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Original Article

Relationship between the total length of the stents and patients' quality of life after percutaneous coronary intervention

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Abstract: The aim of this study was to examine the relationship between the total length of the stents and the postoperative life quality of patients with multi-vessel coronary artery disease who undergo percutaneous coronary intervention (PCI). Using the short-form health survey (SF-36) items, we analyzed the data on the postoperative life quality of 166 patients with multi-vessel coronary artery disease who underwent percutaneous transluminal coronary intervention in the Department of Cardiology of the First Affiliated Hospital of Henan University of Science and Technology from September 2011 to September 2013. Follow-up was performed 6 months later. All of the dimensionalities, except general health and mental health, showed significantly higher scores after PCI. No significant relationships were observed between the total length of the stents and the postoperative life quality of patients with multi-vessel coronary artery disease who underwent PCI. PCI can effectively improve the postoperative life quality of patients; however, there was no significant relationship between the total length of the stents and postoperative life quality of patients.

Keywords: Total length of stents, multi-vessel coronary artery disease, percutaneous transluminal coronary intervention, postoperative life quality

Introduction

Coronary heart disease (CHD) is one of many etiologies of common diseases caused by inherited and environmental factors; it has a high morbidity, mortality, and disability, and it is one of the severe diseases that threaten human health [1-4]. Percutaneous coronary intervention (PCI) has more advantages than coronary artery bypass grafting (CABG) and has become the main treatment method for CHD [5-8]. With the rapid development of PCI technology and the progressive standardization of oral anticoagulation drugs, antiplatelet drugs, and lipid lowering drugs, the scope of PCI indications is continuously expanding; in addition, the proportion of PCI treatment used for complex lesions, multivessel coronary artery disease, longer lesions, and diffuse small vascular lesions are continuously increasing [9-11]. Many patients with complex lesions prefer PCI over CABG; however, the number and total length of the stents placed in multivessel coronary artery disease patients during PCI is also gradually increasing.

PCI can significantly relieve the symptom of angina pectoris and improve the objective physiological indexes. However, it is still controversial whether longer and additional stents used in PCI improve patients' postoperative status.

As life is prolonged, chronic and non-communicable diseases increase and more treatment outcomes of patients with CHD result in survival with diseases. Thus, patients' postoperative life quality is becoming an important criterion for evaluating the survival status and treatment effects of PCI, particularly among medical staff [12-15]. Additionally, the relationship between the total length of the stents and the postoperative life quality of patients with multivessel coronary artery disease who have undergone PCI has gradually received attention. However, research on this topic is lacking, and there is no unified conclusion. Therefore, we followed 166 patients with multivessel coronary artery disease who had different stent lengths placed during PCI to examine the relationship between the total length of the stents and the patients' postoperative life quality after PCI.

Materials and methods

Study objective

Based on the results of coronary angiograms, we selected 166 patients with multivessel coronary artery disease who were hospitalized in the Department of Cardiology from September 2011 to September 2013 and underwent successful selective PCI. Patients who underwent immediate PCI for acute myocardial infarction, rescue PCI, and repeat revascularization were excluded. The patients were divided into four groups according to the total stent lengths: group A, 27 patients (stent length < 36 mm); group B, 63 patients (36 mm ≤ stent length < 72 mm); group C, 55 patients (72 mm ≤ stent length < 108 mm); and group D, 21 patients (stent length ≤ 108 mm). This study was conducted in accordance with the declaration of Helsinki. This study was conducted with approval from the Ethics Committee of Henan University. Written informed consent was obtained from all participants.

Coronary angiography and percutaneous coronary intervention

Using multiple position projections, selective coronary arteriography was performed by two or more experienced associate senior physicians or interventional cardiologists using the Judkins method to evaluate the coronary artery lesion in all the patients. Multivessel coronary artery disease was diagnosed if there were ≥ 2 areas of vascular stenosis > 70% in the main coronary artery with a diameter ≥ 2.5 mm (e.g., the anterior descending coronary artery, circumflex coronary artery, and right coronary artery or its larger branches). Coronary artery stenting and postoperative treatment was performed according to the treatment guidelines for PCI. All the patients received one standardized drug treatment for at least 1 year, which included aspirin (100 mg) and clopidogrel (75 mg), and statin lipid-lowering drugs were taken in the long-term.

