Endocrine Emergencies 2015

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Last Updated
January 12, 2015

Contents

ENDOCRINE OVERVIEW

What is the endocrine system?

Imagine a typical day. You wake up, eat a meal, take a shower, get dressed and go outside, drive to work, run up a flight of stairs. During that time, your body strives to maintain a stable internal environment – a feature called homeostasis. Even though it may be cold outside, your body temperature remains constant. Even though you may have eaten a big sugary donut, your blood sugar, while rising briefly, drops quickly back down to normal. You also need to be able to respond to outside demands, such as being able to increase your heart rate when running up a flight of stairs.

On a typical day, your body responds to the outside world through two main systems. The nervous system responds quickly – imagine touching a hot stove – through nervous impulses that travel from one nerve cell to another, traveling through the spinal cord, and then back to the muscles, causing you to pull your hand back, in just fractions of a second

However control of other body functions, such as temperature, blood sugar, heart rate, and metabolism, are under the influence of the endocrine system. Information is communicated not through nerve cells, but through chemical transmitters that are dumped from different endocrine organs into the bloodstream, where they are transported throughout the body.

We're going to take a tour through this system. It is a vital, yet often overlooked part of the inner workings of our body.

At the end of this overview, you will be able to:

- Recognize the importance of the endocrine system in maintaining homeostasis.
- Recognize the interplay between the hypothalamus and the pituitary.
- Identify the importance of the hormone oxytocin in the birth process.
- Identify the role of the thyroid and the problems of hyper- and hypothyroidism.
- Recognize the importance of the adrenal hormone epinephrine.
- Determine the role of epinephrine in an emergency setting.
- Recognize the role of the pancreas in regulating blood sugar.
- Recognize the characteristics of type 1 and type 2 diabetes.
- Distinguish between the presentations of low and high blood sugar.
- Identify the signs and symptoms of diabetic ketoacidosis.
- Review the key questions to rapidly assess and care for a person with a diabetic emergency.
- Determine the proper indications for checking blood sugar.
- Determine the proper technique, indications and contraindications for administration of oral glucose.
- Identify the guidelines for leaving a hypoglycemic patient at home after treatment.

HYPOTHALAMUS AND PITUITARY

Anatomy and Physiology

It's appropriate to consider the hypothalamus and the pituitary together, because their functions are so intertwined.

The hypothalamus consists of a group of specialized cells that are located deep in the brain, just above the brainstem. It's small – about the size of an almond. The hypothalamus responds to input from the brain, so it serves as the gateway between the nervous system and the endocrine system.

Many of the hormones that the hypothalamus secretes are funneled to another endocrine organ, the pituitary, which is slightly smaller and also sits in the brain just below the hypothalamus, in a well-protected bony cavity.

The list of hormones secreted by the hypothalamus and pituitary is a long one, and includes hormones that regulate growth, metabolism, and various aspects of reproduction.

Case Study

You are dispatched to a 25 year old female "in labor." You arrive to find that your patient has delivered a full-term, apparently healthy baby boy. However you notice that the woman has ongoing hemorrhage. While waiting for paramedics to arrive, you put the baby to the mother's breast, where he suckles vigorously. By the time the paramedics arrive, the bleeding has slowed. The paramedic notices the baby, nicely wrapped and nursing. "Nice job," he says with a smile.

So what happened?

Oxytocin is a naturally occurring hormone produced by the hypothalamus and stored in the pituitary. It was released in your patient's body during labor, promoting contractions and delivery of the baby (the name "oxytocin" means "swift birth" in Greek). After childbirth, nursing stimulated the release of more oxytocin, which in turn increased uterine tone, decreasing the bleeding. Oxytocin has other roles as well. It has been called the "bonding hormone" or the "love hormone" because it promotes social bonding

These effects of oxytocin occur naturally. However, synthetic oxytocin can also be administered by paramedics or hospital staff if post-partum hemorrhage continues.

THYROID

Anatomy and Physiology

The thyroid gland is found in the neck just below the Adam's apple. Responding to signals from the pituitary gland, the thyroid produces hormones that circulate in the blood and regulate metabolism and growth. The thyroid gland produces these hormones by using the chemical element Iodine, which it extracts from the diet.

