CHAPTER I
INTRODUCTION

1.1 Background

The laboratory is part of the health facilities used to support efforts to improve health in order to establish the diagnosis of a disease, health treatment, and recovery. Laboratory tests are usually carried out according to a doctor's request based on the patient's clinical symptoms. Laboratory examinations include examination of clinical chemistry, hematology, microbiology, and urinalysis. Laboratory examination has functions and benefits, one of which is a screening test for the presence of disease. Laboratory examinations aim to determine the risk of disease and detect early disease, especially for individuals at high risk. An example of an examination that doctors often request as a screening test is a urinalysis examination (Setianingsih. D, 2014).

Urine examination is usually used as a screening test to determine the potential for liver disease, diabetes mellitus, kidney disease, and urinary tract infection. Urine examination consists of macroscopic, microscopic, and chemical examination of urine. There are various methods used to obtain urine examination results, one of which is examining urine glucose with Benedict's test. (Mayangsari, C. 2008).

Urine glucose examination by Benedict's test utilizes the nature of glucose as a reducing agent. The principle of Benedict's examination is that glucose in the urine will reduce cuprisulfate to cuprosulfate, which can be seen by a change in the color of Benedict's solution. A positive result is indicated by turbidity and a color change from blue to yellowish-green to brick red. The advantages of this method is that it is less expensive and requires less urine. (Gandasoebrata, 2008)

A positive result in urine can strengthen the suspicion of diabetes mellitus if the patient begins to feel diabetes symptoms. Diabetes Mellitus, or better known as diabetes, is caused by a lack of the hormone insulin (Tjokroprawito, 1986 in Studiawan and Santosa, 2005). This is because the pancreas, as an insulin producer, does not produce insulin in sufficient quantities than needed by the body, so that the burning and use of carbohydrates is not optimal. This disease is a disease of carbohydrate metabolism disorders characterized by glucose in the urine (glucosuria) (Widowati et al., 1997).

The hospital chosen for the study was Rumah Sakit Umum Sari Mutiara in Medan because this hospital is one of the referral hospitals in Medan. This hospital is also surrounded by many residential houses; thus, many patients come for treatment. Based on medical record data, Rumah Sakit Umum Sari Mutiara in Medan has checked urine glucose levels in 2013 as many as 2.871 people, in 2014 as many as 2.907 people, in 2015 as many as 3.005 people, in 2016 as many as 1.734 people, and in 2017 until June as many as 1.220 people. In the initial survey conducted at this hospital, the average patient who went to the Laboratory of Rumah Sakit Umum Sari Mutiara in Medan for checking their urine glucose levels was 250 people per month. Also, the average patient who tested positive for urine glucose was mostly due to age, gender, occupation, and other factors.

Therefore, based on the description mentioned above, the author is interested in conducting research on the Determination of Glucose Levels in urine in the Laboratory of Rumah Sakit Sari Mutiara in Medan.

1.2 Formulation of the Study

Based on the background as mentioned above, the formulation of the study is to determine whether or not patients who come to Rumah Sakit Umum Sari Mutiara in Medan have glucose levels in accordance with the threshold.

1.3 Objective of the Study

This study aims to determine urine glucose levels in patients who came to the Laboratory of Rumah Sakit Umum Sari Mutiara in Medan.

1.4 Significance of the Study

The significance of the study is to provide information to the public to maintain their diet and lifestyle in order to avoid diabetes mellitus so that their urine glucose levels will be in a normal state.

CHAPTER II

LITERATURE REVIEW

2.1 Carbohydrates

Carbohydrates are one of the food substances needed by the body, which functions as the primary fuel to get the energy needed for various physiological activities of cells. Carbohydrates found in food are hexose polymers, and the most important are galactose, fructose, and glucose. (Ganong, 1999)

After entering the cell, glucose will be phosphorylated to form glucose-6-phosphate, which is catalyzed by hexokinase. In the liver, there is another enzyme called glucokinase, which is more sensitive to glucose. In addition, like hexokinase, glucokinase levels will be increased by insulin and decreased during starvation. (Ganong, 1999)

2.1.1 Classification of Carbohydrates

Based on the classification, carbohydrates are divided into 4, namely Monosaccharides, Disaccharides, Polysaccharides, and Oligosaccharides. The classification is as follows:

1. Monosaccharides

Monosaccharides are carbohydrates that consist of one sugar group and are the simplest carbohydrates, or are called simple sugars. Monosaccharides have a sweet taste and are easily soluble in water. Examples of monosaccharides are hexose, glucose, fructose, monose, ribose, and deoxyribose. In chemical nomenclature, monosaccharides always end in –ose. In nutrition, there are only three types of essential monosaccharides, namely glucose, fructose, and galactose. Glucose can be found in nature, especially in fruits, vegetables, honey, corn syrup, and molasses. In the body,

glucose is obtained from starch, sucrose, maltose, and lactose digestion. Fructose is the sweetest, often found in flower crowns, honey, and the hydrolysis results of cane sugar. Galactose is not found free in nature. In the body, galactose is the hydrolysis result of lactose. (Hutagalung, 2004)

2. Disaccharides

Disaccharides are a combination of two kinds of monosaccharides. In the metabolism process, disaccharides will be broken down into two monosaccharide molecules by enzymes in the body. Disaccharides also have a sweet taste and are water-soluble. Disaccharides are grouped into three groups, namely sucrose, maltose, and lactose. Sucrose is a sugar that we use daily. Therefore, sucrose is more often referred to as table sugar or white sugar. The sources of sucrose are sugar cane, beets, sugar sap, jelly. In the body, maltose is obtained from starch digestion, is easier to digest, and tastes better and delicious. Lactose is poorly soluble in water, and its source is only found in milk; so it is called milk sugar (Hutagalung, 2004)

3. Oligosaccharides

Oligosaccharides are simple carbohydrates, which are widely consumed in the form of soft drinks, biscuits, and sugar. Oligosaccharides are short monosaccharides with a unique chemical structure that cannot be digested by human digestive enzymes. (Hutagalung, 2004)

4. Polysaccharides

Polysaccharides are complex carbohydrates, containing more than 60.000 monosaccharide molecules arranged in straight or branched chains. Polysaccharides taste bland, unlike monosaccharides and disaccharides. In general, polysaccharides are tasteless or bitter and are poorly soluble in water. Examples of polysaccharides are starch, dextrin, glycogen, and cellulose. Starch is insoluble in cold water, but soluble in

hot water. The sources of starch are tubers, cereals, and seeds. Dextrin is an intermediate in the breakdown of starch. Its molecules are simpler and more soluble in water. Glycogen is an animal starch, and its sources are abundant in sprouts, cereals, milk, and corn syrup. Cellulose is 50% carbohydrates derived from plants. Cellulose cannot be digested by the human body because there are no enzymes to break down cellulose in the human body. (Hutagalung, 2004)

2.2 Diabetes Mellitus

According to the American Diabetes Association (ADA), Diabetes Mellitus is a group of metabolic diseases characterized by hyperglycemia that occurs due to insulin secretion disorders, insulin action disorders, or both, which causes various chronic complications in the eyes, kidneys, nerves, and blood vessels (Hastuti, 2008 in Fitriyani, 2012).

Diabetes Mellitus is commonly called the silent killer because this disease can affect all organs of the body and cause various kinds of complaints. Many diseases caused by Diabetes Mellitus include visual impairment, cataracts, heart disease, kidney disease, sexual impotence, hard-to-heal wound/gangrene, lung infections, blood vessel disorders, stroke, and so on. There are many people with severe Diabetes Mellitus who undergo limb amputation due to decay. Diabetes Mellitus interferes with the body's ability to use nutrients from food effectively. (Ministry of Health, 2005).

Diabetes Mellitus (DM) is a metabolic group characterized by hyperglycemia, which occurs due to abnormalities in insulin secretion, insulin action, or both. Hyperglycemia is a condition in which glucose levels exceed normal limits. Increased glucose levels beyond normal limits are one of the basics for diagnosing diabetes mellitus. This is because the most critical metabolic disorders are abnormalities in

carbohydrate metabolism. This condition can lead to chronic complications, including cardiovascular disease, gangrene, chronic kidney disease, retinopathy, and neuropathy. More severe complications are common when sugar control is poor. Therefore, people with diabetes mellitus need to manage their diet, especially in consuming carbohydrates (Gustaviani, 2006 in Yunesya, 2016).

