Diabetes, Metabolic Syndrome and Obesity

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ORIGINAL RESEARCH

Effect of Sodium–Glucose Cotransporter 2 Inhibitors on Cardiovascular Outcomes in Patients with Acute Coronary Syndrome and Type 2 Diabetes

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Objective: To investigate the effect of sodium–glucose cotransporter 2 inhibitors (SGLT2i) on cardiovascular outcomes in patients with acute coronary syndrome (ACS) and type 2 diabetes (T2D).

Methods: The clinical data of 88 patients with ACS and T2D who were treated with SGLT2i between January 2020 and December 2021 were collected as the case group through convenience sampling. Patients taking other hypoglycaemic drugs were included as the control group in a 1:1 ratio matched with the case group using retrospective propensity score matching. Relevant data were subsequently collected from both groups for comparison.

Results: Statistically significant differences were observed in glycated haemoglobin (HbA1c) between the two groups (8.11[6.93, 9.41] vs 7.51[6.52, 9.14]%; Z=2.109; P=0.035). The SGLT2i group showed a decrease in major adverse cardiovascular events (MACEs) (P<0.001), secondary composite endpoint events (P=0.024), heart failure readmission (P=0.042) and unplanned revascularisation (P=0.014) compared with the control group. Moreover, the multivariate analysis showed that SGLT2i significantly reduced the risk of MACEs (hazard ratio [HR], 0.472; 95% CI, 0.321–0.694; P<0.001) and unplanned revascularisation (HR, 0.422; 95% CI, 0.212–0.842; P=0.014). In patients with reduced ejection fraction, SGLT2i significantly reduced the risk of MACEs (HR, 0.258; 95% CI, 0.106–0.626; P=0.003) compared with the control group. By contrast, in patients without reduced ejection fraction, SGLT2i significantly reduced the risk of MACEs (HR, 0.640; 95% CI, 0.412–0.996; P=0.048) and unplanned revascularisation (HR, 0.464; 95% CI, 0.222–0.969; P=0.041) compared with the control group.

Conclusion: In addition to significantly reducing the risk of adverse cardiovascular events and unplanned revascularisation in patients with ACS and T2D, the use of SGLT2i can reduce the risk of adverse cardiovascular events regardless of the presence of reduced ejection fraction.

Keywords: sodium–glucose cotransporter 2 inhibitors, acute coronary syndrome, type 2 diabetes, cardiovascular outcomes

Introduction

Atherosclerotic heart disease has always been the leading cause of death among patients with cardiovascular disease (CVD) in China.[1] Cardiovascular disease has become one of the major complications of type 2 diabetes (T2D), accounting for at least 50% of the deaths of patients with T2D.[2] Acute coronary syndrome (ACS) is the most serious type of CVD, including ST segment elevation myocardial infarction (STEMI), non-ST-segment elevation myocardial infarction (NSTEMI) and unstable angina (UA) pectoris.[3] It is reported that people with T2D are three times more likely to experience ACS than healthy people.[4] Moreover, CVD is the main cause of death in patients with T2D, which is also a major contributor to unfavourable prognosis in patients with CVD.[5,6] The *IDF Diabetes Atlas* released by the

Received: 20 February 2024
Accepted: 25 June 2024
Published: 22 November 2024

International Diabetes Federation in 2019 shows that there are approximately 128.9 million patients with diabetes in China.[7,8] Compared with healthy individuals, patients with diabetes have a 2–4 times higher prevalence of CVD.[9] Therefore, the primary goal of treatment is to effectively control the diabetes, improve cardiovascular outcomes in patients with diabetes, mitigate the occurrence of adverse cardiovascular events and reduce the risk of death in these patients.

