LESSON ASSIGNMENT

LESSON 3 Diabetes Mellitus.

LESSON ASSIGNMENT Paragraphs 3-1 through 3-11.

LESSON OBJECTIVES After completing this lesson, you should be able to:

3-1. Define diabetes mellitus.

3-2. Identify the factors that increase the risk of diabetes mellitus.

3-3. Define Type I and Type II diabetes.

3-4. Identify the signs, symptoms, and treatment of diabetes mellitus.

3-5. Define insulin shock and identify the signs, symptoms, and treatment for insulin shock.

3-6. Identify the causes, signs, symptoms, and treatment for hyperglycemia and ketoacidosis.

3-7. Identify characteristics of these diabetic health problems: vascular disturbances, visual problems, neuropathy, and infection.

SUGGESTION After completing the assignment, complete the exercises of this lesson. These exercises will help you to achieve the lesson objectives.
LESSON 3

DIABETES MELLITUS

3-1. INTRODUCTION

a. **Definition.** Diabetes is a term which refers to diseases characterized by excessive urination. Used alone, the word diabetes refers to diabetes mellitus. Diabetes, a disease that affects the way the body uses food, causes sugar levels in the blood to be too high.

b. **Normal Digestive Process.** In the digestive process, the body changes sugars, starches, and other foods into a form of sugar called glucose. The blood carries this glucose to cells throughout the body. Insulin (a hormone) in the body's cells changes glucose into quick energy which can be used immediately by the cells or stored for future needs. (Beta cells in the pancreas produce insulin). The body's process of turning food into energy is critical for survival since the body depends on food for every action—running, jumping, swimming, thinking, pumping blood, etc.

c. **Diabetic Digestive Process.** For the diabetic patient, the body does not turn food into energy in the normal way. The body does change food into glucose, but a problem arises in the production of insulin. In one type of diabetes (Type I diabetes), the pancreas cannot make insulin. In another type of diabetes (Type II diabetes), the pancreas either does not make enough insulin or the body cannot use the insulin or both conditions occur. Without insulin performing its function, cells in the bloodstream cannot use glucose to make energy. What happens is that glucose collects in the blood giving the diabetic person high sugar levels in the blood, a sign of untreated diabetes.

d. **General Information.** Diabetes is a widespread disease affecting about 11 million people or nearly one in every twenty people. Roughly 1 million people have insulin-dependent diabetes (Type I diabetes). Approximately 10 million persons have non-insulin-dependent diabetes. Additionally, there are about 5 million people who have non-insulin-dependent diabetes and do not know they are diabetics. While diabetes cannot be cured, the disease can be managed effectively.

3-2. FACTORS THAT INCREASE THE RISK OF DIABETES MELLITUS

A number of factors influence the risk of a person having diabetes mellitus. Chief among these factors are over 40, overweight, and a family history of diabetes. Persons with these characteristics should see a doctor periodically to be tested for diabetes. For some reason, obesity causes the body to resist using the insulin it produces. Another factor is that the disease tends to be more common among women than men. Women giving birth either to many babies or very large babies are at risk. Other factors include pancreatic disease, injury, or tumor. Some medications are known to increase the risk of diabetes; for example, steroids (adrenal corticosteroids) and thiazides (thiazide
diuretics). Stress—psychological or emotional—is considered a risk factor regardless of what causes the stress (surgery, infection, pregnancy, the environment, etc.).

3-3. **TYPES OF DIABETES MELLITUS**

There are two main types of diabetes mellitus: insulin-dependent and non-insulin-dependent. There are other less common types of diabetes.

**a. Insulin-Dependent (Type I) Diabetes (IDDM).** This type usually occurs before age 30 but may occur at any age. It used to be called juvenile-onset diabetes because it occurred most often in children and young adults. Research revealed that IDDM could occur at any age; therefore, the name was changed. The patient is usually thin, needs insulin medication, and must adjust his diet to control the disease. Typically, the pancreas either stops making insulin or does not make enough insulin. Insulin must be injected every day to help turn food into energy for survival.

**b. Noninsulin-Dependent (Type II) Diabetes (NIDDM).** This type of diabetes is the one which usually affects people who are over 40 and overweight. Often diet and exercise can control this form of diabetes. Here the pancreas produces some insulin, but the body is unable to use that insulin effectively. Sometimes insulin medication is required.

