Original Article

Barriers of achieving and maintaining glycemic target among patients with type 2 diabetes mellitus on insulin therapy

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ABSTRACT

Background: *Many obstacles exist that lead to failure of achievement of glycemic target in persons with diabetes mellitus (DM) prescribed with insulin. However, there is an inadequate amount of data to address these barriers and to make effective intervention. The aim of this study was to identify barriers of achieving and maintaining glycemic target among type 2 diabetic patients on insulin therapy.*

Methods: *This cross-sectional study was carried out in the Department of Endocrinology, BIRDEM General Hospital from March 2020 to August 2022. Total 384 patients with type 2 DM on insulin therapy were recruited by convenient sampling. Face to face interview was taken from the patient by following the inclusion and exclusion criteria. Patients were examined for his/her injection site, injection technique; insulin vial and syringe were also checked for any mismatch. Biochemical reports were collected from patient records. Data analysis was done by SPSS version 25 considering level of significance at 0.05.*

Results: *The mean age of the participants was 56 ± 10, (m±SD) years. Majority (73.9%) were obese. Hypertension (70.6%) was common among the patients. Few (10.7%) patients maintained physical exercise regularly. The mean duration of DM was 12.15± 5.39 years and they were taking insulin for a mean of 4.40± 2.64 years. Most of the patients took premixed insulin (38.3%) followed by split mixed (29.7%) and basal-bolus (21.1%) regimen. Most common cause of poor glycemic control was insulin omission (46.4%). Obesity, using premixed insulin, irregular physical exercise, irregular self-monitoring of blood glucose (SMBG), not following the diet chart, no education on target glucose and insulin dose adjustment were associated with HbA1c >10%, which indicates poor glycemic control.*

Conclusion: *Overall, lack of knowledge about glycemic control and insulin dose adjustment, insulin omission, non-adherence to the diet, irregular physical exercise act as barriers to achieve optimum glycemic control.*

Key words: *Diabetes mellitus, insulin, HbA1C, uncontrolled diabetes, barrier.*

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INTRODUCTION

Diabetes mellitus (DM) is on the rising trend globally; in 2021, about 537 million people worldwide had diabetes and by 2045, the number may rise to 783 million.[1] In India, 76.6% people have poor glycemic control.[2] The scenario is much worse in Bangladesh, 82% people suffering from poor glycemic control.[3] The key objectives of diabetes treatment are to reach the glycemic target, avoid long-term micro- and macro-vascular complications and maintain long-term glycemic control. Along with the life style advices, insulin therapy can provide effective glycemic control even when oral anti-diabetic medicines are inadequate and can improve many of the metabolic abnormalities in type 2 diabetes (T2DM) patients.[4] According to literature, patients main concerns about insulin therapy were insurance coverage, illiteracy, misconceptions about insulin therapy and fear of insulin injection.[5] Negative beliefs related to insulin therapy, such as restrictions in daily life, inconvenience and social stigma affected patients decision to start insulin.[6] Study revealed that one year delay in treatment intensification in patients with poor glycemic control significantly increased the risk of myocardial infarction, heart failure, stroke and a composite endpoint of cardiovascular events.[7] The benefits of timely glycemic control with insulin for reducing the risk of micro- and macro-vascular complications are well established. But the people of our country are not well oriented about the importance of glycemic control and several other factors leads to non-adherence of insulin treatment. So, this study performed to identify the barriers of achieving and maintaining glycemic target among T2DM patients on insulin therapy.

METHODS

This cross-sectional study was carried out in the Department of Endocrinology, BIRDEM General Hospital from March 2020 to August 2022. This study enrolled 384 patients with T2DM on insulin therapy after taking informed written consent. Ethical clearance was obtained from Institutional Review Board (IRB) of BIRDEM General Hospital (BIRDEM/IRB/ 2022/263, Date: 06.06.2021). Biochemical reports were collected from the hospital records. HbA1c >7% was considered as uncontrolled DM. Obesity: BMI status (kg/m^2): using the WHO defined Asian BMI cut points[8]: lean (<18.5), normal (18.5- 22.9), overweight (23-24.9), obesity (≥25).

Data analysis was done by SPSS version 25 considering level of significance at 0.05. Categorical data were presented in frequency/percentages while continuous variables were presented in mean, and standard deviation. Statistical analyses were done by using appropriate statistical tool like chi-square test for categorical variables and independent t test and Mann Whitney U test for continuous variable.

