Chapter 17

Endocrine and Hematologic Emergencies

Introduction (1 of 2)

- Endocrine system affects nearly every:
  - Cell
  - Organ
  - Bodily function
- Endocrine disorders can have many signs and symptoms.

Introduction (2 of 2)

- Hematologic emergencies
  - Rare in most EMS systems
  - Difficult to assess and treat
  - EMT offers support and may save life

Anatomy and Physiology

- Endocrine system is a complex message and control system.
  - Glands secrete hormones.
  - Hormones are chemical messengers.
  - System maintains homeostasis

Pathophysiology (1 of 2)

- Diabetes affects the body's ability to use glucose (sugar) for fuel.
- Occurs in about 7% of the population
- Complications include blindness, cardiovascular disease, and kidney failure.

Pathophysiology (2 of 2)

- As an EMT, you need to know signs and symptoms of blood glucose that is:
  - High (hyperglycemia)
  - Low (hypoglycemia)
- Central problem in diabetes is lack, or ineffective action, of insulin.

Types of Diabetes (1 of 4)

- Diabetes mellitus: “sweet diabetes”
- *Diabetes insipidus*: excessive urination
- Type 1 and type 2 diabetes both:
  - Are equally serious
  - Affect many tissues and functions
  - Require life-long management.

Types of Diabetes (2 of 4)

- Type 1 patients do not produce insulin.
  - Need daily injections of insulin
  - Typically develops during childhood
  - Patients more likely to have metabolic problems and organ damage
  - Considered an autoimmune problem

Types of Diabetes (3 of 4)

- Type 2 patients produce inadequate amounts of insulin, or normal amount that does not function effectively.
  - Usually appears later in life
  - Treatment may be diet, exercise, oral medications, or insulin.

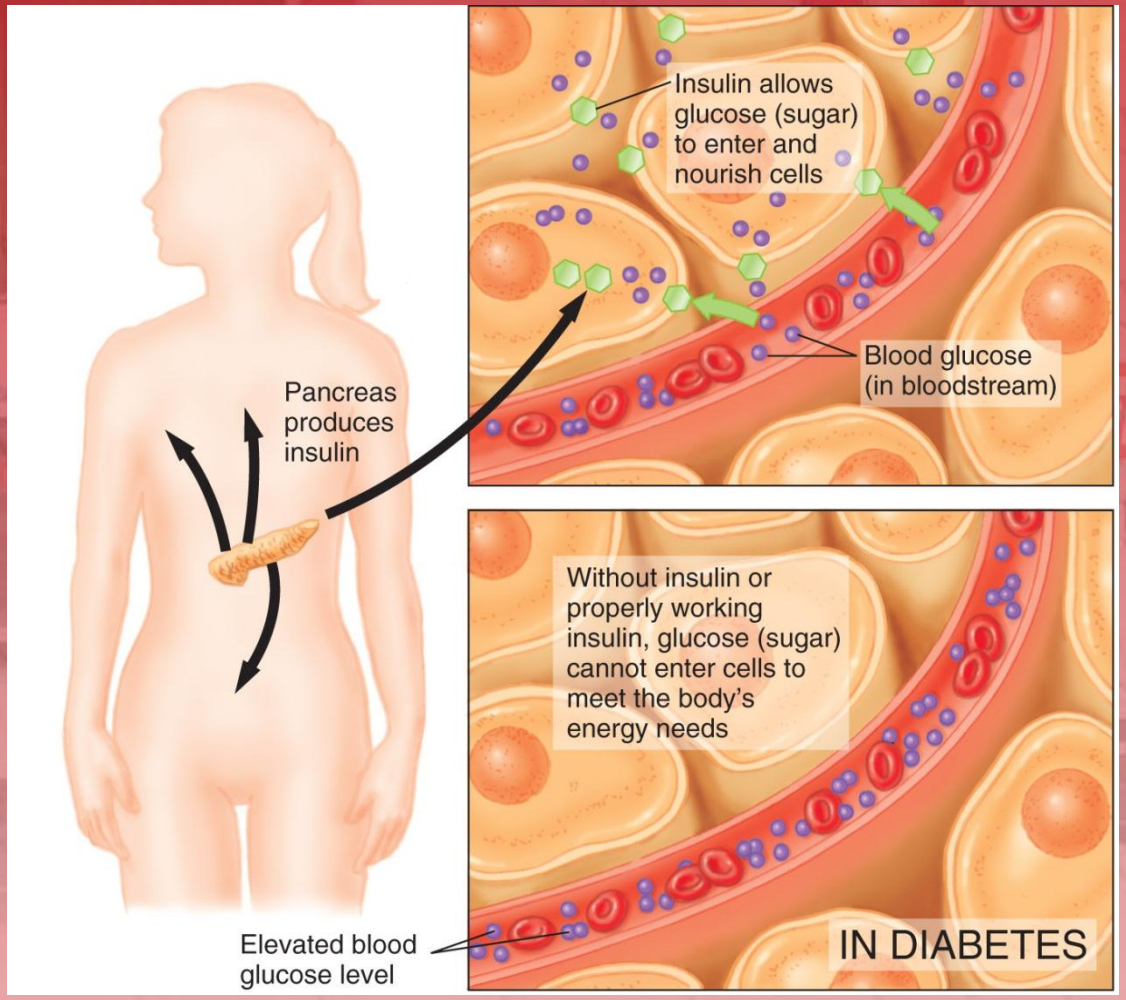
Types of Diabetes (4 of 4)

