Clinical study of patients with coronary artery disease combined multivessel disease

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Research article

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Abstract

Background: To investigate the clinical prognosis of patients with coronary artery disease combined multivessel disease.

Methods: The patients who were diagnosed with multivessel disease by coronary angiography were selected in this study. The clinical datas about the clinical prognosis and the incidence of adverse cardiovascular events within five-year follow-up were analyzed.

Results: A total of 230 participants were included in this study, includeing 129 male (56.09%) and 101 female (43.91%), the average age was 69.73 ± 10.93. The outcomes showed that the patients with three-vessel lesions had significantly higher rate of diabetes history (51.32% vs. 34.62%, P=0.018), unstable angina pectoris history (73.03% vs. 55.13%, P=0.008), and significantly higher risk of cardiogenic mortality (7.24% vs. 1.28%, P=0.045) when compared with patients who had two-vessel lesions. The patients with CTO had significantly higher rate of diabetes history (58.54% vs. 42.86%, P=0.049), unstable angina pectoris history (80.49% vs. 64.02%, P=0.029), MI history (48.78% vs. 25.40%, P=0.003), significantly lower LVEF (58.73±11.30 vs. 64.23±9.49, P=0.001) and significantly higher risk of recurrent myocardial infarction (12.20% vs. 3.2%, P=0.043) when compared with those patients without CTO. The patients with left main lesions had significantly older age (73.61±9.95 vs. 69.02±10.98, P=0.018) and significantly higher risk of cardiogenic mortality (13.89% vs. 3.61%, P=0.025) when compared with those patients without left main lesions.

Conclusions: Among patients with coronary artery disease combined multivessel disease, patients with CTO had significantly lower LVEF and higher risk of recurrent myocardial infarction than patients without CTO. The patients with left main lesions had significantly higher risk of cardiogenic mortality than patients without left main lesions. The patients with three-vessel lesions had higher risk of cardiogenic mortality than patients with two-vessel lesions.

Background

Multi-vessel coronary artery disease (MVD) refers to a lesion with more than 50% of the diameter of the main coronary artery or its branches in two or more epicardium [1−2]. Multivessel disease accounts for about 50% -60% of all coronary angiography results [3]. Recently, MVD is the focus and difficulty in the field of coronary artery disease. However, the long-term prognosis of paitents with different kinds of MVD remians unclear in China, such as three-vessel lesions, chronic total occlusive disease (CTO) or left main lesions. Three-vessel lesions refers to three vessels, such as the right coronary artery, the left anterior descending coronary artery, the left coronary artery cyclotron branch have more serious lesions. Left main lesion (unprotected left main diseases) refers to the degree of left main coronary artery angiography stenosis greater than or equal to 50% of the lesions, and at the same time does not exist unblocked blood vessel bridge good collateral circulation or their right to left. CTO is a dynamic process from quantitative change to qualitative change after coronary artery atherosclerosis, the lesions usually begin with the

rupture of the "vulnerable plaque" in the coronary arteries, forming clots at both ends of the plaque and which endly leading to complete occlusion of the coronary arteries[4–8].

Therefore, we conducted this study to investigate the five-year clinical prognosis of patients with coronary artery disease combined multivessel disease.

1 Methods

1.1 Subjects

From January 2014 to January 2015, patients who were diagnosed as multivessel disease diagnosed by coronary angiography in Beijing Dongzhimen Hospital were indcluded in this study. The clinical follow-up was 5 years. The clinical datas about the clinical prognosis and the incidence of adverse cardiovascular events within five-year follow-up were analyzed. This study had been approved by our institutional ethics committee (the ethical committee of Beijing Hospital of Traditional Chinese medicine, Capital Medical University). The informed consent (written) was obtained from all participants.

1.2 Inclusion And Exclusion Criterias

Inclusion criterias: (1) patients who were diagnozed as multivessel disease by coronary angiography; (2) age was older than 18 years old; (3) patients who had signed the informed consent. Exclusion criteria: (1)patients with congenital heart disease; (2) patients with advanced malignant tumors; (3) patients who were pregnant or lactating women; (4) patients whose datas were incomplete.

