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The Analysis of Ischemic Stroke and Hemorrhagic Stroke based on Sugar Level

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Abstract

Stroke is the second leading cause of death worldwide, and stroke is more severe in patients with hemorrhagic stroke than ischemic stroke. Nearly 2 out of 3 patients with acute stroke have a high blood glucose level as a physiological response to an acute disease. Poor clinical outputs are often found in acute stroke patients with hyperglycemia. This study aims to determine the differences in blood glucose levels in ischemic stroke and hemorrhagic stroke patients in UKI General Hospital. It is descriptive observational research with the cross-sectional method. The sample is 132 patients, using total sampling with specified inclusion and exclusion criteria. The data used is secondary data. Data processing was performed using SPSS. The study revealed that from 108 ischemic stroke patients, 79 patients (73,1%) showed an increase in blood glucose level, and out of 24 hemorrhagic stroke patients, all the patients showed an increase in blood glucose level. The mean value of blood glucose level during ischemic stroke is 129,83mg/dL and in hemorrhagic stroke is 151,12mg/dL. The conclusion of this study, there is a significant difference (= 0,001) in blood glucose level, and the mean value of blood glucose level in hemorrhagic stroke is higher than in ischemic stroke.

Keywords: Random Blood Glucose, Ischemic stroke, hemorrhagic stroke, UKI General Hospital

INTRODUCTION

According to WHO, stroke is a clinical sign that develops rapidly due to a focal or global disturbance of brain function, which lasts for 24 hours or more and causes death without causes other than vascular causes [1]. Stroke is the second leading cause of death worldwide, with a mortality rate of about 5.5 million people [2]. Based on Basic Health Research (Riskesdas), the prevalence of stroke in Indonesia increases over time. In 2013, 7 out of 1000 people had a stroke, and in 2019, 10.9 out of 1000 people had a stroke [3]. The highest prevalence of stroke in Indonesia is in East Kalimantan, where it is found that 15 out of 1000 people suffer from stroke and the prevalence of stroke also increases with age, namely at the age of 75 years and over, 50 out of 1000 people suffer from stroke and the prevalence of stroke by gender is higher [3]. Experienced by men, namely, 11 out of 1000 people are male compared to women.

Stroke is broadly divided into two categories: hemorrhagic and ischemic stroke [4]. Ischemic stroke occurs because of thrombosis and embolus in blood vessels, causing obstruction and will cause a decrease in blood flow to the brain. Hemorrhagic stroke occurs due to intracerebral hemorrhage or subarachnoid hemorrhage, where this bleeding will damage the brain at the site of bleeding by pressing the surrounding tissue [5; 6]. About 80% of stroke cases are ischemic strokes, and another 20% are hemorrhagic strokes. The risk factors for stroke are divided into two, namely non-modifiable risk factors and modifiable risk factors. Non-modifiable risk factors include age, gender, ethnicity, and genetics: hypertension, diabetes mellitus, hyperlipidemia, and smoking [7].

People with diabetes mellitus have a higher risk of stroke than those without diabetes mellitus [8]. Almost 2 (two) of 3 (three) patients with acute stroke experience an increase in blood sugar [9]. In acute stroke patients, hyperglycemia is often found, whereas patients with hyperglycemia mostly have a history of diabetes mellitus, but it can also be found in patients who are not diagnosed with diabetes mellitus. During the 12 hours after stroke, the hyperglycemic state will continue to increase and decrease over the next week or so [10]. Hyperglycemia occurs in almost 30-40% of cases in ischemic stroke patients and 43-59% in hemorrhagic stroke patients [11]. Hyperglycemia in stroke patients can occur due to poor control of diabetes mellitus, a physiological disease response at that time, or a combination of both [12].

Intracerebral hemorrhagic stroke usually has more severe disorders and even causes death. The severity of intracerebral hemorrhagic stroke reaches 40% at one month and 54% at one year, and only 12-39% of patients still have long-term functional independence [13]. In addition, disturbances and poor outcomes can also be found in acute stroke patients with hyperglycemia without a history of diabetes mellitus compared to I stroke patients with hyperglycemia with a history of diabetes mellitus. In addition to causing poor outcomes, acute stroke patients with hyperglycemia without a history of diabetes mellitus also show an increase in mortality and length of hospital stay [10].

Based on the data above, there was a higher incidence of hyperglycemia in hemorrhagic stroke compared to ischemic stroke and a higher degree of severity in hemorrhagic stroke. This research was carried out at UKI General Hospital in 2016-2018; researchers are interested in researching "Differences in Blood Sugar Levels in Ischemic Stroke and Hemorrhagic Stroke at UKI General Hospital." Based on the background of the problem that has been described, the researchers formulated the research question: Is there a difference in blood sugar levels in ischemic stroke and hemorrhagic stroke patients at UKI General Hospital Jakarta? The study aimed to determine the difference in blood sugar levels in ischemic stroke and hemorrhagic stroke patients at UKI General Hospital Jakarta.