- Severity of diabetic complications depends on patient's average blood glucose level and when diabetes began.
- Obesity increases the risk of diabetes.

The Role of Glucose and Insulin (1 of 8)

- Glucose is a major source of energy for the body.
- Insulin is needed to allow glucose to enter cells (except for brain cells).
  - A “cellular key”

The Role of Glucose and Insulin (2 of 8)



The Role of Glucose and Insulin (3 of 8)

- Classic symptoms of uncontrolled diabetes ("3 Ps"):
  - Polyuria: frequent, plentiful urination
  - Polydipsia: frequent drinking to satisfy continuous thirst
  - Polyphagia: excessive eating

The Role of Glucose and Insulin (4 of 8)

- When glucose is unavailable, the body turns to other energy sources.
  - Fat is most abundant.
  - Using fat for energy results in buildup of ketones and fatty acids in blood and tissue.

The Role of Glucose and Insulin (5 of 8)

- Diabetic ketoacidosis (DKA)
  - A form of acidosis seen in uncontrolled diabetes
  - Without insulin, certain acids accumulate.
  - More common in type 1 diabetes
  - Signs and symptoms:
    - Weakness
    - Nausea

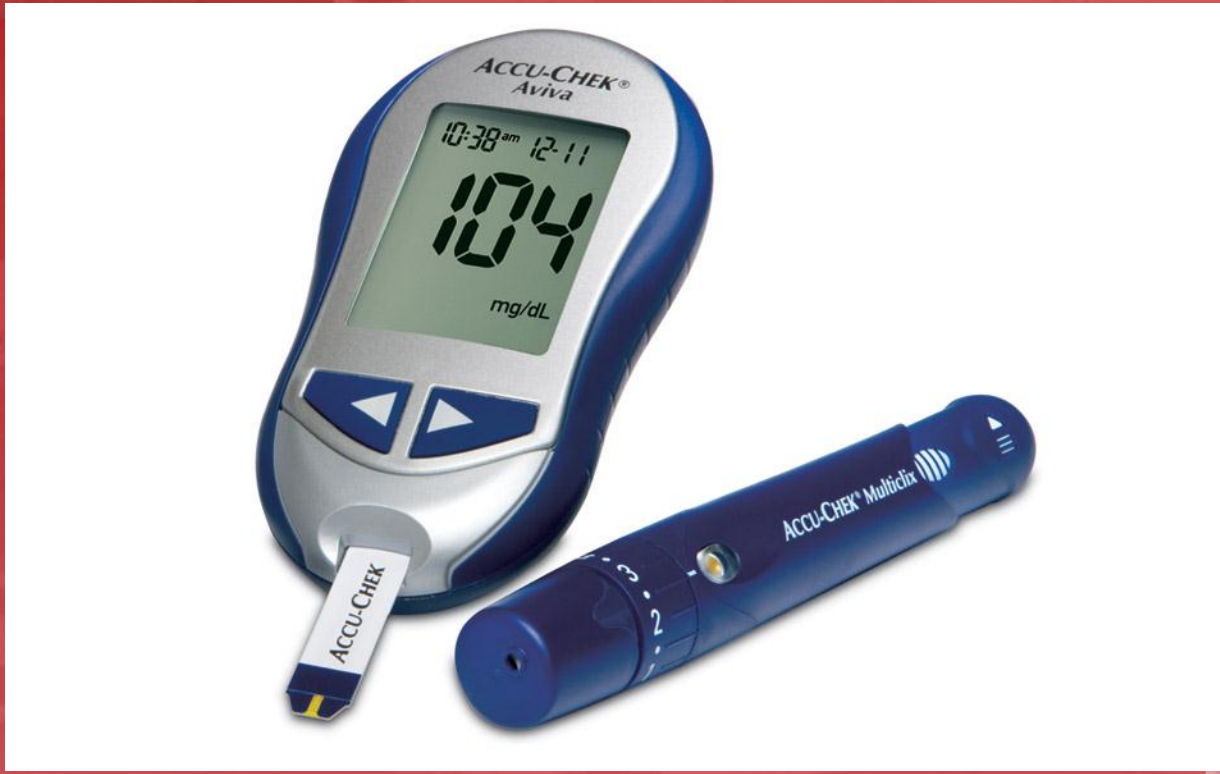
The Role of Glucose and Insulin (6 of 8)