Sodium–glucose cotransporter 2 inhibitors (SGLT2i) are a novel type of hypoglycaemic drug. Recent clinical studies have shown that SGLT2i significantly improve the risk of cardiovascular events in patients with T2D compared with traditional hypoglycaemic drugs[10,11] and have cardiovascular protective effects.[12] Additionally, several large-scale clinical randomised controlled trials on SGLT2i have demonstrated their potential cardiovascular benefits. In addition, the EMPA-REG study demonstrated that empagliflozin reduced the risk of major adverse cardiovascular events (MACEs), which include acute myocardial infarction, cardiac death and ischemic stroke, and all-cause mortality in patients with T2D at high risk of CVD.[13] The CANVAS study suggested that canagliflozin reduces the risk of MACEs in patients with T2D at high risk of CVD.[14] Moreover, the DECLARE-TIMI58 study showed that dapagliflozin exhibited no significant effect on the occurrence of MACEs but effectively reduced the occurrence of cardiac death and heart failure readmission in patients with atherosclerotic heart disease or at high-risk of T2D, whereas the DECLARE-HF study involving patients with heart failure with reduced ejection fraction demonstrated that dapagliflozin significantly improved the outcome of heart failure readmission.[15,16] Based on the cardiovascular benefits demonstrated by SGLT2i in these studies, these inhibitors have been recommended as a first-line treatment for patients with T2D combined with atherosclerotic heart disease to reduce the risk of developing cardiovascular complications. They have also been recommended by the European Society of Cardiology for improving cardiovascular outcomes and preventing adverse cardiovascular events in patients with heart failure with reduced ejection fraction.[17–19]

Studies have indicated that SGLT2i can significantly improve the prognosis of patients with heart failure with reduced ejection fraction. Based on these findings, SGLT2i are recommended for the treatment of patients with T2D with concomitant atherosclerotic heart disease along with the recommendation of dapagliflozin for treating patients with heart failure with reduced ejection fraction. Moreover, randomised controlled studies involving patients with T2D and a history of myocardial infarction have revealed that SGLT2i can significantly reduce the risk of MACEs, cardiac death or heart failure readmission in these patients.

However, there remains a lack of real-world research evidence regarding the effect of SGLT2i on cardiovascular outcomes in patients with ACS and T2D. Therefore, this study explores the effect of SGLT2i on cardiovascular outcomes in this patient population while further investigating whether the presence or absence of reduced ejection fraction (ie left ventricular ejection fraction ≤40%) has different effects on cardiovascular outcomes.

Study Participants and Methods

Study Participants

The clinical data of 88 patients with ACS complicated with T2D following percutaneous coronary intervention who were treated with SGLT2i between January 2020 and December 2021 in our hospital were collected as the case group using the convenience sampling method. The patients in the case group had taken SGLT2i regularly for at least 3 months prior to admission. Patients who took other hypoglycaemic drugs were selected and included as the control group in a 1:1 ratio matched with the case group using retrospective propensity score matching. Matching factors included gender, age, smoking history, duration of diabetes, history of hypertension, history of abnormal lipid metabolism, type of coronary heart disease, presence of heart failure upon admission and medication treatment (including antiplatelet drugs, lipid-lowering drugs, antihypertensive drugs and hypoglycaemic drugs).

The inclusion criteria were as follows: (1) age ≥18 years; (2) patients hospitalised with a confirmed diagnosis of ACS (including UA, acute NSTEMI and acute STEMI), with the criteria for diagnosis being patients with at least one coronary artery stenosis ≥50% identified through computed tomography coronary angiography or coronary angiography; (3) patients hospitalised with a confirmed diagnosis of T2D, with the criteria for diagnosis being diabetic symptoms (including polyuria, polydipsia, polyphagia and unexplained weight loss), and either random plasma glucose levels

>11.1 mmol/l (200 mg/dl) or fasting blood glucose levels >7.0 mmol/l (126 mg/dl) or 2-hour plasma glucose levels >11.1 mmol/l (200 mg/dl) during oral glucose tolerance testing (with 75 g of anhydrous glucose load) and regular use of hypoglycaemic drugs for hypoglycaemic treatment.

The exclusion criteria were as follows: (1) patients with type 1 diabetes; (2) patients with other severe heart diseases, such as severe valvular heart disease or severe dilated cardiomyopathy; (3) patients with more than one episode of hypoglycaemia following the use of other hypoglycaemic drugs or insulin in the past 6 months; (4) patients with more than one instance of estimated glomerular filtration rate (eGFR) <30 mL/min/1.73m^2 during hospitalisation (calculated using the MDRD formula); (5) patients with hemodynamic instability (ie more than one instance of systolic blood pressure <100 mmHg monitored during hospitalisation); (6) patients with other malignant underlying diseases (eg malignant tumours, immune system diseases) and with an expected survival time of less than 1 year; and (7) patients who died during hospitalisation.