LITERATURE REVIEW

Stroke is characterized by a neurological decline resulting from acute focal damage to the central nervous system (CNS), and this damage is caused by disorders of blood vessels such as cerebral infarction, intracerebral hemorrhage, and subarachnoid hemorrhage. Stroke is the world's most significant cause of disability and death [14]. In America, of the entire population, it is estimated that 6.8 million (2.8%) are patients who have had a stroke, of which 3.8 million are women, and 3 million are men. Almost half of the patients who had had a stroke survived but experienced decreased physical abilities, such as weakness or cognitive impairment, six months after the stroke [15]. Stroke is classified into two namely: hemorrhagic stroke, which is caused by bleeding in the brain, namely subarachnoid hemorrhage, which accounts for about 5% of all strokes, and intracerebral hemorrhage, which accounts for about 10% of all strokes. Subarachnoid hemorrhage is bleeding that occurs between the arachnoid layer and the pia mater. Subarachnoid hemorrhage can be caused by several things, such as; vascular aneurysms, cerebral vascular bleeding, and vascular malformations [16]; and Ischemic stroke, ischemic stroke causes brain infarction, spine, and retina, so it can cause neurological dysfunction. Symptoms may last for 24 hours or more [16]. Infarction is caused by an embolus (cardioembolic, as in the case of atrial fibrillation) or atherothrombosis (due to blood vessel atherosclerosis).

The risk factors for stroke are divided into two, namely non-modifiable risk factors and modifiable risk factors. Some non-modifiable risk factors include age, gender, ethnicity, and genetics. The age factor is very influential on the incidence of stroke. Along with increasing age, the incidence of stroke will increase to double every decade after the age of 55 years. In addition, gender also has an effect, and stroke can also be influenced by genetic factors that come from the family and cannot be changed [7]. Meanwhile, modifiable risk factors are essential because early identification of risk factors and modifying them can prevent stroke. These risk factors are hypertension, diabetes mellitus, atrial fibrillation, dyslipidemia, inactive behavior, diet, obesity, and metabolic syndrome [17].

Pathophysiology Stroke is divided into two types: hemorrhagic stroke and ischemic stroke. In hemorrhagic stroke, most intracerebral bleeding is caused by hypertension, and when blood pressure increases, it will cause leakage in the arterioles. Intracerebral hemorrhage occurs only in local areas of the brain. The damage degree is inflicted according to the location, the bleeding volume, and the pressure generated by the bleeding. Intracerebral hemorrhage will be in the brain's white matter and can enter the brain's ventricles, causing an increase in intracranial pressure. The bleeding causes the blood to clot over time, causes swelling of the surrounding brain tissue, and causes nerve cell damage. In addition, hemoglobin contained in the blood, which consists of heme and iron, is toxic to mitochondria in brain cells, which can cause cell death [18]. Subarachnoid hemorrhage is sudden bleeding in the subarachnoid space between the brain's arachnoid and pia mater layers. The cause of subarachnoid hemorrhage is the presence of aneurysms and malformations in blood vessels that trigger bleeding in the brain.

While the mechanism of ischemic stroke can be divided into three, namely thrombosis, embolus, and tissue hypoperfusion, thrombosis is an obstruction in the blood vessels that form in the area of resistance. An embolus is an obstruction in a blood vessel that is formed and originates from another place, while tissue hypoperfusion is caused by a decrease in blood flow to the circulatory system, namely thrombosis and embolus [19].

For stroke, the biomarker in the diagnosis is imaging. All patients with stroke symptoms must perform brain and neurovascular imaging examinations. The imaging used is non-contrast CT (Computed Tomography) and MRI (Magnetic Resonance Imaging) [18]. This imaging helps differentiate between the two strokes, namely hemorrhagic stroke consisting of intracerebral hemorrhagic stroke and subarachnoid hemorrhagic stroke with ischemic stroke. Non-contrast CT is more sensitive for detecting masses, such as abscesses and acute bleeding. Non-contrast CT examination can be performed within 24 hours after the patient is admitted to the hospital. CT can detect extensive lesions in the cortical area and basal ganglia. The non-contrast CT results showed hyperdense areas (white) in hemorrhagic stroke and hypodense areas (black) in the infarct area in ischemic stroke. In patients with acute stroke who have had a non-contrast CT examination, CT angiography is also expected. With CT angiography, blood vessels can be seen both extracranial and intracranial. CT angiography aims to identify blocked blood vessels in ischemic stroke, identify the cause of bleeding, such as the presence of an aneurysm, and also determine the source of bleeding.

Imaging can also be done with MRI (Magnetic Resonance Imaging). MRI has a higher sensitivity than CT. MRI also has better resolution than non-contrast CT. In lesions in the brain stem, the examination that can be done is an MRI. However, non-contrast CT has several advantages; non-contrast CT is faster, more common, and cheaper [20]. Glucose is a monosaccharide, and blood glucose is the level of glucose in the blood. Glucose is the leading energy for cells in the body. The balance of blood glucose is regulated through its production and use. Glucose is obtained from food absorbed and digested by the intestines and distributed to body tissues. 85% of the liver produces glucose in the blood, and the other 15% comes from the kidneys. Glucose is needed by body cells, especially the brain. The brain requires 50% of the total body glucose level, another 25% is distributed to the liver and gastrointestinal system, and the remaining 25% is in muscle and adipose tissue [21].

In healthy adults, glucose in the blood is around 70-99 mg/dl and will be maintained by certain hormones (insulin, glucagon) and the central and peripheral nervous systems. The insulin hormone secreted will bind to insulin receptors in the hypothalamus. Insulin that binds to the hypothalamus will stimulate brain neurons, which will then stimulate the release of IL-6 in the liver, where the function of IL-6 is to activate STAT3 (Signal Transducer and Activator of Transcription 3) which functions in the transcription process. It is activated by the phosphorylation process, which will cause a decrease in the gluconeogenesis process through a decrease in the production of glucose-6 phosphate and phosphoenolpyruvate kinase in the liver, resulting in decreased glucose production and reduced blood levels. Furthermore, adipose tissue will play a role in glucose excretion, storage, and metabolism [21].

