The Effect of Dapagliflozin on Cardiovascular Events After Percutaneous Coronary Intervention in Patients with Acute Myocardial Infarction and Type 2 Diabetes

Authors: Liang Siyu, Xiao Hongkai, Liu Jinghu, Liang Siyu

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Abstract

Abstract

Objective: To investigate the effect of dapagliflozin on cardiovascular events following percutaneous coronary intervention (PCI) in patients with acute myocardial infarction complicated by type 2 diabetes mellitus.

Methods: A total of 155 patients with acute myocardial infarction complicated by type 2 diabetes mellitus admitted to the Department of Cardiology of our hospital from January 2021 to December 2022 were enrolled and randomly divided into an experimental group (n=78) and a control group (n=77) using a random number method. The control group received conventional treatment, while the experimental group received additional dapagliflozin. Clinical indicators, cardiac function parameters, treatment effective rate, and incidence of cardiovascular events were compared between the two groups.

Results: Prior to treatment, no statistically significant differences were observed in baseline characteristics or clinical indicators between the groups ($p>0.05$). After 6 months of treatment, fasting blood glucose (FBG), glycated hemoglobin (HbA1c), high-sensitivity C-reactive protein (hs-CRP), and lipoprotein-associated phospholipase A2 (Lp-PLA2) decreased in both groups compared with baseline ($p<0.05$), with all indicators being significantly lower in the experimental group than in the control group ($p<0.001$). No significant differences in cardiac function parameters existed between groups at baseline. Post-treatment, left ventricular ejection fraction (LVEF) and 6-minute walk test (6MWT) distance were significantly higher in the experimental group, while left ventricular end-diastolic diameter (LVEDD), left ventricular end-systolic diameter (LVESD), N-terminal pro-brain natriuretic peptide (NT-proBNP), and heart rate were significantly lower ($p<0.001$). The overall treatment effective rate was 92.90%, with the experimental group achieving 96.15% compared to 89.61% in the control group ($p<0.01$). The incidence of cardiovascular events was 7.69% in the experimental group, significantly lower than 16.88% in the control group ($p<0.01$).

Conclusion: Dapagliflozin demonstrates significant therapeutic efficacy in patients with acute myocardial infarction complicated by type 2 diabetes mellitus following PCI, providing glycemic control, improving cardiac function, increasing treatment effective rate, and reducing cardiovascular event incidence, thus warranting clinical promotion and application.

Full Text

Preamble

Title: Effect of Dapagliflozin on Cardiovascular Events in Patients with Acute Myocardial Infarction Complicated by Type 2 Diabetes After PCI

Authors: Liang Siyu, Xiao Hongkai, Liu Jinghu

Affiliation: Department of Cardiology, Guangzhou Medical University Affiliated Fourth Hospital, Guangzhou 511300, China

Corresponding Author: Liang Siyu, male, born January 4, 1986, native of Guangzhou, Guangdong. Education: Master's degree. Title: Attending Physician. Department: Cardiology. Research focus: Diagnosis and treatment of heart failure. Email: zoukaiwen128@163.com. Phone: 13925129982

Abstract:
Objective: To investigate the effect of dapagliflozin on cardiovascular events in patients with acute myocardial infarction (AMI) complicated by type 2 diabetes mellitus (T2DM) after percutaneous coronary intervention (PCI). *Methods*: A total of 155 AMI patients with T2DM admitted to our hospital's cardiology department from January 2021 to December 2022 were enrolled and randomly divided into an experimental group (n=78) and a control group (n=77) using a random number method. The control group received conventional treatment, while the experimental group received additional dapagliflozin. Clinical indicators, cardiac function parameters, treatment efficacy, and cardiovascular event incidence were compared between the two groups. *Results*: Before treatment, there were no significant differences in general characteristics or clinical indicators between the groups ($p>0.05$). After 6 months of treatment, fasting blood glucose (FBG), glycated hemoglobin (HbA1c), high-sensitivity C-reactive protein (hs-CRP), and lipoprotein-associated phospholipase A2 (Lp-PLA2) decreased in both groups ($p<0.05$), with all indicators significantly lower in the experimental group ($p<0.001$). There were no significant differences in cardiac function parameters before treatment. After treatment, left ventricular ejection fraction (LVEF) and 6-minute walking test (6MWT) were significantly higher in the experimental group, while left ventricular end-diastolic diameter (LVEDD),

left ventricular end-systolic diameter (LVESD), N-terminal pro-brain natriuretic peptide (NT-proBNP), and heart rate were significantly lower compared to the control group ($p<0.001$). The overall treatment response rate was 92.90%, with the experimental group achieving 96.15%, significantly higher than the control group's 89.61%. The incidence of cardiovascular events was 7.69% in the experimental group, significantly lower than 16.88% in the control group ($p<0.01$). *Conclusion*: Dapagliflozin demonstrates significant efficacy in reducing blood glucose, improving cardiac function, increasing treatment effectiveness, and decreasing cardiovascular event incidence in AMI patients with T2DM after PCI, warranting clinical promotion and application.

