BLOOD GLUCOSE AND CHOLESTEROL CHECKS

A. GLUCOSE

Glucose (a monosaccharide), is one of the most important carbohydrates used as a source of energy for animals and plants. Glucose is one of the products during photosynthesis from the beginning to respiration. The natural form of glucose is also called dextrose, especially in the food industry. Glucose (C6H12O6) has a molecular weight of 180, including hexoses, which are monosaccharides containing six carbon atoms.

Glucose is a source of energy for living things. This happens because glucose is formed from formaldehyde in abiotic conditions, so it will be easily available to primitive biochemical systems. What is more important for higher organisms is the tendency of glucose compared to other hexose sugars to react nonspecifically with the amino groups of a protein. This reaction (glycosylation) reduces or even impairs the function of various enzymes.

Glucose is formed from glucogenic compounds that undergo glycogenesis. Gluconeogenesis fulfills the need for glucose when carbohydrates are not available in sufficient quantities in the diet. A continuous supply of glucose is needed as a source of energy, especially for the nervous system and erythrocytes Glucose is also needed in adipose tissue as a source of glyceralide-glycerol and glucose may also have a role in maintaining intermediate levels in the citric acid cycle in all body tissues. In addition, glucose is the only fuel that supplies energy to skeletal muscles under anaerobic conditions.

Tabel Kadar glukosa darah sewaktu dan puasa sebagai patokan penyaring dan diagnosis DM (mg/dl)

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		Bukan DM	Belum pasti DM	DM
Kadar glukosa darah sewaktu (mg/dl)	Plasma vena	<100	100-199	≥200
	Darah kapiler	<90	90-199	≥200
Kadar glukosa darah puasa (mg/dL)	Plasma vena	<100	100-125	≥126
	Darah Kapiler	<90	90-99	≥100

(Konsensus Pengelolaan dan Pencegahan DM tipe 2 di Indonesia, PERKENI, 2006)

B. Hormone that regulates blood glucose levels

The hormones that regulate blood glucose levels are insulin and glucagon. Insulin is an anabolic hormone that stimulates the synthesis of macromolecular components of cells and results in glucose storage. Glucagon is a catabolic agent that limits macromolecular synthesis and causes the release of stored glucose. An increase in circulating glucose results in an increase in circulating glucose concentration resulting in an increase in insulin secretion and a decrease in glucagon and vice versa. Known blood glucose levels can help predict the metabolism that may occur in cells with available sugar content. If the glucose content in the body is excessive, the glucose will undergo an enzymatic catabolism reaction to produce energy. However, if the glucose content is below the minimum limit, then the pyruvic acid produced from the catabolism process can undergo an anabolic enzymatic process through gluconeogenesis to synthesize glucose and meet the normal level of glucose in the blood (blood plasma) which is 65-110 mg/dl (3, 6 – 6.1 mmol/L).

C. The relationship between blood glucose levels and the state of the human/animal body

Blood glucose levels increase with digestion and absorption of glucose from food. In healthy and normal individuals, these levels do not exceed about 140 mg/dL because the tissues will absorb glucose from the blood, store it for later use or oxidize it to produce energy. If glucose levels continue to rise after a meal, high glucose concentrations can result in the loss of water from the tissues due to the osmotic effect of glucose. The tissue will be dehydrated and its function will be disturbed. Dehydration of the brain can lead to hyperosmolar coma. On the other hand, if blood glucose levels continue to fall after a meal, glucose-dependent tissues will experience a lack of energy. When glucose levels drop suddenly, the brain is unable to produce adequate amounts of ATP. There will be dizziness and lightheadedness, followed by drowsiness, and finally coma. The consequences of a dangerous excess or deficiency of glucose under normal circumstances are avoided because the body is able to regulate its blood glucose levels.

Diabetes mellitus is a condition caused by failure to regulate blood sugar. Diabetes mellitus is a chronic disease caused by the inability of the pancreas to produce sufficient amounts of the hormone insulin, the body cannot use the insulin that has been produced by the pancreas effectively, or it can be caused by a combination of both. Patients with uncontrolled diabetes mellitus will experience an increase in blood glucose levels which is called hyperglycemia. Hyperglycemia that lasts for a long time will cause serious damage to the body's systems, especially the nerves and blood vessels.

Types of diabetes mellitus (DM) are generally divided into three types, including type 1 diabetes, type 2 diabetes, and gestational diabetes. Type 1 diabetes is caused by a lack of insulin production by the pancreas. Type 2 diabetes is caused by insulin resistance so that the body's use of insulin becomes ineffective. Gestational diabetes is hyperglycemia that was first discovered during pregnancy. A condition in which blood glucose levels are higher than normal but not high enough to be diagnosed as diabetes mellitus are called prediabetes. Impaired glucose tolerance (TGT) and impaired fasting blood glucose (GDPT) are included in the prediabetes state. This prediabetes state will increase a person's risk for suffering from type 2 diabetes, heart disease or stroke.

D. Cholesterol

Cholesterol is a complex fat compound, 80% of which is produced from within the body (liver organs) and the remaining 20% from outside the body (nutrients) for various functions in the body, including forming cell walls. The reference value for total cholesterol levels is 140-250 mg/dl.

