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Original Article

Clinical efficacies of percutaneous coronary intervention in patients with maintaining hemodialysis combined with acute coronary syndrome

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Abstract: Objective: The aim of this study was to investigate the safety and efficacy of percutaneous coronary intervention (PCI) in patients maintaining hemodialysis complicated with acute coronary syndrome (ACS). Methods: 15 patients maintaining hemodialysis complicated with ACS were selected. PCI were performed on the patients. The coronary lesion was examined using coronary angiography (CAG). The renal functions, troponin and myocardial enzymes before and after surgery were tested. Results: 13 cases (86%) were successfully implanted stent, while 1 case was not because of the tiny vessels at the distal end of lesion, and 1 cases was not performed PCI for no existence of stenosis or occlusion. Postoperative monitoring of renal function showed no aggravation, and no major cardiac adverse events occurred during the follow-up period. Conclusion: Patients. maintaining long-term hemodialysis would prone to exhibit vascular calcification induced coronary artery occlusion because long-term calcium-phosphorus metabolism disorder can cause secondary hyperparathyroidism, thus often exhibiting such clinical manifestations as arrhythmia, chest tightness, and aggravated chest pain during dialysis, therefore, in-time dialysis after PCI could eliminate the contrast agent, so CAG and PCI were safe and feasible for the patients with dialysis, and the clinical efficacies were good.

Keywords: Maintaining hemodialysis, acute coronary syndrome, coronary angiography, percutaneous coronary intervention

Introduction

Statistics reported that more than 50% of patients with nephropathy died of cardiovascular diseases, and the pathological change was mainly the formation of atherosclerotic plaques [1], atherosclerotic arterial intima calcification occurs in arterial intima, it could participate the formation of atherosclerotic plaques, so the intimal calcification occurred in coronary artery could lead to such ischemic changes as myocardial infarction, and increase the risk of death [2, 3]. A number of studies towards the populations with dialysis had demonstrated that blood pressure variation was an independent risk factor for cardiovascular disease caused death in this population [4, 5]. Flythe [6] studied 6393 patients with regular hemodialysis for up to 1 year, during the observation period, 779 patients died, among who 276 patients died of cardiovascular diseases, accounted for 35% of the total number of deaths. With wide application of blood purification technology, the life of uremic patients had been significantly prolonged, while the incidence of accompanied complications were also increased, secondary hyperparathyroidism caused skin itching, musculoskeletal disorders, sleep disorders and other physical discomforts, as well as cardiovascular calcification, would strongly affect patients' quality of life [7, 8]. Capacity overload was significantly associated with high blood pressure, malnutrition, inflammation and atherosclerosis, which might aggravate the risks of combined cardiovascular diseases [9]. In addition to traditional factors, uremia-specific related factors would also lead to cardiovascular diseases in patients with dialysis [10-12], thereby increasing the morbidity and mortality of cardiovascular complications in patients with dialysis [13, 14]. Clinically, uremic patients had the characteristic of possessing high preva-

lence of coronary artery diseases, even though renal replacement therapy had been performed, cardiovascular complications were still their main cause of death, and the mortality of cardiovascular diseases accounted for about 40%-50%, 5-10 times to the adults with normal renal functions [15]. If long-term dialysis was accompanied with coronary artery calcification caused lumen stenosis, when the lumen was not completely obstructed, patients would often appear such clinical manifestations as chest tightness, chest pain, arrhythmia and others during dialysis, if no intervention treatment was performed in time, these symptoms would appear repeatedly, eventually leading to complete obstruction of coronary artery, as well as the increased risk of death. Currently, the treatments for the patients with final stage renal disease merged with coronary heart disease were mainly drug treatments, and coronary artery bypass grafting (CABG) or percutaneous coronary intervention (PCI) might be selected when drug treatments were not ideal to reconstruct blood supply [16]. Drug therapy could be used as the basic treatment, and as for the patients exhibiting no ideal results to drug treatments, previous researches and clinical practice preferred CABG, but 8.2%-10.6% of patients also exhibited poor long-term prognosis after CABG [16, 17]. Our hospital performed early intervention treatment of coronary angiography (CAG) and PCI for the patients maintaining blood hemodialysis complicated with acute coronary syndrome (ACS) in recent 2 years, and the surgical safety and clinical efficacy of PCI in displaying vascular stenosis were summarized as the following.