1.3 Main Indicators

The main indicators of this study include the patient's gender; age; coronary angiography results, such as double-branch disease, triple-branch disease, left main disease; LVEF; previous medical history, such as history of smoking, history of hyperlipidemia, history of diabetes, history of hypertension, history of cerebrovascular disease, history of unstable angina pectoris, history of myocardial infarction; clinical treatment options, such as conservative medication, percutaneous coronary intervention (PCI), coronary artery bypass surgery (CABG); clinical prognosis, such as the incidence of major cardiovascular adverse events (MACE), all-cause mortality, cardiogenic mortality, incidence of myocardial infarction, incidence of cerebrovascular events, incidence of revascularization, incidence of postoperative restenosis, the incidence of rehospitalization due to angina pectoris.

1.4 Statistical Analysis

We used the software program SPSS 25.0 (IBM, Chicago, USA) to conduct the statistical analysis. The continuous variables of normal distribution were expressed as mean ± standard deviation, the continuous variables of non-normal distribution were expressed as median (interquartile range[IQR]), the categorical variables were expressed as frequency (percentage[%]). For two comparisons, each value was compared by t-test when each datum conformed to normal distribution, while the non-normally distributed

continuous data were compared using non-parametric tests. The counting data were tested by chi-square test. A value of $P < 0.05$ was considered statistically significant.

2 Results

2.1 The general characteristics

A total of 263 patients who were diagnosed with multivessel disease by coronary angiography were recruited in this study. 20 patients were excluded because 5 of them had congenital heart disease, 7 of them had advanced malignant tumors and 8 of them lacked complete clinical information. Another 13 patients were lost follow up during the five-year follow-up. In the end, a total of 230 patients who were diagnosed with multivessel disease by coronary angiography were included for quantitative analysis in this study(Fig. 1). Among these 230 participants, there were 129 male (56.09%) and 101 female (43.91%), the average age was 69.73 ± 10.93.

2.2 The Previous Medical History

In terms of previous medical history, 147 patients (63.91%) had a history of smoking, 149 patients (64.78%) had a history of hyperlipidemia, 105 patients (45.65%) had a history of diabetes, 180 patients (78.26%) had a history of hypertension, 59 patients (25.65%) had a history of cerebrovascular disease, 154 patients (66.96%) had a history of unstable angina pectoris, 68 patients (29.57%) had a history of MI. Moreover, 152 patients had been diagnozed as heart dysfunction, including 43 cases (28.29%) of NYHA I, 49 cases (32.24%) of NYHA II; 40 cases (26.31%) of NYHA III; 20 cases (13.16%) of NYHA IV. The average of LVEF was 63.25 ± 10.03%.

2.3 Outcomes Of Coronary Angiography

All of these 230 have been received coronary angiography. The results showed that 78 patients (33.91%) were diagnozed as two-vessel lesions, 152 patients (66.09%) were diagnozed as three-vessel lesions, 36 patients (15.65%) were diagnozed as left main lesions, 41 patients (17.83%) were diagnozed as CTO.

2.4 The Treatment And Clinical Prognosis

Among these 230 participants, 58 patients (25.22%) were treated with drugs, 14 patients (6.09%) were treated with CABG, and 158 patients (68.70%) were treated with PCI. During the five-year follow-up, the all-cause mortality was 6.96% (16 cases), the cardiogenic mortality were 5.22% (12 cases), the incidence of MI was 5.22% (12 cases), the incidence of cerebrovascular events was 12.61% (29 cases), the incidence of revascularization was 10.87% (25 cases), the incidence of restenosis after surgery was 13.92% (22 cases), the incidence of MACE was 23.04% (53 cases), the incidence of rehospitalization due to angina pectoris was 70.87% (163 cases).

2.5 The subgroup analysis of patients with three-vessel lesion and two-vessel lesion

Among these 230 participants, 152 patients have been diagnozed as three-vessel lesions by coronary angiography, 78 patients have been diagnozed as two-vessel lesions by coronary angiography. When compared with patients who had two-vessel lesions, the patients with three-vessel lesions had significantly higher rate of diabetes history (51.32% vs. 34.62%, P = 0.018) and unstable angina pectoris history (73.03% vs. 55.13%, P = 0.008). Furthermore, the patients with three-vessel lesions were assocaited with significantly higher risk of cardiogenic mortality (7.24% vs. 1.28%, P = 0.045) than those patients with two-vessel lesions. The details were listed in the Table 1.