In some parts of the world, iodine is a scarce element. In these areas, as the thyroid tries to extract minute quantities of iodine, it becomes enlarged, a condition known as “goiter.” In addition, children with iodine deficiencies are a risk for mental retardation, impaired physical development, and death.

Adding small quantities of iodine to the diet, specifically to salt, has greatly reduced the incidence of these problems, and was an early success story of the public health system. The “iodized salt” that you buy in the grocery store was developed in the early 1900s to combat a significant problem with goiter in the US Midwest (where iodine does not occur naturally). Salt companies such as Morton agreed to participate, and by the mid-1920s, iodized salt was widely available for purchase and the incidence of goiter in one study dropped dramatically from about 9% down to less than 1%!

As a pre-hospital care provider you are unlikely to see a person with a goiter resulting from iodine deficiency. However you may see patients who have other types of thyroid problems.

Hypothyroidism – reduced production of thyroid hormones – may cause fatigue, intolerance to cold, and dry skin. Extreme hypothyroidism can cause low blood pressure, hypothermia, and even coma.

Hyperthyroidism – increased production of thyroid hormones – can cause sudden weight loss, tachycardia, sweating, and protruding red, swollen eyes. Extreme hyperthyroidism – thyroid storm – can cause hypertension, tachycardia, fever, and even seizures.

Extremes of both of these conditions are rarely seen – most patients with thyroid problems show more subtle symptoms that have arisen gradually and usually do not require immediate emergency care. However, any patient with a possible thyroid problem needs medical evaluation, bloodwork, and treatment.

Case Study

You are dispatched to a 30 year old female with altered mental status. She presents agitated and confused with damp, hot skin and a temperature of 102. She is non-verbal and does not follow commands. Her vitals are: BP 160/90, HR 146 and irregular, R 24, blood sugar 130, oxygen saturations 98%. Her husband tells you that she has a history of an "overactive thyroid" and recently ran out of her medications. She has been sick for the past week, but otherwise was acting normal when he left for work a few hours earlier.

Based on her altered mental status and heart rate > 140, you request a medic unit.

What's your rule-out? There are many possibilities … drug overdose, medication reaction, meningitis, stroke, head injury, or thyroid problem.

The medics treat and transport the patient. In the emergency room, the patient is found to have dangerously high levels of thyroid hormones. Her "overactive thyroid" (a condition known as hyperthyroidism) suddenly released large amounts of these hormones. This rare and potentially deadly condition is known as "thyroid storm."

Adrenal Glands

The adrenal glands sit on top of the kidneys ("ad" – near, "renal" – kidneys) and serve a myriad of functions. In clearly delineated "zones," the adrenal glands produce stress hormones, sex hormones, and hormones that regulate blood pressure. They also secrete two other important hormones – epinephrine and norepinephrine.

Tumors or other diseases of the adrenal glands can cause a number of different disease processes. When one of the stress hormones, cortisol, is present in excess, a disease called Cushing's syndrome may develop. People with Cushing's syndrome may have weight gain, an accumulation of fat around the face and neck, and thin, easily bruised skin. You may have noticed such skin on patients who take synthetic cortisol or other steroids for conditions such as COPD.

Addison's disease is the opposite problem – the adrenal cortex gets damaged and stops producing the corticoid and androgen hormones. Patients with this disorder may develop symptoms such weakness and fatigue, hypotension, and electrolyte problems. Adrenal insufficiency may also occur in patients who take synthetic versions of cortical hormones. If they suddenly stop taking these drugs, the body cannot resume its own production quickly enough and adrenal insufficiency can occur. This is the reason that patients who take medications such as prednisone must "taper" their use.

Case Study

You are called to the scene of a 35 year old female who was finishing up a meal at a local restaurant. She is complaining of feeling lightheaded, slightly short of breath, and "itchy all over." She tells you that she has an allergy to peanuts, but hasn't knowingly eaten any. Her BP is 86P, HR 110, R 28. She has some scattered wheezes. Her skin is flushed. Her oxygen saturation is 94%.