- DKA
  - Signs and symptoms (cont'd):
    - Weak, rapid pulse
    - Kussmaul respirations
    - Sweet breath
  - Can progress to coma and death

The Role of Glucose and Insulin (7 of 8)

- Hyperosmolar hyperglycemic (HHNC) nonketotic coma
  - More often caused by type 2 diabetes
  - Slower, more gradual onset than DKA
  - No sweet-smelling breath
  - Excessive urination results in dehydration.

The Role of Glucose and Insulin (8 of 8)



Source: Accu-Chek® Aviva used with permission of Roche Diagnostics.

Blood glucose monitoring kit

Hyperglycemia and Hypoglycemia (1 of 3)

- Both lead to diabetic emergencies.
- Hyperglycemia: Blood glucose is above normal.
  - Result of lack of insulin
  - Untreated, results in DKA

Hyperglycemia and Hypoglycemia (2 of 3)

- Hypoglycemia: Blood glucose is below normal.
  - Untreated, results in unresponsiveness and hypoglycemic crisis
- Signs and symptoms of hyperglycemia and hypoglycemia are similar.

Hyperglycemia and Hypoglycemia (3 of 3)

Table 17-1 Characteristics of Diabetic Emergencies

	Hyperglycemia	Hypoglycemia
History		
Food intake	Excessive	Insufficient
Insulin dosage	Insufficient	Excessive
Onset	Gradual (hours to days)	Rapid, within minutes
Skin	Warm and dry	Pale, cool, and moist
Infection	Common	Uncommon
Gastrointestinal tract		
Thirst	Intense	Absent
Hunger	Absent	Intense
Vomiting	Common	Uncommon
Respiratory system		
Breathing	Rapid, deep (Kussmaul respirations)	Normal or rapid
Odor of breath	Sweet, fruity	Normal
Cardiovascular system		
Blood pressure	Normal to low	Normal to low
Pulse	Rapid, weak, and thready	Rapid, weak
Nervous system		
Consciousness	Restlessness, possibly progressing to coma; abnormal or slurred speech; unsteady gait	Irritability, confusion, seizure, or coma; unsteady gait
Treatment		
Response	Gradual, within 6 to 12 hours following medical treatment	Immediately after administration of glucose

Hyperglycemic Crisis (1 of 3)

- Hyperglycemic crisis (diabetic coma) is a state of unconsciousness resulting from:
  - Ketoacidosis
  - Hyperglycemia
  - Dehydration
  - Excess blood glucose

Hyperglycemic Crisis (2 of 3)

- Can occur in diabetic patients:
  - Not under medical treatment
  - Who have taken insufficient insulin
  - Who have markedly overeaten
  - Under stress due to infection, illness, overexertion, fatigue, or alcohol

Hyperglycemic Crisis (3 of 3)

- If untreated, can result in death
- Treatment may take hours in a well-controlled hospital setting.