Table 1
The subgroup analysis of patients with three-vessel lesion and two-vessel lesion

Index	Three-vessel lesions group	Two-vessel lesions group	P
N	152	78	
Male/female	78/74	51/27	0.050
Age(years)	70.78 ± 10.32	67.71 ± 11.85	0.094
Previous medical history			
History of smoking	48(31.582%)	35(44.87)	0.059
History of hyperlipidemia	99(65.13%)	50(63.41%)	0.885
History of diabetes	78(51.32%)	27(34.62%)	0.018
History of hypertension	122(80.26%)	58(74.36%)	0.315
History of cerebrovascular disease	41(26.97%)	18(23.08%)	0.633
History of unstable angina pectoris	111(73.03%)	43(55.13%)	0.008
History of MI	49(32.23%)	19(24.36%)	0.227
LVEF	62.39 ± 10.63	64.92 ± 8.58	0.105
Clinical prognosis			
All-cause mortality	13(8.55%)	3(3.85%)	0.274
Cardiogenic mortality	11(7.24%)	1(1.28%)	0.045
MI	8(5.26%)	4(5.13%)	0.617
Cerebrovascular event	19(12.50%)	10(12.82%)	0.549
Revascularization	17(11.18%)	8(10.26%)	0.512
Restenosis after surgery	12(7.89%)	10(12.82%)	0.167
MACE	38(25.00%)	15(19.23%)	0.208
Rehospitalization due to angina pectoris	112(73.68%)	51(65.38%)	0.124

Note: MI: Myocardial infarction; LVEF: Left ventricular ejection fraction; MACE: Major cardiovascular adverse events.

2.6 The Subgroup Analysis Of Patients With CTO

Among these 230 participants, 41 patients have been diagnozed as CTO by coronary angiography. When compared with those patients without CTO, the patients with CTO had significantly higher rate of diabetes history (58.54% vs. 42.86%, P = 0.049), unstable angina pectoris history (80.49% vs. 64.02%, P = 0.029) and MI history (48.78% vs. 25.40%, P = 0.003). Furthermore, the LVEF was significantly lower among patients with CTO than those patients without CTO (58.73 ± 11.30 vs. 64.23 ± 9.49, P = 0.001). In terms of the clinical prognosis, the patients with CTO were assocaited with significantly higher risk of recurrent myocardial infarction (12.20% vs. 3.2%, P = 0.043). The details were listed in the Table 2.

Table 2
The subgroup analysis of patients with CTO

Index	CTO group	Without CTO group	P
N	41	189	
Male/female	25/16	104/85	0.302
Age(years)	68.10 ± 12.49	70.09 ± 10.57	0.491
Previous medical history			
History of smoking	17(41.46)	66(34.92%)	0.268
History of hyperlipidemia	26(63.41%)	123(65.08%)	0.487
History of diabetes	24(58.54%)	81(42.86%)	0.049
History of hypertension	28(68.29%)	152(80.42%)	0.070
History of cerebrovascular disease	11(26.83%)	48(25.40%)	0.494
History of unstable angina pectoris	33(80.49%)	121(64.02%)	0.029
History of MI	20(48.78%)	48(25.40%)	0.003
LVEF	58.73 ± 11.30	64.23 ± 9.49	0.001
Clinical prognosis			
All-cause mortality	5(12.20%)	11(3.2%)	0.134
Cardiogenic mortality	4(9.76%)	8(2.5%)	0.146
MI	5(12.20%)	7(3.2%)	0.043
Cerebrovascular event	5(12.20%)	24(12.1%)	0.584
Revascularization	4(9.76%)	21(11.5%)	0.529
Restenosis after surgery	2(4.88%)	20(10.2%)	0.208
MACE	12(29.27%)	41(21.7%)	0.199
Rehospitalization due to angina pectoris	24(58.54%)	139(73.54%)	0.044

Note: MI: Myocardial infarction; LVEF: Left ventricular ejection fraction; MACE: Major cardiovascular adverse events.

2.7 The subgroup analysis of patients with left main lesions

Among these 230 participants, 36 patients have been diagnozed as left main lesions by coronary angiography. When compared with those patients without left main lesions, the patients with left main

lesions were assocaited with significantly higher risk of cardiogenic mortality (13.89% vs. 3.61%, P = 0.025). Furthermore, the age of patients with left main lesions was significantly older than those patients without left main lesions (73.61 ± 9.95 vs. 69.02 ± 10.98, P = 0.018). The details were listed in the Table 3.

