Journal of Hainan Medical University

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Correlation of QRS complex after percutaneous coronary intervention with myocardial ischemia reperfusion injury and apoptosis molecule contents

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ARTICLE INFO

Article history:
Received 25 Oct 2017
Received in revised form 28 Oct 2017
Accepted 2 Nov 2017
Available online 14 Nov 2017

Keywords:
Percutaneous coronary intervention
Fragmented QRS complex
Ischemia reperfusion injury
Apoptosis

ABSTRACT

Objective: To study the correlation of QRS complex after percutaneous coronary intervention (PCI) with myocardial ischemia reperfusion injury and apoptosis molecule contents. **Methods:** Patients with non-ST-segment elevation myocardial infarction who were treated in Nanchong Central Hospital between June 2014 and August 2016 were selected and divided into the PCI group who received emergency PCI surgery and the control group who accepted selective PCI or refused emergency PCI after the medical data were retrospectively analyzed. The fQRS as well as the contents of ischemia reperfusion injury indexes and apoptosis molecules was determined after 1 week of treatment. **Results:** The incidence of fQRS in PCI group was significantly lower than that in control group; serum MDA, cTnI, H-FABP, sTWEAK, sFas, sTRAIL and Caspase-3 contents as well as peripheral blood Nrf-2 and HO-1 expression of PCI group were greatly lower than those of control group; serum MDA, cTnI, H-FABP, sTWEAK, sFas, sTRAIL and Caspase-3 contents as well as peripheral blood Nrf-2 and HO-1 expression of PCI group of patients with fQRS complex (+) were greatly higher than those of patients with fQRS complex (-). **Conclusion:** The occurrence of fQRS after PCI is closely related to myocardial ischemia reperfusion injury and apoptosis.

1. Introduction

Percutaneous coronary intervention (PCI) is an effective method for clinical treatment of acute coronary syndrome, and early reascularization of infracted coronary artery can make the myocardium obtain blood reperfusion in time and relieve myocardial injury[1,2]. In the process of blood reperfusion in ischemic myocardium, different degrees of ischemia-reperfusion injury will occur, and the oxidative stress and apoptosis caused by excessive oxygen free radical production are closely associated with ischemia-reperfusion injury. The ischemia-reperfusion injury after PCI can increase the sudden cardiac death, recurring myocardial infarction and other adverse cardiovascular events, and early prediction of the occurrence risk of adverse cardiovascular events and implementation of intervention can effectively improve disease outcomes. Fragmented QRS complex is the new ECG examination index developed in recent years, which has early prediction value for a variety of cardiovascular events[3,4]. The correlation of fQRS complex after PCI with myocardial ischemia reperfusion injury and apoptosis molecule contents was specifically analyzed in the following studies.

2. Case information and research methods

2.1 General case information

Patients with non-ST-segment elevation myocardial infarction who were treated in Nanchong Central Hospital between June 2014 and August 2016 were selected as the research subjects, and all patients

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Fund Project: Projects of Health and Family Planning Commission of Sichuan Province in 2016 No: 16PJ199.

had clinical symptoms of myocardial infarction after admission, were with increased myocardial biochemical markers and ST-T change or pathologic Q wave detected by electrocardiogram, and conformed to the diagnosis of myocardial infarction. A total of 109 patients were enrolled and divided into the PCI group who received emergency PCI surgery and the control group who accepted selective PCI or refused emergency PCI after the medical data were retrospectively analyzed. There were 64 cases in PCI group, including 39 male cases and 25 female cases that were 43-65 years old; there were 45 cases in control group, including 25 male cases and 20 female cases that were 40-62 years old. There was no significant difference in general information between the two groups of patients.

2.2 fQRS complex evaluation after PCI

PCI group received electrocardiogram examination 1 week after operation, control group received electrocardiogram examination 1 week after hospitalized, and the fQRS complex was judged according to the results of electrocardiogram: (1) those with QRS complex duration < 120 ms, QRS complex showed triphasic wave or polyphasic wave, and typical cases showed RSR' type; (2) those with QRS complex duration > 120 ms, two or more adjacent lead R wave or S wave showed more than two incisurae.

2.3 Serum and peripheral blood index detection

The peripheral blood was collected from PCI group 1 week after operation, the peripheral blood was collected from control group 1 week after hospitalized, and the blood was divided into two parts. One part of peripheral blood was centrifuged to separate serum, and enzyme-linked immunosorbent assay was used to determine the contents of MDA, cTnI, H-FABP, sTWEAK, sFas, sTRAIL and Caspase-3; the other part of peripheral blood was added in the Ficoll separating medium and centrifuged to get the peripheral blood mononuclear cells, the antibody of Nrf-2 and HO-1 were incubated, and then the expression intensity was determined on the flow cytometer.