The most important are insulin and several hormones, glucagon, produced by the islets of Langerhans in the pancreas. In the islets of Langerhans in the pancreas, -cells produce insulin, and -cells produce glucagon. The hormone insulin works to reduce blood sugar levels by increasing blood sugar transport to insulin-sensitive cells and storing it through the processes of glycogenesis (change from glucose to glycogen) and lipogenesis (to form fat). Insulin also inhibits the secretion of glucagon. The hormone glucagon plays a role in a state of low blood sugar or hypoglycemia. The role of the hormone glucagon is to increase glycogenolysis (change from glycogen to glucose) and increase gluconeogenesis (change from protein and fat to glucose). Based on several studies, hyperglycemia in stroke patients determines the patient's disease prognosis. Of the stroke patients, 60% had hyperglycemia, and 12-53% were patients who had never been diagnosed with diabetes mellitus [22]. Several things cause high blood sugar levels in stroke patients. High blood sugar levels in patients without a history of diabetes mellitus are referred to as stress hyperglycemia. Acute critical illness will cause disturbances in the immunoneuroendocrine system. In critical illness, it activates the Hypothalamic Pituitary Adrenal (HPA) axis, a neuroendocrine system that activates the sympathetic nervous system and causes the secretion of proinflammatory cytokines. In acute conditions, activation of the HPA axis is caused by Corticotropin Releasing Factor (CRF).

The hypothalamus will produce Adrenocorticotropic Hormone (ACTH), trigger the adrenal kidneys to produce glucocorticoid hormones and cortisol hormones, and cause hypercortisolemia (increased cortisol levels). Cortisol plays a role in increasing the transcription of the PPECK gene (phosphoenolpyruvate carboxykinase), which is the main enzyme in gluconeogenesis, so the process of gluconeogenesis will increase in the liver [23]. Activating the sympathetic nervous system causes the synthesis of catecholamine hormones (epinephrine, norepinephrine), glucagon, and growth hormone. Epinephrine hormone will inhibit insulin receptor substrate (IRS)-1, causing insulin resistance. In addition to the inhibition of IRS and interference with tyrosine kinase, it will cause the failure of transcription of GLUT-4, which plays a role in glucose uptake in peripheral tissues so that glucose uptake will decrease. In addition, the secretion of proinflammatory cytokines, such as tumor necrosis factor (TNF-α), interleukin (IL)-1, IL-6, and IL-8, will also cause insulin resistance and increase glucose levels. IL-6 will increase Corticotropin Releasing Factor (CRF) and Adrenocorticotropic Hormone (ACTH), so cortisol will increase. TNF- plays a role in insulin receptor inhibition and tyrosine kinase and inhibition of PI3K (phosphatidylinositol three kinases) activation, which plays a role in insulin signaling, thereby interfering with GLUT-4 translocation.

The presence of hormones, as well as inflammatory cytokines and their role in eating, will cause blood glucose levels to increase [24]. Hemorrhagic stroke is a stroke with a higher mortality and morbidity rate than ischemic stroke. In hemorrhagic stroke, oxidative stress plays a significant role in brain damage after a hemorrhagic stroke. Oxidative stress is the body's response to disturbances by producing Reactive active oxygen species (ROS) and Reactive Nitrogen Species (RNS). A hemorrhagic stroke will cause bleeding in the brain. In addition, the blood-brain barrier will also be disrupted and cause edema in the brain parenchyma. Inflammatory cells such as microglia and neutrophils play a role in this inflammatory process. In hemorrhagic stroke, blood cells will break down into iron ions, heme, and thrombin. The results of this degradation, as well as neutrophils and microglia, will trigger the production of free radicals. Free radicals will cause damage to nerve cells, starting from brain cells that contain lipids that will be sensitive to free radicals, which cause the lipid peroxidase process and cause disruption of cell membranes resulting in the influx of calcium ions into cells and increased levels in the cells. High calcium levels in cells will cause damage to both cell membranes and cell organelles. With the presence of oxidative stress, an increase in calcium ions in cells, and perihematomal edema, the inflammation that occurs will be very high and cause the release of proinflammatory cytokines such as TNF and interleukins, which have an impact on increasing blood sugar levels higher in hemorrhagic stroke compared to ischemic stroke [25]. High blood sugar will cause disturbances in the nervous system. High blood sugar levels in patients will be toxic to the ischemic brain. The ischemic brain will produce lactic acid and increase intracellular acidosis (due to anaerobic glucose metabolism), which causes an increase in the peroxidation process of lipids and the formation of free radicals and interferes with the function of cell mitochondria. Hyperglycemia, as neurotoxic, will affect the penumbra area around the ischemic area, where there are still nerves that can be saved from infarction. The presence of acidosis in the cells of the penumbral area will cause widespread infarction so that neurons that were able to be saved will turn into infarcts, and hyperglycemia will increase the synthesis of plasminogen activators in tissues, which will cause the expansion of bleeding in intracerebral hemorrhage [26]. Hyperglycemia is found in acute stroke, and several studies revealed that hyperglycemia stems from a disturbance in neuroendocrine regulation in response to lesions in the brain cortex, which is caused by the release of the hormones cortisol and epinephrine [27]. Hyperglycemia can also damage the blood-brain barrier and cause apoptosis in the vascular endothelium. High blood glucose will also cause brain edema, bleeding volume widening, and infarction expansion. Patients with hyperglycemia usually have low insulin levels, leading to reduced uptake from surrounding organs and increased gluconeogenesis, with the expectation that glucose can diffuse to the brain more [3]. This study has two hypotheses: a) Zero hypothesis (Ho): There is no significant difference between blood sugar levels during ischemic stroke and hemorrhagic stroke at UKI General Hospital Jakarta. b) Alternative hypothesis (Ha): There is a significant difference between blood sugar levels during ischemic and hemorrhagic strokes at UKI General Hospital Jakarta.

