EFFECT OF ONE-STAGE STENT IMPLANTATION AND DELAYED STENT IMPLANTATION ON QTC DISPERSION AND MYOCARDIAL PERFUSION IN PATIENTS WITH HIGH THROMBOTIC LOAD ACUTE MYOCARDIAL INFARCTION

Xiaorui Li, Jingxian Liu*
Cardiology Department of Elderly, First Affiliated Hospital of Kunming Medical University, Kunming, 650000, China

ABSTRACT

Objective: *The paper aimed to investigate the effects of primary stent implantation and delayed stent implantation on QTc dispersion and myocardial perfusion in patients with acute myocardial infarction with a high thrombotic load.*

Methods: *A total of 80 patients with acute myocardial infarction (AMI) with a high thrombus burden were selected as the research subjects. According to whether the stent was implanted immediately after opening the vessel, they were divided into a Primary stent implantation group and delayed stent implantation group (40 cases in each group). A total of 40 patients with chest pain but normal coronary angiography was selected as the control group. The general conditions of the patients were observed and recorded, and the preoperative and postoperative QTc dispersion, myocardial perfusion (TIMI blood grading, thrombosis score), PCI status, and major postoperative adverse cardiovascular events (MACE) were compared in each group.*

Results: *In both the Primary stent implantation group and the delayed stent implantation group, postoperative QTc dispersion of AMI patients was significantly reduced, the TIMI3 blood flow proportion was increased, and the thrombosis score was reduced; further, the improvement effect was more obvious in the delayed group ($P<0.05$). The number of stent placement cases, average number of stents, and also diameter and length of stents in the delayed group were significantly lower than those in the primary stent implantation group, with statistically significant differences ($P<0.05$). The incidence of MACE in the in-hospital and delayed groups within 1 year after surgery was much lower than that in the Primary group ($P<0.05$).*

Conclusion: *Delayed stent implantation after vascular opening in AMI patients was beneficial in reducing QTc dispersion and improving myocardial perfusion; thus, it helps achieve a better prognosis effect, which is better than Primary stent implantation.*

Keywords: *Acute myocardial infarction, QTc dispersion, myocardial perfusion.*

DOI: 10.19193/0393-6384_2021_5_393

Received *March 15, 2020;* ***Accepted*** *June 20, 2021*

Introduction

Acute myocardial infarction (AMI) is myocardial necrosis caused by acute and persistent ischemia and hypoxia of the coronary artery, possibly being complicated with arrhythmia, shock, or heart failure. It is a cardiovascular disease with high mortality and disability rate[1-3]. Percutaneous coronary intervention (PCI) is currently the most effective treatment, opening better the culprit's vessel. However, in AMI lesions with high thrombotic load, stent implantation leads to distal vascular embolism and no reflux, further expanding the infarct size, thus increasing the mortality[4-6]. Proper management of acute myocardial infarction (STEMI) lesions with a high thrombotic load and improvement of the myocardial perfusion level and prognosis are significant challenges in the AMI field presently. Some studies have shown that once the criminal vessels are dredged, the delayed stent implantation can improve the myocardial repolarization heterogeneity, electrical activity instability, and

myocardial function in patients to a certain extent[7-10]. However, few reports have compared multiple life indicators of patients in primary stent implantation and delayed stent implantation; further, there is still some controversy about selecting stent implantation time for patients with AMI in clinics. Therefore, the present research investigates the effects of delayed stenting on QTc dispersion, myocardial perfusion, PCI, and prognosis; it also compares the effects of primary stenting on multiple indicators in subjects.

Material and methods

General information

A total of 80 patients with acute myocardial infarction with high thrombotic load admitted to our Cardiology Department from January 2019 to June 2019 were selected as the research subjects, including 44 males and 36 females with an average age of (62.50±7.78) years old. According to the envelope method, the patients were randomly divided into the primary stent implantation and delayed stent implantation groups (40 cases in each group). In both groups, the stent was placed immediately after percutaneous coronary intervention (PCI) and/or catheter thrombus aspiration to open the blood vessel in the primary stent implantation group. While in the delayed stent implantation group, stent placement was decided based on the results of coronary angiography reexamination and the degree of criminal vascular occlusion seven days after opening the blood vessel.

