Dealing With Diabetic Emergencies

by Bryan E. Bledsoe, DO

Diabetes mellitus is a common disorder that affects the way in which the human body processes and uses glucose. Affecting more than 14 million Americans, it is unrecognized and untreated in approximately one-half of those who suffer from the condition. The complications of diabetes itself are many, and it also adversely contributes to numerous other conditions, including heart disease, stroke, kidney disease and blindness.

To minimize complications, people with diabetes must regulate their blood-sugar levels through diet, with oral medications that lower the blood sugar or with insulin. Without proper regulation of blood-sugar levels, extreme variations in blood sugar can result in serious medical emergencies that require prompt and efficient management byprehospital personnel.

Case Presentation

First responders and paramedic ambulance crew 9935 are dispatched to a medical emergency in a rural part of the county. The first responders arrive at the scene within three minutes and find a 17-year-old female lying on the floor moaning and incoherent. The girl’s mother reports that the patient is an insulin-dependent diabetic and that her glucose-monitor readings have been high. She also states that her daughter has been experiencing some “emotional problems” lately, and it is possible that she has not been taking her insulin.

The primary assessment shows that the girl’s airway is patent, she is ventilating well, has a strong pulse and is arousable only to painful stimuli. At this point, the first responders administer supplemental oxygen through a non-rebreather mask.

The paramedics arrive seven minutes into the call. They repeat the primary assessment and begin the secondary survey. Vital signs are: blood pressure—80/50mmHg; pulse rate—132/min.; and respiration—40/min. Pulse oximetry reveals 99-percent saturation, and the glucose reading is too high to register on the glucose monitor. Home medications include Seldane® and insulin. The physical examination reveals a fruity breath odor, rapid deep respirations, and multiple “knots” palpable on the thighs and the anterior abdomen.

Per standing orders, the paramedics establish an IV of normal saline. They continue to provide oxygen and prepare the patient for transport. Medical control is contacted during the 10-minute transport to the hospital.

Upon arrival at the emergency department, the patient’s condition remains relatively unchanged, except that she is now completely unresponsive to painful stimuli. A glucose-stripe test reveals a blood-sugar level greater than 250mg/dl (normal is 70 to 110mg/dl). The cardiac monitor shows a sinus tachycardia.

A second IV is started with lactated Ringer’s and run wide open. An initial arterial blood gas (ABG) is drawn, as well as a chemistry panel, complete blood count, serum ketones, urinalysis, pregnancy test and urine drug screen. A nasogastric tube and Foley catheter are then placed.

Twenty units of regular insulin are administered intravenously. Shortly after being given insulin, the patient suffers a grand mal seizure, which is controlled by administering 10mg of Valium®. A repeat ABG and chemistry are drawn, and 50mEq/L sodium bicarbonate is administered. An endotracheal tube is placed, and the patient is hyperventilated with 100% oxygen. A chest X-ray and cranial CT scan prove negative.

The patient suffers another seizure, which is effectively terminated with an
Figure 1.
Pathophysiology of Diabetes Mellitus
The Johns Hopkins University School of Public Health and Health Services, Maryland Institute of Emergency Medical Services Systems.

additional 10mg of Valium®. She is then loaded with Dilantin®. A 12-lead EKG reveals a sinus tachycardia with diffuse ST-segment changes consistent with cardiac ischemia. A third ABG is drawn, and an insulin drip is started before the patient is transferred to the intensive care unit (ICU).

The patient continues to have seizure activity in the ICU, and an electroencephalogram (EEG) reading reveals diffuse hypoxic brain injury. The patient never regains consciousness and dies in the ICU 24 hours later. The drug screen drawn earlier in her treatment comes back positive for alcohol, marijuana and cocaine. It is later learned that the patient had stopped her insulin after a fight with her boyfriend.

Glucose Metabolism
Diabetes adversely affects the body’s ability to process and use glucose. To understand the disease, it is important to first understand the way in which the body is supposed to process and use glucose.