RESEARCH METHOD

This study is a descriptive observational study using a cross-sectional design with content analysis, namely collecting data from medical records and carried out only at a particular time or period. UKI General Hospital Jakarta from January 2016 to January 2018. The purpose of collecting data was to find differences in blood sugar levels in ischemic stroke and hemorrhagic stroke in stroke patients at UKI General Hospital Jakarta. This research was conducted at the UKI General Hospital, Jakarta Medical Record Unit, from August to November 2019. The subjects that became the population in the study were ischemic stroke and hemorrhagic stroke patients who had been treated at the neurology ward of UKI General Hospital Jakarta from January 2016 to January. Two thousand eighteen as many as 177 patients. The sampling technique used is total sampling, where the number of samples is taken from the entire population based on the inclusion and exclusion criteria determined by the researcher. The samples in this study were only taken from patients with ischemic and hemorrhagic strokes based on the inclusion and outside exclusion criteria. This study uses document analysis techniques with research instruments in the form of medical records that store data on patients with ischemic and hemorrhagic stroke from January 2016 - January 2018 at UKI General Hospital Jakarta. The research data was obtained from the results of observations and data collection that had been carried out at UKI General Hospital Jakarta. Data in the form of secondary data from medical records of ischemic and hemorrhagic stroke patients from January 2016-January 2018. The tabulated research data were analyzed using Univariate analysis to determine the frequency distribution of each variable. Furthermore, Bivariate analysis was carried out by cross-tabulating to determine the relationship between the two variables and conducting an Independent T-test to determine the significance of the difference between the independent and dependent variables. The first is a data normality test to determine the description of the existing data and as a condition for performing an independent t-test, on the results of an independent t-test (if the value of sig. (2-tailed) < 0.05, then Ho is rejected and Ha is accepted, and if the value of sig. (2-tailed) > 0.05, then Ho is accepted. Ha is rejected) Data analysis using the SPSS 17. application.

RESULT AND DISCUSSION

This study determined the blood sugar level difference between ischemic stroke and hemorrhagic stroke patients. Sampling was carried out at the Medical Records Unit of the UKI RSU Jakarta on October 7, 2019, to October 11, 2019. The research sample used a total sampling technique to determine a sample from the entire population. The research subjects were ischemic and hemorrhagic stroke patients at UKI General Hospital from January 2016 to January 2018. The study population consisted of 177 patients and 142 ischemic stroke patients, and 35 hemorrhagic stroke patients. However, only 132 patients met the inclusion and exclusion criteria, with details of 108 ischemic stroke patients and 24 hemorrhagic stroke patients, which were then used as research samples. The results of the study are described as follows:

Table 1: Distribution of Patient Frequency by Type of Stroke

Stroke Type	N	%
Ischemic Stroke	108	81,8
Hemorrhagic Stroke	24	18,2
Total	132	100

Based on table 1, from a total of 132 patients, 108 patients (81.8%) had an ischemic stroke, and 24 (18.2%) had a hemorrhagic stroke. From the results of the study, it was found that there were more patients with ischemic stroke than patients with hemorrhagic stroke.

Table 2: Frequency Distribution of Sex by Type of Stroke

Sex	Ischemic Stroke		Hemorrhagic Stroke		Total	
	N	%	N	%	N	%
Male	61	46,2	15	11,4	76	57,6
Female	47	35,6	9	6,8	56	42,4
Total	108	81,8	24	18,2	132	100

Table 2 shows the number of patients with ischemic and hemorrhagic stroke in both males and females. Based on the study, 132 ischemic and hemorrhagic stroke patients at UKI General Hospital Jakarta, consisting of 76 male patients (57.6%), of which 61 patients (46.2%) had an ischemic stroke, and 15 patients (11.14 %) had a hemorrhagic stroke. Of a total of 56 female patients (42.4%), there were 47 patients (35.6%) had an ischemic stroke, and nine patients (6.8%) had a hemorrhagic stroke. The research found that in men and women, more patients suffered from ischemic stroke (81.8%) than hemorrhagic stroke (18.2%).

Table 3: Frequency Distribution of Patient Age by Type of Stroke

Patient Age (years)	Ischemic Stroke		Hemorrhagic Stroke		Total	
	N	%	N	%	N	%
45-54	28	21,2	8	6,1	36	27,3
55-64	43	32,6	11	8,3	54	40,9
65-75	28	21,2	3	2,3	31	23,5
>75	9	6,8	2	1,5	11	8,3
Total	108	81,8	24	18,2	132	100

Table 3 shows that in the age range of 45 to 55 years, there were 36 patients (27.3%) consisting of 28 patients (21.2%) having an ischemic stroke and eight patients (6.1%) having a hemorrhagic stroke. In the age range of 55-64 years, there were 54 patients (40.9%) consisting of 43 patients (32.6%) having an ischemic stroke and 11 patients (8.3%) having a hemorrhagic stroke. In the age range of 65-75 years, 31 patients (23.5%), consisting of 28 patients (21.2%), had ischemic stroke and three patients (2.3%) had a hemorrhagic stroke. Moreover, at the age of more than 75 years, there were 11 patients (8.3%) consisting of 9 patients (6.8%) with ischemic stroke and two patients (1.5%) with hemorrhagic stroke. The study results found that 55-64 years had a higher risk for ischemic and hemorrhagic stroke.

