McCance: Pathophysiology, 6th Edition

Chapter 47: Shock, Multiple Organ Dysfunction, and Burns in Children

Key Points – Print

SUMMARY REVIEW

Shock and Multiple Organ Dysfunction Syndrome

1. Shock in children is present when there are signs of poor systemic perfusion, regardless of blood pressure.
2. Hypovolemic shock is the most common type of shock in children. Dehydration and trauma are the most common causes of hypovolemic shock.
3. Hypotension is a sign of severe, decompensated shock.
4. Hypovolemia can be caused by volume loss, an increase in the vascular space relative to the amount of volume, or a redistribution of intravascular volume.
5. Clinical manifestations of hypovolemic shock include inadequate systemic perfusion associated with intravascular fluid loss. Adrenergic compensatory mechanisms can produce tachycardia, redistribution of blood flow, peripheral vasoconstriction, cool extremities, delayed capillary refill, and oliguria.
6. Neurogenic shock is caused by a loss of vasomotor tone after severe injury to the spinal cord.
7. Clinical manifestations of neurogenic shock include warm skin, hypotension with a low diastolic blood pressure, and poor systemic perfusion.
8. Cardiogenic shock, with decreased cardiac output, is observed most commonly after cardiovascular surgery or with inflammatory diseases of the heart, such as cardiomyopathy and myocarditis. It is also found in children with obstructive congenital heart disease and those with drug toxicity or severe electrolyte or acid-base imbalances.
9. Clinical manifestations of cardiogenic shock include inadequate systemic perfusion despite adequate intravascular volume. Cardiac output is typically low. Adrenergic compensatory mechanisms are similar to those found in hypovolemic shock.
10. Sepsis in children caused by nosocomial infections is linked to gram-negative infections 40% of the time; gram-positive infections 40% of the time; and viruses, fungi, or rickettsial microorganisms 20% of the time. Sepsis can lead to septic shock.
11. Altered cytokine levels are associated with septic shock in children. TNF levels are directly related to mortality in newborns and children with meningitis and sepsis.
12. Sepsis is a systemic response to infection. It is present when manifestations of SIRS are observed. SIRS is present when the child demonstrates two or more of the following as an acute change from baseline values: fever or hypothermia, tachycardia, tachypnea with respiratory alkalosis, and alteration in the white blood cell count. The newborn often develops hypothermia rather than fever as a sign of infection and may develop bradycardia instead of tachycardia.

13. Severe sepsis is present when the individual demonstrates evidence of SIRS and signs of organ dysfunction, hypoperfusion, or hypotension.
14. The development of septic shock is heralded when the child with severe sepsis develops signs of cardiovascular dysfunction. The child may become hypotensive despite adequate fluid resuscitation or require vasopressors to maintain blood pressure.
15. Reperfusion and inflammatory injury stimulate free oxygen radicals that can damage cell membranes, denature proteins, and disrupt chromosomes. This process likely affects endothelial cells and the microvasculature, causing MODS.
16. Acidosis may be the most sensitive indicator of inadequate systemic perfusion in children. Hypotension is a late sign of shock in infants and children.
17. The goals of treatment for shock are maximization of oxygen delivery and minimization of oxygen demand. Airway, oxygenation, and ventilation must be supported. The child should be kept warm, and shivering should be prevented. Monitor the warmth of the child's extremities, capillary refill, quality of peripheral pulses, level of consciousness and responsiveness, urine output, oxygenation, ventilation, and acid-base status throughout shock therapy.
18. Treatment consists of immediate resuscitation, including fluid replacement (must be aggressive in septic shock), ventilation, pharmacologic support (e.g., vasopressors), ECG analysis, hemodynamic monitoring, administration of blood or blood component therapy, and management of electrolyte and acid-base imbalances.

Burns

1. Burns in children are often the result of inadequate supervision, curiosity, inability to escape the burning agent, or intentional abuse.
2. Scald injuries are commonly seen in young children and result from exposure to hot water, grease, or other hot liquids, whereas flame burns are more prevalent among older children.
3. A child's skin is thinner and thus more susceptible to injury than adult skin. The kitchen and bathroom are common sites of burn injury.
4. It is estimated that from 5% to 22% of all child abuse cases in the United States result from burn injury.
5. Flame burns involving flammable liquids, most notably gasoline, are more common in older children. Risk-taking behaviors in young males can lead to electrical burns. Children may be exposed to chemical injury by swallowing caustic agents at home.
6. Use of the standard rule of nines results in inaccurate calculation of the percentage of TBSA in children. A modified rule of nines deducts 1% from the head and adds 0.5% to each leg for each year of life after 2 years of age.
7. Major burn trauma involves all body systems, and the consequences of injury include shock, infection, hypermetabolism, organ failure, and functional limitations. These effects can be magnified in the pediatric population as a result of physiologic immaturity and age-related variation in treatment modalities.

8. Infection, trauma, or applying ice to the burn area may convert a partial-thickness injury to a full-thickness one, especially in young children, who have thinner, more delicate skin.
9. Marked reduction in cardiac output occurs immediately after injury and is accompanied by an initial increase in systemic vascular resistance. The inefficient and labile peripheral circulation of the infant complicates management of the burn shock phase of treatment. Constriction of the chest and impairment of respiratory excursion may occur in the very young child because of the increased pliability of the rib cage. Younger children are also more susceptible to increased intra-abdominal pressure.
10. Children younger than 2 years lack the ability to concentrate urine because of the immaturity of the renal system and are therefore at increased risk for dehydration. Because children have a relatively larger body surface area in relation to weight than adults, they require proportionately increased fluid during burn shock resuscitation to compensate for evaporative water losses.
11. A biphasic pattern of physiologic responses is evident in the burn injured child. The initial ebb phase occurs during the immediate postburn period and continues for 3 to 5 days. This phase is characterized by reduced oxygen consumption, impaired circulation, and cellular shock. After this phase and the restoration of volume, the metabolic response shifts to a catabolic, or flow, phase. This phase is characterized by hypermetabolism with an increased oxygen consumption and elevation of catecholamines, glucocorticoids, and glucagon.
12. Glycogen stores are limited in children, making it hard for them to meet the increased energy demands of the burn. This prolonged metabolic dysfunction may lead to loss of lean body mass, delayed healing, and increased morbidity.
13. Some children exhibit immunosuppression for a prolonged period after wound closure.
14. Although age was not found to be a predictor of hypertrophic scarring, children have greater skin tension and an accelerated rate of collagen synthesis.
15. Children require fluid resuscitation for smaller burns than do the adult population as a result of limited physiologic reserves. Colloid replacement may be required in the very young child who fails to respond to fluid replacement.
16. The leading cause of death in children after burn injury, as in adults, is inhalation injury.
17. Children require specialized management to ensure optimal functional and cosmetic results. Long-term scar and contracture management is necessary because of changes in body composition as the child grows and matures.