SAWA UNIVERSITY

جامعة ساوة الاهلية
كلية التقنيات الصحية والطبية
قسم التخدير - اللجنة العلمية

ADVANCED MEDICINE

LECTURE ONE : SHOCK

Sawa University — جامعـــــة ســـــــاوة الاهلية

College of health and medical techniques — كليـــــة التقنيـــات الصحيـة والطبيـة

Department of Anesthesia — قسم تقنيـــات التخديـــــر

Fourth Stage — المرحلـــــــــــة الرابعة

Lecture one

Theoretical

Dr. shaker kadhium

M.Sc. medicine

(INTRODUCTION)

- **Shock is the state of insufficient blood flow to the tissues of the body as a result of problems with the circulatory system. Initial symptoms of shock may include weakness, elevated heart rate, irregular breathing, sweating, anxiety, and increased thirst. This may be followed by confusion, unconsciousness, or cardiac arrest, as complications worsen.**
- **Shock is divided into four main types based on the underlying cause: hypovolemic, cardiogenic, obstructive, and distributive shock. Hypovolemic shock, also known as low volume shock, may be from bleeding, diarrhea, or vomiting. Cardiogenic shock may be due to a heart attack or cardiac contusion. Obstructive shock may be due to cardiac tamponade or a tension pneumothorax. Distributive shock may be due to sepsis, anaphylaxis, injury to the upper spinal cord, or certain overdoses.**

Signs and symptoms

The presentation of shock is variable, with some people having only minimal symptoms such as confusion and weakness. While the general signs for all types of shock are low blood pressure, decreased urine output, and confusion, these may not always be present. While a fast heart rate is common, in those on β-blockers, those who are athletic, and in 30% of cases of those with shock due to intra abdominal bleeding, heart rate may be normal or slow. Specific subtypes of shock may have additional symptoms.

Dry mucous membrane, reduced skin turgor, prolonged capillary refill time, weak peripheral pulses, and cold extremities can be early signs of shock

Types of shock

Hypovolemia and Hypovolemic shock

hypovolemic shock is the most common type of shock and is caused by insufficient circulating volume . the most common cause of hypovolemic shock is hemorrhage (internal or external); however, vomiting and diarrhea are more common causes in children. other causes include burns, as well as excess urine loss due to diabetic ketoacidosis and diabetes insipidus.

the severity of hemorrhagic shock can be graded on a 1–4 scale on the physical signs. the shock index (heart rate divided by systolic blood pressure) is a stronger predictor of the impact of blood loss than heart rate and blood pressure alone. this relationship has not been well established in pregnancy-related bleeding.

Cardiogenic shock

Cardiogenic shock is caused by the failure of the heart to pump effectively. This can be due to damage to the heart muscle, most often from a large myocardial infarction. Other causes of cardiogenic shock include dysrhythmias, cardiomyopathy/myocarditis, congestive heart failure (CHF), myocardial contusion, or valvular heart disease problems.

Distributive shock

Distributive shock is low blood pressure due to a dilation of blood vessels within the body. This can be caused by systemic infection (septic shock), a severe allergic reaction (anaphylaxis), or spinal cord injury (neurogenic shock)

Septic shock

Septic shock is the most common cause of distributive shock. It is caused by an overwhelming systemic infection resulting in vasodilation leading to hypotension. The pathophysiology behind septic shock is as follows:

1) Systemic leukocyte adhesion to endothelial cells

2) Reduced contractility of the heart

3) Activation of the coagulation pathways, resulting in disseminated intravascular coagulation

4). Increased levels of neutrophils

Anaphylactic shock

Anaphylactic shock is caused by a severe anaphylactic reaction to an allergen, antigen, drug, or foreign protein causing the release of histamine which causes widespread vasodilation, leading to hypotension and increased capillary permeability.

High spinal injuries may cause neurogenic shock, which is commonly classified as a subset of distributive shock. The classic symptoms include a slow heart rate due to loss of cardiac sympathetic tone and warm skin due to dilation of the peripheral blood vessels.