Table 4: Frequency Distribution of Blood Sugar Levels During Diabetes by Type of Stroke and History of Diabetes Mellitus

GDS (mg/dL)	Ischemic Stroke				Hemorrhagic Stroke				Total	
	DM		No DM		DM		No DM			
	N	%	N	%	N	%	N	%	N	%
<100	1	0,8	18	13,6	0	0,0	0	0	19	14,4
100-140	10	7,6	36	27,3	1	0,8	11	8,3	58	43,9
>140	18	13,6	25	18,9	4	3	8	6,1	55	41,7
Total	29	22,0	79	59,8	5	3,8	19	14,4	132	100,0

Based on table 4, from a total of 132 stroke patients, 19 patients (14.4%) had a stroke who had blood sugar levels <100 mg/dL, and 58 patients (43.9) had blood sugar levels between 100-140 mg/dL. , and 55 patients (41.7%) with blood sugar levels when >140mg/dL. Patients with blood sugar levels above 100 totaled 113 patients (85.6%), consisting of 28 patients (21.2%) with ischemic stroke with a history of DM, of which there were ten patients (7.6%) with blood sugar between 100-140mg/dL. 18 patients (13.6) with blood glucose levels >100mg/dL and 61 patients (46.2%) ischemic stroke without a history of diabetes mellitus, consisting of 36 patients (27.3%) with levels of 100-140mg/dL, and 25 patients (18.9%) with blood sugar levels >140mg/dL. Furthermore, it consisted of 5 patients (3.8%) with hemorrhagic stroke with diabetes mellitus, of which one patient (0.8%) had blood sugar levels between 100-140mg/dL and four patients (3.0%) with blood sugar levels. blood >140mg/dL, in 19 patients (14.4%) hemorrhagic stroke without a history of diabetes mellitus there were 11 patients (8.3%) with blood sugar levels between 100-140mg/dL and 8 patients (6.1%) with blood sugar levels >140 mg/dL. It shows an increase in blood sugar levels in acute stroke patients, both ischemic and hemorrhagic, whether accompanied by diabetes mellitus or not.

Table 5: Frequency Distribution of Diabetes Mellitus History by Type of Stroke and History of Diabetes Mellitus

History of Diabetes Mellitus	Ischemic Stroke		Hemorrhagic Stroke		Total	
	N	**%**	**N**	**%**	**N**	**%**
Yes	29	22,0	5	3,8	34	25,8
No	79	59,8	19	14,4	98	74,2
Total	108	81,8	24	18,2	32	100

Based on table 5, it was found that 34 stroke patients (25.8%) had a history of diabetes mellitus, of which 29 patients (22.0%) were ischemic stroke patients, and five other patients were hemorrhagic stroke patients (3.8%).

Table 6: Distribution of LDL Frequency by Type of Stroke and History of Diabetes Mellitus

LDL (mg/dL)	Category	Ischemic Stroke				Hemorrhagic Stroke				Total	
		History DM		History DM -		History DM		History DM -			
		N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
<100	Normal	3	2,3	4	3	1	0,75	3	2,3	11	8,3
100-129	Moderate	4	3	20	15,2	2	1,5	4	3	30	22,7
130-159	High limit	5	3,8	20	15,2	1	0,75	8	6	34	25,8
160-189	High	11	8,3	23	17,4	1	0,75	3	2,3	38	28,8
>190	Very high	6	4,5	12	9	0	0.0	1	0,8	19	14,4
Total		29	22,0	79	59,8	5	3,8	19	14,4	132	100,0

Based on table 6, it was found that from 132 stroke patients, there were 11 patients (8.3%) who had normal LDL levels, namely <100mg/dL, 30 patients (22.7%) had moderate LDL levels, which were between 100-129mg/dL, 34 patients (25.8%) had high LDL levels of 130-150mg/dL, 38 patients (28.8%) had high LDL levels of 160-189mg/dL, and 19 patients (14.4%) with very high LDL levels >190 mg/dL. In ischemic stroke patients with a history of diabetes mellitus, among 29 patients (22.0%), 22 patients (16.6%) had LDL levels within the high, high, and very high limits. In 79 patients (59.8%) with ischemic stroke without a history of diabetes mellitus, 55 patients (41.7%) had high, high, and very high LDL levels. In 5 patients (3.8%) with ischemic stroke with diabetes mellitus, there were two patients (1.5%) who had LDL levels in the high and high range, and in 19 (14.4) patients with hemorrhagic stroke without diabetes mellitus, there were 12 patients (9.0%) had LDL levels in the high, high and very high limits. So that it can be found that from 98 patients (74.2%) with ischemic and hemorrhagic stroke who did not have a history of diabetes, 67 patients (50.8%) had elevated LDL levels within the high, high, and very high limits. Ischemic stroke and hemorrhagic stroke patients, both those with a history of diabetes and those without, both had more patients with elevated LDL levels.

Table 7: Frequency Distribution of Total Cholesterol Levels by Type of Stroke

Total Cholesterol Levels (mg/dL)	Category	Ischemic Stroke		Hemorrhagic Stroke		Total	
		N	%	N	%	N	%
<200	Normal	56	42,4	17	12,9	73	55,3
200-239	Moderate	39	29,5	6	4,5	45	34,1
≥240	High	13	9,8	1	0,8	14	10,6
Total		108	81,8	24	18,2	132	100

Based on table 7, it was found that in all stroke patients, from 108 ischemic stroke patients, 56 patients (42.4%) had total cholesterol levels <200mg/dL, 39 patients (29.5%) had cholesterol levels between 200-239mg/dL. dL, and 13 patients (9.8%) had high cholesterol levels of 240mg/dL. In 24 hemorrhagic stroke patients, 17 patients (12.9%) had total cholesterol levels <200 mg/dL, 6 patients (4.5%) had total cholesterol levels between 200-239 mg/dL, and 1 patient (0.8 %) had a total cholesterol level of 240mg/dL. An analysis was carried out using the Independent T-test to determine the difference in blood sugar levels in ischemic and hemorrhagic stroke, which previously had a normal distribution test as a condition for conducting the Independent T-test. Data normality test results:

Table 8: Data normality test results One-Sample Kolmogorov-Smirnov Test

Kolmogorov-Smirnov Z	1.227
Asymp. Sig. (2-tailed)	.099
a. Test distribution is Normal.	