Study Methods

The follow-up began from the date of patient discharge and continued for 1 year of regular medication. Patient endpoint events were recorded through outpatient follow-up medical records or contact via telephone, with the occurrence time of the endpoint events also documented.

Endpoint events during follow-up were divided into MACEs and three secondary endpoint events. Specifically, MACEs included acute myocardial infarction, cardiac death, ischemic stroke, heart failure readmission and unplanned revascularisation. The three secondary endpoint events were (1) a secondary composite endpoint (SCE) consisting of acute myocardial infarction, cardiac death and ischemic stroke; (2) heart failure readmission; and (3) unplanned revascularisation.

Cardiac death refers to death caused by cardiac problems where other non-cardiac causes can clearly be excluded.[13] Acute myocardial infarction is defined as recurrent symptoms, with dynamic changes in the electrocardiogram of new-onset symptoms and changes in the markers of myocardial infarction consistent with the condition diagnosis.[15] Ischemic stroke refers to symptoms or signs of neurological damage, supported by imaging examination findings indicating the diagnosis of new stroke lesions.[15] Heart failure readmission refers to the reappearance of heart failure symptoms, with heart failure markers and cardiac ultrasound results supporting the diagnosis of heart failure upon readmission.[16] Unplanned revascularisation refers to percutaneous coronary intervention due to frequent episodes of UA pectoris.

Data Collection

General data and clinical data of the patients were collected. The general data included gender, age, smoking history, history of hypertension, history of cerebrovascular disease, history of lipid metabolism disorders and type of coronary heart disease. The clinical data included left ventricular ejection fraction, B-type natriuretic peptide, glycated haemoglobin (HbA1c), body mass index (BMI), eGFR, history of percutaneous coronary intervention, use of antiplatelet drugs, use of statin lipid-lowering drugs, use of angiotensin receptor-neprilysin inhibitor drugs, use of antihypertensive drugs, use of metformin, use of acarbose, use of insulin, use of dipeptidyl peptidase-4 inhibitors and use of glucagon-like peptide-1 receptor agonists.

Statistical Analysis

The statistical analysis was performed using SPSS 26.0 software ((IBM Corp., Armonk, N.Y., USA). Normality was tested using the Kolmogorov–Smirnov method, with normally distributed measurement data expressed as mean ± standard deviation and intergroup mean comparisons conducted using the *t*-test. Count data were expressed as frequency (n) or rate (%) and analysed using the chi-square (χ^2) test. The skewed distribution data were compared through the Kruskal–Wallis H rank sum test. Logistic multivariate regression was utilised for propensity score matching of the SGLT2i group and the control group in a 1:1 ratio. Kaplan–Meier curves were used to plot the survival curves of various endpoint events at 1-year follow-up, whereas the log rank test was applied for the intergroup comparison of survival functions. Additionally, Cox risk regression analysis was utilised to explore the relevant risk factors of patients. The significance level was set at α=0.05.

Results

General Data

The findings showed that the SGLT2i group consisted of 56 men and 32 women, with an average age of 65.94±12.61 years and an average BMI of 24.57±3.47 kg/m^2. By comparison, the control group included 45 men and 43 women, with an average age of 64.37±11.47 years and an average BMI of 23.87±3.12 kg/m^2. Statistically significant differences were observed in HbA1c (8.11 [6.93, 9.41] vs 7.51 [6.52, 9.14]%, Z=2.109, P=0.035) between the two groups. However, there were no statistically significant differences in gender, BMI, age, smoking history, duration of diabetes, history of hypertension, history of cerebrovascular disease, history of lipid metabolism disorders or type of ACS between the two groups (P>0.05), as shown in Table 1.

