Study on the Relationship between Blood Glucose Control and Diabetic Foot Ulcers at Dr. Moewardi Hospital of Surakarta

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Abstract

Background. Diabetic foot ulcers has several negative impacts on individuals, since it disrupts one's physical activity and psychological condition, as well as the financial loss for the treatment. The purpose of this study was to find the relationship between blood glucose control and foot ulcers. This research used observational analytic study with case-control methods. It applied purposive sampling in 34 diabetes mellitus patients with foot ulcers and 34 diabetes mellitus patients without foot ulcers. The research instruments were documentation study about HbA1c and incidence of diabetic ulcers. The results indicated there was a relationship between blood glucose control and the incidence of foot ulcers in the patients at Dr. Moewardi Hospital. The respondents with poor blood glucose control will have a chance to suffer from foot ulcers 5.800 times than those who have good blood glucose control.

Keywords: ulcers incidence, HbA1c, diabetes mellitus.

1. Introduction

Diabetes mellitus is a chronic disease that occurs when the pancreas does not produce enough insulin or the body does not effectively use the insulin that is produced, resulting in hyperglycemia (WHO, 2012). Diabetes is a disease that can cause serious problems and its prevalence is increasing rapidly (Lewis, *et al*., 2011).

Prevalence of Diabetes in the World in 2000 is 171 million people, is projected to be 366 million people by 2030 (WHO, 2013). In the United States, there are 25,8 million patients with diabetes mellitus consisting of children and adults, 18.8 million people are diagnosed with diabetes, while 7 million people remain undiagnosed . In 2004, patients with diabetes mellitus were detected to have complication of heart disease by 68%. During 2005 to 2008, the patients aged 20 years old and older who were diagnosed with diabetes also suffered from hypertension with blood pressure greater or equal to 140/90 mg/dl and 67% of them should have further treatments. In 2005 to 2008, the diabetes mellitus patients had diabetic retinopathy reached 4.2 million people aged $\geq$ 40 years or 28.5% and nearly 0.7 million people (4.4%) endured severe vision loss. Diabetes mellitus patients with complications of kidney failure reached 44% in

2008, with 48.374 people started to have a treatment for chronic renal failure and 202,290 diabetes mellitus patients with chronic renal failure should live with dialysis or a kidney transplant. About 60-70% of patients suffer from diabetes mellitus and neuropathy, in which more than 60% of patients had non-traumatic amputations because of diabetes (American Diabetes Association, 2011). In Indonesia, the prevalence of diabetes mellitus in 2000 showed 8.426 million cases and it is estimated to reach 21.257 million in 2030 (WHO, 2013).

Due to the absence of diabetic symptoms, people have a propensity for not realizing the illness until they suffer from a further complication in body organs. Complications that can occur in diabetes patients are acute complications, macrovascular and microvascular. The prevalence of diabetes complications in Malaysia in 1077 patients, showed 78% of them had microvascular complications and 17.5% had both microvascular and macrovascular complications (Abougalambou, Hassali, Sulaiman, and Abougalambou, 2011). The prevalence of foot ulcers in diabetes patients was approximately 15%. Despite of its relatively small prevalence, foot ulcers have a high impact (Heitzman, 2010). Diabetic foot ulcers is one of the major sources of morbidity and requires a long term hospitalization as well as high cost treatments. Ulcers, infections, gangrene, amputation are complications that appear together with the disease (Frygberk, Armstrong, Driver, Gurini, Kravitzs, Vanore, 2006). As much as 50-60% of patients' quality of life is affected by foot ulcers.

The control of blood sugar levels fluctuate prolonged or will cause damage to blood vessel walls. It causes inflammation of the endothelium of blood vessels that result in an increase in the progression of atheroma plaque formation, which rises the progressive narrowing of the vascular lumen and disrupts the flow of blood to the peripheral tissues. High levels of blood glucose will increase the viscosity of the blood so that blood flow to the tissues will slow down (Silbernagl and Lang, 2007). HbA1c value is an average picture of glycemic status within the last 5-12 weeks (Soewondo, 2009). Poor control of diabetes mellitus is assumed if the value of HbA1c was > 8 (Waspadji, 2009).

