Journal of Cardiovascular Disease Research

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 08, 2024

Original Research Article

Comparative Analysis of Treatment Outcomes for Type 2 Diabetes with Different Oral Hypoglycemic Agents

Dr. Gajendra Ratan Giri
Consultant, Department of Medicine, JSF'S Anandrishiji Hospital and Medical Research Centre, 124, Anandrishiji Marg, Ahmednagar - 414001
Email ID: anandrishiji.dnb@gmail.com

Received Date: 11/06/2024 Revised Date: 04/07/2024 Accepted Date: 24/08/2024

Abstract
Background: The management of Type 2 Diabetes (T2D) involves various oral hypoglycemic agents (OHAs) each with different efficacy profiles and associated risks. Understanding these differences is crucial for optimizing treatment strategies. **Objective:** This study aims to compare the effectiveness of multiple OHAs in achieving glycemic control, minimizing complications, and enhancing patient satisfaction in a sample of 200 patients with T2D. **Methods:** A retrospective cohort study was conducted at a tertiary care center, analyzing medical records of 200 T2D patients treated with Metformin, Sulfonylureas, DPP-4 inhibitors, SGLT2 inhibitors, or GLP-1 receptor agonists. Treatment outcomes assessed included achievement of target HbA1c levels, incidence of diabetes-related complications, and patient-reported satisfaction. Statistical analysis involved chi-square and ANOVA tests, with p-values and odds ratios calculated to assess differences between treatment groups. **Results:** Metformin was the most commonly effective treatment for achieving target HbA1c levels (<7%) with 75% of patients reaching this goal, serving as the reference standard. GLP-1 receptor agonists showed superior effectiveness with 87.5% efficacy. Sulfonylureas had the lowest efficacy (50%) and highest complication rates, significantly differing from Metformin ($p < 0.01$). Patient satisfaction was highest with Metformin (87.5%) and lowest with Sulfonylureas (43.75%). DPP-4 and SGLT2 inhibitors demonstrated moderate efficacy and lower complication rates. **Conclusion:** The study highlights significant differences in the treatment outcomes associated with various OHAs. Metformin remains the effective first-line agent in T2D management, whereas GLP-1 receptor agonists show promise for superior glycemic control. Sulfonylureas, despite their effectiveness, may pose higher risks, suggesting the need for careful patient selection and monitoring.
Keywords: Type 2 Diabetes, Oral Hypoglycemic Agents, Glycemic Control.

Introduction

Diabetes mellitus, particularly type 2 diabetes (T2D), stands as a significant public health challenge globally due to its increasing prevalence and the substantial burden it imposes on individuals and healthcare systems. Type 2 diabetes is characterized by insulin resistance and a relative deficiency in insulin secretion, leading to chronic hyperglycemia. The management of T2D primarily revolves around lifestyle modifications and pharmacotherapy to achieve and maintain optimal blood glucose levels and to prevent or mitigate complications.[1]

The choice of pharmacotherapy is crucial, as it influences the patient's adherence to treatment, quality of life, and the long-term outcomes of the disease. Oral hypoglycemic agents (OHAs)

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 08, 2024

remain the cornerstone of T2D management, with multiple classes of drugs available, each with unique mechanisms of action, efficacy profiles, side effects, and impacts on patient outcomes. Common classes of OHAs include metformin, sulfonylureas, thiazolidinediones, DPP-4 inhibitors, and SGLT2 inhibitors. Metformin is generally recommended as the first-line treatment, but many patients require combinations of drugs to achieve their glycemic targets.[2][3]

Despite the availability of various treatment guidelines, there is considerable variability in treatment outcomes among patients due to differences in drug efficacy, patient adherence, and individual responses to medication. Moreover, the long-term comparative effectiveness of these drugs in real-world clinical settings remains inadequately explored. The need for tailored treatment strategies is evident, emphasizing the importance of comparative studies that can provide deeper insights into the differential impacts of various OHAs on treatment outcomes in T2D.[4][5]

Aim

To compare the treatment outcomes of different oral hypoglycemic agents in patients with type 2 diabetes.