Forty patients with chest pain and distress but normal coronary angiography admitted simultaneously were selected as the control group, including 23 males and 17 females with an average age of (62.67±8.16) years old. There was no acid-base balance and electrolyte disorder in the cases, and no significant difference ($P>0.05$) was found in age, gender, and complications (diabetes, hypertension, hyperlipidemia, and heart failure) among groups, which was comparable.

Inclusion criteria

Inclusion criteria for patients with AMI:

• Continuous chest pain not less than 30 min, without remission after administration of nitrates;

• ST-segment elevation occurred in more than two leads of ECG, and limb leads ≥0.1 mV; chest leading joint ≥0.2 mV;

• Complete occlusion of coronary artery;

• Dramatic increase and change in concentration of serum markers of myocardial necrosis: troponin T is not less than 0.04 ng/ml, and the peak value of myocardial enzyme exceeds two times of the upper limit of normal;

• Relevant treatment not performed before hospital admission.

Exclusion criteria

Patients with the following criteria were excluded:

• Medical history of old myocardial infarction;

• Cerebrovascular diseases;

• Missing or incomplete clinical information;

• Malignant arrhythmia, atrial fibrillation, cardiomyopathy, rheumatic heart disease, and heart valve relaxation;

• Mental system diseases, such as depression, mania, and schizophrenia;

• Heart disease, diabetes, liver, and renal insufficiency;

• Malignant tumor;

• Autoimmune diseases.

Medical ethics issues

Subjects followed the principle of voluntary participation and signed a study consent form approved by the Ethics Committee of our hospital. The privacy and safety of subjects were adequately protected following clinical study guidelines.

Methodology

General information

General indicators such as age, gender, and complications of the subjects were recorded, and the differences between groups were compared and excluded.

Treatment

Coronary angiography was performed on all patients after their arrival. Aspirin 300 mg was chewed, and clopidogrel 300-500 mg was taken orally before PCI (500 mg 6 hours after AMI; 300 mg before delayed PCI). Also, atorvastatin 80 mg was taken orally. Sufficient heparinization was performed during the operation, other standardized drug treatment.

Primary stent implantation group

Stent implantation was performed within 12 h of the onset of AMI. The specific method was as follows: the guidewire was passed through the occluded lesion, and the thrombus was manually

aspirated by a (thrombus aspiration) catheter and pre-expanded by a balloon at 6-8 atmospheres (fractional expansion can be used for longer lesion sites). One or more stents were placed to treat occluded vasculopathy without post-dilation.

Delayed stent implantation group

Seven days after the vessel was opened, routine coronary angiography was performed through the radial artery to determine the extent of vascular lesions. The guidewire was passed through the occluded vessel, and reexamination was conducted after balloon dilatation to learn the thrombosis complexity and residual stenosis. Conservative treatment with drugs was performed when the residual stenosis of the diseased vessel was less than 70%, and the distal blood flow was TIMI3 grade; otherwise, the balloon was pre-expanded, then the stent was placed, and full post-expansion was performed.

QTc dispersion determination

The 12-lead ECG of the patient 2 h before and 24 h after operation was analyzed, and dynamic ECG examination was performed at 24 h with the recording speed of 20 mm/s. The QT interval of each lead was measured by a specially assigned person (the leads with clear QRS onset and T wave end were selected; at least six leads were measured in each ECG, and three were measured consecutively). The average value was taken as the measured QT interval; QT interval = longest QT interval-shortest QT interval for different leads. To exclude the effect of heart rate, the corrected dispersion was calculated as follows: QTc=QT/(RR)1/2.

TIMI blood flow classification

TIMI blood flow classification was a standard for evaluating coronary artery reperfusion by coronary angiography and had certain relation with the degree of coronary artery stenosis.

