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Original Article

Pattern of Macrovascular Complications and its relationship with HbA1c in Hospitalized Patients with Type 2 Diabetes Mellitus

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Abstract

Background: *Type 2 diabetes is a common metabolic disorder causing high blood sugar due to insulin resistance and relative insulin deficiency. It poses a significant global health burden, especially in low and middle-income countries. This study explores how well-controlled blood sugar (HbA1c) affects the types and patterns of complications in hospitalized patients with type 2 diabetes.*

Methods: *Conducted over six months at a tertiary care hospital, this cross-sectional study included 200 men and women with T2DM. Data were collected through evaluations and documented. Macrovascular complications were identified using specific criteria: elevated cardiac troponin I for myocardial infarction, neurological deficits with imaging for stroke, and foot ulcers or amputation history for peripheral vascular disease.*

Results: *Macrovascular complications were found in 33% of patients, with myocardial infarction being the most common (48.5%), followed by stroke (37.9%) and peripheral vascular disease (13.6%). Patients with complications had significantly higher HbA1c and blood glucose levels.*

Conclusion: *A significant proportion of hospitalized T2DM patients have macrovascular complications, associated with higher HbA1c levels. These findings emphasize the importance of good glycemic control to prevent such complications.*

Keywords: *Type 2 Diabetes Mellitus, Macrovascular Complications, HbA1c, Myocardial Infarction, Stroke, Peripheral Vascular Disease, Glycemic Control, Hospitalized Patients.*

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Background

Type 2 diabetes mellitus T2DM is a metabolic disorder that is characterized by high blood glucose in the context of insulin resistance and relative insulin deficiency.[1] Its global prevalence was about 8% in 2011 and is predicted to rise to 10% by 2030.[2] Nearly 80% of people with diabetes live in low- and middle-income countries.[3]

The proportion of insulin resistance versus beta cell dysfunction differs among individuals, with some having primarily insulin resistance and only a minor defect in insulin secretion and others with slight insulin resistance and primarily a lack of insulin secretion.[4] Other potentially important mechanisms associated with type 2 diabetes and insulin resistance include: increased breakdown of lipids within fat cells, resistance to and lack of incretin, high glucagon levels in the blood, increased retention of salt and water by the kidneys, and inappropriate regulation of metabolism by the central nervous system.[5] However, not all people with insulin resistance develop diabetes, since an impairment of insulin secretion by pancreatic beta cells is also required.[6-8]

Patients with long-standing diabetes are at risk of developing a variety of complications. As many as 25% of people with type 2 diabetes have evidence of diabetic complications at

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the time of initial diagnosis.[1] Macrovascular complications include coronary artery, cerebrovascular and peripheral vascular disease. Microvascular complications of diabetes include retinal, renal, and possibly neuropathic disease. Macrovascular complications are mainly responsible for excess mortality and significant morbidity in type 2 diabetes.

Good glycemic control is needed for the management of diabetic patients along with the control of other risk factors. Glycated hemoglobin (HbA1c) provides the most accurate measure of glycemic control, HbA1c indicates the integrated glycemic control over the lifespan of erythrocytes (120 days)[9].

Diabetes is a major burden upon health-care facilities throughout the world. Globally diabetes caused 4.6 million deaths in 2011, and health-care expenditure attributed to diabetes was estimated to be at least US$465 billion or 11% of total healthcare expenditure[1].

With the advance of science, specialized treatment and management plans of diabetes have been utilized, but after all these management incidences of Diabetes are increasing. Several studies have been conducted on various aspects of DM. Although a few studies have been reported regarding complications of type 2 DM in recent years, the actual picture is yet to be revealed in our country regarding macro vascular complications and their relationship with HbA1c. In this background this study was performed in Dhaka Medical College Hospital, Dhaka.

Objectives

The study aims to investigate the frequency and pattern of macrovascular complications in hospitalized patients with type 2 diabetes mellitus (DM) and to explore the relationship between these complications and HbA1c levels.

Methods:

This cross-sectional study was carried out over 6 months at a tertiary care hospital. Sample size was calculated to ensure good statistical power and 200 participants were included in the study. Participants with type 1 DM and secondary diabetics, and gestational diabetics were excluded. The authors did not include newly diagnosed diabetics for the lack of clarity in some cases regarding the type of diabetes in their presentation. Patients with a history of neuropathy of another cause, significant hepatic or renal disease, and pure vegetarians were excluded from the study. The investigator collected all data, which was manually checked after collection and then checked again automatically after data entry. Any missing or inconsistent data was carefully addressed. Categorical variables were summarized using frequency tables, while continuous variables were summarized using descriptive statistics. Chi-square tests were used to determine associations between variables and means and proportions were compared using Chi-square (χ^2) and t-tests. p-value of less than 0.05 was considered statistically significant.

