

The clinical research of off-pump coronary artery bypass grafting by small incision at the left chest

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Abstract. – OBJECTIVE: To explore the clinical value of off-pump coronary artery bypass grafting by small incision at the left chest, and develop a better surgical regimen for coronary heart disease patients.

PATIENTS AND METHODS: 201 coronary heart disease patients who need coronary artery bypass grafting were required and randomly divided into 2 groups including a control group and an observation group. There were 107 cases in the control group who received coronary bypass grafting by extracorporeal circulation; there were 103 cases in the observation group who received off-pump coronary bypass grafting by small incision at the left chest. The duration of the mechanism ventilation, length of stay in ICU, hospitalization time, postoperative drainage volume, and the occurrence rate of complications were recorded and compared.

RESULTS: The duration of mechanism ventilation, length of stay in ICU, hospitalization time and postoperative drainage volume in the control group were (19.21 ± 1.33) hours, (5.08 ± 0.57) days, (21.20 ± 2.34) days and (997.68 ± 96.35) mL, which were (7.73 ± 0.74) hours, (2.83 ± 0.16) days, (15.67 ± 1.18) days and (901.53 ± 89.32) mL in the observation group respectively, with statistical difference between the two groups ($p < 0.05$). The occurrence rates of renal insufficiency and arrhythmia were both 6.54% and 0.97% in the control group and the observation group, respectively. The occurrence rates of postoperative renal insufficiency and arrhythmia in the observation group were both significantly lower than those in the control group, with statistical significance analysis ($p < 0.05$). Postoperative low cardiac output, second thoracotomy, cerebrovascular disease, pulmonary infection, perioperative cardiac infarction and mortality did not display a significant difference between the two groups ($p > 0.05$).

CONCLUSIONS: Off-pump coronary artery bypass grafting by small incision at the left chest is a surgical method with less injury and

fast recovery, which can be used as the preferred therapeutical method for the coronary heart disease patients who need coronary artery bypass grafting.

Key Words:

Small incision, Off-pump, Coronary artery bypass grafting.

Introduction

As the aging of the society, the morbidity of coronary heart disease becomes higher, and there are more and more elder patients who need coronary artery bypass grafting¹⁻⁴. The coronary artery bypass grafting by extracorporeal circulation is a comparatively mature surgical method. However, it can cause physical injury⁵⁻⁹, such as hemodilution anemia^{10,11}. As the development of minimally invasive technology, the off-pump coronary artery bypass grafting by small incision at the left chest has become the new trend of coronary artery surgery¹²⁻¹⁴.

Patients and Methods

Clinical Data

210 coronary heart disease patients, who need coronary artery bypass grafting admitted during April 2011 to March 2014, were selected and randomly divided into 2 groups. There were 107 cases in the control group and 103 cases in the observation group. All patients were at grade III-IV according to the angina grading published by CCS (Canadian Cardiovascular Society) and conformed to the surgical indications of coronary artery bypass grafting according to ECG and

coronary arteriography. The gender, age, preoperative ejection fraction (EF), diseased vessels and preoperative risk factors were not statistically different, which were comparable ($p > 0.05$), as shown in Table I.

Experimental Procedure

- 1. Control group.** The coronary bypass grafting by extracorporeal circulation was applied. First of all, patients received general anesthesia, then the middle incision was selected and the sternum was opened. The heart rate and blood pressure were controlled by the anesthesiologist, and the left anterior descending branch was exposed, Guidant or Octopus3 fixator (Medtronic, Inc., Minneapolis, MN, USA) was used to stabilize local myocardium. During anastomosis, the intraluminal shunt was used to assist the operation on the anastomotic stoma. The injection syringe was used to inject distilled water to keep the infusion without blood.
- 2. Observation group.** The off-pump coronary artery bypass grafting by small incision at left chest was applied. Firstly, patients received general anesthesia and double-lumen endotracheal intubation. Patients were at supine position, whose left chests were lifted by 30 degrees. The electrode slices were placed on the right front and left posterior chest and connected with a defibrillator *in vitro*. The incision in 4th intercostal space at left anterior chest was 6 cm, and the one-lung ventilation was applied after entering the chest. Suspensory internal mammary artery distractor (Fehling, Acworth, GA, USA) (Medicon Co., Ltd., Essen, Germany) was placed, and the chest wall was pulled when opening ribs to provide a good direct operation field. Left internal mammary artery (LIMA) was obtained under direct vision, which was up to the superior border of the 1st rib and down to the 5th rib. LIMA branch was clipped by pen type titanium clamp (Fehling) (Medicon Co., Ltd., Essen, Germany). Cardiac Tissue Slices (CTS) heart surface tissue fixation equipment (Medtronic, Inc., Minneapolis, MN, USA) was used for local fixation, and then the coronary artery was opened, and intra-coronary artery shunt was put in for vascular anastomosis. The activated blood clotting time was kept at 300-400 seconds. After completing the operation, protamine was used to neutralize heparin with a proportion of 1:2. After confirming that

