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Original Article

Comparison of efficacy and adverse reactions between coronary artery bypass grafting and percutaneous coronary intervention for coronary heart disease

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Abstract: Objective: To explore the benefits of coronary artery bypass grafting and percutaneous coronary intervention for coronary heart disease (CHD). Methods: 46 patients underwent coronary artery bypass grafting and percutaneous coronary intervention. Postoperative hospital stay, mechanical ventilation time, postoperative stay in the intensive care unit (ICU), relevant vessel recanalization rate, and residual arterial stenosis degree were observed and left ventricular ejection fraction (LVEF), incidence of adverse reactions reflected by imperfect ST-segment resolution, and postoperative myocardial injury markers based on cardiac color ultrasound were recorded. Results: Postoperative hospital stay, mechanical ventilation time, and postoperative stay in ICU were shorter in the study group than in the control group. The study group exhibited better myocardial injury markers, operation indices, and quality of life and lower incidence of adverse reactions than the control group (all $P<0.05$). Conclusion: Coronary artery bypass grafting is superior in the treatment of CHD in terms of clinical efficacy.

Keywords: Coronary heart disease, coronary artery bypass grafting, percutaneous coronary intervention, adverse reaction, quality of life, clinical efficacy

Introduction

Cardiovascular disease involves the heart and blood vessels and includes coronary artery disease, coronary heart disease (CHD), and acute coronary syndrome of other diseases. CHD is a leading cause of death and disability in humans; it can lead to myocardial infarction, unstable angina pectoris, heart failure, and a series of clinical symptoms such as myocardial necrosis, ischemia, and hypoxia [1-5]. Due to rapid population aging, the incidence of CHD is increasing with every year; hence, it is crucial to seek safe and effective clinical treatment.

Coronary artery bypass grafting, also known as coronary artery bypass graft, is an important treatment method for ischemic heart disease. It involves the reconstruction of vessels, enhancement of myocardial blood supply, and effective relief or elimination of angina pectoris symptoms [6, 7]. It has proven to be one of the most effective and long-lasting treatments for ischemic heart disease, with a relatively low mortality rate during angioplasty and relatively low reoperation rate. Furthermore, it provides better symptom alleviation [8, 9].

Percutaneous coronary intervention involves opening a stenotic or occluded artery by dilating the balloon in the artery, usually followed by stent insertion to improve myocardial perfusion. It is the most common revascularization method in patients with heart disease [10]. A study has reported that patients who underwent percutaneous coronary intervention were extremely satisfied and required shorter postoperative hospital stay [11]. Although percutaneous coronary intervention is widely considered to be an effective and safe treatment method for CHD, concerns remain regarding the associated postoperative cardiovascular events [12].

Many studies have been conducted on percutaneous coronary intervention and coronary artery bypass grafting for CHD, but only few studies have studied the postoperative myocardial injury and adverse reactions related to these procedures [13-15]. This study compared

percutaneous coronary intervention and coronary artery bypass grafting regarding their clinical efficacy, postoperative stress reaction, and influence on quality of life in patients with CHD.

Materials and methods

General materials

The study sample comprised a total of 92 patients with CHD enrolled in our hospital. Of them, 46 patients undergoing coronary artery bypass grafting comprised the study group (25 men and 21 women; age range, 58-70 years; mean age, 64.54 ± 6.75 years; mean body weight, 24.41 ± 1.37 kg) and the other 46 patients undergoing percutaneous coronary intervention comprised the control group (27 men and 19 women; age range, 60-71 years; mean age, 65.12 ± 6.72 years; mean body weight, 24.87 ± 1.43 kg).

Inclusion and exclusion criteria

Inclusion criteria were as follows: men and non-pregnant women aged 58-71 years with expected survival time of ≥1 year who were diagnosed with CHD based on coronary angiography and could correctly understand relevant contents of the 36-Item Short-Form Health Survey (SF-36) scale and provide an answer [16]. This study was approved by the Ethics Committee of West China Hospital, Sichuan University. The participants and their family members were provided with an explanation of the study, following which they signed an informed consent form. Exclusion criteria: patients without a previous history of coronary artery surgery; patients with acute myocardial infarction, severe hepatic renal dysfunction, infectious disease or hematopoietic failure; patients with other tumor diseases; elderly patients with CHD; and patients with mental illness or family history of psychosis.

Operative methods

The study group underwent coronary artery bypass grafting as follows: All patients received intravenous inhalation anesthesia based on sufentanil (Yichang Humanwell Pharmaceutical Co., Ltd., batch number: H20054256, China). Aspirin and clopidogrel intake was stopped for 1 week, following which the patients underwent conventional tracheal intubation. During surgery, the incision was selected depending on lesions in patients; the depth of anesthesia was controlled or a β-receptor blocker (Beijing Biolab Technology Co., Ltd., item number: M07475-KGL, China) was adopted to decrease patients' heart rate to <60 bpm and reduce patients' myocardial contractility. Adhesion of heart surface was then separated, and diaphragmatic surface of the right ventricle, the ascending aorta, and part of the right atrium were revealed. After systemic heparinization of patients, venous cannulation was performed on the ascending aorta, right atrium, and inferior vena to allow *in vivo* circulation, block the ascending aorta, and infuse cold cardioplegic solution from the aortic root. After patients' heart stopped beating, heart surface adhesion was further separated to reveal the entire heart and the coronary artery requiring bypass grafting was identified based on coronary artery angiography. All patients were postoperatively administered with aspirin (100 mg/day) for long term.

