Original Article

Clinical Profile of Patients with Type 2 Diabetes Mellitus Initiated on Insulin Therapy: A Single-Center Experience

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ABSTRACT

Objective: The objectives of the present study was to describe the demographic and clinical characteristics of people with type 2 diabetes initiated on insulin therapy and to identify common comorbidities and complications present at insulin initiation.

Methodology: It was a retrospective observational study conducted at the Endocrinology clinics of the Shifa International Hospital, Islamabad. Adults (≥18 years) with a diagnosis of T2DM who are being started on insulin therapy for the first time were included in the study. Patients already on insulin or who have used insulin previously due to any reason were excluded. Patients with hyperglycemic emergencies, pregnancy, hospitalization were also excluded. Data was collected from Electronic Medical Records over a period of 3 years from 2022-2025.

Results: In the cohort of 270 patients, who were started on insulin for the first time, there were 150 males (55.6%) and 120 females (44.4%), with a mean age of 56.8 ± 10.1 years (range: 30–80 years). Their mean duration of diabetes was 11.07 ± 5.0 years (range: 2–25 years). The overall mean HbA1c was 10.73 ± 1.81 % (range: 7.3–15.2), while the mean fasting plasma glucose (FPG) was 208.8 ± 41.6 mg/dL (range: 145–400). Most patients (56.7%) were on triple-drug therapy, followed by four-drug therapy (23.3%), dual therapy (15.2%), monotherapy (3.3%), and five-drug therapy (1.5%). Most common microvascular complication was neuropathy (43%) while most common macrovascular complication was CAD (14.4%). The most frequent reason for insulin initiation was failure of oral drugs (81.9%). Basal insulin was the most commonly initiated insulin (67.8%), followed by premixed insulin (31.5%) and basal-bolus (0.7%). Mean HbA1c was significantly higher among those started on premixed insulin (12.19 ± 1.48 %) compared to basal insulin (10.05 ± 1.51 %).

Conclusions: Insulin therapy was most commonly initiated after failure of three or more oral glucose-lowering agents and at markedly elevated HbA1c levels, suggesting delayed treatment intensification. Longer duration of diabetes and poorer glycemic control were associated with a higher prevalence of diabetes-related complications, highlighting the need for earlier insulin initiation and timely optimization of glycemic management..

KEY WORDS: Diabetes type 2, Diabetes complications, Insulin initiation.

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INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder characterized by insulin resistance and progressive pancreatic β-cell dysfunction, often resulting in the need for exogenous insulin therapy. Despite the availability of multiple oral antidiabetic agents and injectable GLP-1 agonists, a significant proportion of patients eventually require insulin to achieve glycemic targets.[1] Understanding the clinical profiles of patients who are initiated on insulin is essential for optimizing care, tailoring education, and improving outcomes.

The transition to insulin therapy in T2DM is a critical juncture that may be influenced by several factors, including disease duration, glycemic control, comorbidities, patient attitudes and healthcare provider practices. Previous studies have highlighted variability in the timing and indications for insulin initiation, but comprehensive profiling of these patients remains limited.[2]

To reduce morbidity and mortality associated with diabetes a special emphasis should be to reach target HbA1c for respective patients quickly and safely. The ADA recommends insulin initiation if target HbA1c cannot be achieved with oral and injectable non-insulin medications and if patient presents with severe hyperglycemia (BSR>300 mg/dl or hBA1c > 10% or symptoms of hyperglycemia or evidence of catabolism.[3,4] By profiling patients at the start of insulin therapy, healthcare providers can better anticipate challenges, address barriers, and individualize treatment strategies. This research proposal aims to systematically investigate the characteristics of T2DM patients at the point of insulin initiation.

The Objectives of the present study were to describe the demographic and clinical characteristics of people with T2DM initiated on insulin therapy and to identify common comorbidities and complications present at insulin initiation.

METHODOLOGY

This was a retrospective observational study conducted at the Endocrinology clinics of the Shifa International Hospital, Islamabad. Adults (≥18 years) with a diagnosis of T2DM who are being started on insulin therapy for the first time were included in the study.