You consider it likely that she unknowingly ingested peanuts due to her symptoms of low blood pressure, wheezing, and widespread hives. You immediately lay the patient down, put her feet up, and administer oxygen.

Either one of those three presentations (hypotension, respiratory distress, or widespread hives) would meet the criteria for administration of epinephrine. After consulting with your partner and confirming that the patient meets the criteria, you administer 0.3 mg IM epinephrine to the patient. By the time paramedics arrive, the patient's blood pressure is 96P, HR 120, R 22. Her oxygen saturation is 98% and her wheezes have diminished. She tells you that she is feeling much better.

What does epinephrine do? Naturally occurring epinephrine, secreted by the adrenal glands, is produced when you need to respond to a physical or mental stress. If you have to run up a flight of stairs carrying your aid kits, for example, you need to increase your heart rate, constrict your blood vessels, and open up your bronchioles, all to get more oxygenated blood to your hard-working muscles.

Injectable epinephrine does the same thing for the patient in anaphylaxis. Just like naturally occurring epinephrine, your injection caused peripheral vasoconstriction, constricting blood vessels in the skin so more blood could be directed to other parts of the body. It also caused bronchodilation, opening up the small airways to allow more air inside. Over time, this will increase the blood pressure and reduce wheezing and respiratory distress – improvements that you saw in your patient. You may also have noticed side effects such as a jittery feeling or an increase in heart rate. These are not unusual and will ease with time.

Paramedics sometimes administer epinephrine to patients in cardiac arrest. Since epinephrine causes peripheral vasoconstriction and redistribution of blood to the body's core, your high-quality CPR may be more effective in perfusing the brain. Epinephrine is also given to increase the heart rate.

The same receptors in the body that respond to adrenal epinephrine or injected epinephrine also respond to chemicals that look similar. This is the reason that drugs like cocaine or methamphetamine cause the signs and symptoms of hypertension, rapid heart rate, and agitation.

PANCREAS

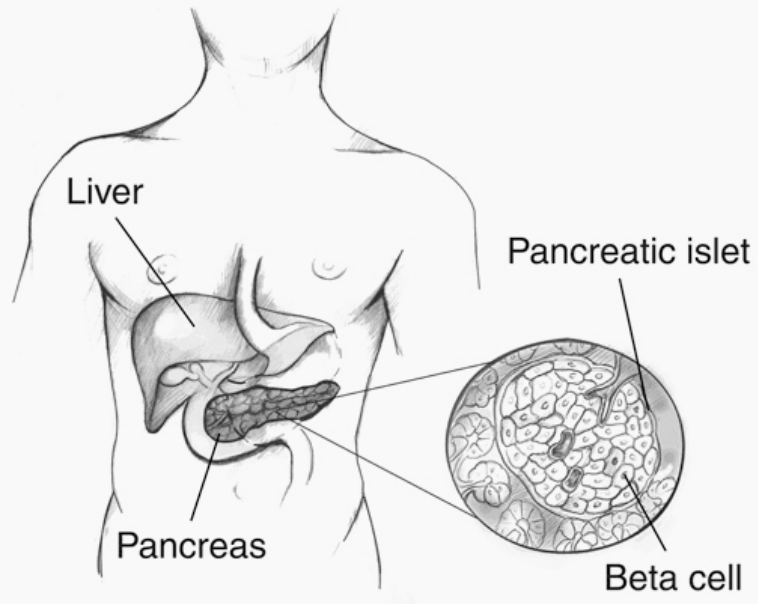
Anatomy and Physiology

Of all the endocrine organs, the pancreas is the one most familiar to most pre-hospital care providers, because of its role in diabetes.

Diabetes occurs when sugar levels in the bloodstream increase. There are many possible reasons why this might occur, but it helps to understand the normal functioning of the pancreas in the body.

The pancreas is located behind the stomach, where it also functions as part of the digestive system, secreting pancreatic juices that help break down carbohydrates, fats, and proteins in the gut.

The endocrine function of the pancreas is carried out by cell clusters called the islets of Langerhans, which comprise several different types of cells. Beta cells secrete the hormone insulin, which decrease blood sugar. (Other cells, alpha cells, secrete the hormone glucagon, which increase blood sugar.)