Short form health survey integral

All patients were required to complete one direct questionnaire survey developed using the SF-36 scale preoperatively to evaluate their preoperative life quality [16]. Six months later, the patients received a telephone follow-up or out-patient review to complete the same survey to evaluate their postoperative life quality. The SF-36 scales were finished by the patients independently. However, for those who completed the survey by phone or for those who had a lower education level, the medical staff helped complete their scales. The SF-36 scale is divided into eight dimensionalities (physical function [PF], role of physical [RP], bodily pain [BP], general health [GH], vitality [VT], social function [SF], role of emotional [RE], mental health [MH]) and 36 child entries. When scoring, the score of the corresponding entries was added to obtain the initial score of each dimensionality, and then it was converted to the initial score of each dimensionality according to a 100 point scale, which was graded using the standard score transformation formula of the SF-36 scale: the standard score = 100 × (the actual score-the lowest possible score of the dimensionality)/(the highest possible score of the dimensionality-the lowest possible score of the dimensionality)/(the highest possible score of the dimensionality). Among the scores of all the child entries, the score of one child entry was not included in the final score when determining the patients' health status in the last year. The higher score of each dimensionality indicates a better quality of life for the patients.

Major adverse cardiac events

The occurrence of major adverse cardiac events (MACE) was recorded via the telephone follow-ups and out-patient reviews. These included cardiac death, non-fatal reinfarction, target vessel revascularization, and recurrence of angina pectoris.

Statistical analysis

All the data was analyzed by using SPSS, version 17.0 (SPSS, Inc., Chicago, IL, USA). A *P* value < 0.05 was defined as statistically significant. The measurement data is expressed as $\overline{x} \pm s$, and the enumeration data is expressed as rates. The compare of the enumeration data is finished using chi-square test.

Table 1. The basic information of four group patients

Group	N	Age	Male (n/%)	Diabetes (n/%)	Value of EF
A	27	62.3±5.39	17 (62.96)	8 (29.63)	56.19±6.36
B	63	64.7±6.82	39 (61.90)	20 (31.75)	54.23±4.67
C	55	63.1±7.83	36 (65.45)	18 (32.73)	53.89±5.76
D	21	65.2±6.74	13 (61.90)	7 (33.33)	55.32±4.87

Notes: A: L < 36 mm. B: 36 mm ≤ L < 72 mm. C: 72 mm ≤ L < 108 mm. D: 108 mm ≤ L.

Table 2. The clinical effectiveness followed up results of each group patients six months after PCI

Item	A (n/%)	B (n/%)	C (n/%)	D (n/%)
Recurrence angina	1 (3.7)	2 (3.2)	3 (5.2)	2 (9.5)
Target vessel Revascularization	1 (3.7)	3 (4.8)	3 (5.2)	2 (9.5)
In stent Restenosis	0 (0)	2 (3.2)	3 (5.2)	3 (14.3)
Major adverse cardiac Events	1 (3.7)*	6 (9.5)*	8 (13.8)*	6 (28.6)*

Note: *P < 0.05, difference in the number of major adverse cardiovascular events for group A, B, C and D was significant.

Results

Coronary angiography and percutaneous coronary intervention

The average values of the total length of the stents placed in group A, B, C, and D were 25.15±8.34 mm, 56.46±11.36 mm, 90.93±11.22 mm, and 135.76±19.56 mm, respectively. In group B, subacute thrombosis of the coronary stent occurred in 1 patient (1.6%) and cardiac tamponade occurred in 1 patient (1.6%). In group C, subacute thrombosis of the coronary stent occurred in 2 patients (3.5%) and cardiac tamponade occurred in 1 patient (1.7%). In group C, subacute thrombosis of the coronary stent occurred in 1 patient (4.8%). There was no difference among the degree of vascular lesions among the groups, and there was also no significant difference in the clinical characteristics (e.g, age, the sex constituent ratio, diabetes, and heart function) among the groups (P > 0.05) (**Table 1**).

Postoperative follow-up

The patients were followed up 6 months later, and the results are presented in **Table 2**. There was recurrent angina in each group, but the difference in the number of recurrent angina for each group was not significant (P > 0.05). However, the difference in the number of MACEs for each group was significant (P < 0.05).