Keywords: Dapagliflozin; Acute myocardial infarction; Type 2 diabetes mellitus; Percutaneous coronary intervention (PCI); Cardiovascular events

Acute myocardial infarction (AMI) is a critical cardiovascular emergency that typically occurs on the basis of coronary atherosclerotic lesions, resulting in acute reduction or interruption of coronary blood supply and causing severe and persistent acute ischemia and necrosis of the corresponding myocardium [1]. In China, approximately 1 million patients suffer from acute myocardial infarction annually, making it one of the leading causes of sudden cardiac death. Particularly in patients complicated with type 2 diabetes mellitus (T2DM), coronary arteries often exhibit diffuse and multivessel disease, resulting in poor prognosis from medical and reperfusion therapies, with high risk of severe heart failure, malignant arrhythmias, and sudden cardiac death [2]. Reports indicate that T2DM is a confirmed risk factor and independent predictor of prognosis in AMI patient risk scoring models. Therefore, glycemic control is crucial for AMI patients with T2DM [3]. Dapagliflozin is a sodium-glucose cotransporter 2 (SGLT2) inhibitor. Studies have reported that besides glycemic control, dapagliflozin offers benefits including blood pressure and lipid reduction, cardio-renal protection, improved cardiac and renal function, and reduced cardiovascular event risk [4]. However, current research on the effect of dapagliflozin on cardiovascular events after PCI in AMI patients with T2DM remains scarce. Based on this, our study aims to investigate the impact of dapagliflozin on cardiovascular events in AMI patients with T2DM after PCI.

Methods

1.1 General Materials

We selected 155 AMI patients with T2DM who underwent PCI at the Department of Cardiology, Guangzhou Medical University Affiliated Fourth Hospital between January 2021 and December 2022. The cohort included 82 males and 73 females, with a mean age of (62.2$±$4.9) years. Inclusion criteria: (1) Age $ $18 years; (2) Met AMI diagnostic criteria: ischemic chest pain symptoms, characteristic ST-T dynamic evolution on ECG or abnormal Q waves, and elevation and decline of serum myocardial enzymes (meeting $ $2 criteria) [5], with PCI completed within the intervention time window; (3) Met T2DM diagnostic criteria per the "Chinese Guidelines for the Prevention and Treatment of Type 2 Diabetes": typical diabetes symptoms with random blood glucose >11.1 mmol/L, or fasting blood glucose >7.0 mmol/L, or OGTT 2-hour blood glucose >11.1 mmol/L, or HbA1c >6.5%; those without typical symptoms required re-examination for confirmation [6]; (4) No PCI contraindications and no allergic reactions to study medications; (5) Complete clinical data, with informed consent obtained from patients and their families who voluntarily agreed to follow-up. This study was approved by our hospital's ethics committee.

Exclusion criteria: Recurrent hypotension and hypoglycemia, congenital organic heart disease, severe hepatic or renal insufficiency, severe autoimmune diseases, immunodeficiency, malignant tumors, severe cognitive or psychiatric disorders, and allergic reactions to study medications.

1.2 Research Methods

The 155 enrolled patients were randomly divided into an experimental group (n=78) and a control group (n=77) using a random number table method. All patients underwent standardized PCI for AMI per treatment guidelines, followed by standardized medical therapy including antiplatelet agents, lipid-lowering drugs, and ventricular remodeling prevention per the rational medication guidelines for coronary heart disease, with control of other cardiovascular risk factors. The control group received hypoglycemic drugs excluding SGLT2 inhibitors, including biguanides, sulfonylureas, α-glucosidase inhibitors, DPP-4 inhibitors, GLP-1 agonists, and insulin [7]. The experimental group additionally received the SGLT2 inhibitor dapagliflozin at 5-10 mg/day orally, based on individual glycemic fluctuations. All included patients received continuous, standardized treatment for 6 months with close follow-up.