Ethical Issue

The protocol was initially submitted to the ethical and research review committees of DMCH and ethical clearance was obtained.

Result

A total of 200 patients with type 2 Diabetes mellitus of either sex aged between 25 to 88 years the mean age was 62.7 ± 10.6 years.. Among these patients, 118 were males and 82 were females with male female ratio of 1.44: 1.

Macrovascular complications were observed in 66 cases (33%) out of 200 patients. Among these myocardial infarctions (32 cases, 48.5%) was most frequent followed by stroke (25 cases, 37.9%) and peripheral vascular disease (9 cases, 13.6%) (Figure 1).

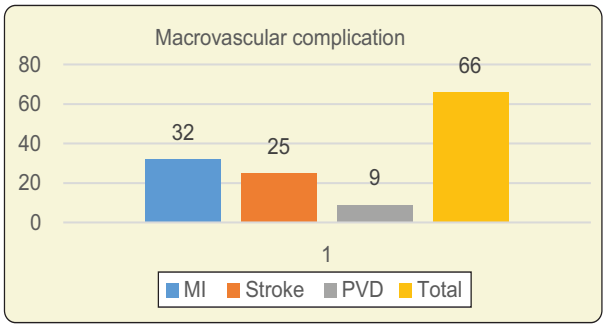

Figure 1. Patterns of macrovascular complications among type 2 Diabetes mellitus patients (n=200)

Among 200 studied cases, socio-demographic profile was similar between patients with macrovascular complication and without complication (P > 0.05) (Table 1).

Table 1. Comparison of socio-demographic characteristics between type 2 Diabetic patients with macrovascular complication and without complication (n=200)

Variable	Macrovascular complication (n=66)	No complication (n=134)	P value
Age group			
25-40 years	5	17	
41-55 years	12	24	0.667
56-70 years	27	53	
Above 70 years	22	40	
Sex (male)	36	82	0.369
Residence (urban)	46	84	0.928
Monthly income			
< 15000 taka	12	26	
15000-40000 taka	36	66	0.770
> 40000 taka	18	42	

Assessment of risk factors showed that frequency of macrovascular complications in type 2 Diabetes mellitus was significantly increased in sedentary workers, smokers and patients with hyperlipidemia, obesity, and longer duration of disease (P < 0.05) (Table 2).

Table 2. *Comparison of risk factors in type 2 Diabetic patients with macrovascular complication and without complication (n=200)*

Risk factor	Macrovascular complication (n=66)	No complication (n=134)	P value
Type of profession			
Sedentary worker	53	89	0.018
Physical worker	13	46	
Smoking history			
Current smoker	41	63	
Past smoker	19	43	0.036
Never smoke	6	28	
Duration of DM			
< 5 year	6	16	
5-10 year	20	64	0.004
>10 year	40	54	
Treatment			
Drug only (OHA)	41	91	0.62
Both OHA and insulin	25	43	
Serum lipid profile			
Normal	12	42	0.049
Increased	54	92	
BMI (mean ± SD)	31.5 ± 3.7	26.6 ± 5.4	0.000

HbA1c and blood glucose (fasting and 2 hours after loading glucose) were assessed in all patients of type 2 Diabetes mellitus. T-test was done to compare mean values between patients with and without macrovascular complications and it showed HbA1c, and blood glucose levels were significantly higher in patients with macrovascular complication (Table 3).

Discussion

Type 2 diabetes is notorious for its large increase in prevalence observed in virtually all regions of the world.[10-15] The increasing prevalence of type 2 diabetes has been multifactorial, related to aging of populations, economic development, and associated transitions in culture and lifestyle,[18] which have also led to a growing heterogeneity in the pathophysiology and phenotypes associated with diabetes globally, including representation of people from both high and low socioeconomic settings, both young and old, and among both obese and relatively lean populations.[15] Unfortunately, data on global trends in the diabetes burden have so far been dominated by cross-sectional studies of prevalence, data on diabetes as an attributed cause of death, and analyses modelling the effect of prevalence on disability and years of life lost. There has been little attention to global trends in diabetes complications, and if and how the characteristics of diabetes-related morbidity have changed which led us to this study.

We studied a population of 200 patients with type 2 Diabetes mellitus of either sex aged between 25 to 88 years. Among these patients, 118 were males and 82 were females with male female ratio of 1.44:1.