Glucose, also called dextrose, is a simple sugar that is required by the body to produce energy. Sugars, also called carbohydrates, are one of the three major food sources used by the body; the other two are proteins and fats. Only three major sources of carbohydrate exist in the normal human diet: sucrose, lactose and starches. Sucrose, commonly known as cane sugar, is essentially common table sugar. Lactose is the sugar contained in milk, while starches are the large sugars present in almost all non-animal foods, particularly grains.

Most sugars in the normal human diet are classified as complex and must be broken down into simple sugars—glucose, galactose and fructose—before they can be used by the body for energy. This breakdown is carried out on a continual basis by enzymes in the gastrointestinal system. The simple sugars are then absorbed from the gastrointestinal system into the body. In the ordinary diet, glucose represents more than 80 percent of the final product of carbohydrate digestion. Shortly after absorption into the body, however, much of the fructose and all of the galactose are rapidly converted into glucose. By the time the various sugars enter the bloodstream, they are more than 95 percent glucose, the principle carbohydrate used for energy production.

For the body to convert glucose to energy, glucose first must be transported through the cell membrane into the cells. However, because the glucose molecule is large, it does not readily diffuse through the cell membrane. Instead, it passes into the cell by binding to a special carrier protein on the cell’s surface in a process called facilitated diffusion. Once bound, the molecule is transported through the cell membrane into the cell and released. Once inside the cell, it can be converted to energy.

The rate at which glucose is transported into the cells can be accelerated 10 or more times by a hormone known as insulin, which is secreted by the pancreas. Without insulin, the amount of glucose that can be transported into the cells is far too small to meet the body’s energy demands.

The pancreas is an important gland located in the folds of the duodenum within the abdominal cavity. It secretes digestive enzymes and endocrine hormones. This secretion of endocrine hormones is accomplished by specialized tissues within the pancreas, referred to as the islets of Langerhans (see Figure 1). The islets of Langerhans secrete three different hormones: insulin, glucagon and somatostatin.

Insulin acts as a messenger. When released by the pancreas, it travels through the blood to targeted tissues. Once at the targeted tissue, it combines with specific insulin receptors (see Figure 1) on the surface of the cell membrane to allow glucose to enter the cell. Without the insulin, significant glucose entry cannot take place. Since glucose is the primary energy source for the cells, adequate insulin is a necessity for cellular survival. However, insulin is also rapidly broken down by the liver and thus must be secreted constantly.

Glucagon is an important hormone that is antagonistic to insulin. Released when the blood-glucose level falls, it increases the level of glucose in the blood by stimulating the liver to release stored glucose from storage sites within the body. In addition, glucagon stimulates the liver to manufacture glucose from other substances to effectively raise the blood-glucose level.

The third pancreatic hormone, somatostatin, inhibits both glucagon and insulin. Its role in regulating the blood-glucose level is not yet completely understood.

Pathophysiology of Diabetes Mellitus
Diabetes mellitus is generally divided into two different categories: Type-1 diabetes and Type-2 diabetes. Type-1 diabetes, also called insulin-dependent diabetes, typically begins in childhood or young adulthood. Usually sudden in onset, it progresses quickly and is characterized by inadequate production of insulin by the pancreas. Type-2 diabetes, also called non-insulin-dependent diabetes, typically occurs in patients more than 40 years of age and tends to be associated with obesity. Insulin secretion is typically reduced in these patients but not to the same degree as with Type-1 diabetes.

Type-1 Diabetes: Although the cause of Type-1 diabetes is not well understood,
one theory holds that a viral infection attacks the pancreatic cells that produce insulin, thus slowing or stopping insulin production. Another theory holds that the body's immune system attacks the insulin-producing cells, thinking that they are foreign. Heredity also appears to be a factor.