1.3 Observation Indicators and Efficacy Criteria

We collected and analyzed baseline general characteristics, clinical indicators before and after treatment including fasting blood glucose (FBG), glycated hemoglobin (HbA1c), high-sensitivity C-reactive protein (hs-CRP), and lipoprotein-associated phospholipase A2 (Lp-PLA2), as well as cardiac function parameters including left ventricular ejection fraction (LVEF), left ventricular end-systolic diameter (LVESD), left ventricular end-diastolic diameter (LVEDD), N-terminal pro-brain natriuretic peptide (NT-proBNP), 6-minute walking test (6MWT), and heart rate.

Treatment efficacy was evaluated based on clinical manifestations: Markedly effective—symptoms disappeared or substantially improved, with cardiac function improvement $ $2 NYHA classes; Effective—symptoms alleviated, with cardiac function improvement $ $1 NYHA class; Ineffective—no improvement or worsening of symptoms and cardiac function. Total effective rate = (markedly effective + effective) / total cases [8]. During follow-up, we recorded and analyzed the incidence of cardiovascular events including angina, non-fatal myocardial infarction, arrhythmia, heart failure, and sudden cardiac death.

1.4 Data Processing

Data analysis was performed using SPSS 22.0. Normally distributed continuous variables were expressed as mean ± standard deviation and analyzed using independent samples t-test. Categorical data were expressed as rates and analyzed using ^{2} test. Intergroup comparisons were performed using one-way ANOVA. P<0.05 was considered statistically significant.

Results

2.1 Comparison of General Patient Characteristics Before Treatment

The 155 enrolled patients were randomly divided into experimental and control groups. The experimental group included 78 patients (42 males, 36 females) with a mean age of (61.9$±4.8)*years.Thecontrolgroupincluded*77*patients*(40*males*, 37*females*)*withameanage* years. Comparisons of general characteristics revealed no significant differences between groups in gender distribution, age, BMI, systolic/diastolic blood pressure, hypertension history, AMI type, or Killip cardiac function classification (P>0.05) .

Table 1 Comparison of general patient characteristics before treatment (n/%, x̄ ± s)

<table>
<tr><th>Parameter</th><th>Experimental Group (n=78)</th><th>Control Group (n=77)</th><th>t/ ^{2}</th><th>P</th></tr>
<tr><td>Gender (Male/Female)</td><td>42 (53.85%) / 36 (46.15%)</td><td>40 (51.95%) / 37 (48.05%)</td><td>-</td><td>>0.05</td></tr>
<tr><td>Age (years)</td><td>61.9$±4.8|62.4±5.1| − | > 0.05||BMI(kg/m^{2})|25.7±2.8|26.1±2.4|− | > 0.05||SystolicBP(mmHg)|141±13|143±$11</td><td>-</td><td>>0.05</td><td></td></tr>
<tr><td>Diastolic BP (mmHg)</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Hypertension History (Yes/No)</td><td>36 (46.15%) / 42 (53.84%)</td><td>34 (44.16%) / 43 (55.84%)</td><td>-</td><td>>0.05</td></tr>
<tr><td>AMI Type (NSTEMI/STEMI)</td><td>35 (52.56%) / 43 (47.44%)</td><td>32 (54.55%) / 45 (45.45%)</td><td>-</td><td>>0.05</td></tr>
<tr><td>Killip Classification (I/II/III)</td><td>45 (57.69%) / 29 (37.18%) / 4 (5.13%)</td><td>46 (59.74%) / 28 (36.36%) / 3 (3.90%)</td><td>-</td><td>>0.05</td></tr>
</table>

Note: P>0.05, no statistically significant difference.

2.2 Comparison of Clinical Indicator Levels Before and After Treatment

Comparisons of clinical indicators showed no significant differences between groups before treatment in FBG, HbA1c, hs-CRP, or Lp-PLA2 (P>0.05). After treatment, all these indicators decreased significantly in both groups (P<0.05). Specifically, post-treatment values in the experimental group—FBG (6.28$±0.58*mmol*/*L*), *HbA*1*c*(6.48±0.76±1.36*mg*/*L*), *andLp*−*PLA*2(147.55±32.81*μg*/*L*)—*weresignificantlylowerthanthoseinthecontrolgroup* : *FBG*(7.97±1.01*mmol*/*L*), *HbA*1*c*(7.82±0.98±1.58*mg*/*L*), *andLp*−*PLA*2(164.73±$38.42 g/L), with all differences reaching statistical significance (P<0.001) .