Cholesterol in the food we eat can increase cholesterol levels in the blood. However, as long as this income is balanced with needs, our bodies will remain healthy.

Cholesterol is insoluble in blood fluids, for it to be sent throughout the body it needs to be packaged together with protein into particles called lipoproteins, which can be considered as 'carriers' (carriers) of cholesterol in the blood.

In our bodies, cholesterol consists of LDL (*low density lipoprotein*), HDL (*high density lipoprotein*), and triglycerides. LDL cholesterol produced in the liver circulates in the blood vessels and goes to body cells, such as heart cells, brain cells, and cells in other organs that need it. The remaining LDL cholesterol will be carried by HDL cholesterol back to the liver and excreted into the gallbladder as bile acids.

LDL (*Low Density Lipoprotein*) is cholesterol that is bad, because it causes cholesterol that was originally free in the bloodstream to stick to the walls of blood vessels. As a result, the blood vessels become narrowed and stiff. This process underlies the risk of heart disease, high blood pressure, stroke, impaired blood flow to other organs (including peripheral nerves) and so on.

LDL molecules can stick to the walls of blood vessels due to the oxidation process by free radicals (e.g. cigarette smoke). The oxidized LDL is able to turn macrophage cells (a type of white blood cell circulating in the blood) into foam cells so that they form a plaque that gets bigger and bigger, and the end result is a narrowing of blood vessels.

Oxidized LDL will also stimulate smooth muscle cells in the walls of blood vessels (blood vessels have muscle in their walls so they can be flexible, expand and contract) and eventually can cause hardening of the walls of blood vessels, can no longer be flexible, and pressure blood can increase because blood flow is not smooth. Hardened blood vessels also break easily if blood pressure rises sharply.

While HDL (*High Density Lipoprotein*), is good cholesterol which will remove cholesterol that is not used by the body, including those attached to the walls of blood vessels to the excretory organs for further disposal from the body.

Fats that lower LDL levels and raise HDL levels are called monosaturated and polysaturated fats. Examples of products include: corn oil, soy bean, cottonseed oil, canola oil, olive oil, fish, peanut, almond, avocado and so on.

The fat group that "raises LDL and HDL in a balanced way" is called saturated fat. Examples of products include whole milk, butter, cheese, ice cream, red meat, coconut, coconut milk, and coconut oil.

The type of fat that "raises LDL" and "lowers HDL" is called trans saturated fat. Examples of products are mostly vegetable oil, and fast food.

PRACTICUM WORKSHEET

TEST BLOOD GLUCOSE LEVELS AND BLOOD CHOLESTEROL LEVELS

1. **Practical Purpose**

   Students are able to understand about blood glucose and blood cholesterol and are able to measure glucose and cholesterol levels in the blood

2. **Tools and Material:**

   1 piece Easy Touch blood test kit

   1 piece of blood sugar checking strip

   1 piece of strip checking blood cholesterol levels

   lancet needle

3. Practical Steps:

The best time to use a blood sugar checker is in the morning before breakfast, so the results will be more accurate. Each strip has an expiration date, so it is best to use it before the expiration date.

The steps are as follows:

- Insert the battery and start the engine.
- Set the time, date and year on the machine.
- Take the yellow chip input into the machine to check the machine.
- If the screen appears "error" means the machine is broken. If the screen appears “OK” it means the machine is ready for use.
- Each bottle of strips on sugar, acid and cholesterol has a test chip.
- To check the sugar, put in the sugar chips and sugar strips first.
- A number/code will appear on the screen according to the strip bottle.
- After that, an image of blood drops and flickering will appear.

- Insert the needle into the lancing / pen-shaped gun and adjust the depth of the needle.
- Use alcohol wipes to clean your fingers.
- Shoot the needle in the finger and press it so that the blood comes out.
- The blood is touched on the strip and not dripped on the strip.
- Touch on the line where there is an arrow.
- Blood will immediately seep to the end of the strip and beep.
- Wait a moment, the results will appear a few seconds on the screen.
- Remove the needle from the lancing as well as the strip and throw it away.
- The sugar chips are in the bottle again.
- Use a cholesterol chip for a cholesterol test. (same steps)
- Close the strip bottle tightly when not in use.
- Pay attention to the expiration period on each strip.
- Each strip has an expiration date, so it is best to use it before the expiration date.

PRACTICUM EXAMINATION WORKSHEET

BLOOD GLUCOSE AND CHOLESTEROL

Blood Glucose Examination Results:

Proband Identity	Glucose Test Results	Information (Normal/Abnormal)
Proband name 1: Gender : Weight : Height :		
Proband name 1: Gender : Weight : Height :		
Proband name 1: Gender : Weight : Height :		

1. What is a blood glucose test?

2. How many types of blood glucose tests are there and what is the normal value?

3. What causes abnormal blood glucose levels? Explain how this can happen!

Cholesterol Examination Results:

Proband Identity	Cholesterol Test Results	Information (Normal/Abnormal)
Proband name 1: Gender : Weight : Height :		
Proband name 1: Gender : Weight : Height :		
Proband name 1: Gender : Weight : Height :		

1. What is a cholesterol test?

2. What is the normal value for blood cholesterol test results?

3. What causes a person's cholesterol levels to be abnormal? Explain how this can happen!