Among the 200 evaluable patients, the mean age was 72.7 ± 10.6 years. Most of the patients were more than 55 years of age (71%). Increasing age was found to be a common risk factor for type 2 diabetes in multiple studies (both urban and rural) which is quite proverbial with the IDF findings- in 2011, the greatest number of people with diabetes is in the 40 to 59 years age group and more than three-quarters of the 179 million people with diabetes in this age group live in low- and middle-income countries.[27]

Socio-demographic profiles (Age, Sex, Residence, Monthly income) were similar between patients with macrovascular complication and without complication (P >0.05). Assessment of risk factors showed that frequency of macrovascular complications in type 2 Diabetes mellitus was

Table 3. Comparison of HbA1c and blood glucose (fasting and 2 hours after loading glucose) in T2DM patients with and woth or without macrovascular complications (n=200)

Test (Mean value ± SD)	Among all patients (n=200)	Macrovascular complication (n=66)	No complication (n=134)	P value
HbA1c (%)	7.85 ± 1.03	8.90 ± 0.26	7.32 ± 0.85	<0.001
Fasting blood glucose (mml/L)	7.46 ± 1.26	8.42 ± 1.09	6.99 ± 1.06	<0.001
Blood glucose 2 hours after 75 gm of glucose (mml/L)	10.92 ± 2.43	12.60 ± 1.85	10.09 ± 2.26	<0.001

significantly increased in sedentary workers, smokers and patients with hyperlipidemia, obesity, and longer duration of disease ($P < 0.05$).

From two urban studies, social class, increasing age, higher income group, sex and WHR were found as risk factors for diabetes in urban areas of Bangladesh.[19,26] The findings showed higher prevalence of risk factors for diabetes in rural areas compared to urban areas. Many of the studies found increasing urbanization, economic development and changing behaviors in the rural area as the underlying causes for emerging risk factors for diabetes.[23-24.]

Our study also revealed that lack of physical exercise had significantly greater risk of macrovascular complications, which was found in other published studies.[21] Though, the prevalence of macrovascular disease in our population (33%) was comparable to the WHO and other western data, it was significantly higher than that demonstrated by other studies conducted in our neighboring country India.[29] The significantly higher prevalence of macrovascular complications in our patient population is likely linked to the patient characteristics (Central adiposity, dyslipidemia, atherosclerotic tendency, average age, lack of awareness etc.) Advanced atherosclerotic vascular changes are often preceded by impairment of endothelium dependent vasodilation, vascular smooth muscle dysfunction and increased arterial stiffness.

In one recent study by Islam et al.[21] it has been found that the prevalence of macrovascular complications was 28.8%. Among them CHD was most frequent 21.2%, stroke 8.4% and PVD 7.2%. A study conducted in our country showed that the prevalence of IHD was 26.5%, CVD 5.3% and foot complications 2.0%.[22] Other studies of different countries also showed similar results like us.[17]

The prevalence of CHD in India was found to be 11.4%, which was higher than other Asian countries in one study.[22] Another study showed that the prevalence of CVD indicated by major Q wave changes was found to be 3.9%, which was similar to the prevalence in the Asian Indians in UK (4.0%).44 Prevalence of PVD in Asian Indians is comparatively low compared with the white population (9.3%). Low prevalence of PVD was demonstrated in Indian patients (4.0%).

In a nutshell, our data suggest that coronary heart disease is the most common macrovascular complication among type 2 DM patients. The risk of macrovascular complications increases with various risk factors like advanced age, longer duration of diabetes, poor glycemic control, lack of physical exercise etc. These findings highlight the need for frequent screening of patients with type 2 DM to identify patients at high risk of health complications and to prevent further disability.

Limitations and Recommendations:

This study had several limitations, including being conducted at a single center, having a cross-sectional design, a small sample size, and the inability to perform long-term follow-up. The results cannot be generalizable to the overall population. Despite these limitations, the findings can be used to raise awareness among diabetic patients and the general population. To gain a more accurate understanding of the national context, it is recommended that further large cohort studies be conducted.

Conclusion

Myocardial infraction, stroke and PVD are the observed macrovascular complications that have been found in our population and it is related with higher level of HbA1C. However, further larger cohort study is needed to finalize the comment.

Competing interests:

The authors declare that they have no competing interests.

Authors' contributions:

The Principal Investigator, Dr. Miftahul Jannat, oversaw all activities related to the conduct of the study and contributed to the study idea and writing of the manuscript. Mahbub Mayukh Rishad, S M Kawser Zafor Prince, Nawsabah Noor, Tazbiha Rahman Kahn, Najeeb Mahiyuddin and Md. Abdul Jalil Ansari contributed to the study idea, data collection, and literature review. All authors accepted the final version. All authors read and approved the final manuscript.

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