RESULTS

Total patients were 384 with a mean age of 56 ± 10, (m±SD) years and 64.4% were female. Seventy percent were suffering from hypertension. Most (74%) of the patients were obese and mean BMI was 27.03 ± 2.90 kg/m^2. Mean duration of DM was 12.15 ± 5.39 years and mean duration of insulin therapy was 4.40 ± 2.64 years. Premixed insulin (38.3%) was the predominant insulin type, followed by split mixed (29.7%) regimen. Most (72.7%) of them were using insulin syringe, while the rest (27.3%) were using various types of insulin pen devices (Table I).

Table I. Socio-demographic and clinical parameters of study participants (N = 384)

Variables		Frequency (%)	Mean±SD
Age	≤50	124 (32.3)	
	>50	260 (67.7)	
Mean age in years			56 ± 10
Gender	Male	137 (35.6)	
	Female	247 (64.40)	
Level of education			
	Illiterate	6 (1.6)	
	Undergraduate	278 (72.4)	
	Graduate	100 (26)	
Co-morbidities			
	HTN	271 (70.6)	
	CAD	78 (20.3)	
	CKD	92 (24)	
	Retinopathy	102 (26.6)	
	Cataract	69 (18)	
BMI (Kg/m^2)			
	Obesity (25 & above)	284 (74)	27.03 ±2.90
Duration of DM in years			12.15 ± 5.39
Duration of insulin treatment in years			4.40 ± 2.64
Treatment modalities			
	Insulin	88 (23)	
	Insulin + OAD	296 (77)	
Types of insulin			
	Basal only	9 (2.3)	
	Short acting only	33 (8.6)	
	Basal bolus	81 (21.1)	
	Pre-mixed	147 (38.3)	
	Split-mixed	114 (29.7)	
Insulin application			
	Pen	105 (27.3)	
	Syringe	279 (72.7)	

Table II demonstrates the different types of barriers to achieve glycemic target. Only 39.6% patients had knowledge about target plasma glucose. Only 38.3% of patients were familiar with insulin dose adjustment. Eighty four percent of patient did not follow the diet chart. Adherence to physical exercise was also poor (10.7%). Only 8.3% patients measured their blood glucose level weekly and 36.2% patients measured it on a monthly basis. Among patient who has education of insulin dose adjustment, only 7.48% patients titrated their insulin dose adequately. About 46.4% omitted their prescribed insulin (Table II).

Table II. Barriers of achieving and maintaining glycemic target (N = 384)

Barriers	Frequency (%)
Patient knowledge	
Target blood glucose	152 (39.6)
Insulin dose adjustment	147 (38.3)
Diet chart	
Follow	60 (15.6)
Do not follow	324 (84.4)
Physical exercise	
Regular (≥150 minutes per week)	41 (10.7)
Irregular	343 (89.3)
Self-monitoring of blood glucose (SMBG)	
Daily	0 (0)
Weekly	32 (8.3)
Monthly	139 (36.2)
None	213 (55.5)
Under-titration	
Fear of hypoglycemia	86 (63.2)
Fear of weight gain	13 (9.6)
Fear of hypoglycemia and weight gain	37 (27.2)
Insulin omission	
Omitted	178 (46.4)
Not omitted	206 (53.6)

Obesity, use of premixed insulin, irregular self-monitoring of blood glucose, lack of physical exercise, lack of education on target plasma glucose and insulin dose adjustment, not following the diet chart were significantly associated with poor glycemic control with a HbA1C ≥10% (Table III).

Table III. Comparison of socio-demographic and clinical parameters with HbA1c level more than or less than 10%

Variable	HbA1c ≥10 N=241 (%)	HbA1c <10 N=143 (%)	P value
Obesity			
Yes	195 (80.9)	89 (62.2)	**<.001**
No	46 (19.1)	54 (37.8)	
Types of therapy			
Only insulin	52 (21.60)	36 (25.2)	.417
Insulin plus OAD	189 (78.4)	107 (74.8)	
Types of Insulin			
Basal only	4 (1.7)	5 (3.50)	
Short acting only	30 (12.4)	3 (2.1)	
Basal bolus	32 (13.30)	49 (34.3)	**<.001**
Pre-mixed	106 (44.0)	41 (28.7)	
Split-mixed	69 (28.1)	45 (31.5)	
Insulin application			
Syringe	199 (82.6)	80 (55.9)	**<.001**
Pen	42 (17.4)	63 (44.1)	
Diet chart			
Follow	4 (1.7)	56 (39.2)	
Don't follow	237 (98.3)	87 (60.8)	**<.001**
Physical exercise			
Regular	5 (2.1)	36 (25.2)	**.001**
Irregular	236 (97.9)	107 (74.8)	
SMBG			
Weekly	7 (2.9)	25 (17.5)	
Monthly	57 (23.7)	82 (57.3)	**<.001**
None	177 (73.4)	36 (25.2)	
Education on target glucose			
Yes	52 (21.6)	100 (69.9)	
No	189 (78.4)	43 (30.1)	**<.001**
Education on dose adjustment			
Yes	50 (20.7)	97 (67.8)	**<.001**
No	191 (79.3)	46 (32.2)	