Table 3
The subgroup analysis of patients with left main lesions

Index	Left main lesions group	Without left main lesions group	P
N	36	194	
Male/female	25/11	104/90	0.056
Age(years)	73.61 ± 9.95	69.02 ± 10.98	0.018
Previous medical history			
History of smoking	14(38.89)	69(35.57%)	0.709
History of hyperlipidemia	20(55.56%)	129(66.49%)	0.124
History of diabetes	14(38.89)	91(46.91%)	0.241
History of hypertension	30(83.33%)	150(77.32%)	0.287
History of cerebrovascular disease	12(33.33%)	47(24.23%)	0.172
History of unstable angina pectoris	27(75.00%)	127(66.49%)	0.178
History of MI	12(33.33%)	56(28.87%)	0.361
LVEF	63.22 ± 10.32	63.26 ± 10.01	0.984
Clinical prognosis			
All-cause mortality	5(13.89%)	11(5.67%)	0.084
Cardiogenic mortality	5(13.89%)	7(3.61%)	0.025
MI	3(8.33%)	9(4.64%)	0.285
Cerebrovascular event	6(16.67%)	23(11.86%)	0.288
Revascularization	3(8.33%)	22(11.34%)	0.425
Restenosis after surgery	4(11.11%)	18(9.28%)	0.463
MACE	12(33.33%)	41(21.13%)	0.087
Rehospitalization due to angina pectoris	25(69.44%)	138(71.13%)	0.490

Note: MI: Myocardial infarction; LVEF: Left ventricular ejection fraction; MACE: Major cardiovascular adverse events.

3 Discussion

Recently, CTO is the focus and difficulty in the field of coronary artery disease. Clinical studies have shown that chronic complete occlusion of coronary arteries accounts for 1/3 of all coronary angiography patients and 10%-20% of all cardiac interventional therapy patients[6–7]. Less than 8% of patients receive interventional therapy and revascularization[8]. Our study presented that the patients with CTO had significantly higher rate of diabetes history, unstable angina pectoris history and MI history. Yahagi, et al. reported that there was a relationship between diabetes and coronary artery atherosclerosis and vascular calcification [9]. Our study confirmed that patients with diabetes really had a higher risk of three-vessel lesions among coronary artery disease.

Besides, our study found that patients with CTO had significantly lower LVEF when compared with those patients without CTO. Previous scholars have suggested that multivessel disease may be one of the reasons for lowering the left ventricular ejection fraction[10–11]. However, the effects of reduced left ventricular ejection fraction on the clinical prognosis of patients with multivessel disease remians unclear. Our study found that patients patients with CTO was really a risk factor for lower LVEF among patients with coronary artery disease.

De et al [12] found that the mortality of patients with multivessel disease combined with CTO was significantly higher than that of patients with multivessel disease without CTO, and proposed that multivessel disease combined with CTO could be used as predict factor for the one-year mortaligy of patients with multiple vessels. However, the long-term mortality of patients with CTO remains unknown. Based on the results of previous studies, our study did not found that patients with CTO have higher mortality within five-year follow-up. However, we found that patients with CTO had significantly higher risk of recurrent myocardial infarction when compared with those patients without CTO. Therefore, CTO is not only a risk factor for the one-year death of patients with multivessel disease [13–15], but also a risk factor for recurrent myocardial infarction within five years.

The results of this study showed that the patients with three-vessel lesions had significantly higher rate of diabetes history and unstable angina pectoris history when compared with patients who had two-vessel lesions. Furthermore, the patients with three-vessel lesions had higher cardiogenic mortality than patients with two-vessel lesions during the five-year follow-up. Previously, there were no enough datas aobut the difference between three-vessel lesions and two-vessel lesions among patients with multivessel disease in China. Our study found that the patients with three-vessel lesions were assocciated with higher risk of cardiogenic mortality than two patients with two-vessel lesions.

