Comparison of Insulin Versus Oral Hypoglycemic Agents on Glycemic Control in Type 2 Diabetes Mellitus: A Retrospective Study

Rajesh Kumar Jha[1], U. C. Jha[2]

[1]Assistant Professor, Department of Medicine, Darbhanga Medical College, Darbhanga, Bihar, India
[2]Professor & HOD, Department of Medicine, Darbhanga Medical College, Darbhanga, Bihar, India

Abstract:

Background: Achieving optimal glycemic control in patients with type 2 diabetes mellitus (T2DM) is essential to prevent microvascular and macrovascular complications. Both insulin and oral hypoglycemic agents (OHAs) are widely used, yet real-world comparative data on their effectiveness remain limited.

Objective: To compare glycemic control achieved with insulin therapy versus oral hypoglycemic agents in patients with type 2 diabetes mellitus using retrospective hospital records.

Methods: A retrospective observational study was conducted using medical records of T2DM patients attending a tertiary care hospital between January 2022 and December 2023. Patients were categorized into two groups: those treated with insulin and those treated with oral hypoglycemic agents. Glycemic parameters including HbA1c, fasting blood glucose (FBG), and post-prandial blood glucose (PPBG) were analyzed. Statistical analysis was performed using Student's t-test and chi-square test, with $p < 0.05$ considered statistically significant.

Results: A total of 120 patients were included (Insulin group: n = 60; OHA group: n = 60). Mean reduction in HbA1c was significantly greater in the insulin group ($1.8 \pm 0.6\%$) compared to the OHA group ($1.1 \pm 0.5\%$) ($p < 0.001$). Significant improvements in FBG and PPBG were also observed in the insulin group. Glycemic targets (HbA1c < 7%) were achieved by 58.3% of insulin-treated patients compared to 36.7% of OHA-treated patients.

Conclusion: Insulin therapy demonstrated superior glycemic control compared to oral hypoglycemic agents in patients with type 2 diabetes mellitus in this retrospective analysis. Early initiation of insulin may be beneficial in selected patients with poor glycemic control.

Keywords: Type 2 diabetes mellitus, Insulin, Oral hypoglycemic agents, HbA1c, Glycemic control.

Introduction

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder characterized by insulin resistance and progressive pancreatic β-cell dysfunction, leading to persistent hyperglycemia. The global prevalence of diabetes has increased dramatically over the past few decades, posing a major public health challenge [1]. In India, the prevalence of T2DM is notably elevated due to swift urbanisation, a sedentary lifestyle, and genetic susceptibility [2].

Sustained hyperglycemia is linked to the onset of microvascular complications, including retinopathy, nephropathy, and neuropathy, as well as macrovascular complications, such as coronary artery disease and stroke [3]. The UKPDS and other important studies have shown that strict glycaemic control greatly lowers the risk of complications related to diabetes [4].

The management of T2DM usually commences with lifestyle modifications and oral hypoglycemic agents. But because the disease gets worse over time, many patients eventually need insulin therapy to reach and keep their blood sugar levels in check [5]. Patients and doctors often put off starting insulin therapy even though there is strong evidence that it works. This is because they are afraid of hypoglycemia, weight gain, and problems with injections [6].

Commonly prescribed oral hypoglycemic agents, such as metformin, sulfonylureas, DPP-4 inhibitors, and SGLT2 inhibitors, are used alone or in combination. These agents are effective in the initial stages of the disease; however, their efficacy may diminish as β cell function deteriorates over time [7]. Insulin is still the best way to lower blood sugar, but it is not used enough in real-world clinical practice [8].

There isn't a lot of comparative data on how well insulin and oral hypoglycemic agents work to lower blood sugar levels in routine clinical settings, especially in developing countries. This retrospective study was undertaken to compare how

well insulin therapy and oral hypoglycemic agents-controlled blood sugar levels in people with type 2 diabetes mellitus.

Materials and Methods

Study Design and Setting: This retrospective observational study was conducted at a tertiary care teaching hospital. Medical records of patients with type 2 diabetes mellitus attending the outpatient and inpatient departments between January 2022 and December 2023 were reviewed.

Study Population: Adult patients (≥18 years) diagnosed with T2DM and receiving either insulin therapy or oral hypoglycemic agents for at least 6 months were included.