The postoperative TIMI blood flow classification of each group was observed with the criteria as follows:

• Complete occlusion of blood vessels at the infarction site and 0 grade for distal no-forward blood flow (no perfusion);

• The basic occlusion of the coronary artery at the infarct site and grade 1 (micro-perfusion), in which only a small amount of contrast agent passed through the lesion site but failed to fill the distal vessels;

• The blood vessels at the infarct site being fully-developed, but the blood flow velocity being slow as grade 2 (partial perfusion);

• The blood vessels at the infarct site being completely-visualized, and the normal flow rate being grade 3 (full perfusion). TIMI grades 0 and 1 indicate non-recanalization of the coronary artery;

• TIMI grades 2 and 3 indicate coronary artery recanalization (reperfusion).

Evaluation of thrombus score

Evaluation of high thrombotic load by thrombotic score: no thrombosis was recorded as 0; A fuzzy thrombus image was recorded as 1; score 2 was assigned when there was a confirmed thrombotic image, and the length of the thrombus was less than half of the inner diameter of the blood vessel; the score was 3 when there was a confirmed thrombotic image, and the length was greater than half or less than two times of the internal diameter of the blood vessel; it was assigned 4 when there was a definite thrombus, and the length was more than two times of the internal diameter of the vessel.

PCI situation comparison

No regurgitation and slow blood flow, the stent placement rate, and the per capita stent placement rate during PCI were observed in all groups.

Major adverse cardiovascular events (MACE)

Postoperative unconscionable vascular events mainly included subspecies arrhythmia, congestive heart failure, and cardiac death. The incidence of MACE in each group was observed and recorded.

Statistical analysis

SPSS20.0 statistical analysis software was used for data processing. Statistical results were expressed as "mean standard deviation." One-way analysis of variance was used for mean comparison among multiple samples, and the least significant difference LSD t-test was used for pairwise comparison of mean between groups. $P<0.05$ indicated that the difference had a statistical significance.

Results

General conditions of patients

The basic conditions of patients in each group are presented in Table 1. As can be seen, there were no significant differences in age and gender ratio among different groups ($P>0.05$). There were no significant

differences in onset time and complication number between the Primary and delayed stent implantation groups (hereinafter the latter referred to as the delayed group) (P>0.05). The interference of the above factors on the test results could be excluded, and the data were comparable.

Group	Number of cases	Age (years)	Male proportion (%)	Onset time (h)	Number of complications (units)
Control group	40	62.67±8.16	23 (57.50%)	-	-
Primary stent implantation group	40	63.42±8.25	23 (57.50%)	7.01±2.24	1.28±0.92
Delayed stent implantation group	40	61.57±7.31	21 (52.50%)	6.25±1.85	1.43±0.75
F-value	-	0.43	0.28	0.25	0.15
P-value	-	>0.05	>0.05	>0.05	>0.05

Table 1: General information of patients.

Effect of primary and delayed stenting on QTc dispersion in patients with AMI

The effects of primary and delayed stenting on QTc dispersion in patients with AMI are shown in Table 2 and Figure 1. As seen in both, compared with the control group, the preoperative QTcs of both the Primary and delayed stent implantation groups were significantly higher than the control group, and the difference was statistically significant (P<0.05). Preoperative QTc values showed no significant differences among patients with AMI (P>0.05). After 48 h of stent implantation, the QTc values of patients were significantly reduced compared with those before surgery, the reduction effect in the delayed stent implantation group was more significant, and the difference was statistically significant (P<0.05). The results showed that stent implantation could significantly improve myocardial repolarization heterogeneity and electrical activity instability in patients, and delayed stent implantation had a better improvement effect (Table 2 and Figure 1).

Group	Number of cases	Preoperative QTc(ms)	Postoperative 48hQTc(ms)
Control group	40	30.71±7.24	31.58±8.91
Primary stent implantation group	40	73.63±9.32	54.51±8.22
Delayed stent implantation group	40	76.17±8.26	46.27±8.35
F-value	-	5.49	6.73
P-value	-	<0.05	<0.05

Table 2: Effect of primary and delayed stenting on QTc dispersion in patients with AMI.