**c. Other Types of Diabetes.**

1. **Gestational diabetes.** Pregnant women sometimes have this type of diabetes during pregnancy. After the birth of the baby, the disease usually disappears.

2. **Secondary diabetes.** Damage to the pancreas from chemicals, particular medicines, or pancreatic disease such as cancer can cause diabetes. In this case, diabetes is secondary, the result of another disease.

3. **Impaired glucose tolerance.** This diagnosis means that the level of sugar in the blood falls between a normal level and a diabetic level. Such people have an increased risk of developing diabetes. Terms previously used for this condition include latent diabetes, chemical diabetes, and borderline diabetes. Impaired glucose tolerance is no longer considered a form of diabetes.

3-4. **SIGNS/SYMPTOMS OF DIABETES MELLITUS**

Listed are signs and symptoms which are typical of the patient who has diabetes. Some individuals who have noninsulin-dependent diabetes have symptoms so mild that neither the person nor anyone else notices.

**a. Signs/Symptoms of Insulin-Dependent Diabetes.** These signs and symptoms usually occur suddenly:
(1) Frequent urination (polyuria).
(2) Excessive thirst (polydipsia).
(3) Extreme hunger (polyphagia).
(4) Sudden weight loss.
(5) Irritability.
(6) Weakness and fatigue.
(7) Nausea and vomiting.

b. Signs/Symptoms of Noninsulin-Dependent Diabetes. Signs and symptoms of insulin-dependent diabetes may be present with these additional conditions:

(1) Hard-to-heal skin infections.
(2) Gum or bladder infections which do not heal quickly.
(3) Drowsiness.
(4) Blurred vision.
(5) Tingling or numbness in hands or feet.
(6) Itching.

3-5. ETIOLOGY OF DIABETES MELLITUS

The cause of diabetes mellitus is unknown. Research indicates that the tendency to develop diabetes may be present at birth. Some viral infections seem to trigger the onset of diabetes. Despite the fact that some viruses are believed to help cause diabetes, diabetes is not a disease that one person can catch from another person. Being overweight is a contributing cause to diabetes in those persons who have a tendency toward non-insulin-dependent diabetes. The reason is that too much fat prevents insulin from being used properly by the body.

3-6. DIAGNOSTIC TESTS FOR DIABETES MELLITUS

Diabetes mellitus is a very complex disease; nevertheless, the disease is very easy to detect. Urine normally contains no glucose or acetone, but both are present in the urine of a diabetic patient. Ketone bodies are also present in the urine of a diabetic if fats are metabolized faster than the body can use them. Blood glucose and glucose
tolerance tests may be needed to confirm a diagnosis of diabetes in addition to a test for glucose in the urine. The reason is that glucose in the urine is not always an indication that the person has diabetes. Also, not all diabetics excrete glucose in the urine.

a. **Urine Tests.**

   (1) **Glucose tests.** These are common methods of tests for glucose in the urine:

   (a) **Tes-tape.** Dip a strip of Tes-tape into the urine specimen. The tape will turn green or blue if glucose is present in the urine. Use only the end of the tape that you have not touched with your fingers. Be sure the tape has not previously been exposed to light or air.

   (b) **Clinitest.** Put ten drops of water in a test tube. Add two or five drops of urine (depending on the type of Clinitest used). Put in one tablet of Clinitest. The liquid in the tube will change colors. A Clinitest color chart will show you how to grade the color chart to grade the resulting color of the urine specimen in the test tube.

   (c) **Diastix.** Dip a plastic strip in urine. You can read the strip in thirty seconds.

   (2) **Ketones.** Ketone bodies are present in the urine of diabetic patients. A doctor will decide whether it is necessary to test for ketones. Two tests are Ketostix strips which test the urine for ketones and Keto-Diastix which tests the urine for glucose and ketones. Testing for ketones is especially important when the patient has a fever, is vomiting, or has glucose in his urine.

b. **Blood Tests.** Common tests include the following:

   (1) **Fasting blood glucose.** The patient fasts for eight hours. Then, a single specimen of blood is taken in the morning. Eighty to 120 mg/dl is the normal range.

   (2) **Postprandial glucose.** Two hours after the patient has eaten a high-carbohydrate meal, a single sample of blood is taken. The normal range is 140 to 160 mg/dl.