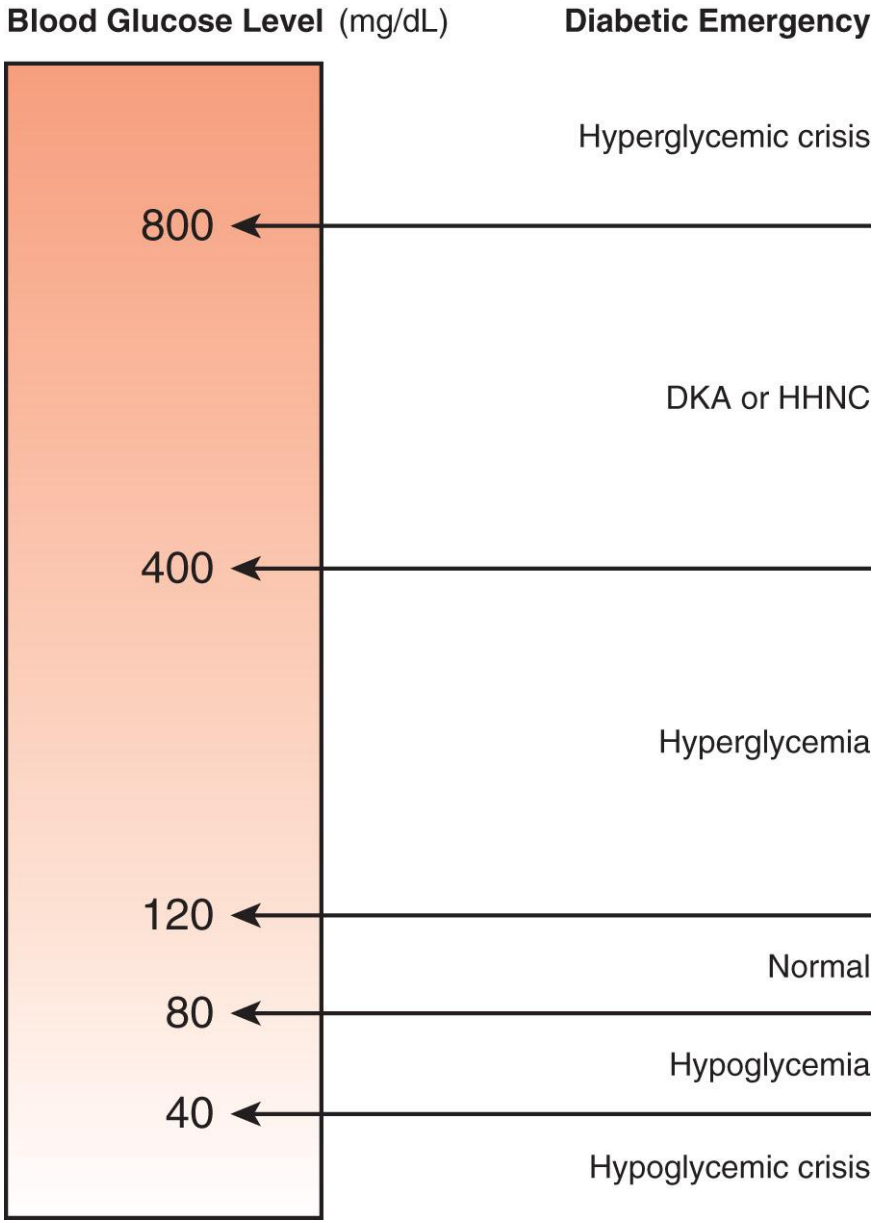
Hypoglycemic Crisis (1 of 3)

- Hypoglycemic crisis (insulin shock) is caused by insufficient levels of glucose in the blood.
- Can occur in insulin-dependent patients:
  - Who have taken too much insulin
  - Who have taken a regular dose of insulin but have not eaten enough food

Hypoglycemic Crisis (2 of 3)

- Can occur in insulin-dependent patients (cont'd):
  - Who have engaged in vigorous activity and used up all available glucose
  - Who have vomited a meal after taking insulin
- Insufficient glucose supply to the brain

Hypoglycemic Crisis (3 of 3)



- If untreated, it can produce unconscious-ness and death.
- Quickly reversed by giving glucose

Patient Assessment of Diabetes

- Patient assessment steps
  - Scene size-up
  - Primary assessment
  - History taking
  - Secondary assessment
  - Reassessment

Scene Size-up

- Scene safety
  - Diabetic patients often use syringes for insulin.
  - Use gloves and eye protection at a minimum.
- Mechanism of injury (MOI)/nature of illness (NOI)
  - Remember, trauma may also have occurred.

Primary Assessment (1 of 4)

- Form a general impression.
  - Other medical or trauma emergencies may be responsible for diabetic patient's symptoms
- Airway and breathing
  - Be alert for Kussmaul respirations and sweet, fruity breath (DKA).

Primary Assessment (2 of 4)

- Airway and breathing (cont'd)
  - Hypoglycemic patients will have normal or shallow to rapid respirations.
  - Manage respiratory distress.

Primary Assessment (3 of 4)

- Circulation
  - Dry, warm skin: hyperglycemia
  - Moist, pale skin: hypoglycemia
  - Rapid, weak pulse: hyperglycemic crisis

Primary Assessment (4 of 4)

- Transport decision
  - Provide prompt transport for patients with altered mental status and inability to swallow
  - Further evaluate conscious patients capable of swallowing and able to maintain airway

History Taking (1 of 3)

- Investigate chief complaint
  - Obtain history of present illness from responsive patient, family, or bystanders.
  - If patient has eaten but not taken insulin, hyperglycemia is more likely.

History Taking (2 of 3)

- Investigate chief complaint (cont'd)
  - If patient has taken insulin but not eaten, hypoglycemia is more likely.
  - Carefully observe signs and symptoms; determine whether hypo- or hyperglycemic.