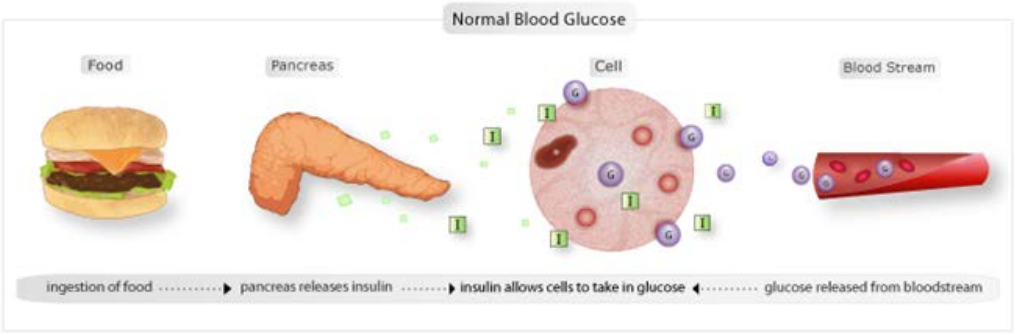
The interplay between the food that you eat, and these two hormones, determines your blood sugar. Here's how:

Normally, during the digestive process, food is broken down into three main nutrients:

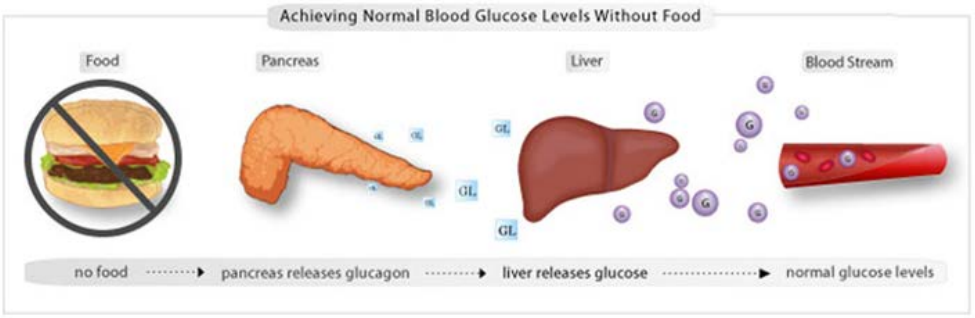
- Fats
- Carbohydrates
- Proteins

Glucose is a simple carbohydrate and the first to be absorbed into the blood. It is essential for all cells, especially brain cells.

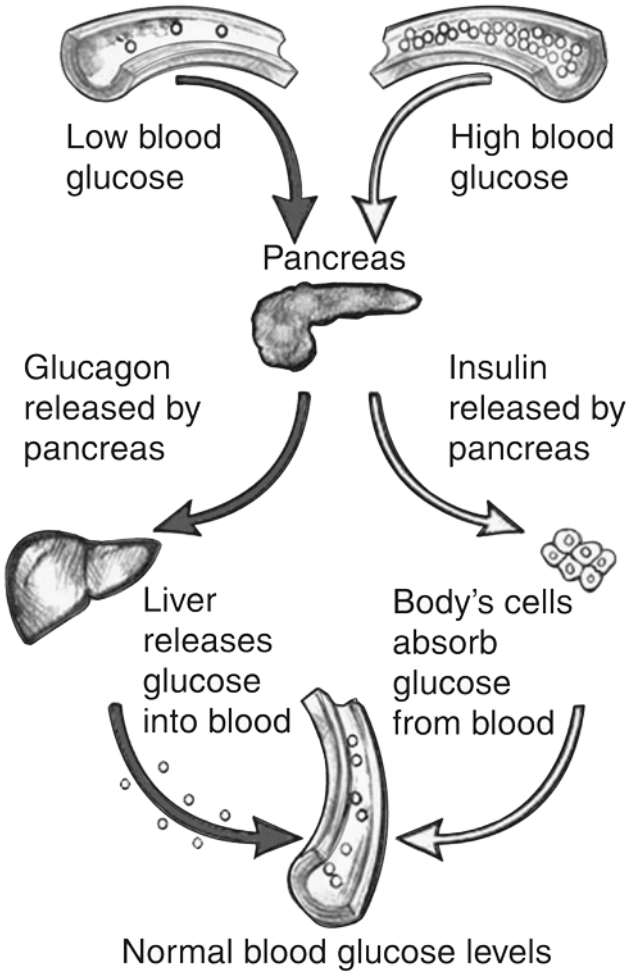
When a healthy person eats, the process of glucose absorption looks like this:



For a healthy person who has not eaten, the pancreas compensates by releasing the hormone glucagon causing the liver to release glucose.



In a healthy person, rising blood glucose levels stimulate the pancreas to secrete insulin. Insulin acts like a funnel that directs glucose into the cells. Insulin helps glucose enter the cells and produce energy.



TYPES OF DIABETES

Type 1 Diabetes

In type 1 diabetes, the pancreas suddenly stops producing insulin. Why this occurs, no one knows for sure. Most scientists who study diabetes believe that type 1 diabetes is an auto-immune disease, meaning that the person's own immune system starts attacking the beta cells that produce insulin. Since an infection or illness often precedes the development of diabetes, it is thought that this event may trigger the immune system's attack on the beta cells. Once the cells are destroyed, the body no longer produces insulin, and the person has become a type 1 diabetic.

Type 1 diabetes usually develops in children and young adults. As the beta cells stop functioning and insulin levels fall, the blood sugar begins to rise. Without the means to absorb sugar into the cells, the body starts to excrete it in the urine – and as sugar is excreted, water follows, causing dehydration. These are two of the cardinal symptoms of early-onset diabetes – polyuria (frequent urination) and polydypsia (increased thirst).

The third symptom, polyphagia (hunger) occurs because the body is experiencing starvation – without the helper molecule insulin, the sugar that cells need for energy cannot pass through the cell membrane. Starving, the body increases food intake and also tries to break down alternative substances for energy, specifically fats and proteins. Byproducts of this breakdown are ketoacids, which can cause significant dehydration, altered mental status, and rapid respiration – a condition you know as ketoacidosis.

Ketoacidosis can occur when a person first develops diabetes but has not yet been diagnosed with the disease and has not been treated. It can also occur later in the person's life if his or her insulin dosage is insufficient for the amount of sugar in the blood.

High blood sugar and ketoacidosis are potentially life-threatening illnesses. They are most easily treated when caught early. YOU may be the one to identify a person with new-onset diabetes by discovering high blood sugar in a person who has called for vague symptoms of malaise, lethargy, thirst, and frequent urination.

Type 1 diabetics must take insulin injections for life, to replace the insulin that their bodies have stopped producing.

Type 2 Diabetes

Type 2 diabetes is a chronic condition in which the beta cells do not produce enough insulin for the body's demands, or the body becomes resistant to the effects of insulin, or both. Why this occurs is not well known, but risk factors for the development of type 2 diabetes include a diet high in fats and carbohydrates, obesity, and inactivity. Originally called "adult-onset diabetes," type 2 diabetes is being diagnosed in an increasing number of children and teenagers.

Although the mechanism is different than in type 1 diabetes, the result is similar – blood sugar begins to rise. The three P's (polyuria, polydypsia, and polyphagia) can also occur in undiagnosed or untreated type 2 diabetics.

In the early stages of the disease, type 2 diabetics may sometimes be able to lower their blood sugar by changing their diet. If their disease is more advanced, they may need oral medications. These medications control blood sugar by a variety of mechanisms:

- Stimulating the pancreas to make more insulin
- Decreasing the amount of glucose made by the liver
- Slowing the absorption of starches
- Making the body more sensitive to insulin

Occasionally, type 2 diabetics need to supplement their oral medications with injectable insulin.

Both type 1 and type 2 diabetes cause damage to blood vessels and nerves, increasing the patient's risk of kidney failure, blindness, heart disease, and stroke.