Table 2 Comparison of clinical indicator levels before and after treatment (x̄ ± s)

<table>
<tr><th>Group</th><th>Time</th><th>FBG (mmol/L)</th><th>HbA1c (%)</th><th>hs-CRP (mg/L)</th><th>Lp-PLA2 (g/L)</th></tr>
<tr><td>Experimental (n=78)</td><td>Before</td><td colspan="4">9.53$±1.76|9.32±0.58|16.21±4.78|226.87±41.26|||After|6.28±0.58∗ |6.48±0.76 ∗ |5.13±1.36 ∗ |147.55±32.81∗ ||Control(n = 77)|Before|9.48±1.84|9.27±0.63|16.75±4.61|228.46±40.53|||After|7.97±1.01∗ |7.82±0.98 ∗ |6.72±1.58 ∗ |164.73±$38.42*</td></tr>
<tr><td></td><td>P-value (between groups)</td><td><0.001***</td><td><0.001***</td><td><0.001***</td><td><0.001***</td></tr>
</table>

Note: *P<0.05 for within-group comparison before vs. after treatment;* **P<0.001 for between-group comparison after treatment.

2.3 Comparison of Cardiac Function Indicators Before and After Treatment

Comparisons of cardiac function revealed no significant differences between groups before treatment in LVEDD, LVESD, LVEF, NT-proBNP, 6MWT, or heart rate (P>0.05). After treatment, all parameters showed significant changes from baseline (P<0.05). Intergroup comparisons demonstrated that the experimental group had significantly higher LVEF (46.23$±5.88±47.83*m*)*comparedtothecontrolgroup*(*LVEF* : 39.12±5.91±49.51*m*), *whileLVESD*(45.43±6.81*n* *proBNP*(164±8.12*ng*/*L*), *andheartrateweresignificantlylowerthaninthecontrolgroup*(*LVESD* :

51.24±6.47mm; LVEDD: 49.42±5.43mm; NT−proBNP: 164±$8.12 ng/L), with all differences being statistically significant (P<0.001) .

Table 3 Comparison of cardiac function indexes before and after treatment (x̄ ± s)

Group	Time	LVEF (%)	LVESD (mm)	LVEDD (mm)	NT-proBNP (ng/L)	6MWT (m)	Heart Rate (bpm)
Experimental (n=78)	Before	31.42$±5.72	64.85±7.24	70.65±7.75	243.68±6.4	301.78±53.14	95.65±5.73
	After	46.23±5.88*	45.43±6.81*	46.63±5.88*	115±7.68*	486±47.83*	71.53±5.08*
Control (n=77)	Before	30.83±5.41	65.17±6.89	71.48±8.32	241.17±7.2	302.27±50.26	96.48±6.32
	After	39.	51.24±6.47*	49.42±5.43*	164±8.12*	437±49.51*	78.92±$4.93*
	P-value (between groups)	<0.001***	<0.001***	<0.001***	<0.001***	<0.001***	<0.001***

Note: *P<0.05 for within-group comparison before vs. after treatment;* **P<0.001 for between-group comparison after treatment.

2.4 Comparison of Treatment Efficacy Between Groups

Treatment efficacy analysis showed that the experimental group achieved markedly effective results in 48 cases (61.54%), effective in 27 cases (34.61%), and ineffective in 3 cases (3.85%). The control group showed markedly effective results in 40 cases (51.95%), effective in 29 cases (37.66%), and ineffective in 8 cases (10.39%). The overall treatment response rate was 92.90%, with the experimental group achieving 96.15%, significantly higher than the control group's 89.61% (P<0.01) .

Table 4 Comparison of treatment efficiency (n/%)

Group	Markedly Effective	Effective	Ineffective	Total Effective
Experimental (n=78)	48 (61.54%)	27 (34.61%)	3 (3.85%)	75 (96.15%)
Control (n=77)	40 (51.95%)	29 (37.66%)	8 (10.39%)	69 (89.61%)
P-value	-	-	-	0.006**

Note: **P<0.01, statistically significant difference.

2.5 Comparison of Cardiovascular Event Incidence After Treatment

Cardiovascular event analysis revealed that the experimental group experienced recurrent angina in 2 cases (2.56%), non-fatal myocardial infarction in 1 case (1.28%), arrhythmia in 2 cases (1.28%), heart failure in 1 case (2.56%), and no sudden cardiac deaths, totaling 6 cases (7.69%). The control group had recurrent angina in 5 cases (6.49%), non-fatal myocardial infarction in 3 cases (3.89%), arrhythmia in 2 cases (2.60%), heart failure in 2 cases (2.60%), and sudden cardiac death in 1 case (1.30%), totaling 13 cases (16.88%). The difference in adverse cardiovascular event incidence between groups was statistically significant (P<0.01) .