Type-I diabetes mellitus is a serious disease that requires patients to take supplemental insulin daily. Type-I diabetes generally have decreased insulin secretion that subsequently leads to elevated blood-glucose levels. However, since insulin is required to transport glucose into the cells, the cells become effectively depleted of glucose despite increased blood-glucose levels. As the cells become glucose-depleted, they begin to use other sources of energy, resulting in the production of various harmful by-products, such as ketones and organic acids. In addition, as the concentration of glucose in the blood continues to rise, the kidneys begin excreting glucose into the urine. As glucose is spilled into the urine, it takes water with it, often leading to life-threatening dehydration. If the various acids and ketones continue to accumulate in the blood, severe metabolic acidosis occurs, and coma ensues. This severe acidosis can result in serious brain damage and death.

Type-II Diabetes: Type-II diabetes mellitus is more common than Type-I. It too, is characterized by decreased insulin production by the pancreas. Although Type-II diabetes typically begins later in life and is usually associated with obesity, it can occur in non-obese patients as well.

The number of insulin receptors in the body either remains the same or decreases. Thus, increased body weight or mass causes a relative decrease in the number of available insulin receptors. Also, insulin receptors can become defective and less responsive to insulin (see Figure 1). In addition, the pancreas becomes less responsive to stimulation by increased blood-glucose levels. Thus, insulin is not secreted as needed, which ultimately leads to increased blood-glucose levels. Type-II diabetes can usually be managed by diet, oral medication or a combination of the two. In some instances, if diet and oral agents fail, insulin may be required. This form of diabetes mellitus is often detected during routine blood-glucose screening. It should also be suspected if the patient suddenly exhibits an increase in food or water intake or has increased urine output. Blood tests are required to confirm the diagnosis.

The first approach in treating Type-II diabetes is to reduce the intake of carbohydrates and to encourage the patient to lose weight if he is obese. In addition, physicians may prescribe oral hypoglycemic agents to stimulate increased insulin secretion and to promote an increase in the number of insulin receptors on the cells. Both actions tend to lower blood-glucose levels.

If not controlled, Type-II diabetes can also lead to a life-threatening dehydration of body cells. This condition differs from Type-I diabetes in that Type-II diabetics have adequate insulin production to prevent the production of ketones and the complications of metabolic acidosis.

Diabetic Emergencies

Diabetic emergencies can be classified as either hyperglycemic or hypoglycemic emergencies. Two types of hyperglycemic emergencies can develop: diabetic ketoacidosis (DKA) and non-ketotic hyperosmolar coma (NKHC). DKA tends to occur in patients with insulin-dependent diabetes, whereas NKHC occurs primarily in older patients who do not require insulin but who have another serious underlying disease. Hypoglycemia is the most critical diabetic emergency and can occur with either type of diabetes.

Hyperglycemic Emergencies

Diabetic Ketoacidosis: DKA, also known as diabetic coma, develops as blood-glucose levels increase beyond the normal range of 70 to 110mg/dl and individual cells become glucose-depleted. As the blood-glucose level rises, the body spills sugar into the urine, causing serious dehydration. As cellular-glucose deprivation continues, ketone and acid production occur, causing the blood to become acidic. If the ketoacidosis is not corrected, coma ensues. Ketoacidosis can occur in patients who fail to take their insulin or in patients who take an inadequate amount of insulin over an extended period of time.

The onset of DKA is slow, lasting from 12 to 24 hours. In its early stages, the signs and symptoms include increased thirst, hunger, urination and malaise. The later stages of DKA are characterized by nausea, vomiting, marked dehydration, tachycardia and weakness. The patient’s skin is usually warm and dry. As evidenced by the patient in the case presentation, the breath may have a sweet or acetone-like odor due to the increased ketones in the blood. In addition, very deep, rapid respirations, called Kussmaul’s respirations, are often present. Such respirations are the body’s attempt to compensate for the metabolic acidosis by blowing off carbon dioxide.

DKA can be complicated by several other electrolyte imbalances, the most

**Glossary of Terms**

**Absorbed**—The process by which a substance passes through some surface of the body into body fluids and tissues.

**Atherosclerosis**—A common disorder of the arteries in which calcium deposits cause a thickening, loss of elasticity and hardening of the artery walls.