The nurses contribute to the prevention of foot ulcers strategy. Determining risk factors for ulcers is a key and very important, because it can provide information and reference for the patients with high risk to the disease, appropriately (Delmas, 2006). The nurses' role in evaluating patients with ulcers should know the history, physical examination, appropriate diagnostic tests and identify the risk factors that can help prevent recurrent ulcer or high risk of amputation (Registered Nurses' Association of Ontario, 2005). The purpose of this study was to find the relationship between blood glucose control and foot ulcers.

2. Literature Review

Diabetes mellitus is a syndrome caused by decreased insulin secretion indicated by an increase in blood sugar levels (Suyono, 2009). Classification of diabetes are type 1, type 2, gestational diabetes, and other types of diabetes (Federal Bureau of Prisons, 2012). The clinical diagnosis of diabetes mellitus is required if typical symptoms typical of polyuria, polydipsia, polyphagia, and weight loss cannot be detected. Other symptoms of DM may be in the form of blurry eyes, pruritus vulva, skin infections, weakness, fatigue, tingling which should be followed by further investigation. Diabetes screening is done by examining blood glucose levels during and or fasting blood glucose levels (Soegondo, 2009). Diabetes mellitus management consists of diet, exercise, medication regimens, monitoring blood sugar levels, and health education (Jordan & Jordan, 2010; PERKENI, 2011).

Foot ulcers is a significant complication of diabetes mellitus and most often a major factor in the amputation of the lower extremities in diabetic patients (Frykberg, *et al*., 2006). High blood sugar makes the blood flow decreases, eventually it can damage nerves in the legs and the soles of the feet leading to lose the ability to feel. Glycosylation of collagen as a result of a long diabetes can cause rigid structure of the capsular and ligamentous (Charcot arthropathy) and cause ulcers (Frygberg, *et al*., 2006; Heitzman, 2010). Uncontrolled blood glucose can lead to complications in diabetic patients, but glycemic control in a population with relatively bad ulcer (Nyamu, Otieno, Amayo, Mcligeyo, 2003; Registered Nurses' Association of Ontario, 2005). Further increase in blood sugar levels inhibits the leukocyte in facilitating the expansion of infection and infection to the bone or osteomyelitis (Tambunan & Gultom, 2009). Glycosylated haemoglobin test is a method used to assess the effect of changes in the previous 8-12 weeks of therapy. HbA1c done every 3-6 months. Poor control of diabetes, if the HbA1c value of more than 8% (Waspadji, 2009). Results of research on 80 respondents, the average value of HbA1c 8% with a standard deviation of 1.4 (Monami, et al, 2008). Levels of HbA1c <7% can prevent microvascular complications in patients with diabetes (American Diabetes Association, 2004).

3.   Research Methods.

This research was a quantitative study. The type of this research was observational analytic study with case-control methods. The respondents were diabetic patients and diabetic patients with foot ulcers. The sampling technique in this study was purposive sampling. The inclusion criteria were diabetic patients who suffered from foot ulcers from May to December, 2012. There were 34 respondents that experienced foot ulcers and 34 respondents that did not have foot ulcers, both of them had good long-term memory. The research involved hospitalized patients/inpatients in Melati room 1&3 and non-hospitalized patients/outpatients at Dr. Moewardi Hospital, Surakarta, from September to January 2013. Independent variable was blood glucose control. The examination of average glycemic status was performed on the patient. Dependent variable was the prevalence of diabetic ulcers. Diabetic ulcer prevalence is a condition of a person injured in the leg as the consequence of complications of diabetes mellitus. The research instruments were documentation study on blood glucose control and the incidence of diabetic ulcers. Analysis data used *chi square*.