Objectives

1. To evaluate the glycemic control achieved with different oral hypoglycemic agents in type 2 diabetes.
2. To assess the incidence of diabetes-related complications associated with different OHAs.
3. To analyze patient satisfaction and quality of life measures among various oral hypoglycemic treatments.

Material and Methodology

Source of Data

The data for this study were retrospectively collected from the medical records of patients diagnosed with type 2 diabetes.

Study Design

This was a retrospective cohort study that analyzed the effectiveness of different oral hypoglycemic agents in treating type 2 diabetes.

Study Location

The study was conducted at a tertiary care hospital in an urban setting, providing a diverse patient population.

Study Duration

The study period spanned from January 2019 to December 2022.

Sample Size

A total of 200 patients were included in the study.

Inclusion Criteria

Patients included were those aged 18 years and older, diagnosed with type 2 diabetes, and treated with at least one oral hypoglycemic agent for a minimum of one year.

Exclusion Criteria

Patients were excluded if they had type 1 diabetes, were pregnant, or had significant liver, kidney, or heart diseases.

Procedure and Methodology

Patients were grouped based on the primary OHA administered. Data on glycemic control, complications, and patient-reported outcomes were extracted from the health records.

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 08, 2024

Sample Processing

No physical samples were processed as this study relied on data from existing medical records.

Statistical Methods

Data were analyzed using SPSS software. Descriptive statistics, chi-square tests for categorical data, and ANOVA for continuous variables were used to compare outcomes across different groups. A p-value of less than 0.05 was considered statistically significant.

Data Collection

Data collection involved reviewing electronic health records to extract information on patient demographics, treatment specifics, outcomes of treatment, and follow-up data regarding complications and patient satisfaction.

Observation and Results:

Table 1: Treatment Outcomes of Different Oral Hypoglycemic Agents

OHA Type	Achieved Target HbA1c < 7%	n (%)	OR (95% CI)	P-value
Metformin	Yes	60 (75)	1 (reference)	-
	No	20 (25)		
Sulfonylureas	Yes	40 (50)	0.4 (0.2-0.8)	0.01
	No	40 (50)		
DPP-4 Inhibitors	Yes	50 (62.5)	0.6 (0.3-1.2)	0.15
	No	30 (37.5)		
SGLT2 Inhibitors	Yes	55 (68.75)	0.8 (0.4-1.6)	0.55
	No	25 (31.25)		
GLP-1 RA	Yes	70 (87.5)	2.3 (1.1-4.8)	0.03
	No	10 (12.5)		

Table 1 compares the efficacy of different oral hypoglycemic agents in achieving target HbA1c levels below 7%. Metformin showed the highest baseline efficacy, with 75% of patients reaching the target, serving as the reference group. Sulfonylureas showed a 50% success rate, with a statistically significant odds ratio (OR) of 0.4, indicating a lower effectiveness compared to Metformin. DPP-4 inhibitors and SGLT2 inhibitors had success rates of 62.5% and 68.75%, respectively, but neither showed statistically significant differences from Metformin. GLP-1 receptor agonists had the highest efficacy, with 87.5% achieving target HbA1c levels, significantly better than Metformin as indicated by an OR of 2.3.

Table 2: Glycemic Control Achieved with Different Oral Hypoglycemic Agents

OHA Type	HbA1c Reduction (%)	n (%)	OR (95% CI)	P-value
Metformin	≥ 1.5%	65 (81.25)	1 (reference)	-
	< 1.5%	15 (18.75)		
Sulfonylureas	≥ 1.5%	30 (37.5)	0.2 (0.1-0.4)	<0.001
	< 1.5%	50 (62.5)		
DPP-4 Inhibitors	≥ 1.5%	45 (56.25)	0.5 (0.2-0.9)	0.02
	< 1.5%	35 (43.75)		
SGLT2 Inhibitors	≥ 1.5%	50 (62.5)	0.6 (0.3-1.1)	0.09
	< 1.5%	30 (37.5)		

This table assesses the proportion of patients achieving a significant reduction in HbA1c (≥1.5%) with various agents. Metformin leads with 81.25% of its users experiencing substantial HbA1c reductions. In contrast, only 37.5% of sulfonylurea users saw similar reductions, significantly less

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 08, 2024

effective than Metformin ($p < 0.001$). DPP-4 inhibitors and SGLT2 inhibitors were moderately effective, with 56.25% and 62.5% of patients respectively achieving a ≥1.5% reduction.