**Hyperglycemia**—A progressive, degenerative disease in which plaques form on the artery walls, causing them to thicken, harden and, subsequently, to decrease in size.

**Diabetic ketoacidosis (DKA)**—A complication of diabetes caused by decreased insulin secretion. DKA is characterized by high levels of glucose in the blood, metabolic acidosis and, in the advanced stages, coma. Ketoacidosis is often called diabetic coma.

**Glucagon**—A hormone that is released by the islets of Langerhans in response to low blood-glucose levels. It increases the level of blood glucose by stimulating the liver to release glucose from storage sites throughout the body.

**Hypoglycemic seizure**—A seizure that can occur when blood-glucose levels fall dangerously low, seriously altering the brain’s energy supply.

**Insulin**—A pancreatic hormone that is needed to properly metabolize blood sugar and regulate blood-sugar levels.

**Islets of Langerhans**—A cluster of cells in the pancreas that secrete the hormones insulin, glucagon and somatostatin.

**Non-ketotic hyperosmolar coma (NKHC)**—A diabetic emergency that results from profound dehydration due to markedly elevated blood-sugar levels. NKHC typically occurs in older patients with Type-II diabetes who have another serious underlying disease.
important of which is decreased potassium levels. Known as hypokalemia, decreased potassium can lead to serious cardiac dysrhythmias or even death.

The approach to the patient with suspected DKA is essentially the same as with any other unconscious patient. First come the ABCs. Then, if there is any evidence of trauma, the cervical spine should be immobilized. During the secondary assessment, providers should pay particular attention to the presence of medical-identification bracelets, insulin in the patient's refrigerator and any history provided by bystanders. In addition, a rapid test for blood glucose should be completed, if available.

Rapid determination of blood-glucose levels is now a fairly simple procedure that can be performed in the field using special chemical reagent strips. A drop of the patient's blood should be placed on the reagent strip and allowed to remain for a predetermined amount of time (usually 60 seconds). The blood is then washed off, and the color change on the strip is compared to the colors on the accompanying box or bottle that correlate with blood-glucose levels.

An even more accurate device to test blood-glucose levels is the automated blood-glucose device. This instrument also relies on a reagent strip, but the strip is placed in a machine that determines the blood-glucose level automatically. These devices are quite accurate and have gone down in price significantly during the past several years.

If the patient's blood-glucose level cannot be quickly determined, a red-top tube (or the tube specified by local protocols) of blood should be taken for analysis, and an IV should be established. Following this, the paramedics should administer 100mg thiamine, 1mg to 2mg naloxone and 50ml of 50% dextrose solution (D50). (The administration of glucose will not adversely affect a ketoacidotic patient because the additional load of glucose is negligible compared to the total quantity present in the body; it may, however, prove lifesaving if the patient is in fact hypoglycemic.)

If the blood glucose can be estimated in the field and is found to be high, the classic findings of DKA may also be evident. Treatment should consist of drawing a red-top tube of blood. Following this, volume expansion with administration of 1 liter to 2 liters of 0.9% sodium chloride is usually indicated to help prevent cerebral edema. If transport time is estimated to be lengthy, a medical-control physician may request the intravenous or subcutaneous administration of regular insulin.

Non-ketotic Hyperosmolar Coma: In NKHC, markedly elevated blood-sugar levels result in profound dehydration due to glucose spillage in the urine. Typically, the patient is unable to drink enough liquids to keep up with urinary fluid loss. This is particularly true in elderly patients with Type-II diabetes, many of whom often have other serious underlying diseases, such as stroke or dementia. They typically cannot replenish lost fluids because of being bedridden or having an altered mental status. It is not uncommon for NKHC to be the first sign of diabetes in a nursing-home patient.

Patients with NKHC are even more apt to develop coma than are patients with DKA; they are also more likely to develop seizures. In addition, they generally have a higher mortality rate than patients with DKA because of their age and underlying medical problems.