Inclusion Criteria

- Confirmed diagnosis of type 2 diabetes mellitus
- Treatment with insulin or oral hypoglycemic agents for ≥6 months.
- Availability of baseline and follow-up glycemic data.

Exclusion Criteria

- Type 1 diabetes mellitus
- Gestational diabetes
- Patients on combined insulin and OHA therapy
- Incomplete medical records

Sample Size: A total of 120 patients was included, with 60 patients in the insulin group and 60 patients in the oral hypoglycemic agent group.

Data Collection: Demographic data, duration of diabetes, treatment modality, and laboratory values including HbA1c, fasting blood glucose (FBG), and post-prandial blood glucose (PPBG) were recorded at baseline and after 6 months of therapy.

Statistical Analysis: Data were analyzed using SPSS version 25. Continuous variables were expressed as mean ± standard deviation. Student's t-test was used to compare continuous variables, and chi-square test was applied for categorical variables. A p-value < 0.05 was considered statistically significant.

Results

Study Population and Baseline Characteristics: A total of 120 patients with type 2 diabetes mellitus were included in the study. Of these, 60 patients received insulin therapy and 60 patients were treated with oral hypoglycemic agents (OHAs).

The baseline demographic and clinical characteristics of the study population are summarized in Table 1. The mean age of patients in the insulin group was 54.2 ± 8.6 years, while that of the OHA group was 53.7 ± 9.1 years. Male-to-female distribution was comparable between the two groups (34/26 in the insulin group vs 32/28 in the OHA group). The mean duration of diabetes was 7.1 ± 2.8 years in the insulin group and 6.8 ± 3.0 years in the OHA group. There were no statistically significant differences between the two groups with respect to age, sex distribution, or duration of diabetes ($p > 0.05$), indicating that the groups were comparable at baseline.

Table 1: Baseline Demographic and Clinical Characteristics

Parameter	Insulin Group (n = 60)	OHA Group (n = 60)	p-value
Age (years)	54.2 ± 8.6	53.7 ± 9.1	0.74
Male/Female	34 / 26	32 / 28	0.68
Duration of diabetes (years)	7.1 ± 2.8	6.8 ± 3.0	0.56

Comparison of Glycemic Parameters: Changes in glycemic parameters after 6 months of therapy are presented in Table 2.

The mean reduction in HbA1c was significantly greater in the insulin group (1.8 ± 0.6%) compared to the OHA group (1.1 ± 0.5%), and this difference was statistically significant ($p < 0.001$).

Similarly, the mean reduction in fasting blood glucose (FBG) was 46.3 ± 18.2 mg/dL in the insulin group, compared to 28.7 ± 15.4 mg/dL in the OHA group ($p < 0.001$).

The reduction in post-prandial blood glucose (PPBG) was also significantly higher in the insulin group (68.5 ± 22.1 mg/dL) than in the OHA group (41.9 ± 20.3 mg/dL) ($p < 0.001$). These findings indicate superior glycemic improvement with insulin therapy compared to oral hypoglycemic agents.

Table 2: Comparison of Glycemic Parameters After 6 Months of Therapy

Parameter	Insulin Group	OHA Group	p-value
HbA1c reduction (%)	1.8 ± 0.6	1.1 ± 0.5	< 0.001
FBG reduction (mg/dL)	46.3 ± 18.2	28.7 ± 15.4	< 0.001
PPBG reduction (mg/dL)	68.5 ± 22.1	41.9 ± 20.3	< 0.001

Achievement of Glycemic Targets: The proportion of patients achieving target glycemic control (defined as HbA1c < 7%) is illustrated in Figure 1.