Table 1 General Data

Items	SGLT2i Group (n=88)	Control Group (n=88)	χ^2/t/Z value	P value
Age (years, x±s)	65.94±12.61	64.37±11.47	1.396	0.169
BMI (kg/m^2, x±s)	24.57±3.47	23.87±3.12	0.877	0.384
Gender (M/F)	56/32	45/43	2.811	0.094
History of Smoking (n)	33	30	0.223	0.637
Duration of Diabetes (year, x±s)	13.38±6.79	14.72±7.54	0.705	0.487
History of Hypertension (n)	72	69	0.321	0.571
History of Cerebrovascular Disease (n)	39	46	1.115	0.291
History of Abnormal Lipid Metabolism (n)	61	64	0.248	0.618
Type pf ACS (n)			0.364	0.834
Unstable Angina Pectoris	41	45		
Acute ST-Elevation Myocardial Infarction	12	11		
Acute Non-ST-Elevation Myocardial Infarction	35	32		
PCI (n)	41	38	0.207	0.649
LVEF≤40% (n)	29	34	0.618	0.432
BNP [ng/L, M (Q1, Q3)]	56.65 (12.91, 187.72)	54.87 (19.72, 204.41)	0.753	0.451
HbA1c [%, M (Q1, Q3)]	8.11 (6.93, 9.41)	7.51 (6.52, 9.14)	2.109	0.035
eGFR [mL/min/1.73m^2, M (Q1, Q3)]	99.37 (79.12, 119.38)	94.38 (72.98, 113.39)	0.446	0.655
Mean Arterial Pressure (mmHg, x±s)	102.63±17.16	105.68±16.39	0.715	0.478
Uric Acid (umol/L, x±s)	356.50±125.74	361.49±120.48	0.370	0.713
Serum Sodium (mmol/L, x±s)	139.47±3.29	137.34±4.23	1.694	0.096
Serum Potassium (mmol/L, x±s)	4.13±0.58	4.33±0.87	0.763	0.449
D-dimer (μg/mL, x±s)	1.14±3.27	1.45±2.33	1.559	0.125
Urea Nitrogen (mmol/L, x±s)	7.94±3.58	8.01±3.21	1.433	0.158
Albumin (g/L, x±s)	40.76±4.71	42.93±4.56	0.564	0.575
Total Cholesterol (mmol/L, x±s)	3.99±1.24	4.10±1.44	0.118	0.907
Low-density Lipoprotein (mmol/L, x±s)	2.51±1.08	2.54±1.09	0.791	0.432
Applied Medication				
Aspirin (n)	78	75	0.450	0.502
Clopidogrel (n)	21	19	0.129	0.719
Ticagrelor (n)	42	41	0.023	0.880
Statin Lipid-lowering Drugs (n)	79	83	1.242	0.265
β-blockers (n)	63	59	0.427	0.513
ACEI/ARB (n)	43	52	1.853	0.173
Metformin (n)	32	35	0.217	0.641
Acarbose (n)	28	26	0.107	0.744
Insulin (n)	25	24	0.028	0.866
DPP4i Drug (n)	21	23	0.121	0.728
GLP-1RA Drug (n)	4	6	0.424	0.515

Abbreviations: BMI, Body Mass Index; ACS, acute coronary syndrome; PCI, Percutaneous coronary intervention; LVEF, Left ventricular ejection fraction; BNP, B-type natriuretic peptide; HbA1c, Glycosylated hemoglobin; eGFR, Estimated glomerular filtration rate; ACEI, Angiotensin converting enzyme inhibitor; ARB, Angiotensin receptor blocker; DPP4i, Dipeptidyl peptidase-4 inhibitor; GLP-1RA, Glucagon-like peptide-1 receptor agonist.

Outcome Events in the Two Groups

Follow-up of the occurrence of outcome events in the two groups after 1 year of drug treatment and survival analysis revealed that the SGLT2i group had a lower incidence of MACEs (12.5% vs 25.0%, P<0.001), and unplanned revascularisation (3.4% vs 9.1%, P=0.014) compared with the control group, and the differences in the incidence between the two groups were statistically significant (Figures 1 and 2). However, no statistically significant differences were found in the comparison of the incidence of acute myocardial infarction, heart failure readmission, all-cause death, ischemic stroke, or SCES between the two groups (P>0.05) (Figure 2).

