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Original Article

Comparison of HbA1c in Adult Patients Taking Oral Medications and Insulin Dependent in Diabetic Clinic of Benazir Bhutto Hospital Rawalpindi

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A B S T R A C T

Objective: To compare the HbA1c levels in adult diabetic patients taking oral medications versus those on insulin therapy, to assess the effectiveness of these treatments in managing diabetes.

Methodology: A comparative cross-sectional study conducted from December 2018 to March 2019, at the diabetic clinic of Benazir Bhutto Hospital in Rawalpindi. Patients already diagnosed with diabetes mellitus and attending the diabetic clinic were included. Approximately 4-5 ml of blood was taken from anticubital vein and collected in EDTA tube for HbA1c measurement and in Fluoride tube for glucose measurement. All the samples were processed on the automated chemistry analyzer Beckman AU 300 for the glucose. HbA1c measurement was taken on WONDFU machine and finally results were taken as final measurement.

Results: In this study, 100 samples of diabetic patients were taken that were taking insulin and oral medication for their diabetic control. However, among patients taking insulin, there is a weak negative correlation ($r = -0.40$), and among those taking oral medication, there is a weak positive correlation ($r = 0.40$), but both of these results are not statistically significant ($p = 0.69$). This suggests that while overall blood sugar control is closely linked with HbA1c, the type of treatment alone may not strongly influence this relationship.

Conclusion: HbA1c level was observed slightly improved in patients who were taking oral medication than those who were on insulin.

Keywords: HbA1c levels, Diabetes mellitus, Oral medications, Insulin therapy, Glycemic control

Introduction

The word diabetes mellitus (DM) is derived from two Greek words; Diabetes means running through and mellitus means honey. Diabetes mellitus is a group of metabolic disorder having disturbed metabolism of carbohydrates, fats and proteins due to deficiency of insulin hormone. Type1 DM: In type1 DM, the body's immune system destroys the cells that release insulin, eventually eliminating insulin production from the body. Insufficient or too little insulin is produced. Therefore, the body needs an external dose of insulin. This is also called insulin dependent diabetes mellitus (IDDM) or juvenile DM.[1]

Type 2 DM: In type 2 DM, the body is not able to use insulin in the right way due to absence of receptors of insulin, this is called insulin resistance. It most commonly becomes apparent during adulthood. It is also called non-insulin dependent DM.[2]

In the past Type-2 diabetes was considered as a disease of ageing and the elderly but now this perception has turned out to be a complete misconception and people with this disease in developing countries including Pakistan are presenting at a younger age. The emergence of this pandemic at an early age is attributable to rapid cultural changes and a high degree of urbanization leading people to adopt unhealthy lifestyles and decreased physical activity. Recent figures related to obesity in adoles-19.35% are at risk of being overweight with an increase in caloric intake and sedentary lifestyle. [3.]

More than 135 million people worldwide had diabetes mellitus in 1995, which is approximately 4% of the global population. Approximately 300 million people are expected to have diabetes in 2025 that will be 5.4% of world population. [4.]

The worldwide prevalence of diabetes has almost doubled between 1994 and 2000, to 239 million people. It has been recently reported that the age standardized (20-50 years) prevalence of known and newly diagnosed type2 diabetes was 20 % in Europeans, 22 % In African Caribbean, and 33 % in Pakistanis in Manchester, UK. [5]

Diabetes mellitus is one of the metabolic disorders which if not properly managed can lead to long-term life-threatening complications and premature deaths.[6.] There is 170% increase in the incidence of diabetes in developing countries as compared to 47% in developed countries. Pakistan stands on number 6 among the top ten countries having increased burden of diabetes mellitus. [7.]

Diabetes is a leading cause of several maladies that include but are not constrained to cardiovascular morbidity as well as mortality and is also a significant contributor to disability in many countries, [8]. It is because of various causes' viz. increase in average age of the population Owing to better facilities, tremendous change in lifestyle, improved diagnostic techniques and increasing health awareness in the masses. [9].

The early onset of diabetes, longer suffering period out of diabetic complications and early death makes Asian population more susceptible to this disease as compared to other regions. As a matter of fact, type II diabetes prevalence has reached epidemic levels in Asia. [10]. The number of cases of diabetes worldwide in the year 2000 among adults was estimated to be 171 million and will rise to 366 million by 2030. India is the "diabetic capital of the world."

Diabetic conditions are known to be associated with environmental, behavioral, and lifestyle factors such as a sedentary lifestyle and highly rich nutrition. In addition, the daily human-environmental interactions and real-life activities that cause an individual's blood glucose to fluctuate remain relatively unexplored in part to data collection challenges. [11].