Preoperative and postoperative quality of life

Statistical results of the standard score of the patients' preoperative and postoperative quality of life are shown in **Table 3**. There was no statistical significance among the differences in the preoperative standard score of the eight dimensionalities (P > 0.05), and there was no statistical significance among the differences in the postoperative standard score of the eight dimensionalities (P > 0.05). However, the postoperative standard scores of the PF, RP, BP, VT, SF, and RE were significantly higher than those preoperatively, and there were significant statistical significances between the postoperative and preoperative standard scores of those six dimensionalities (P < 0.05). An increase in the standard scores of the GH and MH postoperatively was not obvious compared to those preoperatively.

Discussion

This study examined the relationship between the total length of the stents and the postoperative quality of life of patients who underwent PCI for multi-vessel coronary artery disease. After following up with these patients, we found that all the standard scores of eight dimensionalities of the quality of life of four patients groups were significantly increased compared to those preoperatively, expect for the dimensionality of the GH and MH. Additionally, there was no significant statistical significance among the differences in the four patient groups' postoperative quality of life standard scores, indicating that there was no correlation between the patients' postoperative quality of life and the total length of stents placed during PCI.

Over the last decades, many studies on PCI and the quality of life of coronary artery disease patients have been performed. John et al [17] studied the predictors of quality-of-life benefit

Table 3. The standard score of preoperative and postoperative quality of life of patients ($\overline{x} \pm s$)

	Group A		Group B		Group C		Group D	
	Preoperative	Postoperative	Preoperative	Postoperative	Preoperative	Postoperative	Preoperative	Postoperative
PF	75.8±11.1	87.7±13.0	73.2±14.0	89.2±10.8	77.1±13.0	85.1±7.4	69.2±10.8	78.2±7.4
RP	38.5±42.8	76.9±29.7	27.6±36.2	73.7±27.0	33.9±37.5	67.9±20.6	40.0±34.8	73.0±27.4
BP	70.4±18.8	87.8±8.8	60.1±21.9	87.5±12.7	65.4±19.0	80.1±11.4	60.5±30.0	75.5±10.3
GH	50.8±20.6	53.8±19.6	49.2±20.6	57.4±17.4	50.7±19.1	56.1±15.8	45.0±27.0	51.7±26.0
VT	69.6±20.4	81.5±18.6	61.8±16.8	76.3±16.2	65.0±16.6	73.8±14.9	68.3±12.9	80.0±10.5
SF	72.0±18.5	83.9±13.2	68.4±24.2	83.8±13.9	73.1±23.0	80.6±16.1	72.6±7.3	81.5±9.2
RE	59.0±45.5	87.3±16.7	52.7±26.9	79.2±16.4	53.3±27.0	72.6±16.9	48.8±39.1	72.0±17.0
MH	67.1±18.0	70.5±14.8	61.9±13.5	66.9±12.4	61.7±20.1	65.1±16.3	66.0±16.5	66.0±16.5

Notes: PF: Physical Function, RP: Role of Physical, BP: Bodily Pain, GH: General Health, VT: Vitality, SF: Social Function, RE: Role of Emotional, MH: Mental Health.

after PCI. Joseph et al [18] compared the effects of an early interventional strategy versus a conservative strategy on the health-related quality of life in patients with non-ST-segment elevation acute coronary syndromes. Graham et al [19] examined the quality of life after coronary revascularization in the elderly and suggested that age should not deter against revascularization because of the survival and quality-of-life benefits. Li et al [20] studied the quality of life after PCI in the elderly with acute coronary syndrome and also suggested that age, in particular, should not deter against revascularization because of the potential health-related quality of life benefits. All of their study findings showed that PCI can effectively improve patients' postoperative quality of life, and our study also indicated that successful PCI can improve CHD patients' survival state. Some researchers have also studied the quality of life of multivessel coronary artery disease patients underwent PCI; however, there are many different opinions on the improvement of the patients' prognosis after complete and incomplete revascularizations. Daemen and Serruys [21] assessed optimal revascularization strategies for multivessel coronary artery disease. Navarese et al [22] performed a meta-analysis on the clinical impact of simultaneous complete revascularization versus culprit only primary angioplasty in patients with ST-elevation myocardial infarction and multivessel disease. The study showed the safety and efficacy of the multivessel PCI approach in comparison to culprit only revascularization, which included a significant reduction in the rate of revascularizations but no advantages in death and re-infarction. Study findings by Guo et al [23] on the effect of incomplete revascularization using PCI on the outcome and prognosis in aged patients with multivessel coronary artery disease indicated that incomplete revascularizations have a similar clinical effect as complete revascularizations. In our study, there was no significant statistical significance among the differences in the four patient groups' postoperative quality of life standard scores. This indicates that more or longer stents do not improve the patients' quality of life. Perhaps some patients did not require complete revascularizations. It is beneficial for patients to adopt selective partial revascularization and to reduce the number and length of the stents.