   (3) **Oral glucose tolerance test (OGTT).** After the patient has fasted for about eight hours, a blood sample and a urine specimen are taken. The patient consumes an oral glucose solution after which blood is drawn at 30 minutes, 1 hour, 2 hours, and 3 hours. A urine specimen is also collected at each of these times. Be sure to label all specimens with the time of collection. In the nondiabetic patient, the blood glucose level returns to normal after two to three hours; the urine sample is negative for glucose. In the diabetic patient, however, the blood glucose levels return to normal more slowly; the urine tests positive for glucose.
3-7. TREATMENT OF DIABETES MELLITUS

The goal in treating diabetes is to keep the patient's blood sugar level in the normal range. A major factor in the management of diabetes is patient education. The patient must realize that diabetes is a lifelong disease which he can manage if he maintains a balance of diet, exercise, and sometimes medications.

a. Treatment for Insulin-Dependent Diabetes. Generally, treatment includes insulin injections, regular exercise, and a balanced meal plan that limits the consumption of sugar. This diabetic patient may need to eat three meals per day plus two or three snacks a day. This food will have to be eaten at the same time each day in order to balance insulin which is also given at the same time each day.

NOTE: Food raises the level of blood sugar while insulin lowers the level of blood sugar. Therefore, the effects of food and insulin must be balanced in order to control diabetes.

b. Treatment for Noninsulin-Dependent Diabetes. Generally, these patients are treated with a diet plan designed specifically for each patient. The overweight patient must lose weight because fat keeps the body from using the insulin it produces effectively. Sugar intake is restricted, and the patient must follow an exercise plan. The patient may need to take medication, either orally or by injection, if diet and exercise do not bring the blood sugar level in the normal range. Such medication does not correct the blood sugar level alone. The patient must adhere to a special diet and exercise plan, both of which have been designed for him.

c. Diet. The amount and kind of food the diabetic patient consumes is most important in controlling this disease. For example, the diabetic who consumes more carbohydrates than he can use or store will eventually develop ketoacidosis. Ketoacidosis (excessive amounts of ketone acids in the body) is a condition which can progress from severe illness to coma to death. If the diabetic patient takes insulin but does not eat enough food, he may develop hyperinsulinism (insulin shock) which results in hypoglycemia (lower than normal level of glucose in the blood). The results are the same as for ketoacidosis. It is very important for the diabetic patient to eat both the right kind of food and the right amount of food. A special diet is prescribed for each diabetic based on that person's sex, age, height, weight, activity, state of health, former dietary habits, and cultural background. General rules include the following:

(1) The diet will include a balance of calories, percentages of carbohydrates, fats, and proteins.

(2) These foods are usually excluded: sugar, candy, honey, jam, jelly, marmalade, preserves, syrup, molasses, pie, cake, cookies, condensed milk, chewing gum containing sugar, and non-diet soft drinks.
(3) The patient must remember that alcohol is high in calories and that any alcoholic drink he consumes must be counted into his total caloric intake.

(4) The diabetic patient can usually have as much as he wants of these foods: unsweetened gelatin, clear and fat-free broth, unsweetened pickles, cranberries, rhubarb, coffee, tea, and certain salads.

(5) Before eating any dietetic foods, the diabetic patient should consult his physician. Additionally, a diabetic patient should remember to count these foods in his diet and to read the label of these foods. Sugar, fat, and protein contents should be listed. "Low calorie" and "dietetic do not always mean "no sugar."

d. Medications. Oral hypoglycemic agents (Sulfonylureas) will stimulate the pancreas to produce and release insulin. Sulfonylureas are not insulin. When there is some pancreatic function and when diabetes is unable to be controlled by insulin alone, oral hypoglycemic agents are usually given. Oral hypoglycemic agents are NOT usually prescribed when there is no insulin production and when there is cardiac disease. Some of the oral hypoglycemic agents are tolbutamide (OrinaseR), chlorpropamide (diabinese), acetohexamide (DymelorR), and tolazamide (TolinaseR).

