases like acute spinal cord injury. The nerves get damaged and can no longer control the body's blood pressure due to unopposed vagal tone. The patient has decreased heart rate, low cardiac output, and decreased post capillary wedges pressure. Treatment involves stabilizing the blood pressure with vasopressors like dobutamine, epinephrine, atropine and IV fluids.

Diagnosis

In diagnosis of shock, includes the following:

- Physical examination, which involves the presenting symptoms and clinical manifestations of the patient, which helps in diagnosing the type of shock occurring.
- Sepsis screen, if sepsis is suspected
- ECG and Echocardiogram, if Cardiogenic shock is suspected
- Laboratory tests such as complete blood count, which could show lactic acid elevation, BUN test to check for any changes in the blood creatinine level.
- Chest x-ray in cases of obstructive shock.

The table below shows the different signs in patients presenting with different types of shock.

Type	CO	HR	CVP	PCWP	SVR	BP	O2 Sat
Cardiogenic	<	>	≥	>	>	<	<
Hypovolemic	<	>	≤	<	>	<	<
Obstructive	<	>	≥	> Or <	>	<	<
Septic	>	>	≤	<	<	<	>
Anaphylactic	<	>	≤	<	<	<	<
Neurogenic	<	<	≤	<	<	<	<

Prognosis

A world wide prognosis of the different forms of shock shows Sepsis and septic shock to have long term morbidity and mortality rate, with many patients who survive from it requiring long care in medical facilities. Cardiogenic shock has a better improvement over its previous mortality rates. Hypovolemic and obstructive shock both generally have a lot more lower rate of mortality and as a result of that, they respond better to prompt, timely and immediate management and treatment.

CONCLUSION

Any form of shock can be treated, but it is done based on the type of shock involved. The above categories of shock used here is the updated classification. Several anatomical findings can be present in shock such as acute tubular necrosis of the kidney, areas of necrosis in the brain, patchy mucosal hemorrhages in the colon and so on. In other words, shock is a complication of other diseases. Shock should be treated as soon as possible to avoid poor prognosis.

Keys

- > Increased
- < Decreased
- ≥ Normal or increased
- ≤ Normal or decreased
- CO - Cardiogenic output
- HR- heart rate
- CVP - central venous pressure
- PCWP - post capillary wedge pressure
- SVR - systemic vascular resistance
- BP - blood pressure
- O2 sat - oxygen saturation

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