While there are several characteristics that differentiate DKA from NKHC (see Table 1), they are difficult to discern in the field. Thus, the approach to the patient with NKHC should be identical to that of the DKA patient. Older patients, especially those with a serious
underlying disease, should be suspected of suffering NKHC.

Hypoglycemia
At the other end of the spectrum from hyperglycemia is hypoglycemia, sometimes called insulin shock. Hypoglycemia can occur if a patient accidentally or intentionally takes too much insulin or does not eat an adequate amount of food after taking insulin. If untreated, this excess of insulin will cause the blood-glucose level to drop to extremely low levels. This is a true medical emergency that, if not treated quickly, can result in serious injury to the brain, which receives the majority of its energy from glucose metabolism.

The clinical signs and symptoms of hypoglycemia are many and varied, with an abnormal mental status being the most significant finding. In the earliest stages of hypoglycemia, the patient may appear restless or impatient or complain of hunger. As the blood-sugar level falls lower, the patient may display inappropriate anger or rage or display a variety of bizarre behaviors. In some instances, the patient may have been placed in police custody for bizarre or violent behavior, or may have been involved in an automobile accident.

Physical signs can include diaphoresis (sweating) and tachycardia. If the blood sugar falls to a critically low level, the patient may suffer a hypoglycemic seizure or become comatose. The diagnosis of hypoglycemia is often based on a group of signs and symptoms known as Whipple's triad: a plasma-glucose level below 50mg/dl, signs and symptoms of hypoglycemia, and a positive response to food or glucose.

In contrast to DKA, the changes associated with hypoglycemia come on quickly, and a change in mental status can occur without warning (see Table 2). When encountering a patient behaving in a bizarre fashion, EMS responders should always consider hypoglycemia as the cause.

When assessing the hypoglycemic patient, the primary assessment should be performed quickly, and the patient should be inspected for a medical-identification bracelet. If possible, the blood-glucose level should also be determined. If the blood-glucose level is noted to be less than 60mg/dl, a red-top tube of blood should be drawn, and an IV of 5% dextrose in water (D5W) should be started. Next, 50ml to 100ml of D50 should be administered IV. If the patient is conscious and able to swallow,
# Table 2. Signs and Symptoms of Diabetic Emergencies

<table>
<thead>
<tr>
<th>Cardiovascular</th>
<th>Hyperglycemia</th>
<th>Hypoglycemia</th>
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<tbody>
<tr>
<td>Pulse</td>
<td>Rapid</td>
<td>Normal (may be rapid)</td>
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<tr>
<td>Blood pressure</td>
<td>Low</td>
<td>Normal</td>
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<th>Hypoglycemia</th>
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<tbody>
<tr>
<td>Respiration</td>
<td>Exaggerated air hunger</td>
<td>Normal or shallow</td>
</tr>
<tr>
<td>Breath odor</td>
<td>Acetone (sweet, fruity)</td>
<td>Normal</td>
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<tr>
<th>Nervous</th>
<th>Hyperglycemia</th>
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<tr>
<td>Headache</td>
<td>Absent</td>
<td>Present</td>
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<tr>
<td>Mental status</td>
<td>Restless → coma</td>
<td>Apathy, irritability → coma</td>
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<tr>
<td>Tremors</td>
<td>Absent</td>
<td>Present</td>
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<tr>
<td>Seizures</td>
<td>Rare</td>
<td>Present in late stages</td>
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<tr>
<td>Vision</td>
<td>Dim</td>
<td>Double-vision common</td>
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<th>Gastrointestinal</th>
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<tr>
<td>Mouth</td>
<td>Dry</td>
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<tr>
<td>Thirst</td>
<td>Intense</td>
<td>Absent</td>
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<tr>
<td>Vomiting</td>
<td>Common</td>
<td>Uncommon</td>
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<td>Abdominal Pain</td>
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<td>Oxygen</td>
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<td>Fluids</td>
<td>Fluids</td>
<td>Dextrose</td>
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<td>Insulin</td>
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**General SESSIONS**

**REDEFINING THE ROLE OF EMS: A PRESCRIPTION FOR KEEPING EMS VITAL IN THE '90s**

*Marvin Birnbaum, MD*

EMS is at a crossroads. What must be done to move it forward as a vital link in mainstream health care? Dr. Birnbaum has a provocative and compelling message for everyone with a stake in the future role of EMS.