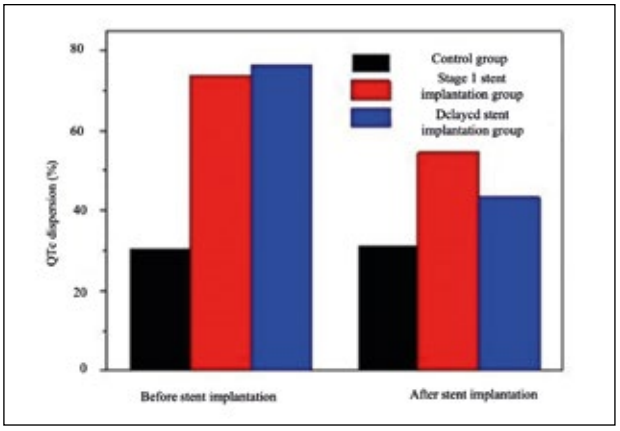

Figure 1: Effects of primary and delayed stenting on QTc dispersion in patients with AMI.

Effects of primary and delayed stenting on TIMI blood flow classification of patients with AMI

The effects of primary and delayed stenting on TIMI blood flow classification in patients with AMI are shown in Table 3 and Figure 2. As observed in both, the blood flow in the preoperative control group was normal, with the TIMI blood flow grade 3 accounting for 100%. The stent implantation group had severe vascular infarction and blood flow obstruction, with the TIMI blood flow grade 3 accounting for 0%. Compared with the control group, the difference was extremely significant (P<0.01). Postoperatively, either primary or delayed stenting significantly increased the patency of criminal blood flow in patients with AMI and the proportion of TIMI3 grade blood flow. The increase in the proportion of TIMI3 grade blood flow in the delayed group was more significant, and the difference was statistically significant (P<0.05). The results showed that after stent implantation in the coronary artery at the infarct site, the mobility of criminal blood was significantly increased; further, the effect of delaying the patency of blood vessels in the stent implantation group was better (Table 3 and Figure 2).

Group	Number of cases	Preoperative TIMI3 grade i3 flow	Postoperative TIMI3 flow
Control group	40	40 (100%)	40 (100%)
Primary stent implantation group	40	0 (0%)	30 (75.00%)
Delayed stent implantation group	40	0 (0%)	38 (95.00%)
F-value	-	7.86	5.72
P-value	-	<0.01	<0.05

Table 3: Effect of primary and delayed stenting on QTc dispersion in patients with AMI.

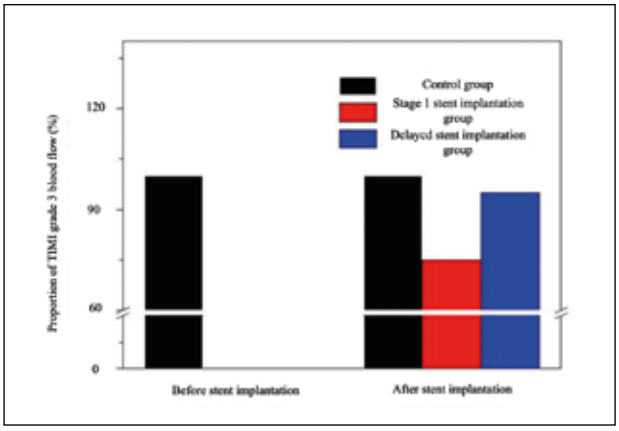

Figure 2: Effects of primary and delayed stenting on TIMI blood flow classification in patients with AMI.

Effect of primary and delayed stenting on thrombotic scores of patients with AMI

The effects of primary and delayed stent implantation on the thrombotic scores of patients with AMI are provided in Table 4.

The preoperative thrombosis scores in the primary stent group and the delayed stent group were (3.63±0.72) and (3.47±0.56), respectively, which were significantly higher than those in the control group 0.21±0.01 (P<0.05). After stent implantation, the thrombosis scores of criminal vessels in patients with AMI were significantly reduced, the reduction effect in the delayed group was more significant, and the difference was statistically significant (P<0.05). The results showed that the thrombotic occlusion of criminal vessels was significantly reduced after stent implantation in the coronary artery at the infarct site; also, the effect of delaying the patency of vessels in the stent implantation group was better.

