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Original Research Article

Cardiovascular Outcomes Associated with Sodium–Glucose Cotransporter-2 Inhibitors in Patients with Type 2 Diabetes Mellitus: A Retrospective Study from a Tertiary Care Center in Eastern India

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Abstract

Background: Type 2 diabetes mellitus (T2DM) is closely linked to an increased risk of cardiovascular morbidity and mortality. Sodium–glucose cotransporter-2 (SGLT2) inhibitors have demonstrated cardiovascular benefits beyond glycemic control; however, real-world evidence from Indian tertiary care settings remains limited.

Methods: A retrospective observational study was conducted at Darbhanga Medical College, Bihar. Medical records of 100 adult patients with T2DM treated with SGLT2 inhibitors between March 2025 and September 2025 were reviewed. Cardiovascular outcomes included hospitalization for heart failure, major adverse cardiovascular events (MACE), and changes in cardiovascular risk parameters.

Results: Patients receiving SGLT2 inhibitors showed a reduction in heart failure-related hospitalizations along with favourable trends in blood pressure and body weight. The incidence of major cardiovascular events during follow-up was low.

Conclusions: SGLT2 inhibitor therapy was associated with improved cardiovascular outcomes in this real-world retrospective cohort, supporting their role in routine diabetes care.

Keywords: Type 2 diabetes mellitus, SGLT2 inhibitors, cardiovascular outcomes, Heart failure, and Retrospective study.

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Introduction

Type 2 diabetes mellitus (T2DM) is a major global public health concern, with a rapidly increasing prevalence across both developed and developing nations. According to the International Diabetes Federation, India is among the countries with the highest number of individuals living with diabetes, a figure projected to rise significantly in the coming decades [1]. The growing burden of T2DM poses serious challenges to healthcare systems, particularly due to its chronic complications and associated mortality.

Cardiovascular disease represents the leading cause of death among patients with T2DM, accounting for more than half of diabetes-related mortality worldwide [2]. Individuals with T2DM are at a substantially increased risk of coronary artery disease, heart failure, stroke, and cardiovascular death compared to the non-diabetic population [3]. This elevated risk is multifactorial and arises from chronic hyperglycemia, insulin resistance, dyslipidemia, hypertension, endothelial dysfunction, oxidative stress, and systemic inflammation [4,5]. Historically, intensive glycemic control was expected to reduce cardiovascular risk in patients with T2DM. Early landmark trials such as the UK Prospective Diabetes Study demonstrated benefits of glucose lowering on microvascular outcomes; however, the impact on macrovascular complications was modest and delayed [6]. Subsequent large randomized trials including ACCORD, ADVANCE, and VADT failed to demonstrate significant reductions in major cardiovascular events with intensive glucose control and, in some cases, reported increased risks of hypoglycemia and mortality [7–9]. These findings underscored the need for therapeutic strategies that provide cardiovascular protection beyond glycemic control alone.

Sodium–glucose cotransporter-2 (SGLT2) inhibitors have emerged as a novel class of glucose-lowering agents that act by inhibiting renal glucose reabsorption in the proximal tubules, leading to increased urinary glucose excretion [10]. Unlike traditional antidiabetic therapies, SGLT2 inhibitors

exert insulin-independent effects and are associated with additional metabolic benefits, including modest weight loss and blood pressure reduction [11].

Over the past decade, several large cardiovascular outcome trials have established the cardiovascular safety and efficacy of SGLT2 inhibitors. The EMPA-REG OUTCOME trial demonstrated a significant reduction in cardiovascular mortality and hospitalization for heart failure with empagliflozin in patients with T2DM and established cardiovascular disease [12]. Similarly, the CANVAS Program showed that canagliflozin reduced major adverse cardiovascular events, while the DECLARE-TIMI 58 trial reported a significant reduction in heart failure hospitalization with dapagliflozin [13,14].

Importantly, the cardiovascular benefits of SGLT2 inhibitors appear to extend beyond patients with established atherosclerotic cardiovascular disease. Trials such as DAPA-HF and EMPEROR-Reduced have demonstrated significant reductions in heart failure outcomes even in patients without diabetes, suggesting a direct cardioprotective effect of this drug class [15,16]. Proposed mechanisms include osmotic diuresis, natriuresis, reduction in preload and afterload, improved myocardial energy utilization, modulation of neurohormonal pathways, and reduction in cardiac fibrosis and inflammation [17–19].