DISCUSSION

The American Diabetes Association (ADA) recommends to achieve and sustain their HbA1C levels below 7% to reduce the risk of micro-vascular and

cardiovascular complications in the person with DM.[9-11] In this study patient who had poor control of diabetes were selected and they had one or more complications and co-morbidities like hypertension in 70.6%, CAD in 20.3%, CKD in 24%, retinopathy in 26.6%, cataract in 18%. Mean duration of diabetes was 12.15 ± 5.39 years that also justified the presence of complications. The mean duration of insulin therapy was 4 years indication that it took 8 years to initiate insulin after diagnosis of diabetes which also correlates with a study where median time to insulin initiation was 7.2 years.[12] The incidence and prevalence of complications especially microvascular increase with the duration of diabetes.

Historically, adherence to insulin is poor among the patients. In this study, the main reason for poor diabetes control was insulin omission (46.4%) that in line with Donnelly et. al (30%).[13] Patients either discontinued the entire regimen or part of prescribed insulin regimen.

Obesity is linked with insulin resistance and poor glycemic control. In this study, obese patients had higher HbA1c (≥10%) compared with non-obese persons, which is also seen in meta-analysis from US databases.[14]

Adherence to life-style modification is essential for both preventing diabetes complication and optimal glycemic control.[15] In the present study, 84.4% diabetic patients did not follow the diet chart. Similarly, in the study of Mumu et al.[16], most of the respondents (88%) were non-adherent to diet, which is also quite similar to the other studies.[17]

The present study found that only 39.9% patients had knowledge about target plasma glucose and 38.3% of patients were familiar with insulin dose adjustment. Casciano et al.[18] also found that diabetes education also had a significant effect on the importance assigned to administration between T2DM patients who received diabetes training and those who did not (28.21% vs. 33.68%, respectively; $p < 0.0001$). To improve insulin adherence, patients just starting to take insulin or patient taking insulin for a shorter period of time can be benefitted from the guidance of insulin-experienced patients. However, even with the most successful instructional efforts, the percentage of patients who do not take their insulin as prescribed cannot be fully eliminated.[19] According to the results of the present study, the main reasons for poor glycemic control despite insulin therapy were inadequate titration (92.5%) of prescribed insulin dose due to fear of hypoglycemia (63.23%), irregular physical exercise (89.3%), not following the diet chart (84.4%) irregular self-monitoring of blood glucose (SMBG) and ignorance about diabetic education. These results concord with other studies.[20-21]

Insulin delivery device has important implications in diabetes control. Majority of users found using pen is simple and easier method, which also reflected in their glycemic control. Pen users have significantly ($p<.001$) better glycemic control than the syringe users, which is also found in other studies.[22]

Types of insulin is significant determinant for good glycemic insulin. In this study, premixed insulin users had poor glycemic control compared with patients using basal bolus regimen. Anyanwagu et al. also found better control with basal bolus insulin regimen.[23]

One of the major reason for not reaching the glycemic goal was inadequate titration of insulin by the patients. Fear of hypoglycemia (63.2%) and weight gain (9.6%) were the barriers for inadequate titration which is quiet different form Berard et al. (fear of weight gain 52%, hypoglycemia 37%).[24]

It was a single hospital-based study that lacks generalization of findings to the overall population and may contain institution-based bias.

In conclusion, obesity, use of premixed insulin, irregular self-monitoring of blood glucose, lack of physical exercise, lack of education on target plasma glucose and insulin dose adjustment, not following the diet chart were significantly associated with very poor glycemic control.

Authors' contributions: MAI designed, coordinated this research, drafted the manuscript and carried out the data analysis. MD, MT, MSI, IR, US, PG helped in drafting the manuscript. FA, MFA, SMA participated in research coordination. The authors read and approved the final manuscript.

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