Patients already on insulin or who have used insulin previously due to any reason, patients with Type 1 Diabetes or with suspicion of type 1 diabetes, history of decompensated Cirrhosis of Liver or acute Hepatitis, history of recent Diabetic Emergency (Ketoacidosis or Hyperosmolar state). history of Gestational Diabetes or on insulin for control of diabetes during pregnancy, patients started on Insulin temporarily prior to any hospitalization or acute infection and patients requiring hospitalization due to reasons other than diabetes were excluded from the study.

Total number of patients included in this study were 270, calculated with an anticipated population proportion of 50%, absolute precision of 6% and having 95% confidence level.

Data was collected from Electronic Medical Records over a period of 3 years from 2022-2025 that included patients demographics (age, gender, initial or follow-up visits), duration of diabetes, HbA1c, BMI, prior oral antidiabetic use and comorbidities such as Chronic Kidney Disease (CKD), Coronary artery disease (CAD), Stroke, diabetic foot and diabetic microvascular complications. Peripheral neuropathy, micro albuminuria/ diabetic nephropathy and diabetic retinopathy was diagnosed by examination of feet (impaired vibration sense, impaired reflexes, impaired touch sensations), urine albumin to creatinine ratio or 24hour urine protein measurements and Fundoscopy. Diabetic Nephropathy was diagnosed when proteinuria was above 300mg/dl. HbA1c and fasting blood glucose were used to assess glycemic control.

Table-I: Patient medications when insulin was initiated.

		Diabetes Duration (years)	*HbA1c*
No. of Non-Insulin medications	*N*	*Mean (Std. Deviation)*	*Mean (Std. Deviation)*
Monotherapy	9	11.11 (2.977)	12.4 (1.0345)
Dual Therapy	41	11.80 (5.689)	11.6(1.7308)
Triple Therapy	153	10.67 (4.703)	10.8 (1.6810)
On 4 Drugs	63	11.41 (5.572)	10.1 (1.8962)
On 5 Drugs	4	13.75 (1.893)	11.3(2.3670)
Total	270	11.07 (5.008)	10.7 (1.8090)

Other complications like coronary artery disease, stroke and Diabetic foot were diagnosed on the basis of history and past records. Chronic kidney disease was diagnosed when eGFR was below 50.

Descriptive statistics will summarize patient characteristics. Comparative analyses (e.g., t-tests, chi-square tests, ANOVA) were used to explore associations between demographic and clinical variables.

RESULTS

In the cohort of 270 patients, who were started on insulin for the first time, consisted of 150 males (55.6%) and 120 females (44.4%), with a mean age of 56.8 ± 10.1 years (range: 30–80 years). Their mean duration of diabetes was 11.07 ± 5.0 years (range: 2–25 years).

The overall mean HbA1c was 10.73 ± 1.81 % (range: 7.3–15.2), while the mean fasting plasma glucose (FPG) was 208.8 ± 41.6 mg/dL (range: 145–400).

Most patients (56.7%) were on triple-drug therapy, followed by four-drug therapy (23.3%), dual therapy (15.2%), monotherapy (3.3%), and five-drug therapy (1.5%). Respective duration of diabetes can be seen in Table-I. A weak, negative correlation was observed between duration of diabetes and HbA1c ($r = -0.117$, $p = 0.055$), which was not statistically significant.

Most commonly used drug class was Biguanide (Metformin): 92.2% followed by Sulfonylureas: 83.3%, DPP-4 inhibitors: 81.9%, SGLT2 inhibitors: 38.5%, Thiazolidinediones (TZDs): 5.6%, Acarbose: 2.2%, GLP-1 agonists: 1.1%. A stepwise decline in mean HbA1c was noted with increasing number of OADs, although not statistically significant ($p > 0.05$)

Base line Microvascular and Macrovascular Complications: Most common microvascular complication was neuropathy (43%) while most common macrovascular complication was CAD (14.4%). For details seen Table-II and Box Plot-1 (Fig.1).

Table-II: Complications when insulin was initiated.

