Shock

Shock is the result of circulatory dysfunction, and it is characterized by failure to provide adequate quantities of oxygen and other nutrients to meet the metabolic requirements of the body's tissues.

I. **Pathophysiology of Shock**

A. **Hypovolemic shock** results from the loss of effective blood volume secondary to massive hemorrhage or severe dehydration caused by gastroenteritis.

B. **Septic shock** is caused by infection and it follows the release of a series of mediators that cause peripheral vasodilation, myocardial depression, hypotension, ventilatory insufficiency, and anemia.

C. **Cardiogenic shock** may occur after surgical repair of congenital heart defects or it may be associated with cardiomyopathy or tachyarrhythmias. Decreased myocardial contractility leads to low cardiac output and hypotension.

D. **Obstructive shock** occurs with pericardial tamponade or because of congenital cardiac outflow obstructions.

E. **Distributive shock** may be the result of anaphylaxis or neurogenic causes and is due to altered vascular tone.

F. **Endocrine shock** may occur when inappropriate amounts of hormones cause an imbalance between peripheral oxygen consumption and delivery.

G. **Dissociative shock** may result from oxygen not being released effectively by hemoglobin, as with carbon monoxide poisoning.

H. Shock may be divided into three phases: compensated, uncompensated, and irreversible.

II. **Clinical Evaluation**

A. A complete medical history should be completed and a thorough physical examination should be performed, including the state of consciousness, the pulse rate, the respiratory rate, the temperature, the blood pressure, the status of the skin and mucous membranes, capillary refilling, and urine output.

B. Frequently repeated physical examinations with compared and analyzed serial measurements may provide the first evidence of shock.

C. In compensated shock, neurologic status usually remains normal, but the pulse rate may be persistently elevated, the skin mottled, the extremities cool due to increased systemic vascular resistance, the capillary refilling prolonged, and the urinary output decreased.

D. Capillary refilling time measured in the fingernail bed should be less than 2 seconds. This may be prolonged by hypotension, dehydration, hypothermia, hyponatremia, and cardiac

failure; a time greater than 4 seconds indicates a critical problem.

E. Hypotension usually is a late finding because of the activation of compensatory mechanisms.

F. Progression to uncompensated and irreversible shock, as manifested by hypotension, severe acidosis, oliguria or anuria, and lethargy and coma, can usually be prevented through early intervention.

G. The pathophysiology of septic shock is markedly different from the other forms of shock. In the early compensated stage, cardiac output is increased, systemic vascular resistance is decreased, and pulse pressure is widened. Tachycardia and tachypnea occur, but the extremities are warm. Should the process progress to the uncompensated phase, the extremities become cold and the patient becomes listless and develops anuria and respiratory distress.

III. **Management of Shock**

A. Airway patency should be maintained, often requiring assisted ventilation. Oxygen should be administered, and efforts should be made to reduce the patient's oxygen requirements, which may become greater as a result of extreme body temperatures and the increased work of breathing.

B. Venous access, with a large-bore catheter, should be initiated for rapid fluid replacement. Should IV access not be available, intraosseous infusion may be lifesaving. Effective monitoring of vital signs, cardiac function, and neurologic status is essential. This may include the insertion of arterial and venous (central venous pressure line or Swan Ganz catheter) catheters.

C. Metabolic acidosis should be corrected and any underlying pathologic condition treated. Renal function should be supported and coagulation status monitored for abnormalities.

D. Hypovolemic shock requires immediate fluid resuscitation with the rapid administration of isotonic crystalloid solutions in aliquots of 20 mL/kg. If no response in blood pressure is obtained, the same volume should be given again rapidly. Patients must be assessed carefully before further fluid is administered.

E. Septic shock requires appropriate antibiotic therapy; volume resuscitation; and the use of inotropic agents, vasoactive drugs, or both.

Pharmacologic Treatment of Shock		
Drug	**Primary Mechanism of Action**	**Dosage (IV)**
Dopamine	Inotrope, vasodilator at low dose, vasoconstrictor at high dose	2-20 mcg/kg/min
Dobutamine	Inotrope	2-15 mcg/kg/min
Amrinone	Inotrope, vasodilator	Bolus: 0.75 mg/kg over 3 min Infusion: 5-10 mcg/kg/min
Epinephrine	Inotrope, vasoconstrictor	0.05-1 mcg/kg/min
Isoproterenol	Inotrope, vasodilator	0.05-4 mcg/kg/min
Norepinephrine	Vasoconstrictor	0.05-1 mcg/kg/min
Nitroprusside	Vasodilator	0.05-8 mcg/kg/min
Furosemide	Diuretic	1-2 mg/kg

F. **Cardiogenic shock** is corrected by maximizing cardiac performance by eradicating any dysrhythmias, controlling preload with diuretics and fluid restriction or augmentation, improving cardiac contractility with inotropic drugs, and reducing afterload with appropriate vasodilators.

G. **Obstructive shock** may be corrected by removal of pericardial fluid in patients who have tamponade or by surgical relief of vascular obstructions.

H. **Distributive shock (anaphylaxis)** is treated with epinephrine, aggressive fluid administration, and other pharmacologic preparations.

I. Rapid recognition and early aggressive management of septic shock can prevent significant morbidity and mortality. §