History Taking (3 of 3)

- SAMPLE history—Has the patient:
  - Taken insulin or pills to lower blood sugar?
  - Taken his or her usual dose today?
  - Eaten normally?
  - Experienced illness, unusual amount of activity, or stress?

Secondary Assessment (1 of 2)

- Physical examination
  - Full-body scan
  - Focus on mental status, ability to swallow, and ability to protect airway.

Secondary Assessment (2 of 2)

- Vital signs
  - Obtain complete set of vital signs.
    - Use available monitoring devices (eg, glucometer, pulse oximeter).
    - Normal blood glucose: 80 to 120 mg/dL

Reassessment (1 of 4)

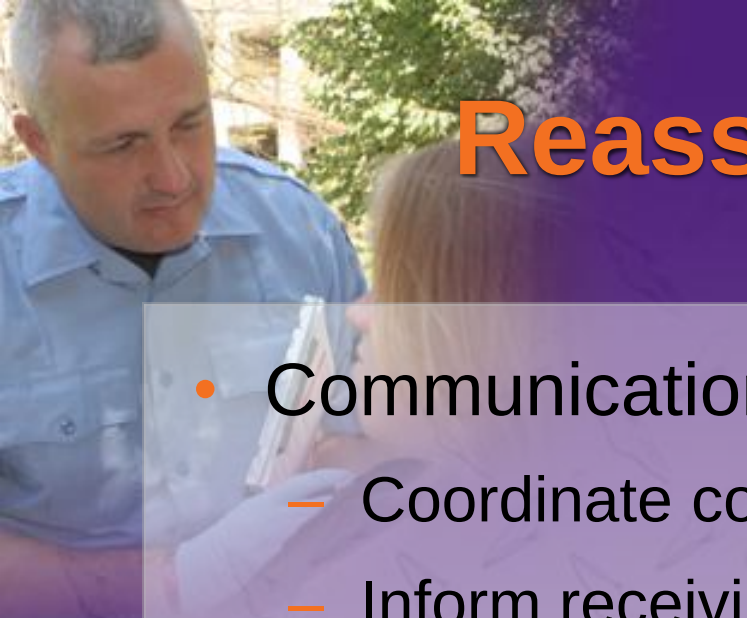
- Interventions
  - Reassess patient frequently.
  - Provide indicated interventions.
    - Hypoglycemic, conscious, can swallow:
      - Encourage patient to drink juice.
      - Administer oral glucose (if protocols allow).
      - Provide rapid transport.

Reassessment (2 of 4)

- Interventions (cont'd)
  - Hypoglycemic, unconscious, risk of aspiration:
    - Patient needs intravenous (IV) glucose or intramuscular (IM) glucagon (beyond EMT competencies).
    - Provide rapid transport.

Reassessment (3 of 4)

- Interventions (cont'd).
  - Unconscious, known diabetic:
    - If hypoglycemic, give oral glucose (if protocols allow).
    - If hyperglycemic, patient needs insulin and IV fluid therapy (beyond EMT competencies).
  - When in doubt, give glucose (if protocols allow).



Reassessment (4 of 4)

- Communication and Documentation
  - Coordinate communication and documentation
  - Inform receiving hospital about prehospital patient assessment and care.

Emergency Medical Care for Diabetic Emergencies (1 of 2)

Source: Courtesy of Paddock Laboratories, Inc.

- Oral glucose
  - Commercially available gel given to increase blood glucose
  - Follow local protocols for administration (**Skill Drill 17-1**).

Emergency Medical Care for Diabetic Emergencies (2 of 2)

- Oral glucose (cont'd)
  - Contraindications: inability to swallow and unconsciousness
  - Wear gloves before putting anything in patient's mouth.

Problems Associated With Diabetes (1 of 7)

- Seizures
  - Rarely life threatening
  - May indicate an underlying condition
  - Consider trauma and hypoglycemia as causes.
  - Ensure airway is clear.
  - Place patient on side.

Problems Associated With Diabetes (2 of 7)

- Seizures (cont'd)
  - Put nothing in patient's mouth.
  - Have suctioning equipment ready.
  - Provide oxygen or artificial ventilations for inadequate respirations or cyanosis.
  - Transport promptly.

Problems Associated With Diabetes (3 of 7)

- Altered mental status
  - May be caused by diabetes complications
  - May be caused by other conditions (poisoning, head injury, postictal state, or decreased brain perfusion)
  - Ensure airway is clear.

Problems Associated With Diabetes (4 of 7)

- Altered mental status (cont'd)
  - Be prepared to provide artificial ventilations and suctioning if patient vomits.
  - Provide prompt transport.
- Alcoholism
  - Symptoms mistaken for intoxication

Problems Associated With Diabetes (5 of 7)

- Alcoholism (cont'd)
  - Especially common when symptoms result in a motor vehicle crash or other incident
  - Confined by police in a "drunk tank," the diabetic patient is at risk.
  - Look for emergency medical identification bracelet, necklace, or card.