Table 5 Comparison of cardiovascular event incidence after treatment (n/%)

Group	Angina	Non-fatal MI	Arrhythmia	Heart Failure	Sudden Cardiac Death	T
Experimental (n=78)	2 (2.56%)	1 (1.28%)	2 (2.56%)	1 (1.28%)	0 (0%)	6
Control (n=77)	5 (6.49%)	3 (3.89%)	2 (2.60%)	2 (2.60%)	1 (1.30%)	13
P-value	-	-	-	-	-	0.

Note: **P<0.01, statistically significant difference.

Discussion

In recent years, with accelerated population aging and improved living standards, the incidence of AMI has been increasing annually. Coronary atherosclerotic heart disease (CAD), represented by AMI, has become one of the leading causes of death among Chinese residents [2,9]. Simultaneously, the number of diabetic patients in China has risen significantly, reaching 140.9 million reported cases in 2021, with epidemiological surveys indicating that diabetes prevalence will continue to increase over the next decade [10]. Multiple authoritative domestic and international studies have identified diabetes as an independent risk factor for cardiovascular disease, with 70%-80% of T2DM patients dying from cardiovascular complications. Moreover, coronary artery lesions in T2DM patients are characterized by diffuse, calcified, multivessel, and small-vessel disease, leading to high rates of cardiovascular event recurrence and poor prognosis after PCI [11]. Consequently, achieving glycemic control while providing cardiovascular protection has become a new therapeutic goal. SGLT2 inhibitors represent a novel class of non-insulin-dependent hypoglycemic agents that primarily reduce plasma glucose levels by inhibiting SGLT2 expression in the kidneys, decreasing renal glucose reabsorption, and increasing urinary glucose excretion. Unlike conventional hypoglycemic agents such as sulfonylureas and insulin, these drugs do not increase hypoglycemia risk. Dapagliflozin, a typical SGLT2 inhibitor, has been shown in multiple studies to improve cardiovascular prognosis, reduce cardiac load, enhance cardiac metabolism and bioenergy utilization, inhibit myocardial Na+/H+ exchange, reduce myocardial necrosis and fibrosis, and decrease inflammatory factor production and epicardial adipose tissue content [4,12]. To investigate the clinical efficacy of dapagliflozin in AMI patients with T2DM, we conducted this study examining its impact on cardiovascular events after PCI.

Our study enrolled 155 patients admitted to our cardiology department between January 2021 and December 2022, randomly assigned to experimental (n=78) and control (n=77) groups. All patients were diagnosed with AMI complicated by T2DM and underwent PCI within the therapeutic window, with the experimental group receiving additional dapagliflozin postoperatively. Results demonstrated that after 6 months, both groups showed reductions in FBG, HbA1c, hs-CRP, and Lp-PLA2 from baseline, with significantly greater reductions in the experimental group. Cardiac function comparisons revealed that post-treatment LVEF and 6MWT were significantly higher in the experimental group, while LVEDD, LVESD, NT-proBNP, and heart rate were significantly lower. T2DM is characterized by hyperglycemia, and studies have demonstrated a positive correlation between elevated blood glucose, high glycated hemoglobin, and increased cardiovascular disease incidence. Dapagliflozin's glucose-lowering mechanism is independent of pancreatic function and insulin resistance, producing stable glucose excretion rates across different DM populations and effectively controlling blood glucose to improve cardiac function [13]. Research has shown that in diabetic patients with coronary heart disease, dapagliflozin exhibits pleiotropic effects beyond glycemic control, particularly providing definitive cardiovascular protection [12]. In our study, the overall treatment response rate was 92.90%, with the experimental group achieving 96.15%, significantly higher than the control group's 89.61%, and cardiovascular event incidence was 7.69% in the experimental group versus 16.88% in the control group. These findings suggest that dapagliflozin effectively improves cardiovascular outcomes in diabetic patients by reducing risks of angina, non-fatal myocardial infarction, arrhythmia, heart failure, and sudden cardiac death. The underlying mechanisms may involve renal function improvement, diuresis during the acute phase, reduced cardiac volume load, improved long-term prognosis, and decreased or delayed occurrence and progression of cardiovascular events after AMI [14].

In summary, for AMI patients with T2DM, dapagliflozin application after PCI effectively regulates blood glucose, improves cardiac function, enhances treatment efficacy, and reduces cardiovascular event risk, warranting clinical promotion and application.

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Note: Figure translations are in progress. See original paper for figures.