Despite strong evidence from randomized controlled trials, real-world data are essential to assess the effectiveness of SGLT2 inhibitors in routine clinical practice. This is particularly important in low-resource settings, where patient characteristics, comorbidity profiles, and healthcare access may differ significantly from those enrolled in clinical trials [20]. Indian data on cardiovascular outcomes associated with SGLT2 inhibitor use remain limited, especially from public sector tertiary care hospitals.

Therefore, this retrospective study was undertaken to evaluate cardiovascular outcomes associated with SGLT2 inhibitor therapy in patients with T2DM treated at a tertiary care medical college hospital in Eastern India.

Materials and Methods

Study design and setting: This was a retrospective observational study conducted at Darbhanga Medical College, Bihar, a tertiary care teaching hospital catering to a large population in Eastern India.

Study population: Medical records of 100 adult patients diagnosed with T2DM and treated with SGLT2 inhibitors between March 2025 and September 2025 were included. Patients with type 1 diabetes mellitus, gestational diabetes, or incomplete medical records were excluded.

Data Collection: Demographic details, duration of diabetes, comorbid conditions, baseline cardiovascular history, and concomitant medications were extracted from hospital records. Cardiovascular outcomes assessed included hospitalization for heart failure, occurrence of major adverse cardiovascular events (myocardial infarction, stroke, or cardiovascular death), and changes in blood pressure and body weight during follow-up.

Statistical Analysis: Data were analyzed using descriptive statistics. Continuous variables were expressed as mean ± standard deviation, and categorical variables were presented as frequencies and percentages.

Results and Discussion

The findings of this retrospective study demonstrate favourable cardiovascular outcomes associated with the use of sodium–glucose cotransporter-2 (SGLT2) inhibitors in patients with type 2 diabetes mellitus. The observed reduction in heart failure–related hospitalizations and the low incidence of major adverse cardiovascular events are consistent with results from large cardiovascular outcome trials evaluating this drug class [12–14]. Similar benefits have been reported across diverse patient populations, including those with and without established atherosclerotic cardiovascular disease.

Evidence from landmark heart failure trials has further strengthened the role of SGLT2 inhibitors as cardioprotective agents. Studies such as DAPA-HF and EMPEROR-Reduced demonstrated significant reductions in heart failure hospitalization and cardiovascular mortality, supporting a class effect that extends beyond glucose lowering [15,16]. These benefits are thought to arise from multiple mechanisms, including natriuresis, osmotic diuresis, reduction in preload and afterload, improved myocardial energetics, and attenuation of adverse cardiac remodeling [17–19].

Real-world observational studies have also confirmed the cardiovascular benefits of SGLT2 inhibitors in routine clinical practice. Large registry-based analyses and population-level studies have consistently shown lower risks of heart failure hospitalization and all-cause mortality among patients initiated on SGLT2 inhibitors compared with other glucose-lowering therapies [21–23]. The findings of the present study align with these real-world data and further support the effectiveness of SGLT2 inhibitors in tertiary care settings.

In addition to cardiovascular benefits, growing evidence indicates that SGLT2 inhibitors exert substantial renal protective effects, which may indirectly contribute to improved cardiovascular outcomes. The DAPA-CKD trial demonstrated that dapagliflozin significantly reduced the risk of

kidney disease progression and cardiovascular death in patients with chronic kidney disease, irrespective of diabetes status [24]. The interrelationship between renal dysfunction and cardiovascular disease suggests that these cardiorenal benefits may play an important role in reducing overall cardiovascular risk in patients with type 2 diabetes. Current international treatment guidelines now strongly endorse the use of SGLT2 inhibitors in patients with type 2 diabetes who have established cardiovascular disease, heart failure, or chronic kidney disease. The joint consensus statement from the American Diabetes Association and the European Association for the Study of Diabetes recommends prioritizing agents with proven cardiovascular and renal benefits as part of individualized diabetes management strategies [25]. The results of the present study support these guideline recommendations in a real-world Indian clinical context.

Limitations

The limitations of this study include its retrospective design, relatively small sample size, short duration of follow-up, and lack of a comparator group. These factors limit causal inference and generalizability.

Conclusion

In this retrospective study conducted at a tertiary care center in Eastern India, SGLT2 inhibitor therapy was associated with favorable cardiovascular outcomes in patients with type 2 diabetes mellitus. These findings support the role of SGLT2 inhibitors as cardioprotective agents in routine clinical practice.

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