

Stroke among Type 2 Diabetes Mellitus Patients at Haji Adam Malik General Hospital, Medan, Indonesia

Rina Amelia^{1*}, Novita Sari Harahap²

¹*Department of Community Medicine, Public Health, Faculty of Medicine, Universitas Sumatera Utara, Jl. dr. Mansyur No. 5 Kampus USU, Medan 20155, North Sumatra, Indonesia;* ²*Department of Sports Sciences, Faculty of Sports Sciences, Universitas Negeri Medan, Medan, North Sumatra, Indonesia*

Abstract

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***Correspondence:** Rina Amelia, Department of Community Medicine/Public Health, Faculty of Medicine, Universitas Sumatera Utara, Jl. Dr Mansyur No.5 Kampus USU, Medan 20155, North Sumatra, Indonesia. E-mail: rina2@usu.id

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BACKGROUND: Increasing Blood Sugar Level (BSL) in Diabetes Meletus can be various microvascular and macrovascular changes, in the end, will cause complications. The complications can occur in some organs, such as the heart, blood vessels, eyes, kidney, and nerves. Stroke is one of the complications from diabetes that is increasing in every year.

AIM: The study aims to analyse the relationship between diabetes and the prevalence of stroke at Haji Adam Malik General Hospital Medan.

METHODS: This study is an analytical study with a cross-sectional approach. The population was all Integrated Inpatient ward at Haji Adam Malik General Hospital Medan. The subjects were 180 people chosen by consecutive sampling technique.

RESULTS: The results showed that diabetes has a relationship with the prevalence of stroke ($p < 0.05$; CI = 95%). The risk of diabetes is 1.34 times higher than those without diabetes at Haji Adam Malik General Hospital Medan.

CONCLUSION: Based on the results, the diabetic patient has a higher risk of incidence of stroke. Excellent control for diabetic patients will prevent them from stroke and any complication.

Introduction

Diabetes Mellitus (DM) is a metabolic dysfunction with an increase in Blood Sugar Level (BSL) that can result in complications. The complications can occur in some organs, such as the heart, blood vessels, eyes, kidney, and nerves. The most complication resulted from diabetes is heart disease and vascular malformation (cardiovascular); diabetes will increase the risk of heart disease and vascular malformation in the brain (stroke). About 50% of diabetes patients will die due to heart disease and stroke [1], [2].

Stroke is a vascular disease in which the blood supply to the brain is disturbed or damaged, and the brain cells are damaged [3]. Since the brain is

the centre of control of everything we do, such as moving, balancing, thinking, speaking, understanding, remembering, seeing, and hearing, the brain damage caused by stroke will result in the disruption of brain functions and can also result in disability even death — the risk of diabetes patients suffering from strokes 2-5 times greater [4]. Patients with diabetes have a higher mortality rate but tend to have a more severe disability and from a stroke when compared with non-diabetic patients [4], [5].

The uncontrolled increase of blood glucose level in an extended period results in the disruption of the functions and structural changes in blood vessels in many tissues that cause the insufficient blood supply to the tissue. It will increase the risk of heart attack, stroke, final-stage kidney disease, retinopathy, ischemia, and gangrene on the leg [6]. Hypertension

and diabetes will increase the risk to the occurrence of stroke independently, and the combination of both will increase the risk to the occurrence of stroke drastically [7]. The cause of death on diabetes patients are 20% by a stroke. It can be said that diabetes patients have a risk 1,5 to 3 times to get a stroke than the general population [1], [2], [8].

Material and Methods

The research type is analytic with a cross-sectional design. The calculation of the number of the subject was by using a limited population proportion data with amount 180 patients, the sample of study chosen by consecutive sampling in which the researcher implemented the inclusion and exclusion criteria on the determination of subjects. The inclusion criteria in this study are patients who had hospitalised at Adam Malik General Hospital (proven by medical records), the determination of stroke is an expert (neurologist) by conducting a series of diagnosis enforcement checks, all required data was containing in medical records and data relating to diabetes disease he suffered. Exclusion criteria in this study were stroke patients caused due to previous diseases such as blood clotting disorders, tumours, and accidents, patients with pregnancy, patients whose examination data were not complete.

Prior, the research protocol has approval by the Research Ethics Committee of the Faculty of Medicine, Universitas Sumatera Utara. In this study using is the secondary data (medical records), therefor the demographic characteristics, the diagnosis of stroke and diabetes history.

The data collected from media records were separated into several groups, namely groups of diabetic and non-diabetic patients, patients who are having a stroke and not a stroke. Data were analysed using the Chi-square statistical test with SPSS for Windows program.

Results

Baseline Characteristics of patients T2DM at Haji Adam Malik General Hospital

Table 1 describe that the majority of patients in this study were women (53.3%), based on the most age group was early elderly (32.2%), based on the duration of diabetes, the majority of people had diabetes more than 10 years (56.6%).

Table 1: Characteristics of Patients T2DM at Haji Adam Malik General Hospital

	Frequency (n)	Percentage (%)
Gender		
Man	84	46.7
Woman	96	53.3
Age Group		
Early adulthood (26-35 years old)	34	18.9
End adulthood (36-45 years old)	28	15.6
Early elderly (46-55 years old)	58	32.2
End elderly (56-65 years old)	34	18.9
Elderly (> 65 years old)	26	14.4
Duration of Illness		
<10 years	78	43.3
≥10 years	102	56.7

The Relationship T2DM and the Prevalence of Stroke at Haji Adam Malik General Hospital

Results Table 2 explains that of the 39 diabetic patients suffering from a stroke as much as 20%, while 141 non-diabetic patients suffered a stroke of 53.9%. Chi-square test results stated that there was a relationship between diabetes and the incidence of stroke ($p < 0.05$). Then the calculation of risk factors, it is known that the risk of diabetes patients to suffer a stroke is 1.34 times greater than non-diabetic patients.