Gestational Diabetes

Gestational diabetes is a type of diabetes that begins during pregnancy. It usually becomes apparent in the 24th to 28th weeks of pregnancy. In many cases, the blood glucose level returns to normal after delivery.

The symptoms are usually mild and not life-threatening to the pregnant woman. However, increased maternal glucose levels are associated with larger birth weight and an increased rate of prenatal complications, including birth trauma, hypoglycemia, jaundice and fetal death.

The majority of gestational diabetics adjust their food intake and exercise to lower their blood sugar; however, some cases may require insulin injections.

Other Types of Diabetes

While type 1, type 2, and gestational diabetes are the most common kinds of diabetes, other conditions or illnesses can occasionally damage the pancreas and cause diabetes. Surgery on the pancreas and certain medications, such as steroids, can cause high blood sugar. An unrelated condition, diabetes insipidus, does not affect insulin production, but causes polyuria due to the kidney's inability to conserve water and concentrate urine.

DIABETIC EMERGENCIES

Hypoglycemia

Hypoglycemia, or low blood sugar, occurs most commonly when a diabetic takes insulin but does not eat enough. Cells deprived of their energy source – sugar – cannot function well. The brain is especially sensitive to low blood sugar.

Low blood sugar that produces an alteration in mental status is also called an insulin reaction or insulin shock.

Signs and symptoms, which usually develop over a period of minutes to hours, can include:

- Cold, pale, clammy skin
- Abnormal or hostile, bizarre behavior (patient may appear intoxicated)
- Shaking, trembling, weakness
- Full, rapid pulse
- Dizziness, headache, blurred vision
- Seizures
- Unconsciousness

While hypoglycemia is most common in type 1 diabetics who have taken too much insulin, it can also occur in type 2 diabetics. Certain diseases and medications can also cause low blood sugar, even if the person is not a diabetic.

Case Study

It is early morning and you are called to the scene of a 45 year old female with altered mental status. Her family states that they were unable to awaken her this morning, however she seemed to be fine when she went to bed last night.

Your patient is lying in bed, unarousable, with BP 130/80, HR 92, R 16. Her skin is cool and wet. There are no signs of trauma.

Members of the family tell you that the patient has a history of a recurrent urinary tract infection, for which she started taking Bactrim (trimethoprim/sulfamethoxazole, an antibiotic) yesterday. She is otherwise healthy and takes no other medications. She has no history of illicit drug use or heavy alcohol use. Her last meal was yesterday evening at dinner.

You request a medic unit due to the patient's altered mental status. And because of this altered mental status, you check the patient's blood sugar. The patient's blood sugar is 20, even though she has no history of diabetes.

What happened here?

In this patient, the antibiotic Bactrim likely caused the hypoglycemia. While too much insulin in a type 1 diabetic is the most common cause of hypoglycemia, other situations (such as certain medications) can also cause alterations in blood sugar. Always check blood sugar in a patient with altered mental status.

Hyperglycemia

Hyperglycemia can occur when a diabetic does not treat his or her high blood sugar. It can occur in new-onset diabetes, or in a person who has been diagnosed with diabetes but whose high blood sugar is untreated. It can also occur in non-diabetics with other medical conditions, such as sepsis.

Early signs of hyperglycemia are:

- High blood glucose levels
- The three P's
  - polyuria (frequent urination)
  - polydypsia (excessive thirst)
  - polyphagia (increased appetite, eating)

A particularly dangerous type of hyperglycemia is ketoacidosis. This occurs when the body becomes so starved for sugar that it begins to break down fats and proteins for energy. Ketoacids are byproducts of this breakdown. They can accumulate and cause acidosis and dehydration.

Case Study

You respond to a 9 year old with "flu-like symptoms" according to parents. They state that their child has had increasing lethargy and has been drinking "a lot of water" over the past few days. He has been complaining of abdominal pain and has had several episodes of vomiting. Other than a recent GI illness a few weeks ago, he has been healthy and takes no medications.

Your patient is lying in bed, awake but drowsy. He is complaining of abdominal pain and feeling weak and tired. His vital signs are BP 80/50, HR 140, R 32. His lungs are clear. His skin is warm and dry. You check the patient's blood sugar and it reads 650.