Problems Associated With Diabetes (6 of 7)

- Alcoholism (cont'd)
  - Perform blood glucose test at scene (if protocols allow) or emergency department.
  - Diabetes and alcoholism can coexist in a patient.

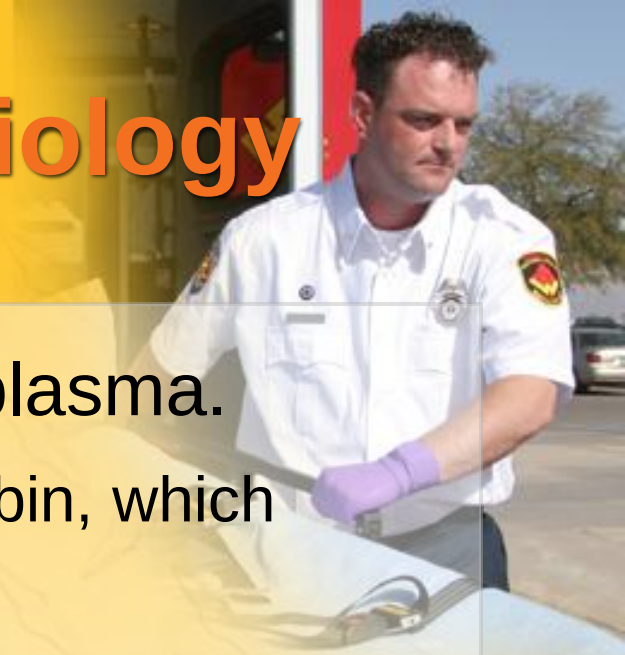
Problems Associated With Diabetes (7 of 7)

- Airway management
  - Patients with altered mental status can lose gag reflex.
  - Vomit or tongue may obstruct airway.
  - Carefully monitor airway.
  - Place patient in lateral recumbent position.
  - Make sure suction is available.

Hematologic Emergencies

- Hematology is the study and prevention of blood-related diseases.
- Blood is “the fluid of life.”
  - Understanding it helps understand disorders.

Anatomy and Physiology

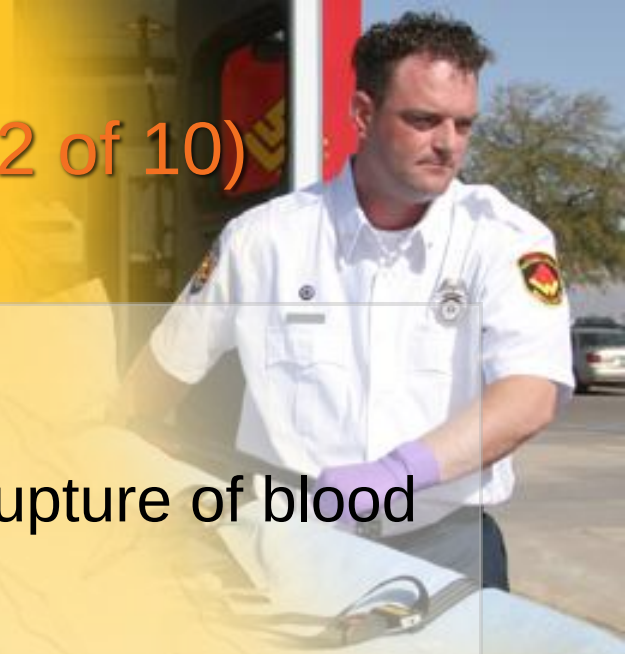


- Blood is made up of cells and plasma.
  - Red blood cells contain hemoglobin, which carries oxygen to the tissues.
  - White blood cells “clean” the body.
  - Platelets are essential for clot formation.
  - Plasma transports blood cells.

Pathophysiology (1 of 10)

- Sickle cell disease
  - Inherited disorder, affects red blood cells
  - Predominant in African Americans and persons of Mediterranean descent
  - Red blood cells are sickle or oblong shaped, contain hemoglobin S, are poor oxygen carriers, and live for only 16 days.