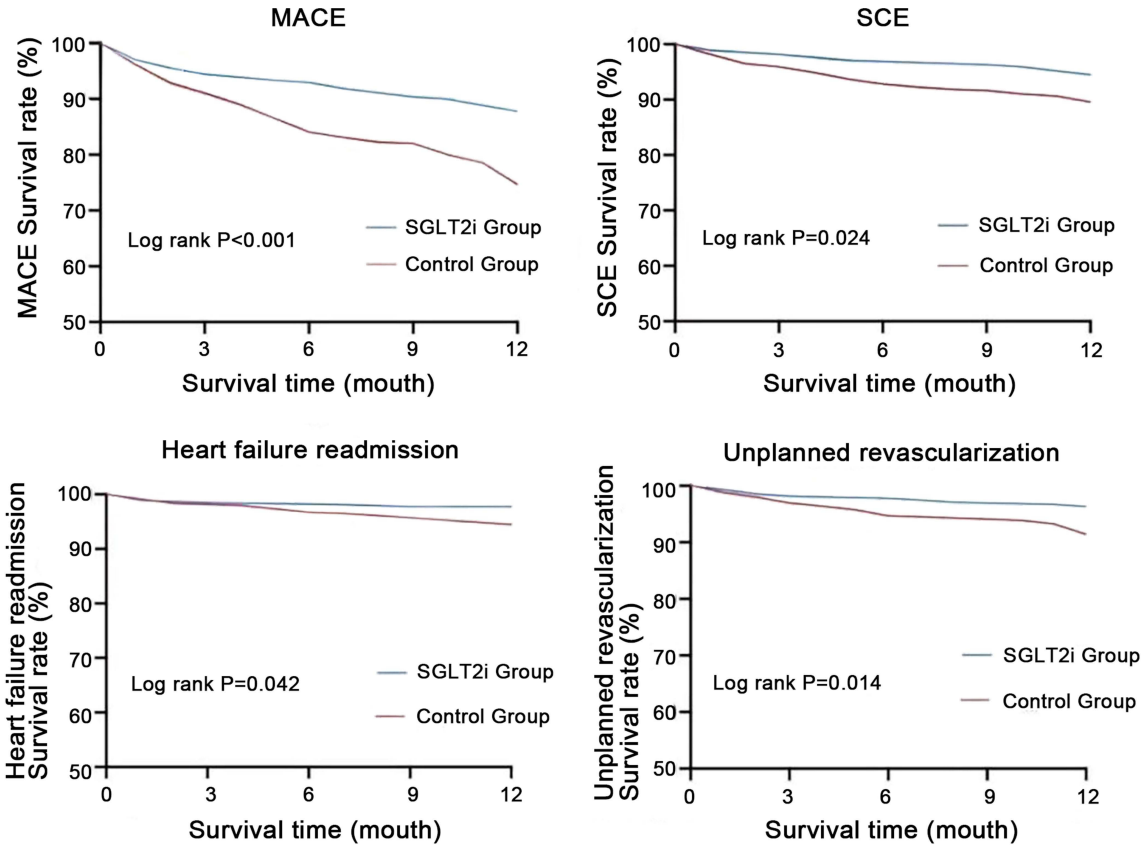

Figure 1 K-M Curves of Outcome Events with Statistically Significant Differences between the 2 Groups.
Note: MACE: Major adverse cardiovascular event (including acute myocardial infarction, all-cause mortality, ischemic stroke, heart failure readmission, and unplanned revascularization); SCE: Secondary composite endpoint.