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vessel formation in the eye, creating a progressive loss of vision.

Diabetes also affects the central nervous system. Diabetic neuropathy most commonly affects the peripheral nerves, which accounts for the abnormal or absent feeling many diabetics experience bilaterally in their arms and legs. Chronic and severe pain can be another result of diabetic neuropathy. Because of the lack of sensation, diabetics are at increased risk of sustaining serious injuries to their hands and feet. Additionally, they can develop limb-threatening foot and leg ulcers due to the effect of diabetes on both the circulation and the peripheral nerves. The nerves that innervate the stomach may also be affected, resulting in delayed stomach emptying, particularly at night. Diabetic neuropathy also affects sexual function and renders many patients impotent.

The final late complication of diabetes is diabetic nephropathy, which involves the alteration of blood flow to and through the kidneys due to atherosclerosis and arteriosclerosis. When this occurs, kidney function gradually declines, and many patients require kidney dialysis for life. Many of these late complications of diabetes can be minimized by proper regulation of blood sugar, proper attention to diet and regular exercise.

Conclusion
Diabetes mellitus is a common medical condition. The emergencies occur when blood-sugar levels become excessively elevated or reduced. The most serious of these emergencies, hypoglycemia, occurs when the blood-sugar level falls to dangerous levels. The condition must be recognized and treated promptly and appropriately by administration of glucose either orally or intravenously. If not promptly treated, hypoglycemia can result in serious brain damage and even death.

At the other end of the spectrum are the hyperglycemic emergencies, DKA and NKHC. Both result from excess glucose in the blood, causing dehydration, accumulation of toxic substances in the body, and ultimately altered mental status and even death. As with hypoglycemia, prompt recognition and treatment, including fluid replacement and, in certain instances, insulin administration, are essential.

References

Bryan Bledsoe is an emergency physician at Baylor Medical Center in Waxahachie, Texas, and at St. Joseph's Hospital in Fort Worth. He is the author of numerous articles and books and recently co-authored the Paramedic Emergency Care textbook.
1. Diabetes is a disease that affects the body’s ability to:
   a. Store glucose as glycogen
   b. Produce insulin
   c. Process and use glucose
   d. Produce glucagon

2. Complex sugars must be broken down into what three simple sugars before they can be used by the body?
   a. Alpha, beta and delta
   b. Sucrose, lactose and starches
   c. Glucose, galactose and fructose
   d. Insulin, glucose and glucagon

3. The only sugar that can be used directly by the cells for energy production is:
   a. Glucagon
   b. Lactose
   c. Insulin
   d. Glucose

4. The rate at which glucose is transported into the cells is enhanced by the hormone:
   a. Glucagon
   b. Insulin
   c. Somatostatin
   d. Adrenaline

5. The primary site of insulin production in the body is:
   a. The cell membrane
   b. The gastrointestinal tract
   c. The liver
   d. The pancreas

6. The hormone responsible for increasing the level of glucose in the blood is:
   a. Glucagon
   b. Insulin
   c. Somatostatin
   d. Adrenaline

7. John is a 43-year-old obese male. He has noticed that he is eating more and is often thirsty. His doctor orders tests and diagnoses John as a diabetic. The most likely type of diabetes in John’s case is:
   a. Type-1
   b. Type-II

8. In which type of diabetes does the patient need to take supplemental insulin daily?
   a. Type-I
   b. Type-II

9. Why does Type-I diabetes produce ketones and organic acids?
   a. Insufficient glucose in the cells causes the cells to break down other substances for energy. Ketones and organic acids are the by-products of this breakdown.
   b. Excess insulin in the blood is metabolized into ketones and organic acids.
   c. An inability of the cells to utilize glucose results in the liver breaking down the glucose into ketones.
   d. Ketones and organic acids result from osmotic diuresis.