Table 2: Relationship between T2DM and Stroke at Haji Adam Malik General Hospital

	Stroke		Non-Stroke		Total	p	PR
	f	%	f	%			
Diabetic patients	36	20	3	1.7	39	0.003	1.34
Non-Diabetic Patients	97	53.9	44	24.4	141		

Discussion

The results showed that there was a relationship between diabetes and stroke at Adam Malik Hospital General Hospital Medan. The result is in line with other previous studies [9], [10]. Diabetes is one of the essential factors causing a stroke. There are several possible mechanisms of diabetes, causing a stroke. A stroke occurs because of vascular endothelial dysfunction, namely the occurrence of early atherosclerosis due to diabetes, systemic inflammation and thickening of the capillary basement membrane. The function of the vascular endothelium is vital to maintaining the structural and functional integrity of the vascular wall and vasomotor control. In the diabetes patients, the formed atherosclerosis plaque tends to be more clarified, the core of necrosis is covered by Receptor for Advanced Glycosylation Endproducts (RAGE), and infiltrated by T-cell and macrophage [8], [11]. Plaque in the diabetes patients tends to rupture due to the unstable plaque so that increases the risk of embolic and ischemic stroke, through the formation of thrombus and intraplaque haemorrhage caused by the inflammation on the tunica adventitia and vasa vasorum

neovascularisation [1], [8].

Chronic Hyperglycemia in diabetes patients also causes mitochondrial dysfunction that increases to Reactive Oxygen Species (ROS). Reactive Oxygen Species will inhibit the Endothelial Nitric Oxide Synthase (eNOS) synthesis, so that improve the production of superoxide anion (O₂⁻). The superoxide will then have a bond with nitric oxide (NO) to form peroxynitrite (ONOO⁻), a potent oxidant that selectively inhibits prostacyclin (PGI₂). The prostacyclin inhibition will induce the vasoconstriction of vessels, increase the vessels injury, endothelial dysfunction, platelet aggregation, pro-inflammatory cytokines adhesion, cells apoptosis, and aggregate platelet, adhesive cytokine-cytokine pro-inflames, apoptosis cell, and vascular smooth muscle cells activation [1], [12], [13].

These cytokines stimulate the proliferation of vascular smooth muscle cells and the recruitment of immune cells [12], [13]. The intimal smooth muscle cells also respond with the improved production of the extra-cells matrix that will cover plaque with a fibrous stamp. This plaque is very vulnerable to rupture and can be covered by thrombosis so that causes the blockage or acute obstruction on the vessels that can also result in strokes [1], [11], [14].

An increased inflammatory response is often in individuals with diabetes; inflammation plays an essential role in the development of atherosclerotic plaques. C-reactive protein, cytokines, and adiponectin are primary serum markers of inflammation. C-reactive protein and plasma levels of these cytokines including interleukin-1, interleukin-6 and tumour necrosis factor- α are independent predictors of cardiovascular risk. Adiponectin appears to be a modulator of systemic lipid and inflammatory metabolism. Low levels of adiponectin it self-are also associated with cardiovascular disease [1].

In this study found that diabetes is the risk factor for stroke with PR of 1.34. Another study found diabetes has 1.5 times higher for stroke [8], and the other found 3 times [11]. The uncontrolled increase of glucose level in an extended period of diabetes causes the disruption of the function and structural changes in the tissues of the tissues that cause the insufficient blood supply to the tissues. It increases the risk of heart attack, stroke, final-stage kidney disease, retinopathy, ischemia, and gangrene on the leg [6]. Hypertension and diabetes increased the risk for stroke independently and the combination of both increased risk for the occurrence of stroke drastically: diabetes and other cardiovascular diseases [7], [8].

Stroke triggers a stress reaction that involves activation of the hypothalamic-pituitary-adrenal axis, thus increasing serum glucocorticoid levels, activation of the sympathetic autonomic nervous system and increased catecholamine release. Increased levels of stress hormones increase the rate of aerobic glycolysis, promote glucose release from

gluconeogenesis and glycolysis and inhibit insulin-mediated glycogenesis [1], [11], [12], [13], [14], [15].

Hyperglycemia increases brain lactate production, decreases the amount of collagen tissue and causes a larger final infarct size. Hyperglycemia further cause exacerbates the consequences of stroke through augmented reperfusion injury by increasing oxidative stress, stimulating systemic inflammation and increasing barrier permeability. Patients with acute ischemic stroke with diabetes and hyperglycemia experience increased platelet aggregation and adhesion to the endothelium. Uncontrolled diabetes makes the patients risky of ischemic and hemorrhagic stroke. In another study, significant differences were observed in patients with an ischemic stroke along with diabetes compared with nondiabetics the imaging of the brain showed with a higher frequency of lacunar infarction in the brain and hypertension [1], [15].

In conclusion, diabetes patients have more risks for stroke. Uncontrolled diabetes will further increase the risk of patients suffering from a stroke. With blood sugar control and lifestyle changes will control blood sugar levels and reduce the risk of stroke and death.

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