Global prevalence of diabetes was about 2.8% in 2000 and is estimated to be around 4.4% by 2030. It has been estimated that in the 30-year period, the prevalence of diabetes in India would increase by 195%, which is the highest in the world. The International Diabetes Federation estimates the total number of diabetic subjects to be around 40.9 million in India and this is further set to rise to 69.9 million by the year 2025. [12]

Pakistan belongs to high prevalence area, currently having 6.9 million affected people, with projected estimates expected to double by 2025 and affect 11.5 million people. This alarming situation can have serious repercussions and presents as a challenge for Health Care Providers and healthcare policy makers in the country. According to WHO survey of rural areas of NWFP,[13] the overall prevalence of type 2 diabetes and impaired glucose tolerance (IGT) in both sexes is 11.1% and 9.4%, respectively and the trend of diabetes mellitus is increasing. [14.]

Although the widespread use of these treatment options, there is a lack of comparative data on HbA1c levels among adult patients using oral medications versus those dependent on insulin, particularly in local clinical settings. Understanding these differences is essential to optimize treatment strategies and personalize diabetes management. However this study has been done fill this gap by comparing HbA1c levels in adult patients on oral medications and those on insulin therapy. The findings may provide valuable insights for healthcare professionals to evaluate treatment efficacy, guide clinical decision-making, and potentially improve patient outcomes through better-targeted interventions.

Methodology

The study was designed as a comparative cross-sectional study conducted over a period of four months, from December 2018 to March 2019, at the diabetic clinic of Benazir Bhutto Hospital in Rawalpindi. A total of 100 patients already diagnosed with diabetes mellitus and attending the diabetic clinic were included in the study. The inclusion criteria encompassed all diabetic patients attending the medical outpatient department (OPD), irrespective of age and gender, while asymptomatic patients with normal glucose values were excluded

from the study. Blood samples were collected from the antecubital vein of each participant, with approximately 4-5 ml of blood drawn and distributed into two types of tubes: an EDTA tube for HbA1c measurement and a fluoride tube for glucose measurement. Written consent was obtained from all 100 participants prior to sample collection, ensuring ethical compliance.

The primary objective was to compare HbA1c levels in adult diabetic patients receiving two different treatment modalities: oral medications and insulin therapy.

The blood samples were processed using standardized laboratory techniques. Glucose levels were measured using the glucose dehydrogenase method on an automated chemistry analyzer, the Beckman AU 300. This method relies on the enzymatic oxidation of glucose to gluconolactone by glucose dehydrogenase, with the generated NADH

being proportional to the glucose concentration. The test is quantitative and can be performed using both kinetic and endpoint methods, making it suitable for automation. Commercial kits were used, and the procedure followed the manufacturer's instructions. Reference ranges for glucose levels were defined as follows: fasting blood sugar (FBS) between 60–100 mg/dl and random blood sugar (RBS) between 80–160 mg/dl. Patients with fasting blood glucose levels >126 mg/dl or random blood glucose levels >200 mg/dl were classified as diabetic.

For HbA1c measurement, the fluorescence immunoassay technology was employed using the WONDFU machine. This method is based on the sandwich immune detection principle. When a blood sample is added to the test cartridge, fluorescence-labeled detector antibodies bind to HbA1c and Hb antigens, forming immune complexes. These complexes migrate along the nitrocellulose matrix of the test strip via capillary action, where they are captured by immobilized antibodies. The fluorescence signal intensity reflects the HbA1c-to-Hb ratio in the blood sample. The procedure involved drawing 10 µL of whole blood, mixing it with detection buffer, transferring 75 µL of the mixture to the test cartridge, and processing it on the WONDFU machine. Results were displayed within four minutes, with an HbA1c level >6.5% considered indicative of diabetes.

Out of the 100 patients, 51 were on insulin therapy, while 49 were taking oral medications. The study aimed to assess the effectiveness of these treatments in managing diabetes by comparing HbA1c levels between the two groups. The results indicated that patients on oral medications had slightly better HbA1c control compared to those on insulin therapy. The findings underscore the importance of proper diabetes management, including lifestyle modifications such as regular exercise, low caloric intake, and reduced sugar consumption, along with patient awareness and adherence to therapeutic measures. These strategies are crucial for preventing diabetes-associated complications and improving overall glycemic control.

Results

In this study, the total number of 100 subjects was selected, written consent was taken from all 100 Participants, HbA1c and glucose of the samples was measured. All the samples were processed on the automated chemistry analyzer Beckman AU 480 for the glucose estimation. HbA1c measurement was taken on WONDFU machine and finally results were taken as final measurement.