Based on the table obtained p of 0.099 >: 0.05, it can be concluded that the data is usually distributed and meets the requirements for the Independent T-Test test.

Table 9: Independent T-test Results

	Type of stroke	N	Mean
When blood sugar	Ischemic Stroke	108	129.83
	Hemorrhagic Stroke	24	151.12

		Levene's test for equality of variances		T-test for quality of means		
		f	sig	t	df	Sig (2-tailed)
Blood sugar	Equal variances assumed	2.589	.110	-3.321	130	.001

The results of the Independent T-Test test showed a sig. (2-tailed) of 0.001 <: 0.05, where Ho was rejected, and Ha was accepted, meaning there is a significant difference between current blood sugar levels in ischemic and hemorrhagic stroke patients in UKI General Hospital. So it was found that blood sugar levels during hemorrhagic stroke patients were higher than in ischemic stroke patients, with the average blood sugar being 129.83mg/dL and the average hemorrhagic stroke being 151.12mg/dL.

Based on the study results, it was obtained from a total of 132 stroke patients at UKI General Hospital Jakarta, as many as 108 patients (81.8%) had an ischemic stroke, and 24 other patients (18.2%) had a hemorrhagic stroke. The results of this study indicate that the number of patients with ischemic stroke is more than that with hemorrhagic stroke, which follows the results of various studies that have been conducted previously. Based on an article compiled by Feigin Valery L regarding the Golden Burden of Stroke, it is stated that globally the incidence of ischemic stroke is higher than hemorrhagic stroke. There were 3,627 patients (67.03%) with ischemic stroke and 1,784 patients (32.97%) with hemorrhagic stroke. It is often the case in Asian countries, where studies have shown that high rates of ischemic stroke are associated with high rates of hypertension, diabetes mellitus, and dyslipidemia, which are the highest risk factors for ischemic stroke [28].

From the study results obtained from 132 stroke patients at UKI Jakarta General Hospital from January 2016 to January 2018, 76 patients (57.6%) were male, and 56 (42.4%) were female. In 76 male patients, 61 people (46.2%) had an ischemic stroke, and 15 (11.4%) had a hemorrhagic stroke. Of 56 female patients, 47 (35.6%) had an ischemic stroke, and 9 (6.8%) had a hemorrhagic stroke. These results indicate that both types of stroke, namely ischemic stroke and hemorrhagic stroke, are more common in men than women.

These results follow research and studies that have been conducted previously. Based on the 2013 Global Burden of Disease study, it was found that the incidence of stroke in men was higher than in women, where in men, the incidence of ischemic stroke occurred in 132 people out of 100,000 people, and hemorrhagic stroke occurred in 64 people per 100,000 people. In women, ischemic stroke occurs in 98 people out of 100,000 people, and hemorrhagic stroke occurs in 45 people out of 100,000 [3]. According to the American Heart Association (AHA), in 2008, men stated the highest prevalence of stroke globally was experienced by men [29]. It is due to differences in risk factors for men and women. In men, risk factors such as smoking, atrial fibrillation, hypertension, diabetes mellitus, hypertension, and metabolic syndrome were higher than in women. In addition, in premenopausal women, high content of 17-estradiol (E2) was found to reduce the risk of stroke [30].

The results showed that from a total of 132 stroke patients at UKI General Hospital Jakarta, 36 patients (27.3%) were in the age range of 45-54 years. In the age range of 55-64 years, there were 54 patients (40.9%), in the age range of 65-75 years, there were 31 patients (23.5%), and at the age of more than 75 years, 11 patients were found (8.3%), wherein each age range the number of ischemic stroke patients is higher than the number of hemorrhagic stroke patients. From the study results, it was found that those over 55 years had a higher risk of ischemic and hemorrhagic stroke.

These results are consistent with previous studies, which stated that ten years after the age of 55 years, both males and females were twice as likely to have a stroke [31]. Another study also found that people aged 55 years had about 5.8 times greater risk of having a stroke than those aged 15-44 [32]. Based on previous studies, it was stated that stroke could occur at any age, but at the age of 55-64 years, it was found that the risk factors for stroke were highest compared to other age ranges, so the risk for stroke was also higher. The risk factors are high blood pressure (hypertension), diabetes mellitus, and atherosclerosis, which frequently increase with age. Hypertension will cause atherosclerotic plaques, hypertrophy, and changes in vascular smooth muscle.

Another risk factor that increases in the elderly is diabetes mellitus, and diabetes mellitus will cause changes in the structure of blood vessels. The result is a decrease in blood flow to the brain, and besides that, this will also cause blood vessels to rupture and cause bleeding. In addition, disorders of the heart, such as atrial fibrillation (AF), can also cause a stroke by causing fibrillation in the left atrium of the heart, causing thrombus formation in blood vessels, and also causing an embolus in the brain, which will disrupt cerebral blood flow [33]. Based on the risk factors that have been described, people aged more than 55 years have a high risk for stroke.