Materials and methods

Subjects

15 patients maintaining hemodialysis admitted into our hospital because of ACS from January 2013 to November 2014 were selected; 3 days before surgery, patients were administrated with 300 mg of aspirin (total amount) and 300 mg of clopidogrel, 3000 u-5000 u of ordinary heparin through arterial sheath before CAG, and 200 g × 2 of nitroglycerin through coronary artery; before implanting stent, 8000 u-10000 u of ordinary heparin was injected through arterial sheath, and 200 g × 4 of nitroglycerin through coronary artery; after surgery, aspirin (100 mg/d), clopidogrel (75 mg/d) and atorvastatin (200 mg/d) were administrated for more than one year. This study was conducted in accordance with the declaration of Helsinki. This study was conducted with approval from the Ethics Committee of Dalian University. Written informed consent was obtained from all participants.

Patients' clinical characteristics

Patients aged 39-80 years old, with an average age of (57.63±20.5) years old, including 9 males and 6 females; 9 cases of essential hypertension, 5 cases of diabetes, and 1 case of old myocardial infarction. Duration of dialysis: (4.36±4.2) years. Preoperative creatinine level: (680.7±358.6) μmol/L. Types of coronary artery: 9 cases of non-STEMI (60%), and 6 cases of unstable angina (UA) (40%). All patients were performed preoperative and postoperative tests of blood routine, troponin, myocardial enzyme spectrum and renal functions.

Definitions of coronary artery diseases

CAG used quantitative cardiovascular angiographic analysis system for the evaluation. Main coronary artery stenosis ≥50% was defined as significant stenosis, left main vessel diameter ≥30% was defined as significant stenosis, and according to the involved vessels, the situations were divided into single-, double-, three-vessel and left main coronary artery disease.

Interventional operations and definitions of clinical events

Successful stent implantation was defined as the stent completely covered the target lesions and the residual stenosis was <20%. Major adverse cardiac events included death, acute myocardial infarction, and target vessel revascularization (including re-PCI or surgical bypass).

Follow up

Clinical follow-up included outpatient follow-up and phone follow-up, which recorded major adverse cardiac events within 1 year after surgery.

Table 1. Changes of renal functions, troponin and myocardial enzymes before and after surgery (mean ± SD)

Group	Before surgery	After surgery	t	P
Bun (mol/L)	20.91±9.18	20.10±8.90	0.25	0.81
Cr (umol/L)	775.93±284.90	729.27±212.54	0.51	0.62
CK-MB (ng/ml)	8.33±2.45	2.376±1.584	2.59	0.02
Troponin (ng/ml)	0.61±0.48	0.147±0.078	3.27	0.01
CK (ng/ml)	80.55±58.57	52.56±7.58	2.45	0.02
LDH (mmol/L)	386.53±191.41	346.53±150.55	0.61	0.55

Bun, urea nitrogen; Cr, creatinine; CK-MB, creatine kinase lsoenzyme; CK, creatine kinase; LDH, lactate dehydrogenase.

Statistical analysis

SPSS 22.0 was used for data analysis, the measurement data were expressed as mean ± SD, the intergroup comparison used the t test, with $P<0.05$ considered as statistically significant difference.

Results

Coronary lesions

CAG showed 2 cases of single-vessel coronary lesion, 12 cases of three-vessel coronary lesion, and 1 case of normal CAG. Before surgery, the mean percentage of coronary artery stenosis was 90.33%, and that was 3.3% after surgery. The stents deployed successfully, and no residual stenosis was found after surgery. The blood flow was unobstructed, with good vessel filling.

Procedures of PCI

All 15 cases in this study were performed PCI through right radial artery, among which 13 cases (86.6%) were successfully implanted with 17 drug-elution stents. The average diameter of the stents was (3.0±0.75) mm, and the average length was (28±14) mm, no intra-stent re-stenosis occurred after PCI.

Changes of renal functions, troponin and myocardial enzymes before and after surgery

As shown in **Table 1**, the comparisons of renal functions, troponin and myocardial enzymes before and after surgery revealed that, the urea nitrogen, creatinine and lactate dehydrogenase showed no statistically significant increasing before and after surgery ($P>0.05$); troponin and myocardial enzymes were significantly reduced after surgery than before ($P<0.05$). This indicated that, PCI did not aggravate the renal impairment, while alleviated the myocardial ischemia.