2.4 Statistical methods

SPSS 20.0 software was used for the t test of the differences in measurement data and the chi-square test of the differences in count data between two groups, and $P<0.05$ meant statistical significance in differences in test results.

3. Results

3.1 The incidence of fQRS complex

There were 17 cases in PCI group who showed fQRS complex 1 week after operation and the incidence of fQRS complex was 26.56%; there were 28 cases in control group who showed fQRS complex 1 week after operation and the incidence of fQRS complex was 62.22%. After chi-square test, the incidence of fQRS complex in PCI group was significantly lower than that in control group. The differences in the incidence of fQRS complex were statistically significant between the two groups ($P<0.05$).

3.2 Ischemia reperfusion injury index contents in serum and peripheral blood as well as their correlation with fQRS complex

Analysis of serum MDA (μmol/L), cTnI and H-FABP contents as well as peripheral blood Nrf-2 and HO-1 expression intensity between two groups of patients was as follows: serum MDA, cTnI and H-FABP contents as well as peripheral blood Nrf-2 and HO-1 expression of PCI group were greatly lower than those of control group. Analysis of the correlation between fQRS complex and ischemia reperfusion injury indexes in PCI group was as follows: serum MDA, cTnI and H-FABP contents as well as peripheral blood Nrf-2 and HO-1 expression of PCI group of patients with fQRS complex (+) were greatly higher than those of patients with fQRS complex (-).

Table 1.

Ischemia reperfusion injury index contents in serum and peripheral blood of two groups of patients.

Groups	*n*	MDA	cTnI	H-FABP	Nrf-2	HO-1
PCI group	64	7.98±0.93	1.28±0.20	29.38±4.25	1.02±0.15	1.45±0.17
Control group	45	15.18±2.03	2.43±0.36	47.12±5.58	1.86±0.25	2.83±0.36
t		12.109	9.284	9.119	8.689	9.958
P		<0.05	<0.05	<0.05	<0.05	<0.05

Table 2.

Relationship of ischemia reperfusion injury index contents in serum and peripheral blood with fQRS in PCI group.

fQRS complex	*n*	MDA	cTnI	H-FABP	Nrf-2	HO-1
fQRS complex (+)	17	14.59±2.32	2.19±0.32	40.58±6.58	1.77±0.23	2.29±0.34
fQRS complex (-)	47	3.46±0.52	0.55±0.08	22.31±3.29	0.52±0.08	0.84±0.11
t		34.592	27.361	8.595	19.985	13.586
P		<0.05	<0.05	<0.05	<0.05	<0.05

3.3 Serum apoptosis molecule contents and their correlation with fQRS complex

Analysis of serum apoptosis molecules sTWEAK (μg/mL), sFas (pg/mL), sTRAIL (pg/mL) and Caspase-3 (pg/mL) contents between two groups of patients was as follows: serum sTWEAK, sFas, sTRAIL and Caspase-3 contents of PCI group were greatly lower than those of control group. Analysis of the correlation between fQRS complex and apoptosis molecules in PCI group was as follows: serum sTWEAK, sFas, sTRAIL and Caspase-3 contents of PCI group of patients with fQRS complex (+) were greatly higher than those of patients with fQRS complex (-).

Table 3.

Serum apoptosis molecule contents of two groups of patients.

Groups	*n*	sTWEAK	sFas	sTRAIL	Caspase-3
PCI group	64	1.15±0.16	10.31±1.48	574.8±74.8	37.68±5.96
Control group	45	1.77±0.20	17.68±2.32	792.1±93.5	71.25±8.95
t		7.598	8.271	7.214	9.595
P		<0.05	<0.05	<0.05	<0.05

Table 4.

Relationship between apoptosis molecule contents in serum and fQRS in PCI group.

fQRS complex	*n*	sTWEAK	sFas	sTRAIL	Caspase-3
fQRS complex (+)	17	1.92±0.25	18.03±2.42	835.6±92.4	67.22±8.69
fQRS complex (-)	47	0.51±0.07	6.84±0.92	306.9±46.8	20.31±3.95
t		20.398	17.393	13.586	24.502
P		<0.05	<0.05	<0.05	<0.05