Group	Number of cases	Preoperative thrombotic score	Postoperative thrombotic score
Control group	40	0.21±0.01	0.18±0.01
Primary stent implantation group	40	3.63±0.72	1.51±0.23
Delayed stent implantation group	40	3.47±0.56	1.07±0.33
F-value	-	4.84	5.63
P-value	-	<0.05	<0.05

Table 4: Effect of the primary and delayed stent implantation on thrombosis scores of patients with AMI.

Comparison of PCI status in patients with AMI

The results of PCI comparisons among AMI patients in each group are presented in Table 5. As observed, the delayed stent implantation group compared to the primary stent implantation group had the lower number of stent placement cases, the average number of stents, and the diameter and length of stents, with significant differences (P<0.05).

Group	Number of cases	Cases (a) of stent implantation	Average number of stents (a)	Support diameter (mm)	Support length (mm)
Control group	40	0	0	0	0
Primary stent implantation group	40	40(100%)	1.31±0.20	3.46±0.62	26.43±6.21
Delayed stent implantation group	40	33(82.5%)	1.02±0.16	3.07±0.59	21.07±5.73
F-value	-	6.81	5.72	5.68	6.23
P-value	-	<0.05	<0.05	<0.05	<0.05

Table 5: Comparison of PCI status among different groups.

Comparison of MACE among different groups

The results of MACE incidence in patients of each group are presented in Table 6. As seen, the incidence of MACE in the delayed stent implantation group was significantly lower than that in the primary stent implantation group both in the hospital and within one year after discharge, and the difference was statistically significant (P<0.05).

Group	Number of cases	Incidence of MACE in hospital (%)	Incidence of MACE within 1 year of discharge (%)
Control group	40	-	-
Primary stent implantation group	40	7(17.50%)	11(27.50%)
Delayed stent implantation group	40	2(5.00%)	4(10.00%)
F-value	-	5.49	5.37
P-value	-	<0.05	<0.05

Table 6: MACE incidence in patients of each group.

Discussion

AMI can change myocardial local conduction velocity and electrophysiological properties, significantly increase QTc dispersion, lead to severe arrhythmia, and finally increase patient mortality[11-13]. PCI, as the primary treatment for patients with AMI, can reduce the QTc dispersion and myocardial perfusion level to a certain extent[14-15].

However, plaque rupture, endothelial damage, and inflammatory reaction can further induce the formation of polar thrombosis during the treatment; the stent implantation can also promote the further increase of this phenomenon to some extent[16].

Identifying an effective and reasonable diagnosis and treatment plan for AMI is the greatest challenge currently being faced.

At present, there are few reports on the comparison of multiple life indicators of patients in primary stent implantation and delayed stent implantation; additionally, there are still some disputes on selecting stent implantation time for patients with AMI in clinics. Therefore, in this study, 80 patients with acute myocardial infarction (AMI) showing high thrombotic load by coronary angiography were selected as the research subjects. They were divided into a primary stent implantation group and a delayed stent implantation group (40 cases in each group) according to whether stent implantation was performed immediately after opening the blood vessel. Forty patients with chest pain and distress but normal coronary angiography admitted to the hospital at the same time were selected as the control group. There were no significant differences in age, gender, or the number of complications among the groups, and the data were comparable. According to the results, in both the primary and delayed stent implantation groups, QTc dispersion was significantly reduced in patients with AMI after an operation; further, the improvement effect in the delayed group was more significant ($P<0.05$). Specifically, the delayed stent implantation could significantly improve the myocardial repolarization heterogeneity and electrical activity instability in patients. This is since the ischemic area exists in the infarcted vessel of the coronary artery in patients with AMI, which delays the transmembrane potential and increases the heterogeneity of myocardial cell repolarization in each part, resulting in a significant QTc dispersion value[17]. After stent implantation, blood vessels at the infarction site recanalized, the blood supply to the ischemic area recovered, and ventricular electrical activity instability and QTc dispersion decreased. Compared with primary stent implantation, delayed stent implantation can reduce the fragmentation of unstable plaques and the incidence of vasospasm, further reducing QTc dispersion[18].