Postoperative major adverse cardiac events

Before surgery, the patients had recurring chest pain, chest stuffiness, shortness of breath and other symptoms, which were aggravated during the dialysis and could not be alleviated by drug treatment. After surgery, above symptoms were obviously relieved.

All patients continued the maintaining hemodialysis in our hospital after surgery, and followed up for 2 years, no major adverse cardiac events occurred.

Discussion

Cardiovascular disease (CVD) was a common complication of chronic renal disease [18]. Even renal replacement therapy was performed, the mortality rate of CVD in uremic patients still accounted for 40-50%, and 5-10 times than the populations with normal renal functions [15]. There were many cardiovascular risk factors for patients with maintaining hemodialysis, most patients might exist long-term hypertension, calcium-phosphorus metabolism disorders, secondary hyperparathyroidism and diabetes, which thus caused calcification of heart valves and vessels, and they would prone to appear coronary artery stenosis, normally no symptom of angina might occur, but during or after hemodialysis, ultrafiltration dehydration caused changes of blood volume in a short period would make patients appear hypotension in the middle or late stage of dialysis, which would then induce myocardial ischemia, and manifested chest tightness, chest pain, and arrhythmia, ECG might often exhibit no obvious myocardial infarction changes such as ischemia aggravation or ST segment elevation, and the period that patients exhibited chest tightness and pain was not fixed, the same symptoms might easily repeat and aggravate, and the patients might even appear serious arrhythmias such as atrial fibrillation and ventricular fibrillation, etc., after dialysis. In this study, 1 patient appeared ventricular fibrillation

and cardiac arrest, while successfully rescued after CPR and admitted to ICU, CAG revealed the three-vessel lesion, after PCI, the patient achieved stable conditions, continued dialysis for half a year, and in good condition currently. Especially in patients with end-stage renal disease merged with diabetes, although merged with severe coronary artery diseases, there might be no symptoms of ischemia.

As for the patients with maintaining hemodialysis combined with coronary heart diseases, because of the factors such as uremia combined with calcium-phosphorus metabolism disorders, anemia and toxins that might result in vascular calcification [19], controlling the complications and drug therapy were still the main treatment methods, but the drugs could not solve such repeated problems as angina, arrhythmia and hypotension during dialysis in some patients, so when the patients were combined with the dynamic changes of troponin and myocardial enzymes, surgeons must not relax their vigilance, and should perform CAG when patients' conditions permitted to make clear the conditions of coronary artery stenosis, PCI should also be performed in time, when such clinical symptoms as chest tightness and chest pain disappeared, and no similar episode occurred during dialysis, the patients could continue dialysis to prolong their lives.

CAG was still the gold standard for the diagnosis of CAD, when performing CAG towards the patients with selective renal replacement therapy, it might have high perioperative risks, including contrast agent led blood volume load increasing, induced pulmonary edema and increased bleeding, etc. As for the patients with unideal results of drug therapy and severe coronary artery stenosis, previous researches and clinical practice preferred surgical bypass. However, surgical bypass had perioperative mortality more than 8.2%-10.6% [16, 17], and the long-term poor prognosis limited its applications. American renal data system showed that the 1- and 2-year survival rates of patients with dialysis were 57% and 70% after surgical bypass, respectively, and the 5-year survival rate was only 28% [17]. Otsuka et al. [20] observed 106 patients with hemodialysis, who were all implanted sirolimus eluting stent, and the average follow-up was 3 years. The results showed that patients with hemodialysis had higher target vessel reconstruction rate. American renal data system showed that from 2004 to 2009, the hospital mortality of patients with dialysis was 2.7% after stent implantation, and the postoperative 1-, 2- and 5-year survival rates were 71%, 53% and 24%, respectively, when compared with coronary artery surgical bypass, the hospital mortality was significantly lower [17]. This study retrospectively analyzed 15 uremic patients, and performed CAG and PCI early intervention towards the patients with maintaining hemodialysis merged with ACS, the clinical outcomes and prognosis were good.

Conclusions

Patients with long-term maintaining hemodialysis might easily exhibit vascular calcification induced coronary artery occlusion because of long-term calcium-phosphorus metabolism disorders and secondary hyperparathyroidism, thus often appearing arrhythmia, chest tightness, aggravated chest pain and other clinical manifestations during dialysis, because dialysis could in-time eliminate contrast agent after PCI, so CAG and PCI were safe and feasible towards the patients with dialysis, and the clinical efficacies were good.

Disclosure of conflict of interest

None.

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