From the results of the study obtained data from 132 stroke patients, there were only 34 patients (25.8%) who had a history of diabetes mellitus, consisting of 29 patients (22.0%) with ischemic stroke and five patients (3.8%) with stroke. Hemorrhagic. So it was found that more ischemic stroke patients had a history of diabetes mellitus than hemorrhagic stroke. These results follow the meta-analysis studies that have been carried out previously, which stated that of the total acute stroke patients there were about 20-33% of patients had diabetes mellitus, and patients with diabetes mellitus had a higher chance of having an ischemic stroke than hemorrhagic stroke [34].]. People with diabetes mellitus experience endothelial dysfunction, stiffness in the arteries and inflammation, and thickening of the basement membrane of blood vessels. Endothelial dysfunction occurs due to a decrease in NO (nitric Oxide), which functions to vasodilate blood vessels. In people with diabetes mellitus, NO will decrease and cause endothelial dysfunction and a decrease in elasticity and cause stiffness of blood vessels. Besides that, an increase in the inflammatory response in blood vessels also triggers the formation of atherosclerotic plaque, which is the leading cause of ischemic stroke [35]. With this mechanism, it was found that having a history of diabetes mellitus would increase the incidence of ischemic stroke compared to hemorrhagic stroke.

The results of the study obtained data from 132 patients with ischemic stroke, and hemorrhagic stroke, 11 patients (8.3%) had normal LDL levels of <100mg/dL, and 30 patients (22.7%) had moderate LDL levels between 100-100 mg/dL. 129 mg/dL, 34 patients (25.8%) had high LDL levels between 130-159 mg/dL, 38 patients (28.8%) had high LDL levels between 160-189 mg/dL, and 19 patients (14.4%) had very high LDL levels >190 mg/dL. In ischemic stroke patients with or without diabetes mellitus, LDL levels in both of them increased more than the normal threshold. In ischemic stroke patients with a history of diabetes mellitus, from 29 patients (22.0%), 22 patients (16.6%) had LDL levels within the high, high, and very high limits. In 79 patients (59.8%) with ischemic stroke without a history of diabetes mellitus, 55 patients (41.7%) had high, high, and very high LDL levels. In 5 patients (3.8%) with ischemic stroke with diabetes mellitus, there were two patients (1.5%) who had LDL levels in the high and high ranges, and in 19 (14.4) patients with hemorrhagic stroke without diabetes mellitus, there were 12 patients (9.0%) had LDL levels in the high, high and very high limits. So it can be concluded from 98 patients (74.2%) with stroke without a history of diabetes that 67 patients (50.8%) have elevated LDL levels within the high, high, and very high limits. It shows that the incidence of stroke has many risk factors. In addition to diabetes mellitus and hypertension, dyslipidemia is a risk factor for stroke, especially in ischemic stroke. It is consistent with previous studies, which stated that people with dyslipidemia had more ischemic strokes (92.3% of all ischemic strokes) than hemorrhagic strokes (85.9% of all hemorrhagic strokes). Dyslipidemia is a condition with abnormal blood fat levels, one of which is an increase in LDL levels. Dyslipidemia, especially with elevated LDL, can form atherosclerotic plaques leading to stroke [36]. An increase in blood cholesterol levels causes changes in the permeability of the endothelial walls of blood vessels, which causes migration of lipids, especially LDL, to the arterial wall in the subendothelial layer and settles in the intima layer of blood vessels and will subsequently cause the release of VCAM-1 (vascular adhesion molecule-1), which results in the release of VCAM-1 (vascular adhesion molecule-1). It causes monocytes to adhere to the subendothelial space of blood vessels and become macrophages. LDL will be oxidized and bound to macrophages and form foam cells (foam cells); smooth muscle cells in the intima will bind oxidized LDL and make foam cells. The proliferation of vascular muscle will cause thickening, form sclerosis, and become atherosclerotic plaques [37].

Based on the table, 132 patients with ischemic and hemorrhagic stroke, 59 patients (44.7%), had cholesterol levels above normal, i.e.,> 200 mg/dL. The results of this study indicate that total cholesterol level is one of the risk factors for stroke. This study is in line with research conducted by Dr. Kariadi Semarang in 2013, with the result that 43.8% of stroke patients had a total cholesterol level above normal, with an average total cholesterol of 202.45mg/dL. High cholesterol levels are associated with atherosclerotic plaques in blood vessels. High cholesterol levels can cause changes in blood vessel permeability which affect the formation of atherosclerotic plaques, which cause blockages in blood flow and cause an increased risk of stroke [38].

From the results of the study obtained, from a total of 132 stroke patients, there were 19 patients (14.4%) stroke who had blood sugar levels <100 mg/dL, 58 patients (43.9) had blood sugar levels between 100-140 mg. /dL, and 55 patients (41.7%) with current blood sugar levels >140 mg/dL. Patients with blood sugar levels above 100, totaling 113 patients (85.6%), consisting of 33 patients (25%) of the total 34 (25.8%) patients with a history of diabetes mellitus and 80 patients (61%) of the total. Ninety-eight patients (74.2%) without a history of diabetes mellitus. Based on the results of this study, it was found that blood sugar levels in patients with dominant ischemic and hemorrhagic stroke ranged between 100-140 mg/dL and > 140 mg/dL. According to the American Diabetes Association, based on previous research, hyperglycemia is characterized by blood sugar levels > 140 mg/dL.