Complication	*n (%)*
Neuropathy	116 (43.0%)
Microalbuminuria	79 (29.3%)
Nephropathy	30 (11.1%)
Retinopathy	56 (20.7%)
Diabetic foot	7 (2.6%)
Coronary Artery disease (CAD)	39 (14.4%)
Stroke	7 (2.6%)
Chronic kidney disease (CKD)	32 (11.9%)

Relationship Between Glycemic Control and Complications: ANOVA analysis revealed a significant difference in HbA1c among groups stratified by number of microvascular complications ($p = 0.033$). Mean HbA1c increased progressively with greater complication burden as can be seen in the box plot 1. Patients with CKD had a slightly lower mean HbA1c (10.35 ± 1.89 %) compared with those with normal renal function (10.78 ± 1.80 %), though the difference was not significant ($p > 0.05$).

Reasons for Insulin Initiation: The most frequent reason for insulin initiation was failure of oral drugs (81.9%), followed by others as can be seen in Table-III.

Regarding insulin regimens, basal insulin was the most commonly initiated (67.8%), followed by premixed insulin (31.5%) and basal-bolus (0.7%). Mean HbA1c was significantly higher among those started on premixed insulin (12.19 ± 1.48 %) compared to basal insulin (10.05 ± 1.51 %).

Among the participants, 208 (77%) were started on insulin on their initial visit, while 62 (23%) patients were on their follow-up visits. Patients on follow-up had significantly better glycemic control with lower mean HbA1c (9.69 ± 1.64 %) compared to new patients (11.04 ± 1.74 %, $p < 0.001$).

DISCUSSION

This study evaluated the clinical and treatment characteristics of patients with type 2 diabetes mellitus (T2DM) at a tertiary care center with a particular focus on glycemic control, oral antidiabetic drug (OAD) use and diabetes-related complications. The findings reveal that overall glycemic control among this cohort was suboptimal with a mean HbA1c of 10.7%, despite

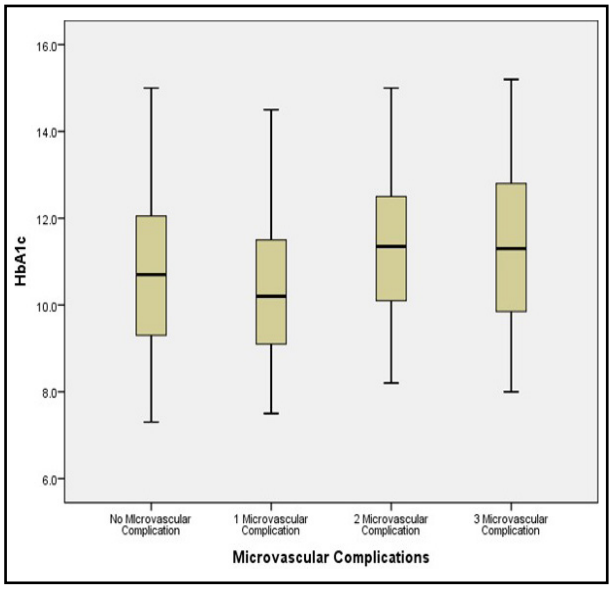

Fig.1: Box Plot 1. HbA1c and Microvascular complications when insulin was initiated.

Table-III: Reasons of initiation of Insulin.

		HbA1c	
Reason for Start	*N (%)*	*Mean*	*Std. Deviation*
Failure of Oral Drugs	221 (81.9)	10.518	1.7801
Poor control (HbA1c > 10%)	14 (5.2)	12.450	1.0882
Side effects of oral medications	3 (1.1)	9.167	.9292
Long Duration of Diabetes (>10yrs)	20 (7.4)	11.880	1.4863
Complications of Diabetes and Long Duration	7 (2.6)	11.643	1.5219
CKD and poor control	5 (1.9)	10.200	2.1048

the majority of patients being on combination therapy. This highlights persistent challenges in achieving optimal glycemic targets in real-world settings, even with polypharmacy and newer therapeutic agents.