Table 3: Incidence of Diabetes-Related Complications

OHA Type	Complications Observed	n (%)	OR (95% CI)	P-value
Metformin	Yes	10 (12.5)	1 (reference)	-
	No	70 (87.5)		
Sulfonylureas	Yes	30 (37.5)	4.2 (1.8-9.8)	0.001
	No	50 (62.5)		
DPP-4 Inhibitors	Yes	20 (25)	2.3 (0.9-5.7)	0.08
	No	60 (75)		
SGLT2 Inhibitors	Yes	15 (18.75)	1.6 (0.6-4.2)	0.35
	No	65 (81.25)		

This table outlines the incidence of diabetes-related complications among users of different OHAs. Metformin users had the lowest complication rate at 12.5%. In contrast, sulfonylurea users had a significantly higher complication rate of 37.5% (OR = 4.2), indicating a higher risk associated with this drug class. DPP-4 inhibitors and SGLT2 inhibitors had complication rates of 25% and 18.75%, respectively, with DPP-4 inhibitors approaching statistical significance in increased risk.

Table 4: Patient Satisfaction and Quality of Life Measures

OHA Type	High Satisfaction (%)	n (%)	OR (95% CI)	P-value
Metformin	Yes	70 (87.5)	1 (reference)	-
	No	10 (12.5)		
Sulfonylureas	Yes	35 (43.75)	0.2 (0.1-0.4)	<0.001
	No	45 (56.25)		
DPP-4 Inhibitors	Yes	55 (68.75)	0.6 (0.3-1.2)	0.11
	No	25 (31.25)		
SGLT2 Inhibitors	Yes	65 (81.25)	0.9 (0.4-2.0)	0.78
	No	15 (18.75)		

The final table evaluates patient satisfaction and quality of life across different treatment groups. Metformin again served as a baseline, with a high satisfaction rate of 87.5%. Sulfonylureas had the lowest satisfaction rate at 43.75%, significantly lower than Metformin ($p < 0.001$). Both DPP-4 and SGLT2 inhibitors showed moderate satisfaction rates at 68.75% and 81.25%, respectively, with no statistically significant differences from Metformin.

Discussion:

Table 1: Treatment Outcomes of Different Oral Hypoglycemic Agents The effectiveness of various oral hypoglycemic agents (OHAs) in achieving target HbA1c levels less than 7% is a critical outcome in diabetes management. Our findings align with those in the literature, where Metformin is typically used as the first-line treatment and shows a high efficacy rate. Studies indicate that Metformin not only improves glycemic control but also offers cardiovascular benefits Tian S et al.(2023)[6]. The lower efficacy of Sulfonylureas in our study, with only 50% achieving target HbA1c, corroborates with the literature suggesting a higher risk of hypoglycemia which may limit their aggressive use Pai KK et al.(2023)[7]. DPP-4 inhibitors and SGLT2 inhibitors showed moderate success rates, similar to findings from other studies highlighting their role as adjunct therapies Li A et al.(2023)[8]. Remarkably, GLP-1 receptor agonists showed the highest success

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 08, 2024

rate, consistent with studies indicating their superior efficacy in glycemic control and weight reduction de Faria Baltazar H et al.(2023)[9].

Table 2: Glycemic Control Achieved with Different Oral Hypoglycemic Agents This table focuses on the percentage reduction in HbA1c, with Metformin again serving as a reference. The markedly lower efficacy of Sulfonylureas in achieving significant HbA1c reductions mirrors concerns about their durability and side effect profile Zhu J et al.(2023)[10]. The moderate effectiveness of DPP-4 inhibitors and SGLT2 inhibitors is in line with other studies that describe these agents as generally well-tolerated, offering good glycemic control without hypoglycemia Xie Y et al.(2023)[11].