Pathophysiology (2 of 10)



- Sickle cell disease (cont'd)
  - May cause hypoxia; swelling or rupture of blood vessels or spleen; and death
  - Four main types of sickle cell crises:
    - Vaso-occlusive crisis
    - Aplastic crisis
    - Hemolytic crisis
    - Splenic sequestration crisis

Pathophysiology (3 of 10)

- Sickle cell disease (cont'd)
  - Vaso-occlusive crisis
    - Blood flow to organs is restricted
  - Aplastic crisis
    - Worsening of baseline anemia
  - Hemolytic crisis
    - Acute, accelerated drop in hemoglobin level
  - Splenic sequestration crisis
    - Acute enlargement of spleen

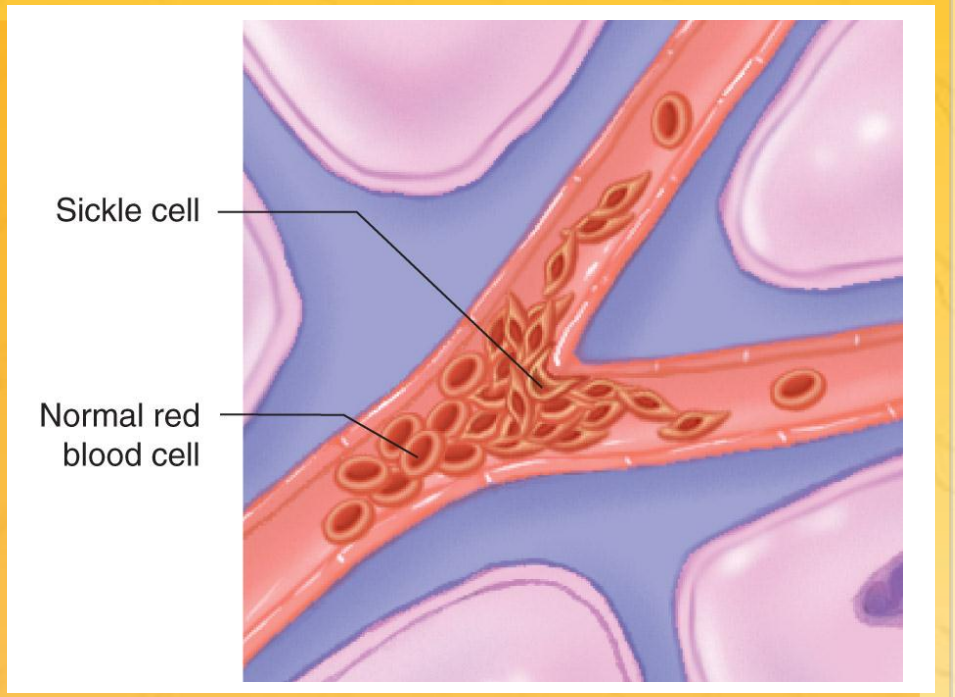
Pathophysiology (4 of 10)

- Sickle cell disease (cont'd)
  - Complications:
    - Cerebral vascular attack
    - Gallstones
    - Jaundice
    - Avascular necrosis

Pathophysiology (5 of 10)

- Sickle cell disease (cont'd)
  - Complications (cont'd)
    - Splenic infections
    - Osteomyelitis
    - Opiate tolerance
    - Leg ulcers

Pathophysiology (6 of 10)



- Sickle cell disease (cont'd)
  - Complications (cont'd)
    - Retinopathy
    - Chronic pain
    - Pulmonary hypertension
    - Chronic renal failure

Pathophysiology (7 of 10)

- Clotting disorders
  - Thrombosis
    - Development of blood clot in blood vessel
  - Thrombophilia
    - Tendency to develop blood clots
    - Blood-thinning medications used to treat

Pathophysiology (8 of 10)

- Clotting disorders (cont'd)
  - Thrombophilia (cont'd)
    - Not common in pediatric patients
    - Risk factors:
      - Recent surgery, impaired mobility, congestive heart failure, cancer, respiratory failure, infectious diseases, over 40 years of age, being overweight/ obesity, smoking, oral contraceptive use

Pathophysiology (9 of 10)

- Clotting disorders (cont'd)
  - Hemophilia
    - Congenital; impaired ability to form blood clots
    - Predominant in males (1 per 5,000–10,000)
    - Hemophilia A most common
    - Hemophilia B second most common

Pathophysiology (10 of 10)

- Clotting disorders (cont'd)
  - Hemophilia (cont'd)
    - Signs and symptoms:
      - Spontaneous, acute, chronic bleeding
      - Intracranial bleeding (major cause of death)
    - During assessment, seriously consider injury/illness that can cause bleeding.

Patient Assessment of Hematologic Disorders

- Patient assessment steps
  - Scene size-up
  - Primary assessment
  - History taking
  - Secondary assessment
  - Reassessment

Scene Size-up

- Scene safety
  - Most sickle cell patients will have had a crisis before.
  - Wear gloves and eye protection at a minimum.
- MOI/NOI
  - Remember, trauma may also have occurred.