Table I: Distribution of HbA1c fasting blood sugar and random blood sugar among diabetic patients.

Characteristic	Groups	N	%
HbA1c	6.8% to 9.5%	62	62%
	9.6% to 14.5%	38	38%
Fasting Blood Sugar	120 to 200	57	57%
	201 to 250	43	43%
Random Blood sugar	180 to 250	76	76%
	250 to 350	24	24%

Table II shows correlation between HbA1c and characteristics including BSR, patients on insulin and patients on medication. There is strong correlation between HbAIc and BSR (p=0.00). There is a positive correlation(r=0.40) between HBA1C and patients on medication as compared to patients on insulin which shows negative relationship (r=-0.40).

Table II: Correlation between HbA1c and BSR, in patients taking insulin and oral medication

Characteristics	HBA1C	P value
Random blood sugar	r=0.79	0
Patients on Insulin	r=-0.40	0.69
Patients on Medication	r=0.40	0.69

Table III shows findings of glycemic control among patients taking insulin and those on oral

medications. Out of 100 patients, 62.7% of insulin users and 61.2% of oral medication users had HbA1c levels between 6.8% and 9.5%. Additionally, 37.3% of insulin users and 38.8% of those on oral medications had poor control with HbA1c levels ranging from 9.6% to 14.5%.

Table. III: HbA1c level in patients who were taking insulin and Oral Medications

Treatment	No. of Patients	HbA1c Level
Insulin	32	6.8 to 9.5%
	19	9.6 to 14.5%
Oral Medications	30	6.8 to 9.5%
	19	9.6 to 14.5%

Discussion

Out of 100 patients, 51 patients were taking insulin and 49 were on oral medicine. All the 100 patients were showing their abnormal HbA1c level, with 62% patients showing HbA1c level between 6.8% to 9.5% and 38% patients showing HbA1c level between 9.6% and 14.5%. Out of 51 patients who were taking insulin, 32 patients were showing their Hba1c level between 6.8 to 9.5% and 19 patients were showing 9.6 to 14.5%. Out of 49 patients who were taking oral medications, 30 patients were showing their HbA1c level between 6.8 to 9.5% and 19 patients were showing their HbA1c level between 14.5%.

Consistent findings were advocated in studies conducted by Anjum et al, Adams et al, Vaughan et al, who described that while insulin therapy is essential for many patients, oral medications may offer better glycemic control for others, especially when considering factors like adherence, cost, and patient preferences.[15,16,17]

Our study identified a strong positive correlation between HbA1c and random blood sugar (RBS) levels ($r = 0.79$, $p < 0.001$), indicating that higher RBS values are associated with elevated HbA1c levels. This is consistent with previous research demonstrating significant correlations between HbA1c and various blood glucose measurements. For instance, Ansari et al. reported Pearson correlation coefficients of 0.75 for postprandial glucose, 0.73 for fasting glucose, and 0.59 for random glucose, all with p-values < 0.01, suggesting that postprandial glucose correlates most strongly with HbA1c levels.[18] Similarly, a study by Kazmi et al found a significant linear positive correlation between HbA1c and random blood glucose levels, reinforcing the utility of RBS measurements in assessing long-term glycemic control.[19]

In our cohort, 51% of patients were on insulin therapy, with 32% exhibiting HbA1c levels between 6.8% and 9.5%, and 19% between 9.6% and 14.5%. Among the 49% on oral medications, 30% had HbA1c levels between 6.8% and 9.5%, and 19% between 9.6% and 14.5%. These findings suggest that patients on oral medications may achieve comparable glycemic control to those on insulin therapy. This observation aligns with the study by Farmer et al, which concluded that while both treatment modalities were ineffective in achieving optimal glycemic control, oral medications significantly lowered HbA1c levels compared to insulin therapy.[20]

A meta-analysis by Bongiovanni et al further backed our finding by concluded that patients on oral agents, particularly metformin and SGLT2 inhibitors, often exhibited better adherence and glycemic outcomes than those on insulin, who were more prone to fluctuations in HbA1c due to regimen complexity and risk of hypoglycemia.[21]

Conclusion

In this study the HbA1c level slightly improved in patients who were taking oral medication than those who were on insulin. Diabetes is the leading cause of most diseases. So, proper control, patient awareness and management measures should be taken to prevent the spread of diseases that are associated with diabetes mellitus. The daily exercise routine, low caloric intake, limited use of sweet intake in their routine life and their awareness about the diabetes mellitus are strongly associated with their HbA1c control

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