In our study, we completed coronary angiography follow-up on 72 patients, which accounted for 43.4% (72/166) of all the study subjects. The follow-ups indicated that the occurrence of in-stent restenosis and MACEs was relatively higher in patients who were had more and longer stents placed. Among the four patient groups, the occurrence of MACEs increased along with the increasing total length of the stents, and there was a statistically significance among the four patient groups. We think that the stent itself is a metal foreign body that may cause thrombi to form, because drug-coated stents can inhibit intima hyperplasia and also delay endothelialization. Therefore, the compatibility of the stents themselves and the incomplete reendothelialization can induce a blood hypercoagulable state that is associated with a longer stent, which increases the possibility in-stent restenosis. With the increase in the number and total length of the stents, the number of ends and interfaces of the stents will also increase, and this may cause the increase in the MACEs, which does not solve the problem but instead will influence the patients' state of health. Thus, it is beneficial to improve the patients' postoperative quality of life by performing a careful preoperative evaluation, solving a significant amount of vasculopathy, and optimizing the tactics of PCI.

In 2012, the SYNTAX study by Head et al [24] showed that CABG is still the standard treatment for patients with complex lesions; thus, PCI may be a good alternative for revascularization in patients whose lesions are not complex. Presently, many scholars believe that those patients whose lesions are complex should be recommended to receive CABG and should have ≥ 3 stents placed. Although the curative effect of CABG is definitive, it requires thoracotomy and general anesthesia, its trauma is serious, many patients require extracorporeal circulation during CABG, and the postoperative restoration is also relatively slow. CABG is not suitable as a repeated operation, and it has certain restrictions in some patients. Thus, many patients with complex lesions would rather select PCI than CABG, which increases the occurrence rates of in-stent restenosis and MACEs. We recommend that patients with multivessel coronary artery disease should have ≥ 3 stents placed and CABG should be selected in cases with physical conditions to prevent the occurrence rates of in-stent restenosis and MACEs and to improve the patients' postoperative life quality.

The 4-year follow-up findings of a meta-analysis of nine randomized controlled experiments on drug-eluting stents and bare metal stents was presented by Stone et al [25] which showed that the stent thrombosis occurrence rates for sirolimus-eluting stents was 1.2%, the paclitaxel-stent was 1.3%, and bare metal stent was 0.6%. The occurrence rate of stent subacute thrombosis in patients with multivessel coronary artery disease with more drug-eluting stents was 0.6% [26, 27]. In this study, four patients had subacute thrombosis during the stay in hospital (the occurrence rate is 2.4%), the total length of the stents placed in the four patients respectively are 36 mm ≤ L < 72 mm one patient, 72 mm ≤ L < 108 mm two patients and 108 mm ≤ L one patient, and there is no significant statistical significance among the four groups. The formation rate of in-stent subacute thrombosis of this research is slightly higher than the above-mentioned report, we think it mainly is related to the small sample size, and it maybe is related to the postoperation residual stenosis or the patients' drug compliance of antiplatelet drugs, for example clopidogrel.

The limitations of this study were the patient selection, which was not random, retrospective analysis of the consecutive patients, lack of a control group, short follow-up, small sample size, and lower follow-up rate of coronary angiography. Therefore, we need to perform a polycentric, prospective study with a longer follow-up period to determine the relationship between the total length of the stents and the postoperative life quality of patients with multivessel coronary artery disease who undergo PCI.

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Disclosure of conflict of interest

None.

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