Elevated blood sugar levels are often found in the early stages of stroke [39] [69]. This statement follows the results of this study where blood sugar levels were found when the patient was more dominant in the range of 100-140mg/dL and >140mg/dL. The table also found that the incidence of increased blood sugar levels equally occurred in stroke patients with diabetes mellitus or without diabetes mellitus. It follows research that states that an increase in blood sugar levels like this is often found in acute stroke patients, whether with diabetes mellitus or not. The presence of diabetes mellitus does not always cause the state of hyperglycemia in acute stroke patients but can also be caused as a response to diabetes mellitus from stress by releasing the hormones cortisol and norepinephrine [40]. This increase in blood sugar levels occurs due to a stress reaction caused by a stroke. This stress reaction will activate the Hypothalamic-Pituitary-Axis (HPA), so that serum glucocorticoid levels will increase, increase the release of catecholamines and also cause activation of the autonomic sympathetic nervous system. Increased levels of this hormone will cause an increase in the process of glycolysis, gluconeogenesis, and glycogenolysis and cause insulin inhibition. As a result, blood sugar levels will increase. Elevated glucose levels in acute stroke may be associated with high mortality and poor outcome [41].

Based on the results of the analysis, it was found that the average blood sugar level in hemorrhagic stroke patients was higher than in ischemic stroke patients. The average temporary blood sugar in hemorrhagic stroke patients was 151.12 mg/dL, and the average temporary blood sugar in ischemic stroke patients was 129.83mg/dL. The difference between the two types of stroke was 21.28. Based on the independent t-test, the value of sig. (2-tailed) = 0.001 <: 0.05, so Ho is rejected, Ha is accepted, and there is a significant difference between blood sugar levels during ischemic and hemorrhagic strokes. This study's results follow previous studies—research conducted by Indrayarti in 2002 at Dr. RSUPN. Cipto Mangunkusumo showed that blood sugar levels during the hemorrhagic stroke are higher than in ischemic stroke. In this study, the average blood sugar during ischemic stroke was 107.2 mg/dL and 134.3 mg/dL in hemorrhagic stroke, so there was a significant difference between blood sugar levels during hemorrhagic and ischemic stroke. In another study by Dwiputra in 2015 at RSAU, Dr. M. Salamun found that the median value of blood sugar levels during hemorrhagic stroke was 125mg/dL and 110.5mg/dL in ischemic stroke. Based on previous studies, hyperglycaemic states are standard in the acute period of stroke in both diabetic and nondiabetic patients [42]. This condition is referred to as a hyperglycemic stress state (a hyperglycemic state caused by a stress response from an inflammatory reaction to a disease. Stress hyperglycemia is characterized by blood sugar levels of 140mg/dl in the first 72 hours of acute stroke [43].

One of the causes of higher transient blood sugar levels in hemorrhagic stroke is the inflammatory reaction which was found to be more severe in hemorrhagic stroke than in ischemic stroke [44]. In hemorrhagic stroke, the expansion of the hematoma area immediately causes an increase in intracranial pressure. In effect, severe inflammation is characterized by the accumulation and activation of inflammatory cells and inflammatory mediator cells. In addition, in hemorrhagic stroke, there is direct infiltration of blood components such as red blood cells, leukocytes, macrophages, and plasma proteins in the area where bleeding occurs. So there is a high inflammatory response following the infiltration of blood components, the inflammatory response in the form of the release of inflammatory mediators, activation of proteases, microglia cells, and astrocyte cells in response to nerve tissue damage [45]. This more significant inflammatory reaction will trigger a greater stress response as well. This high-stress response will trigger the activation of the Hypothalamic Pituitary Adrenal Axis (HPA Axis) and trigger the release of hormones that can cause hyperglycemia, namely cortisol, and catecholamines. The release of these hormones will trigger an increase in the process of gluconeogenesis and the occurrence of insulin resistance due to interference with binding to insulin receptors and signal transduction in insulin, and causes an increase in glucose production in the liver and a decrease in peripheral glucose uptake, resulting in blood sugar levels will increase [46].

Previous studies found that high blood sugar levels in hemorrhagic stroke refer to the severity of nerve damage [47]. In a state of hyperglycemia, it will cause apoptosis in nerve cells which is caused because, in a state of hyperglycemia, it will trigger the formation of free radicals from the inflammatory response and the formation of toxins in nerve cells. Due to the increased free radicals in the body, the production of superoxide (antioxidants) will increase, disrupting the blood-brain barrier and cerebral edema. As a result, hyperglycemia will cause a poor outcome compared to stroke patients without hyperglycemia.

CONCLUSION

Based on the results of the research and discussion described in the previous chapter, the following conclusions can be drawn: a) Based on the study results, the number of ischemic stroke patients is higher than hemorrhagic stroke patients. In a total of 132 ischemic and hemorrhagic stroke patients, 108 patients (81.8%) had an ischemic stroke, and 24 patients (18.2%) had a hemorrhagic stroke; b) Based on the results of the study, it was found that blood sugar levels during ischemic stroke patients who had blood sugar levels between 100-140 mg/dL were 46 patients (34.8%), and those who had blood sugar levels more than 140 mg/dL were 43 patients (32.6%). Of 24 patients with hemorrhagic stroke, 12 patients (9.1%) had blood glucose levels between 100-140mg/dL and 12 patients (9.1%). Based on these results, and there were 55 patients (41.7 %) had hyperglycemia with blood sugar >140mg/dL; c) Based on the results of statistical tests using the independent T-test, there was a significant difference between blood sugar levels during ischemic stroke and hemorrhagic stroke, as evidenced by the sig. (2-tailed) value of 0.0010 < :0.05. The average blood sugar in ischemic stroke is 129.83mg/dL and in hemorrhagic stroke is 151.12mg/dL

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