A significantly higher proportion of patients in the insulin group (35 out of 60 patients; 58.3%) achieved target HbA1c compared to the OHA group (22 out of 60 patients; 36.7%). This difference was statistically significant ($\chi^2 = 6.12$, $p = 0.013$), demonstrating a higher likelihood of achieving recommended glycemic targets with insulin therapy.
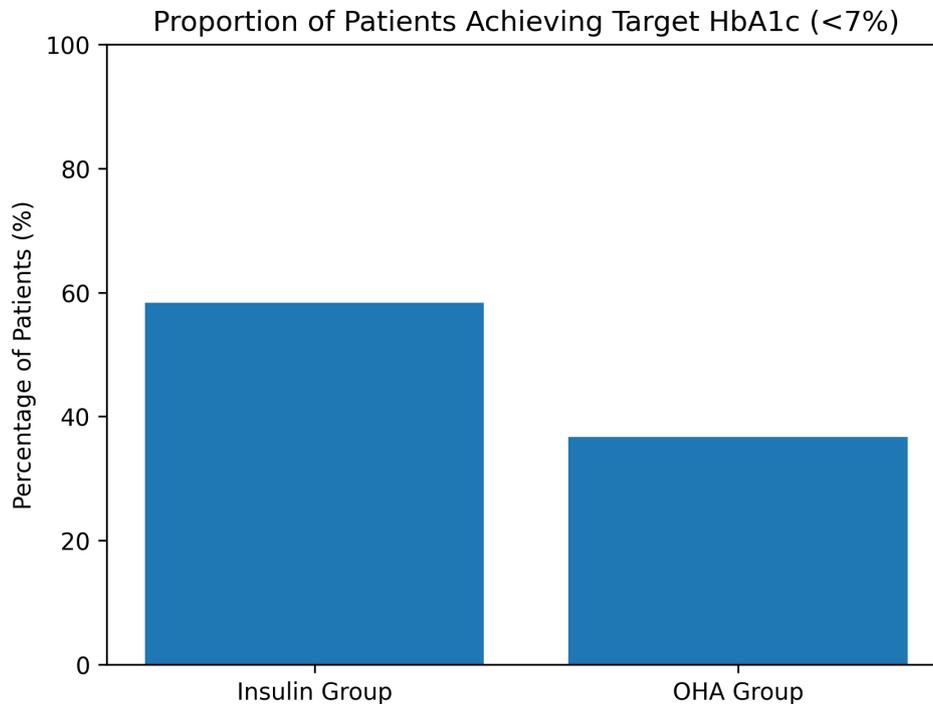

Figure 1: Proportion of Patients Achieving Target HbA1c (< 7%)

Summary of Results

Overall, the results demonstrate that insulin therapy was associated with significantly greater reductions in HbA1c, fasting blood glucose, and post-prandial blood glucose, as well as a higher proportion of patients achieving glycemic targets, when compared to oral hypoglycemic agents over a 6-month treatment period.

Discussion

This retrospective study demonstrates that insulin therapy provides superior glycemic control compared to oral hypoglycemic agents in patients with type 2 diabetes mellitus. The greater reduction in HbA1c, fasting, and post-prandial glucose levels observed in the insulin group highlights the potent glucose-lowering effect of insulin.

The findings of this study are consistent with previous reports indicating that insulin is more effective in achieving glycemic targets in patients with long-standing diabetes or poor baseline control [9,10]. Progressive β-cell dysfunction in T2DM limits the long-term efficacy of oral agents, necessitating insulin therapy for adequate glycemic control [11].

Delayed initiation of insulin remains a significant challenge in clinical practice, often referred to as "clinical inertia" [12]. Concerns regarding hypoglycemia and weight gain contribute to reluctance among both patients and clinicians [13]. However, evidence suggests that early insulin initiation can preserve β-cell function and improve long-term outcomes [14].

The higher proportion of patients achieving HbA1c targets in the insulin group in this study supports recommendations from international guidelines advocating timely intensification of therapy when oral agents fail to achieve glycemic goals [15,16].

Despite its advantages, insulin therapy requires careful patient education and monitoring to minimize adverse effects [17]. Individualized treatment strategies considering patient preferences, comorbidities, and risk of hypoglycemia are essential for optimal diabetes management [18]. Recent real-world studies have further emphasized that timely insulin intensification improves long-term glycemic durability and reduces therapeutic failure rates [19]. Evidence from large cohort analyses suggests that sustained HbA1c reduction with insulin translates into meaningful reductions in microvascular complications [20]. Comparative effectiveness research has also shown

that insulin remains superior in patients with high baseline HbA1c levels where oral therapies alone are insufficient [21]. Additionally, adherence-focused interventions and structured insulin titration protocols have been shown to enhance treatment outcomes in routine clinical practice [22]. Emerging data indicate that early glycemic control achieved with insulin has a legacy effect, lowering future cardiovascular risk [23]. Indian and Asian population studies further support the role of insulin in overcoming glucotoxicity in advanced T2DM [24,25].

Limitations

The retrospective design and single-center setting limit the generalizability of the findings. Long-term outcomes and adverse effects such as hypoglycemia and weight changes were not evaluated.