Left main lesion (unprotected left main diseases) refers to the degree of left main coronary artery angiography stenosis greater than or equal to 50% of the lesions, and at the same time does not exist unblocked blood vessel bridge good collateral circulation or their right to left. Left main coronary disease

is seen in 4%-6% of patients undergoing coronary angiography for an ischemic evaluation and is a potentially fatal condition if not promptly identified and treated [16]. In our study, we found that the patients with left main lesions had significantly higher risk of cardiogenic mortality when compared with those patients without left main lesions which was consistent with previous studies. Besides, we also found that the patients with left main lesions had significantly older age than those patients without left main lesions. The results of Harada et al [17] showed that coronary artery disease with multivessel disease was prone to occur in elderly patients. With the gradual aging of China in these years, the number of patients with multivessel disease of coronary heart disease is increasing year by year, which deserves clinical attention [18–24].

There were several limitations in this study. Firstly, this study was not a randomized controlled trial. Therefore, there was still a certain risk of bias. Secondly, this study was a single-center clinical study with a small sample size. Another multi-center clinical trial with large sample size was still needed in the future.

Conclusions: During the five-year follow-up, the patients with three-vessel lesions had higher risk of cardiogenic mortality than patients with two-vessel lesions. The patients with CTO had significantly lower LVEF and higher risk of recurrent myocardial infarction than patients without CTO. The patients with left main lesions had significantly higher risk of cardiogenic mortality than patients without left main lesions.

List Of Abbreviations

CABG: Coronary artery bypass surgery

CTO: Chronic total occlusive disease

LVEF: Left ventricular ejection fraction

MI: Myocardial infarction

MACE: Major cardiovascular adverse events

PCI: Percutaneous coronary intervention

Declarations

Ethics Approval and Consent to Participate

This study had been approved by our institutional ethics committee (the ethical committee of Beijing Hospital of Traditional Chinese medicine, Capital Medical University). The informed consent (written) was obtained from all participants.

Consent to publish

All of the authors were consent to publish.

Availability of data and materials

The data supporting our findings can be found by our email.

Competing interests

All of the authors had no any personal, financial, commercial, or academic conflicts of interest separately.

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Authors' Contributions

YH Z was the first author and corresponding author. YY W and YY L was the co-first author. XX S was the Co-corresponding author. All of these authors were contributed to this paper.

YH Z: had substantial contributions to the conception; design of the work; the acquisition, analysis; interpretation of data; have drafted the work and substantively revised it. YY W: had substantial contributions to the interpretation of data and substantively revised it. YY L: had substantial contributions to the the acquisition, analysis. XX S : had substantial contributions to the conception; design of the work; the acquisition, analysis; interpretation of data. MF S had substantial contributions to the conception; design of the work.

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Figures

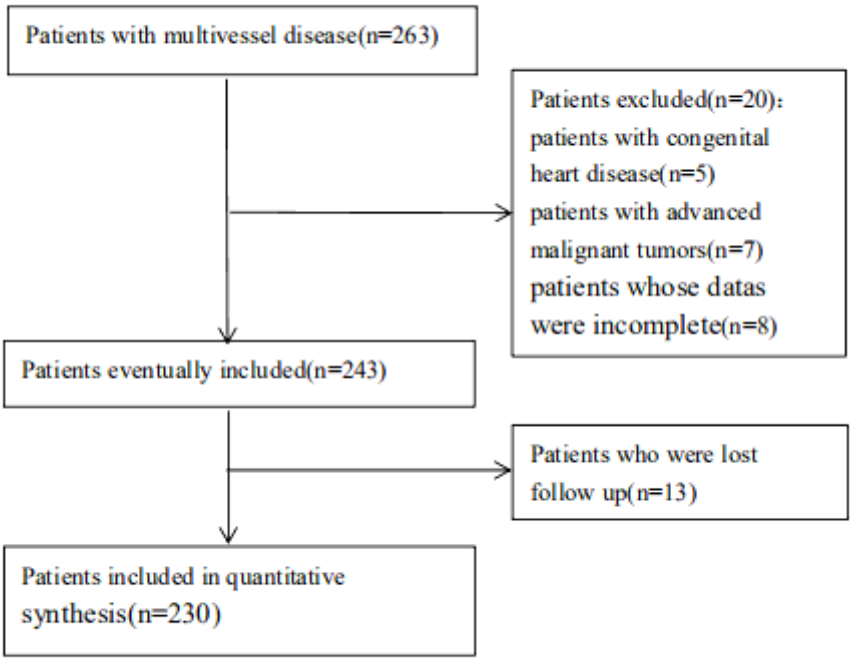

Figure 1

The flow chart. A total of 230 participants were included in this study.