4.   Results of the study and Discussion

Table 1. The Relationship between the blood glucose control and the incidence of foot ulcer on patient with Diabetes Mellitus at Dr. Moewardi Hospital of Surakarta in December 2012.

Blood glucose control	Foot Ulcer incidence				p *value*	OR	CI 95 %	
	Nonulcer		Ulcer				Min	Max
	N	%	n	%				
Good	17	50	5	14.7	0.002	5.800	1.813	18.558
Poor	17	50	29	85.3				
Total	34	100	34	100				

Based on Table 1, the respondents who experienced ulcer as much as 85.3% and they have poor blood glucose control. Despite of not the entire respondents suffer from ulcers, only 50% of them had good blood glucose control. Statistical analysis showed the significant relationship between the control of blood glucose levels and the incidence of foot ulcers (p value = 0.002). The result of the bivariate analysis indicated that control of blood glucose is a risk factor on the incidence of foot ulcers with a value of OR = 5.8 (CI = 1.813 to 18.558), it means that respondents who have poor blood glucose control have a possibility to experience ulceration of 5.8 times than those who have good blood glucose control.

The result of a reliable research showed there were 80 respondents with the average value of HbA1c of 8% with a standard deviation of 1.4, suffering from foot ulcer (Monami, *et al*, 2008). Poor control of diabetes is assumed if the HbA1c value is more than 8% (Waspadji, 2009). In addition, 63% of the 1524 subjects of research on type 2 diabetes develop complications which are associated with glycemic control with HbA1c values of > 7.5% (Liu, Fu, Wang, Xu, 2010). Different levels of HbA1c according to Nyamu, Otieno, Amayo, Mcligeyo (2003) showed a mean HbA1c of 9.63% which lead to foot ulcers.

The glycemic load or controlled HbA1c is <7% (PERKENI, 2011). Patients are diagnosed with DM if the value of HbA1c levels is ≥ 6.5%. Levels of HbA1c of < 7% can reduce the risks of both microvascular and macrovascular complications (American Diabetes Association, 2010).Glucose can interact with haemoglobin to form HbA1c, which will increase the concentration in the blood and indicate a state of hyperglycemia that has lasted a long time. HbA1c has a higher oxygen affinity and therefore relatively has a difficulty to release oxygen in the periphery. HbA1c results are highly accurate in single examination to assess long-term glycemic status and can be applied to all types of patients with DM. A1C is a triggering factor to the possibility of complications of DM (Soewondo, 2009).

Glycosylated haemoglobin test is a method used to assess the effect of changes in therapy in the previous 8-12 weeks. HbA1c is performed every 3-6 months (PERKENI, 2011). Poor control of diabetes is assumed if the HbA1c value is higher than 8% (Waspadji, 2009). DM pathogenesis of chronic complications due to hyperglycemia, namely the theory of sorbitol—a build-up of glucose in the cells and tissues as a result of hyperglycemia—has caused some glucose can be metabolized by the aldose reduktase enzyme of sorbitol to fructose. The build-up of sorbitol in the cells or the tissue will cause complications in diabetes mellitus. Glycation theory would be the process of glycation of the proteins, in particular lysine-containing compound, which happens because of hyperglycemia. The incidence of microvascular complications and macrovascular complications on diabetic patients occur mainly because of protein glycosylation in the basal membrane (Waspadji, 2009). The state of hyperglycemia may bring forth leukocytes dysfunction, lymphocytes suppression, and a decrease in blood circulation, which can increase the risk of foot ulcers or recurrent foot ulcers (Tambunan & Gultom, 2009).

5. Conclusion

There is a relationship between blood glucose control and the prevalence of diabetic ulcers in the patients with diabetic mellitus at Dr. Moewardi Hospital of Surakarta. The respondents who have poor control of blood glucose level have a possibility to experience ulceration of 5.8 times than those who have good blood glucose control. Finally, it is recommended that patients should change their way of life and perform blood glucose management to prevent the foot ulcer complication.

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