According to Widowati et al. (1997), diabetes mellitus is grouped into four types, namely type 1 diabetes, type 2 diabetes, type 3 diabetes and type 4 diabetes. Type 1 diabetes was originally known as juvenile diabetes or insulin-dependent diabetes. It occurs when the pancreas cannot produce insulin. This usually begins in childhood or juvenile and continues into adulthood. Type 1 diabetes is caused by damage to the beta cells in the pancreas that secrete insulin. At first, this immune disease is caused by toxins or viruses. This incident prompts the immune system to attack the pancreas. Beta cells in the pancreas are damaged by the attack and can no longer produce insulin (D'Adamo and Whitney C, 2005). Patients with type 1 diabetes mellitus are dependent on insulin therapy and are not recommended to take oral antidiabetic drugs. Patients can not be cured and depend on insulin injections for the rest of their life. (Subroto, 2006).

Type 2 diabetes is diabetes that occurs in adults but sometimes also occurs in adolescents. Endogenous insulin is sufficient to prevent ketoacidosis. However, the insulin is often at less than normal levels. Obesity, which generally causes impaired insulin action, is a common risk factor for this type of diabetes. Most of these type 2 diabetes patients gain weight. (Katzung, 2002).

Type 3 diabetes (Pregnancy Diabetes) is diabetes that occurs during pregnancy. The blood sugar of pregnant women with this disease is very high, so the fetus will grow bigger, reaching 4 kg in the womb. This type of diabetes usually only occurs if the

patient is pregnant. If not pregnant, the patient's blood sugar will be normal, but this diabetes may become persistent. (Katzung, 2002).

Type 4 diabetes (other types of diabetes) is a type of diabetes whose causes can vary, for example, due to syndromes such as Cushing's syndrome, androgen hormone disorder syndrome, and others. (Katzung, 2002).

2.2.1 Diabetes Symptoms

The symptoms of Diabetes are excessive thirst and urination (polyuria), leading to frequent drinking of high amounts of water (polydipsia). These changes are caused by the excretion of large amounts of glucose into the urine; known as glucosuria. Diabetes mellitus means "excess secretion of sweet urine." In severe conditions, namely, uncontrolled diabetes mellitus, the glucose amount in the urine can exceed 100 g per 24 hours, whereas, in normal individuals, only a small amount is excreted. A large amount of urine in diabetes reflects the need for the kidneys to excrete large amounts of water with glucose since the capacity of the kidneys to clear solutes in urine is limited. Glucose measurement in urine secretion within 24 hours is one of the diagnostic tests for diabetes (Albert, 1992).

Another hallmark of metabolic changes in diabetes is excessive but incomplete oxidation of fatty acids in the liver so that the ketone bodies (acetoacetate and β-OH-butyrate) are produced in excess and cannot be used by peripheral tissues as quickly as the liver makes them. In addition to the acetoacetate and β-OH-butyrate, diabetic blood also contains acetone, which is produced by spontaneous decarboxylation of acetoacetate. Acetone is very volatile and is present in the breath of people with diabetes (diabetics) that gives them a distinctive aroma, namely a sweet organic odor. Passed-out diabetics are usually suspected of being drunk due to the smell of acetone in their breath. Excessive production of ketone bodies is called ketosis, which causes an

increase in these compounds in the blood (ketonemia) and urine (ketonuria) (Albert, 1992).

2.2.2 Causes of Diabetes Mellitus

Diabetes mellitus is caused by heredity, foods containing too much sugar, overweight, and stress or depression. This disease cannot be cured but can be controlled with treatment that requires patience and high discipline (Sudewo, 2004).

2.3 Diagnosis of Diabetes

The clinical diagnosis of DM (Diabetes Mellitus) is when there are typical complaints of DM, namely polyuria, polydipsia, polyphagia, and unexplained weight loss. Other complaints felt by patients are weakness, tingling, itching, blurred eyes, erectile dysfunction in men, and pruritus vulva in women. If the complaint is typical, blood glucose examination is sufficient to diagnose DM when > 200 mg/dL. Meanwhile, in examining glucose in the urine, the diagnosis can be confirmed by the precipitate color (Gustaviani, 2006).