You request an ALS evaluation for hyperglycemia and possible ketoacidosis. Medics arrive and evaluate the patient. "Nice catch on the blood sugar," says one of the medics. She starts an IV, and begins fluid resuscitation.

Ketoacidosis usually develops slowly, over a period of hours to days. Signs and symptoms include:

- Hypotension
- Tachycardia
- Deep, rapid respirations ("Kaussmaul respirations")
- Confusion, lethargy
- Coma
- Occasionally, a fruity odor on the patient's breath

ASSESSMENT OF DIABETIC EMERGENCIES

Assessment for a diabetic emergency begins with an initial determination of SICK or NOT SICK based on respiratory effort, pulse, mental status, skin signs and body position.

For a conscious patient, an accurate past medical history is important and includes key questions such as:

- When did you eat last?
- How much did you eat?
- Have you taken your insulin today?
- Has there been a change in your health, stress or exercise level?
- Have you changed your insulin dosing recently?
- When did the symptoms begin?

You should maintain a high index of suspicion for all patients with an altered level of consciousness. For an unconscious patient, you must assure the ABCs and search for clues such as medic alert tags or medical history from a family member.

Glucometry

Blood glucometry is an effective tool for determining if a case of altered mental status is due to a blood sugar problem.

What is the Normal Range for Blood Glucose?

An individual's blood glucose level will vary throughout the day depending on diet and exercise. For an individual without diabetes, a normal fasting blood glucose level is in the 60-100 mg/dL range. After eating, blood glucose may increase to 120 to 150 mg/dL, but it will return to normal within a short time.

If the blood glucose drops below 50 (for example if a diabetic takes insulin but forgets to eat), there is a progressive loss of mental function.

On the other hand, if the glucose level is very high, in the 400s or higher, symptoms of high blood sugar (the 3 Ps, altered mental status) can occur.

EMERGENCY CARE

Oral Glucose

A hypoglycemic patient needs a quick source of sugar such as honey, orange juice, candy or granulated sugar or a bead of commercial sugar preparation. Here are some guidelines:

- Ask patient if he or she is able to swallow
- If the patient cannot swallow, then do not administer
- Do not check the gag reflex by inserting a tongue blade in the patient's mouth
- Position upright
- Ask patient to sip or chew sugar-containing substance
- Monitor patient's response to glucose
- Repeat glucometry 10-15 minutes after providing oral glucose. It may take 15-20 minutes for patient's blood sugar to return to normal.

Because some patients respond quickly to a sugar drink or glucose, they may not see the need to be evaluated at the hospital once their body sugar returns to normal. Be familiar with your department's guidelines for leaving a diabetic patient at home. If the patient stays at home you must leave written after care instructions and document this in your report.

Patients on Oral Medication

Type 1 diabetics who are successfully treated for their hypoglycemia and return to normal mental status are often left at home to eat a meal and follow up with their private MD. This is because their hypoglycemia is usually the result of something simple such as miscalculating the insulin dose or forgetting to eat.

On the other hand, type 2 diabetics who become hypoglycemic are more complex. Their hypoglycemia may result from an overdose of their oral medications or a change in the way that their body reacts to the medications. Regardless of the cause, they are at risk for recurrent episodes of hypoglycemia. Even if the blood sugar returns to normal after treatment, they should be strongly advised to seek further evaluation by a physician.

Hyperglycemia

Hyperglycemia may be an incidental finding in a patient who has called you for some other reason (for example, a fall patient). Or, it may be the cause of the symptoms that prompted the call (for example, a diabetic who has stopped taking his insulin and is now dehydrated).

Guidelines for treatment are as follows:

- Maintain airway
- Monitor vital signs and LOC
- Request ALS if indicated. ALS indicators:
  - Altered LOC
  - Absent or depressed gag reflex
  - Unstable vital signs
  - Rapid respirations (Kaussmal respirations)
  - Signs and symptoms of shock, including poor skin signs (pale, sweaty), sustained tachycardia, hypotension
  - Suspected diabetic ketoacidosis (glucometry reading greater than 400 or “high” with associated symptoms)

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