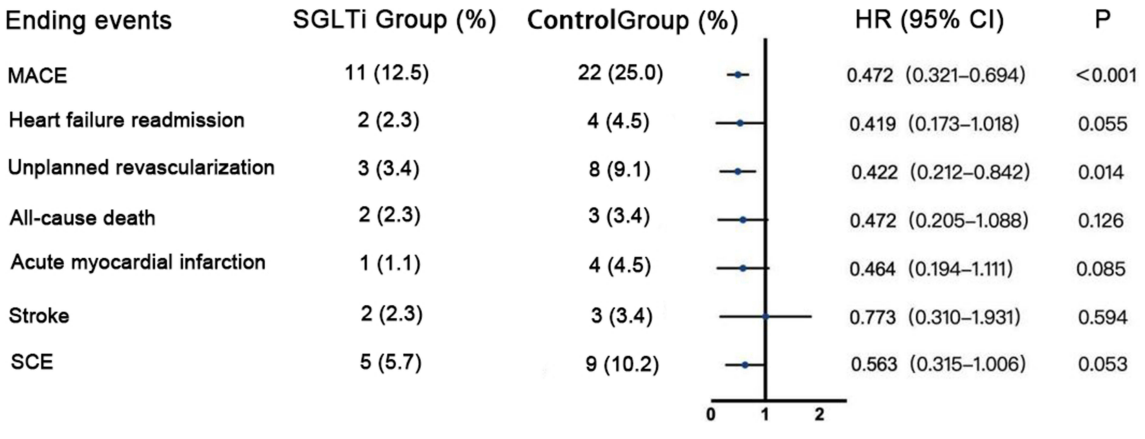

Figure 2 Forest Plot of Patient Outcome Events in the 2 Groups.
Note: MACE: Major adverse cardiovascular event (including acute myocardial infarction, all-cause mortality, ischemic stroke, heart failure readmission, and unplanned revascularization); SCE: Secondary composite endpoint; HR: Hazard ratio; 95% CI: 95% confidence interval.

Cox risk regression analysis was performed on outcome events with statistically significant differences between the two groups (including variables such as grouping, gender, age, smoking history, diagnosis, presence of heart failure, HbA1c, BMI, eGFR and use of metformin and statin lipid-lowering drugs). The analysis revealed that patients in the SGLT2i group had a significantly lower risk of MACEs (hazard ratio [HR]=0.472; 95% CI, 0.321–0.694; P<0.001) and unplanned revascularisation (HR=0.422; 95% CI, 0.212–0.842; P=0.014) compared with the control group, with statistical significance. Despite no statistically significant differences in the occurrence risk of SCEs (HR=0.563; 95% CI, 0.315–1.006; P=0.053) and readmission for heart failure (HR=0.419; 95% CI, 0.173–1.018; P=0.055) between the SGLT2i group and the control group, the use of SGLT2i reduced the risk of SCEs and readmission for heart failure by 44% and 49%, respectively (Figure 2).

Ejection Fraction Subgroup Analysis

Following propensity score matching, all patients were divided into two subgroups (one with reduced ejection fraction and one without reduced ejection fraction) based on whether the left ventricular ejection fraction was <40%. The subgroup with reduced ejection fraction included a total of 63 patients (SGLT2i group: n=29; control group: n=34), whereas that without reduced ejection fraction included a total of 113 patients (SGLT2i group: n=59; control group: n=54).

The survival analysis of outcome events in the subgroup with reduced ejection fraction revealed no statistically significant difference (P>0.05) in the occurrence of SCEs and unplanned revascularisation compared with the control group. In addition, Cox risk regression analysis was performed on outcome events with statistically significant differences between the two groups, indicating a significantly reduced risk of MACEs in patients of the SGLT2i group (HR=0.258; 95% CI, 0.106–0.626; P=0.003) compared with the control group, with statistically significant differences. Despite no statistically significant differences in the risk of heart failure readmission between the SGLT2i group and the control group (HR=0.133; 95% CI, 0.017–1.017; P=0.052), the use of SGLT2i reduced the risk by 84% (Figure 3).

By contrast, the survival analysis of outcome events in the subgroup without reduced ejection fraction showed no statistically significant differences (P>0.05) in reduced occurrence of SCEs and heart failure readmission between the SGLT2i and control groups. Cox risk regression analysis was performed on outcome events with statistically significant differences between the two groups, revealing that the SGLT2i group had a significantly lower risk of MACEs (HR=0.640; 95% CI, 0.412–0.996; P=0.048) and unplanned revascularisation (HR=0.464; 95% CI, 0.222–0.969; P=0.041) than the control group, and the differences were statistically significant (Figure 3).