Table I. The comparison of general data in two groups.

Gender			Preoperative risk factors											
Group	N			Age (year)	Pre-operative EF (%)	Amount of diseased vessels	Cerebrovascular disease history							
		Male	Female				Unstable angina	Acute cardiac infarction	Remote cardiac infarction	Diabetes mellitus history	Hyper-tension history	Hyper-lipidemia history	Renal insufficiency	
Control group	107	91 (85.05)	16 (14.95)	62.01 ± 6.32	58.32 ± 5.67	2.83 ± 0.26	98 (91.59)	21 (19.63)	33 (30.84)	27 (25.23)	11 (10.28)	58 (54.21)	53 (49.53)	13 (12.15)
Observation group	103	88 (85.44)	15 (14.56)	62.11 ± 6.74	58.46 ± 5.38	2.85 ± 0.27	94 (91.26)	20 (19.42)	32 (31.07)	26 (25.24)	11 (10.68)	56 (54.37)	51 (49.51)	13 (12.62)
t/χ^2		1.003		0.196	0.382	0.110	0.935	0.844	0.808	0.019	0.811	0.792	0.028	1.019
		0.873		0.683	0.534	0.958	0.884	0.918	0.922	0.992	0.931	0.936	0.983	0.869

there was no hemorrhagic spot, the drainage tube was placed in the 6th intercostal space and the chest was closed.

Observation Indexes

The duration of mechanical ventilation, the length of stay in ICU, hospitalization time and postoperative drainage volume were recorded and compared. The postoperative low cardiac output, renal insufficient, second thoracotomy, cerebrovascular disease, pulmonary infection, perioperative cardiac infarction and mortality were recorded.

Statistical Analysis

SPSS13.0 software (SPSS Inc., Chicago, IL USA) was used for analysis, measurement data were analyzed by *t*-test, enumeration data were analyzed by χ^2 test, $p < 0.05$ was considered as statistically significant.

Results

Treatment Conditions

The duration of mechanism ventilation, length of stay in ICU, hospitalization time and postoperative drainage volume in the control group were (19.21 ± 1.33) hours, (5.08 ± 0.57) days, (21.20 ± 2.34) days and (997.68 ± 96.35) mL, which were (7.73 ± 0.74) hours, (2.83 ± 0.16) days, (15.67 ± 1.18) days and (901.53 ± 89.32) mL in the observational group, there was statistical difference between the two groups ($p < 0.05$), as shown in Table II.

Complications

The occurrence rates of renal insufficiency and arrhythmia were both 6.54% and 0.97% in the control group and the observational group respectively. The occurrence rates of postoperative renal insufficiency and arrhythmia in the obser-

vational group were both lower than those of the control group, with statistical significance ($p < 0.05$). Postoperative low cardiac output, second thoracotomy, cerebrovascular disease, pulmonary infection, perioperative cardiac infarction and mortality displayed no significant difference between the two groups ($p > 0.05$), as shown in Table III.

Discussion

Coronary heart disease is a clinically common disease in elderly people, in which the stenosis or obstruction of coronary artery are caused by atherosclerosis¹⁵⁻¹⁸. It significantly affects the blood supply of heart to cause myocardial ischemia, even cardiac infarction to cause the death of patients^{19,20}. Coronary artery bypass grafting is an effective surgical method to treat coronary heart disease at present^{1,21-23}. The theory is that there is new bypass between the proximal terminal and distal terminal of coronary artery stenosis, which make sure that the blood can reach the distal terminal to provide oxygen and nutrient for myocardium and improve the function of the heart^{24,25}. It serves as a bridge; thus, it is called bypass operation.