e. Insulin. Sources of insulin are animals, genetic engineering of E. Coli. Injectable insulin is obtained from cattle, pigs, and E. Coli. Insulin promotes glucose uptake by cells. There are two categories of insulin: the short-acting and the long-acting types. The short-acting type of insulin has an onset of 30 to 60 minutes and reaches its peak effectiveness at four to six hours. This type of insulin is effective for a period of six to twelve hours. Short-acting insulin agents are Regular, Actrapid, and Semilente. The longer acting type of insulin has an onset of one to two hours and reaches its peak of effectiveness from eight to twelve hours. It has a duration of 24 to 48 hours. The agents of the longer acting insulin type are NPH, Lente, and Lentard. Insulin is not given orally because gastric acids will destroy insulin. Insulin is administered subcutaneously or intravenously in concentration of U-40 (40 units/1 cc) or U-100 (100 units /1cc). Insulin must be stored at 75 degrees Fahrenheit. Freezing temperatures may change the crystal size of insulin.

f. Exercise. Proper exercise is important in controlling diabetes mellitus. Exercise improves circulation and helps the body metabolize carbohydrates, both of which decrease the need for insulin. A patient who exercises very little during the week but is more active on the weekends will find that the amount of glucose in his blood varies greatly. If there is no way the patient can exercise more during the week, he should discuss this situation with his physician. His food and insulin requirements may need to be adjusted to fit his activities. A patient should be sure to have some easy to eat carbohydrates with him during exercise in case he feels symptoms of hypoglycemia (weak, sweaty, pale skin, etc.).
g. **Skin and Foot Care.** Breaks in the skin heal more slowly in diabetic patients; therefore, skin and foot care is important to keep the patient's skin soft and supple with a minimum of cracks. These general guidelines should be followed:

(1) Use proper first aid measures even for minor skin abrasions. If redness occurs, consult a physician immediately. Ulcers or gangrene may develop from any break in the skin.

(2) Do not use strong irritating antiseptics such as iodine on breaks in the skin. After using a mild antiseptic, cover the area immediately with sterile gauze. Use fine paper tape or cellulose tape (scotch tape) rather than adhesive tape. Adhesive tape may tear the skin.

(3) Take good care of the feet in order to avoid dry cracked skin. Wash the feet daily with mild soap and lukewarm water. Dry the feet thoroughly but do not rub hard since the skin is delicate. Dry feet can be rubbed with vegetable oil to keep them soft, prevent excess friction, remove scales, and prevent dryness. The patient should wear low heeled shoes that fit comfortably and correctly to prevent shoes rubbing on the feet and creating problems.

**3-8. INSULIN REACTION (INSULIN SHOCK)**

a. **Definition.** Insulin reaction, also called insulin shock, is defined as low blood sugar. It may be caused by an overdose of insulin or of an oral agent. Increased exercise or a delayed or missed meal may also cause an insulin reaction.

b. **Signs/Symptoms.** Included are the following:

(1) Hypoglycemia. The sugar level in the blood is lower than normal.

(2) Sweating and pale skin.

(3) Hunger.

(4) Irritability.

(5) Dizziness.

(6) Headache.

(7) Tremors.

(8) Palpitations and tachycardia (abnormally fast heart beat).

(9) Lethargy.
Seizures.

Coma.

c. **Treatment.** Insulin shock is a critical situation, and the patient must be treated immediately. Emergency treatment includes the following:

1. Give a conscious patient orange juice, soft drinks which contain sugar, sugar cubes, or candy to help raise his carbohydrate level.

2. If the patient is unconscious, **do not try to give him something to drink.** Instead follow this procedure:
   
   (a) Establish an airway and administer oxygen.

   (b) Rub a sugar cube on the patient's tongue. (Do not leave the sugar cube in his mouth. The cube could become lodged in his throat).

   (c) Give treatment for complications such as shock or convulsions.

   (d) Transport the patient immediately to a medical treatment facility.

3. A patient will usually improve immediately after consuming sugar. Here is a list of foods that supply an adequate amount of glucose:

   (a) Nabisco Animal Crackers (4).

   (b) Apple juice (4 ounces).

   (c) Orange juice (4 ounces).

   (d) Lifesavers (5-6).

   (e) Coca-Cola (3 ounces).

   (f) Ginger ale (4 ounces).

   (g) Corn syrup (2 level teaspoons).

   (h) Gumdrops (10 small ones).

   (i) Honey (2 level teaspoons).