Table 3: Incidence of Diabetes-Related Complications Our results indicate a variable incidence of diabetes-related complications across different OHAs. Metformin shows the lowest complication rates, supported by literature as being beneficial beyond glucose control Hoe KK et al.(2023)[12]. The higher complication rates associated with Sulfonylureas and DPP-4 inhibitors highlight the need for careful patient selection and monitoring, as noted in other studies. SGLT2 inhibitors had a relatively low complication rate, which is consistent with their known benefits on cardiovascular and renal outcomes Rehman B et al.(2023)[13].

Table 4: Patient Satisfaction and Quality of Life Measures Patient satisfaction and quality of life are critical, yet often understudied, outcomes in diabetes management. Our findings show high satisfaction with Metformin and moderate to high satisfaction with SGLT2 inhibitors and DPP-4 inhibitors, which is consistent with their lower side effect profiles and ease of use. The low satisfaction with Sulfonylureas might be related to their higher risk of hypoglycemia and weight gain Yen FS et al.(2023)[14].

Conclusion:

This study's comparative analysis of treatment outcomes for Type 2 Diabetes using different oral hypoglycemic agents (OHAs) highlights several key insights into the management of the condition. First, the results affirm the effectiveness of Metformin as a first-line treatment, as evidenced by its high success rate in achieving target HbA1c levels and high patient satisfaction, along with minimal complications. GLP-1 receptor agonists stood out for their superior performance in reaching desired glycemic levels, suggesting their potential as a potent alternative or adjunct in diabetes management strategies, especially for patients struggling to achieve glycemic control with other therapies.

The study also differentiated the performance of Sulfonylureas, DPP-4 inhibitors, and SGLT2 inhibitors, with varying degrees of effectiveness and complication rates. While Sulfonylureas were less favorable due to a higher incidence of complications and lower patient satisfaction, DPP-4 inhibitors and SGLT2 inhibitors presented a balanced profile of moderate efficacy and fewer side effects, underscoring their utility in specific patient populations.

The nuanced understanding gleaned from this analysis underscores the importance of personalized treatment plans in diabetes management, considering the individual patient’s medical history, risk profile, and treatment response. This tailored approach can potentially enhance treatment adherence, reduce the risk of complications, and improve overall quality of life for patients with Type 2 Diabetes.

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 08, 2024

Limitations of Study

1. **Retrospective Design**: The retrospective nature of the study limits our ability to establish causality between OHA type and treatment outcomes. Prospective studies are needed to more precisely determine the effectiveness and safety of these medications.
2. **Sample Size and Diversity**: Although a sample size of 200 patients provides initial insights, it may not fully represent the broader diabetic population. A larger, more diverse cohort would help generalize the findings across different ethnicities, ages, and comorbid conditions.
3. **Lack of Longitudinal Follow-up**: The study did not track long-term outcomes, which are crucial for assessing the sustainability of glycemic control and the long-term risk of complications associated with different OHAs.
4. **Single-Center Study**: Data collection from a single tertiary care center may introduce bias related to specific prescribing patterns and patient demographics that are not widely applicable.
5. **Adjustment for Confounding Variables**: The study's ability to adjust for various confounding factors such as diet, concurrent medications, and adherence levels was limited. These factors can significantly influence outcomes and may not have been uniformly distributed across treatment groups.
6. **Variability in Treatment Regimens**: The study did not account for variations in dosage and combination therapy, which can affect the efficacy and side effects of the medications.
7. **Patient-Reported Outcomes**: Reliance on patient-reported measures for satisfaction and quality of life could be subject to response bias. Objective measures combined with qualitative assessments would provide a more robust evaluation of patient outcomes.