You respond to a residence for an "unresponsive" patient. On arrival, you find a 74-year-old unconscious female. Her airway is patent, and her breathing is deep and rapid. Her skin is warm and dry. Your partner detects a distinct fruity odor on her breath. A neighbor hands you a bag of the woman’s medications, and you note that one of them is Novolin L50, a form of insulin. The neighbor states that the patient has been sick since the day before. Questions 10 through 12 apply to this scenario.

10. Based on the information in the scenario, what, most likely, is wrong with this patient?
   a. She is a Type-I diabetic who has not taken her insulin.
   b. She is a Type-I diabetic who has overdosed on insulin.
   c. She is a Type-II diabetic who has not yet eaten today.
   d. She has suffered a stroke.

11. As a BLS responder, your treatment for this patient should include:
   a. Delivering oxygen, monitoring vital signs, giving orange juice and transporting
   b. Controlling the airway, delivering oxygen via non-rebreather mask, monitoring vital signs and rapidly transporting
   c. Calling for ALS, as there is nothing a BLS crew can do
   d. Controlling the airway, delivering oxygen via non-rebreather mask, monitoring vital signs and administering insulin

12. The type of breathing exhibited by this patient is:
   a. Cheyne-Stokes respiration
   b. Biot’s breathing
   c. Kussmaul’s breathing
   d. Eupneic respirations

13. The two major causes of hypoglycemia are:
   a. Overeating and failure to take insulin
   b. Fasting and failure to take insulin
   c. An overdose of insulin or eating an inadequate amount of food after taking insulin
   d. An overdose of insulin or overeating after taking insulin

14. In hypoglycemia, the blood-glucose level is:
   a. Too high
   b. Within normal limits
   c. Too low

15. Of the two major diabetic emergencies, hyperglycemia and hypoglycemia, which is the most urgent?
   a. Hyperglycemia
   b. Hypoglycemia

The following questions are mandatory for paramedics. EMRs may elect to answer questions 16 through 20, but credit will not be applied to their scores.

16. Appropriate drug therapy for an unconscious hypoglycemic patient includes:
   a. 50ml to 100ml 50% dextrose (D50) IV push
   b. 50ml to 100ml D50, 1mg to 2mg naloxone and 100mg thiamine
   c. 50ml to 100ml D50 and 1mg to 2mg naloxone
   d. IV fluid challenge of 200cc to 500cc Ringer’s lactate

17. An IV bolus of 1 liter to 2 liters of normal saline is indicated in cases of diabetic ketoacidosis (DKA) to:
   a. Prevent cerebral edema
   b. Dilute the concentration of glucose in the blood
   c. Force diuresis of the excess glucose
   d. Cause glycogenosis

18. Cardiac arrhythmias are most likely to be seen in cases of:
   a. DKA
   b. Hypoglycemia
   c. NKHC
   d. Insulin overdose

19. The normal blood-glucose range is:
   a. 3.5mEq/L to 4.5mEq/L
   b. 70mg/dl to 110mg/dl
   c. 3000mg/dl to 900mg/dl

20. You respond to the local nursing home for a comatose patient. Upon arrival, you find an 87-year-old unconscious male. The staff tells you that he has been seizing and is now unresponsive. He has a history of liver disease and diabetes. A reagent strip blood-glucose test shows that his blood sugar is off the high end of the scale. You suspect this patient is suffering from:
   a. DKA
   b. NKHC
   c. Insulin shock
   d. Hypoglycemia

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2. Save 40% by signing up for the JEMS CEU Preregistration Program and take up to 16 tests for $3 each. (That's $2 per credit. See coupon below for details.)