Cause

Type	Cause
Low volume	Fluid loss such as bleeding or diarrhea
Cardiogenic	Ineffective pumping due to heart damage
Obstructive	Blood flow to or from the heart is blocked
Distributive	Abnormal flow within the small blood vessels

Shock is a common end point of many medical conditions . Shock triggered by a serious allergic reaction is known as anaphylactic shock, shock triggered by severe dehydration or blood loss is known as hypovolemic shock, shock caused by sepsis is known as septic shock, etc.

Pathophysiology

shock is a complex and continuous condition, and there is no sudden transition from one stage to the next. at a cellular level, shock is the process of oxygen demand becoming greater than oxygen supply. one of the key dangers of shock is that it progresses by a positive feedback loop. poor blood supply leads to cellular damage, which results in an inflammatory response to increase blood flow to the affected area.

normally, this causes the blood supply level to match with tissue demand for nutrients. however, if there is enough increased demand in some areas, it can deprive other areas of sufficient supply, which then start demanding more. this then leads to an ever escalating cascade .

Initial

During the Initial stage (Stage 1), the state of hypoperfusion causes hypoxia. Due to the lack of oxygen, the cells perform lactic acid fermentation. Since oxygen, the terminal electron acceptor in the electron transport chain, is not abundant, this slows down entry of pyruvate into the Krebs cycle, resulting in its accumulation. The accumulating pyruvate is converted to lactate (lactic acid) by lactate dehydrogenase. The accumulating lactate causes lactic acidosis.

Compensatory

The Compensatory stage (Stage 2) is characterized by the body employing physiological mechanisms, including neural, hormonal, and bio-chemical mechanisms, in an attempt to reverse the condition. As a result of the acidosis, the person will begin to hyperventilate in order to rid the body of carbon dioxide (CO_2) since it indirectly acts to acidify the blood; the body attempts to return to acid–base homeostasis by removing that acidifying agent.

The baroreceptors in the arteries detect the hypotension resulting from large amounts of blood being redirected to distant tissues, and cause the release of epinephrine and norepinephrine.

Progressive/decompensated

The Progressive stage (stage 3) results if the underlying cause of the shock is not successfully treated. During this stage, compensatory mechanisms begin to fail. Due to the decreased perfusion of the cells in the body, sodium ions build up within the intracellular space while potassium ions leak out. Due to lack of oxygen, cellular respiration diminishes and anaerobic metabolism predominates.

As anaerobic metabolism continues, the arteriolar smooth muscle and precapillary sphincters relax such that blood remains in the capillaries. Due to this, the hydrostatic pressure will increase and, combined with histamine release, will lead to leakage of fluid and protein into the surrounding tissues.

Refractory

At Refractory stage (stage 4), the vital organs have failed and the shock can no longer be reversed. Brain damage and cell death are occurring, and death will occur imminently. One of the primary reasons that shock is irreversible at this point is that much of the cellular ATP (the basic energy source for cells) has been degraded into adenosine in the absence of oxygen as an electron receptor in the mitochondrial matrix. Adenosine easily perfuses out of cellular membranes into extracellular fluid, furthering capillary vasodilation, and then is transformed into uric acid.

Management

Treatment of shock is based on the likely underlying cause. An open airway and sufficient breathing should be established. Any ongoing bleeding should be stopped, which may require surgery or embolization. Intravenous fluid, such as Ringer's lactate or packed red blood cells, is often given. Efforts to maintain a normal body temperature are also important. Vasopressors may be useful in certain cases. Shock is both common and has a high risk of death. In the United States about 1.2 million people present to the emergency room each year with shock and their risk of death is between 20 and 50%.

Fluids

Aggressive intravenous fluids are recommended in most types of shock (e.g. 1–2 liter normal saline bolus over 10 minutes or 20 mL/kg in a child) which is usually instituted as the person is being further evaluated. Colloids and crystalloids appear to be equally effective with respect to outcomes., Balanced crystalloids and normal saline also appear to be equally effective in critically ill patients. If the person remains in shock after initial resuscitation, packed red blood cells should be administered to keep the hemoglobin greater than 100 g/L.

QUIZ

Enumerate the types of shock

Any questions?