The results of the myocardial perfusion test showed that after stent implantation, the blood flow proportion of TIMI3 grade in patients with AMI was significantly increased, and the thrombotic score was reduced. The improvement effect in the delayed group was more significant ($P<0.05$). This is because the primary stent implantation increases the endothelial damage and plaque rupture of criminal vessels in patients, which is not conducive to the recanalization of distal perfusion[19]. The results of the PCI comparison showed that the number of cases of stent placement, the average number of stents, the diameter and length of stents in the delayed group were significantly lower than those in the primary group (both $P < 0.05$). The causes of this phenomenon were as follows: in emergency PCI, the lesion site cannot be clearly exposed from the image due to heavy thrombus load, increasing stent length; at the early stage of AMI, the diameter of criminal blood vessels is affected by the increased vasoconstrictor and platelet content in blood, affecting the selection of stent diameter in turn[20]. The results further showed that the incidence of MACE in the hospital and within one year after surgery in the delayed group was much lower than that in the primary group ($P<0.05$). This suggested that delayed stent implantation had a better prognosis.

In summary, after opening the vessels of patients with AMI, the delayed stent implantation exerted favorable effects on the reduction of QTc dispersion and improvement of myocardial perfusion. The PCI and prognosis effects were better, superior to the primary stent implantation with high clinical application and promotion value.

References

1) Isaiah E., Susanti F., Sunday A., Jamiatun., Chaerunnisa D., Effect of therapy hypothermia on hemodynamic status of post-cardiac arrest in acute myocardial infarction, Enfermería Clínica, 2020, 30(3), 92-94.

2) Gregory D.R., Nathaniel R.S., Jeffrey S.B., MSacJonathan D.N., Association of thrombocytopenia, revascularization, and in-hospital outcomes in patients with acute myocardial infarction, The American Journal of Medicine, 2019, 132(8), 942-948.e5.

3) Lee S.H., Kim H.K., Lee J.M., Hong Y.J., Lim K.S., Kim H.B., Choi K.H., Shin E.S., Nam C.W., Doh J.H., Yang J.H., Song Y.B., Hahn J.Y., Jeong M.H., Samady H., Escaned J., Coronary circulatory indexes in non-infarct-related vascular territories in a porcine acute myocardial infarction model, JACC: Cardiovascular Interventions, 2020, 13(1025), 1155-1167.

4) Lee S.H., Jeong M.H., Kim J.H., Kim J.H., Kim M.C., Sim D.S., Hong Y.J., Ahn Y., Chae S.C., Seong I.W., Park J.S., Chae J.K., Hur S.H., Cha K.S., Kim H.S., Gwon H.C., Seung K.B., Rha S.W., A new risk score for ventricular tachyarrhythmia in acute myocardial infarction with preserved left ventricular ejection fraction, Journal of Cardiology, 2018, 72(5), 420-426.