   (j) Wheat peanut butter crackers (3).
(4) You need not worry about the amount of sugar you have given the patient. The doctor at the medical treatment facility will balance the patient's sugar level against insulin production.

NOTE: Diabetic patients have trouble with the level of blood sugar being either too high or too low. If the patient is exhibiting signs of insulin shock (hypoglycemia), give sugar (one of the foods listed in paragraph 3-8c(3)). The person with too high a blood sugar level will not be harmed. And on the other hand, you may save the life of a patient whose blood sugar level is too low.

(5) Frequently, diabetic patients carry a card in the wallet which advises the reader that if the person is behaving strangely, he may be having an insulin reaction or his blood sugar may be too low. The reader is instructed to give the diabetic sugar, candy, fruit juice, or a sweetened drink. The reader is also instructed to call a physician or send the person to a hospital immediately.

3-9. HEALTH PROBLEMS REQUIRING IMMEDIATE CARE

In addition to insulin shock, there are several other conditions a diabetic patient may have, conditions which require immediate attention. Hyperglycemia (high blood sugar) and ketoacidosis (diabetic coma) are two such conditions.

a. **Hyperglycemia**. The level of sugar in the blood is too high in this condition. The patient has probably eaten too much food or not taken enough insulin. Other causes of high blood sugar include illness and emotional stress. Large amounts of sugar in the urine and blood indicate hyperglycemia. The patient may also be very thirsty, urinate more often than usual, and feel nauseated. A physician should be consulted to treat high blood sugar.

b. **Ketoacidosis**. This is another name for diabetic coma, a condition which may go along with high blood sugar. The cause of the condition is an imbalance of insulin and blood sugar to so great a degree that ketones build up in the blood. Ketones in great amount in the blood are poisonous. A slow developing ketoacidosis (occurring over several hours or several days) can usually be controlled at the first signs of high blood sugar or ketones in the urine. (Consult a physician immediately for instructions.) Other symptoms the patient may experience in addition to high blood sugar and ketones in the urine include dry mouth, great thirst, loss of appetite, excessive urination, dry and flushed skin, labored breathing, and fruity smelling breath. Less common symptoms which are sometimes present include vomiting, abdominal pain, and unconsciousness. Type I diabetics (insulin-dependent) are most likely to develop ketoacidosis.
3-10. OTHER HEALTH COMPLICATIONS FOR THE PATIENT

Diabetes mellitus is a complex metabolic disorder that can affect many parts of the body. Disturbances in other body parts may occur even before the usual symptoms of excessive thirst, too frequent urination, etc., appear.

a. Vascular Disturbances. There may be disturbances in the vessels of any part of the body. Most likely are problems in the nerves (diabetic neuropathy), the retina of the eye (diabetic retinopathy), kidneys, and the legs. The diabetic patient has a decreased blood supply to the tissues of the lower extremities (legs and feet) which increases the risk of problems in those areas. Any infection in the legs and feet must be attended to promptly; otherwise, ulcers may form and even gangrene leading to amputation.

b. Visual Problems. The retinal capillaries in diabetic patients have a tendency to develop multiple tiny bulges with small points of hemorrhage and exudates. The result is that scarring occurs in these capillaries from repeated hemorrhages. Presently treatment involves controlling the level of sugar in the blood and managing hypertension associated with the blood sugar level. The effect of laser therapy is being evaluated and researched also.

c. Neuropathy. Damage to nerve tissue is possible for the diabetic patient. The patient may experience facial paralysis or loss of muscle tone in the urinary system may result in diarrhea or constipation. A more common condition is problems in the legs. The patient may feel itching, numbness, tingling, and/or pain in the legs, a condition which is worse at night. There may also be a loss of sensation in the legs with the result that since the patient does not feel intense heat, for example, he can be burned without realizing it.

d. Infection. Infections heal slowly in diabetic patients. While the infection persists, diabetes becomes more severe. Skin lesions such as carbuncles and furuncles occur and are very slow to heal. If a diabetic patient has any skin eruption, he should contact his physician immediately.

3-11. CLOSING

Since the brain is so dependent on sugar, the patient with low blood sugar is in a life-threatening situation. Look for the signs and symptoms which spell impending doom and manage the situation early. Making a diagnosis is not critical, but appropriate interpretations of the patient's signs and symptoms are.
EXERCISES, LESSON 3

INSTRUCTIONS. The following exercises are to be answered by writing the answer in the space provided. After you have completed all the exercises, turn to the solution at the end of the exercises and check your answers.