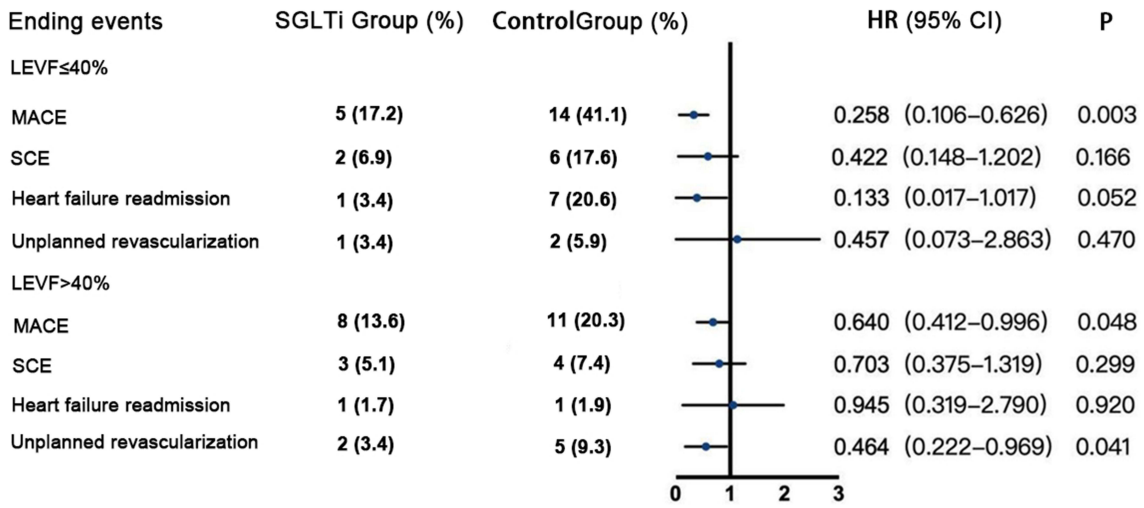

Figure 3 Forest Plot of Patient Outcome Events in Subgroups.
Note: MACE: Major adverse cardiovascular event (including acute myocardial infarction, all-cause mortality, ischemic stroke, heart failure readmission, and unplanned revascularization); LVEF: left ventricular ejection fraction; SCE: Secondary composite endpoint; HR: hazard ratio; 95% CI: 95% confidence interval.

Discussion

Based on the overall findings, the multivariate risk regression analysis demonstrated that SGLT2i can significantly reduce the risk of MACEs and unplanned revascularisation in patients with ACS and T2D, with statistically significant differences. It also reduces the occurrence risk of SCEs and heart failure readmission. Moreover, the use of statin lipid-lowering drugs, an age less than 65 years and no history of acute myocardial infarction are also influencing factors in reducing the risk of SCEs. Reduced ejection fraction also increases the risk of heart failure readmission in patients. Several large-scale randomised controlled trials on the cardiovascular outcomes of SGLT2i have also demonstrated their cardiovascular protective effects in patients with T2D.[13–15] Studies on dapagliflozin in patients with chronic heart failure with reduced ejection fraction alone have shown its cardiovascular protective effects independent of its glycaemic control.[16] However, a subgroup analysis of the DECLARE-TIMI58 study showed that dapagliflozin reduced the relative risk of MACEs (including acute myocardial infarction, cardiac death, ischemic stroke) in patients with a history of myocardial infarction and T2D by 16%, with an absolute risk reduction of 2.6% (15.2% vs 17.8%, HR=0.84; 95% CI, 0.72–0.99; P=0.039), thereby reducing the absolute risk of cardiac death or heart failure readmission by 1.9% (8.6% vs 10.5%; HR=0.81; 95% CI, 0.65–1.00; P=0.046).[20]

A large number of studies have demonstrated the protective effect of strict control of blood glucose on the heart. Strict glycaemic control can play a cardioprotective role through anti-inflammatory and anti-apoptotic mechanisms, anti-oxidative stress, endothelial protection, free fatty acid reduction, anti-glucotoxicity, IR and cardiac fuel metabolism improvement, cardiac stem cell protection and activation of adrenergic system reduction.[21–23] As a new hypoglycaemic drug, SGLT2i can significantly reduce the occurrence risk of ischemic heart disease in patients with T2D.[24] Moreover, research involving ischemia-reperfusion animal models and cellular-level experiments has confirmed that SGLT2i can alleviate cardiac remodelling and the occurrence of heart failure following myocardial infarction.[25,26] Furthermore, research by Lahnwong et al involving rats with acute myocardial ischemia-reperfusion injury confirmed that dapagliflozin may exhibit cardiovascular protective effects by improving myocardial infarct size, increasing left ventricular function and reducing arrhythmias.[26] Potential mechanisms may include the delayed progression of diabetes, improved myocardial energy metabolism, activated cardiac protection mechanisms to counteract the remodelling process, myocardial anti-fibrotic and anti-apoptotic effects, potential anti-inflammatory mechanisms and direct interactions with cardiomyocytes.[27] These studies have demonstrated the SGLT2i-induced improvement in myocardial ischemic symptoms from multiple perspectives, consistent with the findings of the present study.