Primary Assessment (1 of 3)

- Form a general impression.
  - Perform a rapid scan.
- Airway and breathing
  - Inadequate breathing or altered mental status:
    - High-flow oxygen at 12 to 15 L/min via NRB mask

Primary Assessment (2 of 3)

- Airway and breathing (cont'd)
  - Sickle cell crisis patients may have increased respirations or signs of pneumonia
  - Manage respiratory distress.

Primary Assessment (3 of 3)

- Circulation
  - Sickle cell patients: increased pulse rate
  - Hemophilia patients:
    - Be alert for signs of acute blood loss.
    - Note bleeding of unknown origin.
    - Be alert for signs of hypoxia.
- Make a transport decision.

History Taking (1 of 3)

- Investigate chief complaint.
  - Obtain history of present illness from responsive patients, family, or bystanders.
  - Physical signs indicating sickle cell crisis:
    - Swelling of fingers and toes
    - Priapism
    - Jaundice

History Taking (2 of 3)

- Assess pain using OPQRST mnemonic.
  - Single location or felt throughout body?
  - Visual disturbances?
  - Nausea, vomiting, or abdominal cramping?
  - Chest pain or shortness of breath?

History Taking (3 of 3)

- Obtain SAMPLE history from responsive patient or family member.
  - Have you had a crisis before?
  - When was the last time you had a crisis?
  - How did your last crisis resolve?
  - Recent illness, unusual amount of activity, or stress?

Secondary Assessment

- Physical examination
  - Focus on major joints.
  - Determine level of consciousness (AVPU).
- Vital signs
  - Obtain complete set of vital signs.
    - Look for signs of sickle cell crisis.
    - Use pulse oximeter, if available.

Reassessment (1 of 2)

- Reassess vital signs frequently.
- Interventions
  - Provide indicated interventions
  - Reassess interventions
- Hospital care for sickle cell crisis:
  - Analgesics, penicillin, IV fluid, blood transfusion

Reassessment (2 of 2)

- Hospital care for hemophilia:
  - IV therapy (for hypotension)
  - Transfusion of plasma
- Coordinate communication and documentation.

Emergency Medical Care for Hematologic Disorders

- Mainly supportive and symptomatic
- Patients with inadequate breathing or altered mental status:
  - Administer high-flow O_2 at 12 to 15 L/min.
  - Place in a position of comfort.
  - Transport rapidly to hospital.

Summary (1 of 12)

- The endocrine system maintains stability in the body's internal environment (homeostasis).
- Type 1 and type 2 diabetes involve abnormalities in the body's ability to use glucose (sugar) for fuel.

Summary (2 of 12)

- Polyuria (frequent, plentiful urination), polydipsia (frequent drinking to satisfy continuous thirst), and polyphagia (excessive eating due to cellular hunger) are common symptoms, or the “3 Ps,” of uncontrolled diabetes.

Summary (3 of 12)

- Patients with diabetes have chronic complications that place them at risk for other diseases.
- Hyperglycemia is the result of a lack of insulin, causing high blood glucose levels.

Summary (4 of 12)

- Hypoglycemia is a state in which the blood glucose level is below normal. Without treatment, permanent brain damage and death can occur.
- DKA is the buildup of ketones and fatty acids in the blood and body tissue that results when the body relies upon fat for energy.

Summary (5 of 12)

- Hyperglycemic crisis (diabetic coma) is a state of unconsciousness resulting from DKA, hyperglycemia, and/or dehydration due to excessive urination.

Summary (6 of 12)

- Hypoglycemic crisis (insulin shock) is caused by insufficient blood glucose levels. Treat quickly, by giving oral glucose (if protocols allow), to avoid brain damage.

Summary (7 of 12)

- When assessing diabetic emergencies, err on the side of giving oral glucose (if protocols allow). Do not give oral glucose to patients who are unconscious or who cannot swallow properly and protect the airway. In all cases, provide rapid transport.

Summary (8 of 12)

- Problems associated with diabetes include seizures, altered mental status, “intoxicated” appearance, and loss of a gag reflex, which affects airway management.
- Hematology is the study and prevention of blood-related disorders.

Summary (9 of 12)

- Sickle cell disease is a blood disorder the affects the shape of red blood cells. Symptoms include joint pain, fever, respiratory distress, and abdominal pain.

Summary (10 of 12)

- Hemoglobin A is considered normal hemoglobin. Hemoglobin S is considered an abnormal type of hemoglobin and is responsible for sickle cell crisis.

Summary (11 of 12)

- Patients with sickle cell disease have chronic complications that place them at risk for other diseases, such as heart attack, stroke, and infection.

Summary (12 of 12)

- Patients with hemophilia are not able to control bleeding.
- Emergency care in the prehospital setting is supportive for patients with sickle disease or a clotting disorder such as hemophilia.