1. Diabetes is a disease that __________________________________________
   __________________________________________.

2. ______________________ (Type I) diabetes is the kind of diabetes in which
   the pancreas either does not make insulin or makes too little insulin for the body's
   needs.

3. List three factors that increase the risk of diabetes.
   a. __________________________________________.
   b. __________________________________________.
   c. __________________________________________.

4. In a person without diabetes, blood carries glucose to cells throughout the body,
   and insulin changes glucose into quick energy which ________________ or
   stored for future energy needs.

5. In the digestive process of a diabetic patient, the normal process breaks down at
   the point where insulin should change glucose into quick energy or store the
   glucose. Instead, cells in the bloodstream cannot use glucose to make energy,
   and glucose ________________ resulting in _______________________.

   MD0583 3-12
6. ________________________ diabetes usually affects people who are over 40 and overweight.

7. Hard-to-heal skin infections, blurred vision, tingling or numbness in the hands or feet, and gum infections which clear up slowly are signs/symptoms of _________ ________________ diabetes.

8. How does obesity increase the risk of diabetes? __________________________

9. The Tes-tape test in a urine test. If glucose is present in the urine, tape dipped into the urine will turn _______________ or ________________.

10. For the ________________________ test, the patient fasts for eight hours after which a blood sample and a urine specimen are taken. The patient drinks an oral glucose solution after which blood is drawn at 30 minutes, 1 hour, 2 hours, and 3 hours.

11. The goal in treating diabetes mellitus patients is to ________________________

12. Excessive amounts of ketone acids in the body is called ________________.

13. A diabetic patient who takes insulin but does not eat enough food may develop ________________, also called ________________ shock.
14. A proper diet for the diabetic patient will have a balance of:
   a. __________________________________________.
   b. __________________________________________.
   c. __________________________________________.
   d. __________________________________________.

15. List two reasons exercise is of vital importance for the diabetic patient.
   a. __________________________________________.
   b. __________________________________________.

16. List four signs/symptoms of insulin shock.
   a. __________________________________________.
   b. __________________________________________.
   c. __________________________________________.
   d. __________________________________________.

17. ________________ is the result when the diabetic patient's insulin and blood sugar become imbalanced to such a degree that ketones (poisonous in abundance) build up in the blood.

18. A diabetic patient may burn his leg because he has lost sensation to heat in his leg, a condition termed ____________________________.

   Check Your Answers on Next Page
1. Affects the way the body uses food and causes sugar levels in the blood to be too high. (para 3-1).

2. Insulin-dependent. (para 3-3a)

3. You are correct if you listed any three of the following:
   - Heredity.
   - Obesity.
   - Women who have large babies.
   - Women who have many babies
   - Pancreatic injury, disease, or tumor.
   - Emotional stress.
   - A major disease. (para 3-2)

4. Can be used by the cells immediately. (para 3-1b)

5. Accumulates in the blood.
   - High blood sugar levels. (para 3-1c)

6. Noninsulin-dependent. (para 3-3b)

7. Noninsulin-dependent. (para 3-4b)

8. Too much fat keeps insulin from being used properly by the body. (para 3-5).

   - Blue. (para 3-6a(1)(a))

10. Oral glucose tolerance test. (para 3-6b(3))

11. Keep the patient's blood sugar level in the normal range. (para 3-7)

12. Ketoacidosis. (para 3-7c)

13. Hyperinsulinism.
   - Insulin. (para 3-7c)

   - Carbohydrates.
   - Fats.
   - Proteins. (para 3-7c(1))
15. Exercise improves circulation. Exercise helps the body metabolize carbohydrates. (para 3-7f)

16. You are correct if you listed any four of the following:

   Hypoglycemia.
   Sweating and pale skin.
   Hunger.
   Irritability.
   Dizziness.
   Headache.
   Tremors.
   Palpitations and tachycardia.
   Lethargy.
   Seizures.
   Coma. (para 3-8b)

17. Ketoacidosis (diabetic coma). (para 3-9b)

18. Diabetic neuropathy. (para 3-10c)