4. Discussion

fQRS complex is specifically referring that two adjacent or more than two leads show different forms of QRS triphasic wave or polyphasic wave[5]. In recent years, the physiopathologic mechanisms of qQRS complex production include[6,7]: (1) the myocardial cells survived like island in myocardial infarction area will be delayed in polarization, which is manifested as incisure or abortion in electrocardiogram, and results in fQRS complex production; (2) myocardial infarction area cannot be depolarized in the order from endocardium to epicardium, but is depolarized in the tangent or slant around the infarction area in the circuitous path, which can cause fQRS complex; (3) after scar repair in myocardial infarction area, the depolarization of myocardial cells in the scar site is slow and uneven, which further results in fQRS complex. In recent years, the value of fQRS complex to predict malignant arrhythmia, sudden cardiac death, cardiac arrhythmias and other adverse cardiovascular events has received more and more attention[8,9], but it is not clear about the relationship between the fQRS complex and myocardial injury in patients with myocardial infarction. In the study, analysis of the occurrence of fQRS complex after treatment in myocardial infarction patients showed that the incidence of fQRS complex in PCI group was significantly lower than that in control group. This means that the emergency PCI therapy can reduce the incidence of fQRS complex. It also indicates that the fQRS complex is closely related to myocardial ischemia hypoxia injury, and implementing early PCI to make the myocardium obtain blood reperfusion can alleviate myocardial ischemia reperfusion injury and reduce the incidence of fQRS complex.

Emergency PCI can make the myocardium obtain the blood reperfusion as soon as possible and reduce the damage caused by ischemia hypoxia. In the process of myocardial cell damage, the cTnI, H-FABP and other molecules in cells will be released into the blood circulation and become the makers to reflect the degree of myocardial injury; cTnI is the troponin involved in the regulation of cell contraction, and H-FABP is a fatty acid binding protein that participates in the oxidative energy supply of fatty acids[10,11]. At the same time, ischemia hypoxia can also increase the generation of oxygen free radicals, which can on the one hand, cause lipid peroxidation and produce MDA[12,13], and on the other hand, activate the antioxidant pathway Nrf-2 and increase the HO-1 expression[14,15]. In the study, analysis of the changes in above myocardial injury index contents showed that serum MDA, cTnI and H-FABP contents as well as peripheral blood Nrf-2 and HO-1 expression of PCI group were greatly lower than those of control group. The emergency PCI can make the ischemic myocardium obtain blood perfusion in time, but under the influence of ischemia-reperfusion injury, there is still certain occurrence risk of recurring myocardial infarction, sudden cardiac death and other adverse cardiovascular events in the process of reperfusion. In the process of myocardial ischemia reperfusion injury, early prediction of the risk of myocardial injury and adverse cardiovascular events can help early intervention and improve prognosis. In order to define the prediction value of fQRS complex for ischemia-reperfusion injury after PCI, the correlation between fQRS complex and above myocardial injury indexes was specifically analyzed in the study, and the results showed that serum MDA, cTnI and H-FABP contents as well as peripheral blood Nrf-2 and HO-1 expression of PCI group of patients with fQRS complex (+) were greatly higher than those of patients with fQRS complex (-). This indicates that the production of fQRS complex is closely related to myocardial ischemia reperfusion injury, and the determination of fQRS complex has prediction value for the occurrence of myocardial ischemia reperfusion injury after PCI.

During myocardial infarction, ischemia hypoxia can not only increase the generation of oxygen free radicals and cause oxidative stress damage to cells, but also activate the cell apoptosis. sTWEAK and sTRAIL are two members of the tumor necrosis factor superfamily, which can be combined with membrane receptor to enhance the activity of various caspase molecules and induce

apoptosis[16]; sFas is the regulatory molecule of death receptor apoptosis pathway, which can be combined with ligand FasL to activate caspase-8 and then activate the caspase cascade activation response[17,18]. Caspase-3 is the co-action molecule of various apoptotic regulation pathways, which can catalyze the fracture process of DNA double strand, and thus directly cause apoptosis of cells. In the study, analysis of the changes in above apoptosis molecule contents showed that serum sTWEAK, sFas, sTRAIL and Caspase-3 contents of PCI group were greatly lower than those of control group. This indicates that emergency PCI therapy can inhibit the apoptosis of myocardial cells on the basis of early recovering myocardial cell perfusion. The incidence of recurring myocardial infarction, sudden cardiac death and other adverse cardiovascular events after PCI is closely related to the excessive apoptosis of myocardial cells, and early determining the myocardial cell apoptosis after PCI can help predict the risk of adverse cardiovascular events. As mentioned earlier, fQRS complex has predictive value for the occurrence of myocardial ischemia-reperfusion injury after PCI, and in order to further clarify the predictive value of fQRS complex for myocardial cell apoptosis after PCI, the correlation between fQRS complex and above apoptosis molecules was specifically analyzed, and the results showed that serum sTWEAK, sFas, sTRAIL and Caspase-3 contents of PCI group of patients with fQRS complex (+) were greatly higher than those of patients with fQRS complex (-). This indicates that the production of fQRS complex is closely related to myocardial ischemia reperfusion injury, and the determination of fQRS complex has prediction value for the occurrence of myocardial ischemia reperfusion injury after PCI.

To sum up, it can be concluded that the occurrence of fQRS complex after PCI can predict myocardial ischemia reperfusion injury and apoptosis.

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