5) Nicolas D., Michel F., Marianne Z., Etienne P., Yves C., Loïc B., Gilles L., Guillaume C., Laurent J., Thibault P., Denis A., Franck A., Jean F., François S., Investigators F.M., Long-term outcomes after acute myocardial infarction in patients with familial hypercholesterolemia: The French registry of Acute ST-elevation and non-ST-elevation Myocardial Infarction program, Journal of Clinical Lipidology, 2020, 14(3), 352-360.e6.
6) Pimprapa V., Danai K., Mohammad M., Konstantinos C., Vernon A.H., Salman A., Prakash B., Smalling R.W., Abhijeet D., Outcomes of acute myocardial infarction in patients with influenza and other viral respiratory infections, The American Journal of Medicine, 2019, 132(10), 1173-1181.
7) Choe J.C., Cha K.S., Lee J.G., Kim J.M., Shin J.Y., Ahn J.H., Park J.S., Lee H.W., Oh J.H., Choi J.H., Lee H.C., Hong T.J., Jeong M.H., Long-Term outcomes of biodegradable versus second-generation durable polymer drug-eluting stent implantations for myocardial infarction, JACC: Cardiovascular Interventions, 2020, 13(113), 97-111.
8) Vos N.S., Fagel N.D., Giovanni Amoroso M.D., Herrman J., Patterson M.S., Piers L.H., Schaaf R., Ton Slagboom M.D., Vink M.A., Paclitaxel-Coated balloon angioplasty versus drug-eluting stent in acute myocardial infarction: The REVELATION randomized trial, JACC: Cardiovascular Interventions, 2019, 12(179), 1691-1699.
9) Kim Y.H., Her A.Y., Jeong M.H., Effect of renin-angiotensin system inhibitors on major clinical outcomes in patients with acute myocardial infarction and prediabetes or diabetes after successful implantation of newer-generation drug-eluting stents, Journal of Diabetes and its Complications, 2010, 34(6), 107574.
10) Lee J.M., Rhee T.M., Chang H., Ahn C., Hahn J.Y., Deferred versus conventional stent implantation in patients with acute ST-segment elevation myocardial infarction: An updated meta-analysis of 10 studies, International Journal of Cardiology, 2020, 2301, 509-517.
11) Yandrapalli S., Malik A.H., Pemmasani G., Gupta K., Harikrishnan P., Nabors C., Aronow W.S., Cooper H.A., Panza J.A., Frishman W.H., Jain D., Risk factors and outcomes during a first acute myocardial infarction in breast cancer survivors compared with females without breast cancer, The American Journal of Medicine, 2020, 133(4), 444-451.
12) Xiang G., Shan P., Zhou C.Z., Clinical features and prognosis of acute myocardial infarction caused by non-tumor origin coronary artery embolism, The American Journal of Emergency Medicine, 2020, 38(6), 1185-1191.
13) Saito Y.C., Kobayashi Y., Percutaneous coronary intervention strategies in patients with acute myocardial infarction and multivessel disease: Completeness, timing, lesion assessment, and patient status, Journal of Cardiology, 2019, 74(2), 95-101.
14) Hilda M., Goto Y.C., Cardiac mechanoenergetics in patients with acute myocardial infarction: from pressure-volume loop diagram related to cardiac oxygen consumption, Heart Failure Clinics, 2020, 16(3), 255-269.
15) Kim Y.C., Jeong M.H., Ahn Y.K., Results of a 10-year experience in Korea using drug-eluting stents during percutaneous coronary intervention for acute myocardial infarction (from the Korea acute myocardial infarction registry), The American Journal of Cardiology, 2018, 122(31), 365-373.
16) Hui W.S., Elizabeth H.T., Tan H.C., Clinical outcomes one year and beyond after combination sirolimus-eluting endothelial progenitor cell capture stenting during primary percutaneous coronary intervention in st-segment elevation myocardial infarction. Cardiovascular Revascularization Medicine, 2019, 20(9), 739-743.
17) Kazemi B., Reza H., Ranjbar A.H., Evaluation of Speak to end/QT and Speak to end/QTc ratios in patients with STEMI undergoing percutaneous intervention vs. thrombolytic therapy. Journal of Electrocardiology, 2020, 58, 160-164.
18) Idris A., Hatchet M., Edris B., Acute myocardial infarction in the setting of left bundle branch block: Chapman's sign, The American Journal of Emergency Medicine, 2019, 37(10), 1991.e5-1991.e7.
19) Asim Y., Anne M.G., Henry J.D., Increased precordial qtc dispersion predicts ventricular fibrillation during acute myocardial infarction, The American Journal of Cardiology, 1996, 78(615), 706-708.
20) William S.M., Danielle R.W., Stephen C.I., et al. ST-Segment elevation myocardial infarction in a young woman: undiagnosed turner syndrome, JACC: Case Reports, 2020, 2(1), 55-58.

Corresponding Author:
Jingxian Liu
Email: lixiaorui20210607@163.com
(China)