Extracorporeal circulation is needed in the conventional coronary artery bypass grafting, which is completed under the condition of cardiac arrest. However, due to the application of extracorporeal circulation, the production and release of inflammatory factors are increased, which can cause systemic inflammatory response syndrome to damage the organs and tissue²⁶⁻²⁹. Besides, the reperfusion after blocking aorta can cause ischemia-reperfusion injury of the myocardium, which causes arrhythmia and accelerate the necrosis of myocardial cells³⁰⁻³².

In this study, patients received off-pump coronary artery bypass grafting. As the perfusion

Table II. The comparison of treatment conditions in two groups.

Group	n	Postoperative duration of mechanism ventilation (h)	Postoperative length of stay in ICU (d)	Postoperative hospitalization time (d)	Postoperative drainage volume (ml)
Control group	107	19.21 ± 1.33	5.08 ± 0.57	21.20 ± 2.34	997.68 ± 96.35
Observation group	103	7.73 ± 0.74	2.83 ± 0.16	15.67 ± 1.18	901.53 ± 89.32
<i>t</i>	6.138	5.227	4.963	1.328	
<i>p</i>	0.028	0.033	0.046	0.182	

Table III. The comparison of treatment conditions in two groups.

Group	n	Low cardiac output	Postoperative renal insufficiency	Perioperative cardiac infarction	Second thoracotomy	Postoperative arrhythmia	Postoperative cerebrovascular disease	Pulmonary infection	Death
Control groups	107	2 (1.50)	7 (6.54)	0 (0)	5 (4.67)	7 (6.54)	10 (9.35)	20 (18.69)	5 (4.67)
Observation group	103	2 (1.94)	1 (0.97)	1 (0.97)	1 (0.97)	1 (0.97)	7 (6.80)	16 (15.53)	4 (3.88)
χ^2		1.128	7.305	2.038	5.034	7.305	4.110	3.024	1.928
<i>p</i>		0.864	0.036	0.716	0.068	0.036	0.168	0.238	0.733

pressure of coronary artery has to be maintained during the whole surgery, and the drug administered by anesthetist only has assistant effect^{33,34}. Thus, the blood distribution of the heart during operation is not significantly different from pre-operation distribution, and the non-ischemic endocardium is not ischemic which is similar to the physiological status. During the operation, the proximal terminal can be anastomosed according to the demand, and there is no concern about the extension of coronary artery blocking time³⁵. As the medical mode transverses, minimally invasive operation is more and more accepted by patients, and the application in clinical is increased³⁶⁻³⁸. Dissociating left internal mammary artery to make an anterior descending branch by small incision at left chest is a classic minimally invasive coronary artery bypass grafting, and the sternum is not necessary to be opened, the postoperative pain is alleviated, and the occurrence of sternum infection and disability are avoided; thus, the patients can do mild physical activity in the early stage after surgery, due to the fact that its effect on lung function is small and the recovery is fast.

In this study, the duration of mechanism ventilation, the length of stay in ICU, the hospitalization time, the postoperative drainage volume in the control group were (19.21 ± 1.33) hours, (5.08 ± 0.57) days, (21.20 ± 2.34) days and (997.68 ± 96.35) mL. The occurrence rates of renal insufficiency and arrhythmia were 24.30% and 58.88%, which were (7.73 ± 0.74) hours, (2.83 ± 0.16) days, (15.67 ± 1.18) days and (901.53 ± 89.32) mL, 12.62% and 40.78% in the observation group, respectively. In off-pump coronary artery bypass grafting by small incision at the left chest, these data suggest that the treatment time is shorter, the recovery is faster, the injury is less, and the occurrence rate of postoperative complications is lower respect to the coronary bypass grafting by extracorporeal circulation.

Conclusions

Off-pump coronary artery bypass grafting by small incision at left chest is a surgical method of less injury and fast recovery, which can be considered as the preferred therapeutical method for the coronary heart disease patients who need coronary artery bypass grafting.

Conflict of Interest

The Authors declare that there are no conflicts of interest.

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