In the analysis of the subgroup with reduced ejection fraction, SGLT2i significantly reduced the occurrence risk of MACEs. It is speculated that the underlying molecular mechanism is that the significant decrease in intracellular sodium levels induced by SGLT2i improves cardiac contractility and dysfunction. This is considered to be the key molecular mechanism for SGLT2i's role in cardio protection, especially in reducing the risk of heart failure and protecting the cardiac function of patients with heart failure from further deterioration.[28] Moreover, in patients with T2D, SGLT2i prevents the upregulation of SGLT2 expression in endothelial cells and reduces oxidative stress, pro-inflammatory cytokines and the content of myocardial interstitial collagen.[29,30] It effectively prevents the risk of acute ischemic events caused by inflammation-dependent atherosclerotic plaque rupture.[31]

However, the present study found no statistically significant reduction in the occurrence risk of heart failure readmission compared with the control group. This differs from the findings of the DAPA-HF study, which showed a reduced risk of heart failure readmission in patients with New York Heart Association cardiac function ≥class II or left ventricular ejection fraction ≤40%. It is hypothesised that this may be due to the relatively fewer recorded occurrences of outcome events.

By comparison, the analysis of the subgroup without reduced ejection fraction showed that SGLT2i significantly reduced the occurrence risk of MACEs and unplanned revascularisation compared with the control group, without affecting the occurrence of SCEs and heart failure readmission. The multivariate risk regression analysis also suggested that a history of acute myocardial infarction is an independent influencing factor for the occurrence of SCEs. A clinical cohort study on the effect of SGLT2i on ischemic cardiomyopathy found that SGLT2i reduced the incidence risk of ischemic cardiomyopathy in patients with T2D, which was significant at 6 months of follow-up.[32] Additionally, the effect

of SGLT2i on reducing the risk of unplanned revascularisation in patients with coronary artery disease and T2D was also observed in this study, further confirming the ameliorative effect of SGLT2i on ischemic symptoms. The increased excretion of urinary glucose and sodium by SGLT2i, as well as its reduction in blood volume and alleviation of volume load, may be associated with the reduction in the occurrence risk of ischemic events.[22] Moreover, relevant animal experiments have also confirmed that SGLT2i can improve vascular endothelial and smooth muscle cell function while alleviating oxidative stress and inflammatory responses.[23] These effects all contribute positively to improving adverse cardiovascular outcomes in patients using SGLT2i.

However, this study has some limitations. First, this was a single-centre observational study and no intervention was performed throughout the study, meaning it may not be strong enough to define a cause–effect relationship. Second, detailed information on glycaemic control of the patients was not obtained during the 1-year clinical follow-up, resulting in a lack of comparison between the efficacy of glycaemic control between SGLT2i and other hypoglycaemic drugs. Third, it was difficult for the outcome events to develop due to the insufficient sample size of the SGLT2i group in the subgroup with reduced ejection fraction, thereby affecting the stability of the study results. It is suggested that the sample size be expanded in future studies and more prospective intervention studies be conducted to further demonstrate the conclusions of this study.

Conclusion

In conclusion, the application of SGLT2i can significantly reduce the occurrence risk of MACEs, SCEs, heart failure readmission and unplanned revascularisation compared with other hypoglycaemic drugs. Specifically, SGLT2i can reduce the occurrence risk of MACEs and heart failure readmission in patients with reduced ejection fraction while also significantly reducing the occurrence risk of MACE and unplanned revascularisation in those without reduced ejection fraction.

Data Sharing Statement

All data generated or analyzed during this study are included in this published article.

Ethics Approval and Consent to Participate

This study was conducted in accordance with the declaration of Helsinki.This study was conducted with approval from the Ethics Committee of Huangshi Aikang Hospital in Hubei Province.Written informed consent was obtained from all participants.

Acknowledgments

No funding or sponsorship was received for this study or publication of this article.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

This research did not receive any funding support.

Disclosure

The authors declare that they have no competing interests.

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