*Recognized by NREMT, NASEMSD, and the National Council of State EMS Training Coordinators. (Requirements vary by state.)

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Even lower prices apply when you and your coworkers sign up together. Call Dotty at 619/431-9797 for details!

CLIP & MAIL TO: JEMS CEU Program, P.O. Box 2789, Carlsbad, CA 92018

CEU Enrollment Form
☐ Preregister me for 24 Continuing Education Credits (16 tests @ $3 each—$2 per credit) for a total of $48. I understand that I can take these tests any month I choose. I'll receive 16 discount coupons, one to be mailed back with each test I take.
☐ Preregister me for 12 Continuing Education credits, (8 tests @ $3 each—$2 per credit) for a total of $24. I understand I can take these tests any month I choose. I'll receive eight discount coupons, one to be mailed back with each test.

Note: You may send this month's completed test along with this order form; coupons will be deducted accordingly.

Name
Title
Address
City_________State_______Zip_____
Phone (___)_______Charge my: Visa MasterCard
Total Payment $_________Exp. Date_____
☐ My check is enclosed, payable to JEMS.

SPECIAL OFFER for CEU Participants: JEMS at 10% Off!

☐ In addition to the CEU Program, please sign me up for my personal, one-year subscription to JEMS, 12 issues for just $19.77 (California residents must add 8.25% sales tax—total is $21.40).

CEU Answer Sheet #46
Diabetic Emergencies

This article is sponsored in part by a grant from Brady Publishing. To be considered for credit, this test must be postmarked by Aug. 15, 1992.

Name
Organization
Address
City/State/Zip
State License #: Phone:
S.S. #: National Registry #

Skill Level: ☐ EMT-1 ☐ Paramedic
Area of Service: ☐ Rural ☐ Urban
Status: ☐ Volunteer ☐ Paid

Do you presently have a personal subscription to JEMS? ☐ Yes ☐ No
Are you using this test as part of your requirements for recertification? ☐ Yes ☐ No

Instructions for Obtaining CEU Credit
1. Study the CEU article in this issue.
2. Answer the test questions on this form that are appropriate to your level of care. (Photocopies of this answer sheet are accepted if others wish to take the test, for grading purposes, however, this form should not be enlarged or reduced.)
3. Mail completed answer sheet and the $5 testing fee or a JEMS/CEU program coupon to:

JEMS-CEU
P.O. Box 2789
Carlsbad, CA 92018

4. Within six weeks, you will receive your test score, the rationale for the test answers and, if you passed, a CEU certificate. The passing score is 70 percent.
5. Please retain all course materials for future reference.

Answers
Mark your answers to the test by checking the appropriate boxes (☐) below. Each question has only one answer. EMTs: Answer questions 1 through 15. Paramedics are required to answer all questions.

1. ☐ a. ☐ b. ☐ c. ☐ d. 11. ☐ a. ☐ b. ☐ c. ☐ d.
2. ☐ a. ☐ b. ☐ c. ☐ d. 12. ☐ a. ☐ b. ☐ c. ☐ d.
3. ☐ a. ☐ b. ☐ c. ☐ d. 13. ☐ a. ☐ b. ☐ c. ☐ d.
5. ☐ a. ☐ b. ☐ c. ☐ d. 15. ☐ a. ☐ b. ☐ c. ☐ d.
6. ☐ a. ☐ b. ☐ c. ☐ d. 16. ☐ a. ☐ b. ☐ c. ☐ d.
7. ☐ a. ☐ b. ☐ c. ☐ d. 17. ☐ a. ☐ b. ☐ c. ☐ d.
8. ☐ a. ☐ b. ☐ c. ☐ d. 18. ☐ a. ☐ b. ☐ c. ☐ d.
9. ☐ a. ☐ b. ☐ c. ☐ d. 19. ☐ a. ☐ b. ☐ c. ☐ d.
10. ☐ a. ☐ b. ☐ c. ☐ d. 20. ☐ a. ☐ b. ☐ c. ☐ d.