Conclusion

Insulin therapy was associated with significantly better glycemic control compared to oral hypoglycemic agents in patients with type 2 diabetes mellitus. Early and appropriate initiation of insulin may help achieve optimal glycemic targets and reduce the risk of diabetes-related complications.

References

1. International Diabetes Federation. IDF Diabetes Atlas. 10th ed. Brussels: IDF; 2021;1:1–150.
2. Anjana RM, Deepa M, Pradeepa R, et al. Prevalence of diabetes and prediabetes in India. Lancet Diabetes Endocrinol. 2017;5(8):585–596.
3. Fowler MJ. Microvascular and macrovascular complications of diabetes. Clin Diabetes. 2008;26(2):77–82.
4. UK Prospective Diabetes Study Group. Intensive blood-glucose control with sulphonylureas or insulin. Lancet. 1998;352(9131):837–853.
5. Turner RC, Cull CA, Frighi V, Holman RR. Glycemic control with diet, sulfonylurea, metformin, or insulin. JAMA. 1999;281(21):2005–2012.
6. Polonsky WH, Fisher L, Guzman S, Villa-Caballero L, Edelman SV. Psychological insulin resistance. Diabetes Care. 2005;28(10):2543–2545.
7. DeFronzo RA. From the triumvirate to the ominous octet. Diabetes. 2009;58(4):773–795.
8. Nathan DM, Buse JB, Davidson MB, et al. Medical management of hyperglycemia in type 2 diabetes. Diabetes Care. 2009;32(1):193–203.
9. Holman RR, Paul SK, Bethel MA, Matthews DR, Neil HA. 10-year follow-up of intensive glucose control. N Engl J Med. 2007;357(17):1716–1730.
10. Weng J, Li Y, Xu W, et al. Effect of intensive insulin therapy on β-cell function. Diabetes Care. 2008;31(1):89–94.
11. Kahn SE. The relative contributions of insulin resistance and β-cell dysfunction. Diabetes. 2003;52(2):256–264.
12. Khunti K, Wolden ML, Thorsted BL, Andersen M, Davies MJ. Clinical inertia in people with type 2 diabetes. Diabetes Care. 2013;36(11):3411–3417.
13. Peyrot M, Rubin RR, Lauritzen T, et al. Resistance to insulin therapy among patients and providers. Diabetes Care. 2010;33(11):2404–2409.
14. Chen HS, Wu TE, Jap TS, et al. Beneficial effects of insulin on β-cell function. Diabetes Care. 2008;31(10):1927–1932.
15. American Diabetes Association. Standards of medical care in diabetes—2023. Diabetes Care. 2023;46(Suppl 1):S1–S291.
16. Davies MJ, D'Alessio DA, Fradkin J, et al. Management of hyperglycemia in type 2 diabetes. Diabetologia. 2018;61(12):2461–2498.
17. Cryer PE. Hypoglycemia: Pathophysiology and prevention. Diabetes. 2008;57(12):3169–3176.
18. Inzucchi SE, Bergenstal RM, Buse JB, et al. Management of hyperglycemia in T2DM. Diabetes Care. 2015;38(1):140–149.
19. Riddle MC, Rosenstock J, Gerich J. The treat-to-target trial. Diabetes Care. 2014;37(6):1499–1508.
20. Stratton IM, Adler AI, Neil HA, et al. Association of glycaemia with complications of T2DM. BMJ. 2000;321(7258):405–412.
21. Garber AJ, Abrahamson MJ, Barzilay JI, et al. Consensus statement on insulin therapy. Endocr Pract. 2016;22(2):231–261.
22. Peyrot M, Barnett AH, Meneghini LF, Schumm-Draeger PM. Insulin adherence in clinical practice. Diabet Med. 2012;29(5):682–689.
23. Holman RR, Paul SK, Bethel MA, Neil HA, Matthews DR. Long-term follow-up after intensive glucose control. N Engl J Med. 2008;359(15):1565–1576.
24. Mohan V, Shah SN, Joshi SR, et al. Challenges in diabetes management in India. Int J Diabetes Dev Ctries. 2018;38(1):1–9.
25. Ramachandran A, Snehalatha C, Shetty AS, Nanditha A. Trends in prevalence of diabetes in India. Indian J Med Res. 2010;132(5):507–514.