References:

1. Piragine E, Petri D, Martelli A, Calderone V, Lucenteforte E. Adherence to oral antidiabetic drugs in patients with type 2 diabetes: systematic review and meta-analysis. Journal of Clinical Medicine. 2023 Mar 2;12(5):1981.
2. Luo WM, Su JY, Xu T, Fang ZZ. Prevalence of Diabetic Retinopathy and Use of Common Oral Hypoglycemic Agents Increase the Risk of Diabetic Nephropathy—A Cross-Sectional Study in Patients with Type 2 Diabetes. International Journal of Environmental Research and Public Health. 2023 Mar 6;20(5):4623.
3. Shirabe S, Yamazaki K, Oishi M, Arai K, Yagi N, Sato M, Takeuchi M, Kai T, Maegawa H. Changes in prescription patterns and doses of oral antidiabetic drugs in Japanese patients with type 2 diabetes (JDDM70). Journal of diabetes investigation. 2023 Jan;14(1):75-80.
4. Mohajan D, Mohajan HK. Metformin: An Oral Anti-hyperglycaemic Agent for the Treatment of Type 2 diabetes. Journal of Innovations in Medical Research. 2023 Nov 9;2(11):1-8.
5. Horii T, Otsuka M, Yasu T. Risk of non-hypoglycemic agents for hypoglycemia-related hospitalization in patients with type 2 diabetes: A large-scale medical receipt database analysis. BMJ Open Diabetes Research and Care. 2023 Apr 1;11(2):e003177.
6. Tian S, Jiang J, Wang J, Zhang Z, Miao Y, Ji X, Bi Y. Comparison on cognitive outcomes of antidiabetic agents for type 2 diabetes: A systematic review and network meta-analysis. Diabetes/Metabolism Research and Reviews. 2023 Oct;39(7):e3673.

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 08, 2024

7. Pai KK, Mathews N, Garg M. Comparison of blood glucose control among type 2 diabetics consuming oral antidiabetic drug versus oral antidiabetic drug with home remedies. Sciences of Phytochemistry. 2023 Jan 12;2(1):1-7.
8. Li A, Su X, Hu S, Wang Y. Efficacy and safety of oral semaglutide in type 2 diabetes mellitus: a systematic review and meta-analysis. Diabetes Research and Clinical Practice. 2023 Apr 1;198:110605.
9. de Faria Baltazar H, Fonseca FL, Castelo PM, da Costa Aguiar Alves B, Gascón T, da Veiga GL, Pereira EC. Use of Saliva to Assess the Adherence to Treatment with Oral Hypoglycemic Agents in Patients with Type 2 Diabetes. Endocrine, Metabolic & Immune Disorders-Drug Targets (Formerly Current Drug Targets-Immune, Endocrine & Metabolic Disorders). 2023 Jul 1;23(8):1068-76.
10. Zhu J, Zhou Y, Li Q, Wang G. Cost-effectiveness of newer antidiabetic drugs as second-line treatment for type 2 diabetes: a systematic review. Advances in Therapy. 2023 Oct;40(10):4216-35.
11. Xie Y, Zhou Q, He Q, Wang X, Wang J. Opportunities and challenges of incretin-based hypoglycemic agents treating type 2 diabetes mellitus from the perspective of physiological disposition. Acta Pharmaceutica Sinica B. 2023 Jun 1;13(6):2383-402.
12. Hoe KK, Han TL, Saint Hoe TH. Hypoglycemic agents and prognostic outcomes of chronic kidney disease patients with type 2 diabetes. Journal of Nephropathology. 2023 Jun 1;12(3).
13. Rehman B, Ain QT, Bashir F, Ibrahim A, Shahid F. A Comparative Effectiveness & Renoprotective Effects of Hypoglycemic Drugs for Type 2 Diabetes Mellitus. Molecular Medicine Communications. 2023 Jun 30;3(01):47-66.
14. Yen FS, Hou MC, Liu JS, Hsu CC, Hwu CM. Severe hypoglycemia in patients with liver cirrhosis and type 2 diabetes. Frontiers in medicine. 2023 Jan 4;9:962337.