The mean HbA1c of 10.7% observed in this study is notably higher than that reported in regional and international studies where mean HbA1c levels typically range from 8.0% to 9.0% among treated T2DM populations.[5] Such elevated HbA1c values suggest delayed treatment intensification, inadequate adherence, or clinical inertia in initiating insulin therapy. Clinical inertia remains a major barrier to achieving glycemic targets worldwide. Evidence indicates that insulin initiation is often delayed for several years after failure of oral glucose-lowering therapy, exposing patients to prolonged periods of hyperglycemia and increasing the risk of diabetes-related complications. Recent consensus statements advocate timely treatment intensification and individualized therapeutic approaches to minimize therapeutic inertia.[5-7]

Over half of the participants (56.7%) were on triple OAD therapy, while almost a quarter were on four-drug combinations. Metformin, sulfonylureas, and DPP-4 inhibitors were the most commonly used medications, inconsistent with current international guidelines and prescribing trends.[3,4] The relatively low use of SGLT2 inhibitors (38.5%) and GLP-1 receptor agonists (1.1%) indicates limited uptake of newer, evidence-based agents in local practice likely due to cost constraints or access issues. Contemporary international guidelines increasingly recommend SGLT2 inhibitors and GLP-1 receptor agonists not only for glycemic control but also for their proven cardiovascular and renal protective effects, irrespective of baseline HbA1c in patients with established cardiovascular disease, chronic kidney disease, or heart failure. Limited utilization of these agents in our cohort may reflect economic barriers, restricted availability, and prescribing practices in low- and middle-income countries.[6,7] A trend toward improved HbA1c with increasing number of oral medications was noted, though it did not reach statistical significance.

The prevalence of microvascular complications—neuropathy (43%), retinopathy (20.7%) and microalbuminuria (29.3%) were slightly higher than rates reported in other international studies.[8,9] The high burden of complications likely reflects prolonged disease duration, suboptimal glycemic control, and limited routine screening practices.

The presence of multiple microvascular complications was significantly associated with higher HbA1c and fasting glucose levels (p = 0.033 and p = 0.029, respectively). This reinforces the established relationship between chronic hyperglycemia and microvascular damage, as demonstrated in landmark trials such as the UKPDS and DCCT. Macrovascular disease was also common, with ischemic heart disease present in 14.4% and stroke in 2.6% of patients, further highlighting the dual burden of vascular complications in poorly controlled diabetes.

Although patients with CKD exhibited slightly lower mean HbA1c compared to those with normal renal function, the difference was not statistically significant. This apparent paradox has been described in previous literature and may be explained by reduced erythrocyte lifespan, altered glycation kinetics, or selective treatment intensification among patients with renal impairment.[10-11]

The predominant reason for initiating insulin therapy in this cohort was failure of oral drugs (81.9%), reflecting a pattern of late insulin initiation similar to that reported in other Asian studies.[8] Patients started on premixed insulin had significantly higher baseline HbA1c (12.2%) compared to those on basal insulin (10.0%), suggesting that premixed regimens were often chosen for individuals with more advanced disease or poorer control. These results underscore the

importance of early identification of treatment failure and timely transition to injectable therapy to prevent long-term metabolic deterioration.[11]

A significant reduction in HbA1c was observed among follow-up patients compared to new cases (9.7% vs. 11.0%, $p < 0.001$), indicating that ongoing clinical engagement and therapy optimization can yield meaningful glycemic improvements. This finding emphasizes the importance of structured follow-up, patient education, and timely treatment intensification for long-term control.

The high rates of uncontrolled diabetes despite multiple drug therapies highlight an urgent need for early therapeutic intensification and individualized treatment strategies. Expanding access to newer glucose-lowering agents, addressing medication adherence, and strengthening diabetes education programs are critical steps to improving outcomes in this population. This study has several limitations. Being cross-sectional, causal relationships between treatment patterns and outcomes cannot be established. Data were derived from a single center, which may limit generalizability. Self-reported adherence and lifestyle factors were not assessed, which could influence glycemic outcomes. Despite these limitations, the study provides valuable insight into real-world diabetes management patterns and unmet needs in glycemic control within the local population.

The main limitation of this study was the single center analysis and data collection. More similar studies are needed with bigger sample size.

CONCLUSION

Insulin therapy was most commonly initiated after failure of three or more oral glucose-lowering agents and at markedly elevated HbA1c levels, suggesting delayed treatment intensification. Longer duration of diabetes and poorer glycemic control were associated with a higher prevalence of diabetes-related complications, highlighting the need for earlier insulin initiation and timely optimization of glycemic management.

Competing interest: Nothing to declare.

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Ethical Approval: The study was approved by the institutional review board of Shifa international Hospital, Islamabad-Pakistan.

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