CHAPTER III

MATERIALS AND METHODS

3.1 Research Time and Place

The research was carried out in June 2017 at the Laboratory of Rumah Sakit Mutiara in Medan and the Chemistry Laboratory at Universitas Medan Area in Medan.

3.2 Materials and Tools

The materials used in this study were the patient's urine and Benedict's solution. The compositions of Benedict's solution were Copper (II) Sulfate ($CuSO_4.5H_2O$), Trisodium Citrate ($Na_3C_6H_5O.2H_2O$), Sodium Carbonate (Na_2CO_3), anhydrous, and Distilled Water. The tools used in this study were test tubes, test tube rack, dropper pipette, measuring cup, and stopwatch.

3.3 Research Method

This research is descriptive, namely by providing qualitative and quantitative data on urine glucose levels of patients at Rumah Sakit Sari Mutiara. The sample used was urine from patients who came for treatment at Rumah Sakit Umum Sari Mutiara, both outpatients and inpatients. The characteristics of the sample were patients aged 40-60 years, male and female. The total number of urine samples taken was 25 samples.

3.4 Work Procedure

The work procedures carried out in the study consisted of urine sampling, qualitative urine examination, and quantitative urine examination.

3.4.1 Urine Sampling

The urine used in this study was the patient's urine taken in the morning, in which the patient had not consumed food and drank except water. The urine collection process was carried out by the patient himself with the correct collection procedure. The ideal urine is the middle urine (midstream), where the first urine that comes out is discarded a little, and the next flow is accommodated up to the mark that has been set in the container provided at the time of urine collection. (Gandasoebrata, 2008).

3.4.2 Qualitative Examination of Urine Glucose

5 ml of Benedict's solution was measured and put into a test tube. After that, 5-8 drops of the patient's urine sample were added and burned over a blazing fire for 5 minutes. The sample was then left at room temperature and left to cool. After that, the color change and the precipitate that occurred were observed.

Table 3.1 Interpretation of Qualitative Benedict's Test Results

No.	Reaction	Color of solution and precipitate
1.	Negative	Blue, cloudy green color
2.	Positive 1	The solution color is cloudy and green (0.5-1%)
3.	Positive 2	The solution color is greenish-yellow with a yellow precipitate (1-1,5%)
4.	Positive 3	The solution color is reddish yellow with a red-yellow precipitate (2-3.5% glucose)
5.	Positive 4	The solution color is orange to brick red (more than 3,5% glucose)

Source: Gandasoebatra; 2018

3.4.3 Quantitative Examination of Urine Glucose

5 ml of Benedict's solution was measured and put into a test tube. Then, 1-2 grams of sodium carbonate (Na_2CO_3) and two boiling stones were added. After that, the solution was burned over a blazing fire until it boiled, then the urine was dripped using a 1 ml pipette. When dripping the urine, the liquid should not stop boiling. If the blue color begins to disappear, the urine infusion should be slow (about 30 seconds between each drop). The titration ends when the blue color is no longer visible. (Gandasoebrata, 2008).

Urine glucose level calculation:

$$\text{Urine glucose level} = \frac{2 \times \text{dilution factor}}{\text{Urine sample volume (ml)}}$$

CHAPTER V
CONCLUSION AND SUGGESTIONS

5.1 Conclusion

Based on the examination results of 25 patients at Rumah Sakit Umum Sari Mutiara in Medan, it can be concluded that there are 15 patients whose urine is positive for glucose, while the other 10 patients do not contain glucose in their urine.

5.2 Suggestions

Sari Mutiara General Hospital Medan needs to remind patients about the importance of medical check-ups to monitor their urine glucose levels continuously. For laboratory personnel, they need to provide knowledge to patients about the importance of regular check-ups. For patients, they should always control their urine glucose levels regularly.

PROOFREADING

1.	advantages	:	advantage
2.	is	:	are
3.	carbohydrates,	:	carbohydrates
4.	water,	:	water
5.	and so on	:	etc.
6.	urine;	:	urine.
7.	Benedict	:	Benedict’s
8.	and	:	, and
9.	person	:	people
10.	Melitus	:	Mellitus
11.	with	:	by
12.	so	:	, so
13.	, while	:	In comparison