The control group underwent percutaneous coronary intervention as follows: all patients were administered with 300 mg of aspirin (Weihai Zi Teng Biotechnology Co., Ltd.; item number: 27942, China) and 300 mg of clopidogrel (Shanghai Xi Yuan Biotechnology Co., Ltd.; item number: XYQC-QC160700, China), following which they underwent the procedure. All patients were administered with lidocaine (Chongqing Publikebio Co., Ltd.; item number: 639662, China) for local anesthesia, following which they underwent femoral artery puncture in the supine position. Subsequently, the patients were implanted with a stent after balloon pre-dilation or directly implanted with a stent depending on their disease, and then they were implanted with a sheath tube and injected with 3000 U of heparin (Shanghai Runwell Technology Co., Ltd., item number: HY-17567, China) from the sheath tube sidewall. Subsequently, they were intravenously injected with 5000-7200 U of heparin, followed by catheter-guided insertion to maintain the activated coagulation time at 300-350 s. All patients were administered with aspirin (100 mg/day) for long term and clopidogrel (75 mg/day) for 1 year.

Observation indices

The two groups were observed, and their postoperative hospital stay, mechanical ventilation time, and postoperative stay in ICU were recorded. Fasting venous blood (5 ml) collected from all patients in the early morning before surgery

and the next day after surgery was centrifuged to separate serum at 670.8 × g; the serum was kept at 20°C-25°C for 10 min for later use. Cardiac troponin I and creatine kinase isoenzyme levels in the two groups were detected using an automated chemiluminescence immunoassay analyzer (Wuhan Easydiagnosis Biomedicine Co., Ltd. China) in strict accordance with instrument and kit instructions. Relevant vessel recanalization rate and residual arterial stenosis degree were recorded for both groups. Furthermore, LVEF and imperfect ST-segment resolution based on GE LOGIQ E9 super high-end systemic color ultrasound (cardiac color ultrasound) (Shanghai hanfei. Biomart.cn, China) were observed and recorded for both groups.

Postoperative quality of life of the two groups

The two groups were followed up, and their quality of life was assessed using the SF-36 scale during 1 year postoperatively. This scale included the following items: physiological function (PF), to assess whether patients' daily physical activity is hindered by their health status; role physical (RP), to assess the limitations imposed by patients' health problems on their functions; body pain (BP), to measure the impact of patients' level of pain due to illness on daily life; general health (GH), to assess patients' health status and development trends; vitality (VT), to measure patients' feelings regarding energy and fatigue; social function (SF), to measure limitations on patients' social activity due to physiological functions or emotions; role emotional (RE), to measure limitations on patients' functions due to their own emotional problems; and mental health (MH), to assess patients' mental and psychological states.

Statistical methods

Statistical analysis was performed using the statistical software SPSS 22.0 (SPSS, Inc., Chicago, IL, USA). Data of the separate groups were presented as the number of cases/percentage [n (%)] and analyzed using χ^2 test. Those with theoretical frequency <5 in χ^2 test were analyzed using continuity correction χ^2 test. Measurement data were expressed as mean ± standard deviation ($\bar{x}$ ± SD). Measurement data between-group comparisons were subjected to t-test and those within-group comparisons pre- and postoperatively were subjected to paired t-test. P<0.05 indicated a significant difference.

Results

No significant between-group differences of the general materials and methods

No significant between-group differences were noted regarding general clinical baseline data including sex, age, weight, education level, marital history, place of residence, occupation, course of disease, family history of CHD, combined chronic disease, smoking history, drinking history, and history of hypertension (all P>0.05; **Table 1**).

The study group required less general materials postoperatively than the control group

The study group required less postoperative hospital stay, mechanical ventilation time, and postoperative stay in ICU than the control group (all P<0.05; **Table 2** and **Figure 1**).

The study group showed better operation indices postoperatively than the control group

Postoperatively, the study group showed higher vessel recanalization rate and LVEF score (both P<0.05) and lower residual arterial stenosis degree and incidence of imperfect ST-segment resolution (both P<0.05) than the control group (**Table 3**).

The study group showed lower myocardial injury markers pre- and postoperatively than the control group

Preoperatively, there were no between-group differences in cardiac troponin I and creatine kinase isoenzyme levels (both P>0.05); however, postoperatively, the study group showed lower levels of these markers (both P<0.05) (**Table 4** and **Figure 2**).

The study group showed lower total incidence of adverse reactions than the control group

In the study group, one patient had arrhythmia (2.17%), two had angina pectoris (4.35%), one had chest pain (2.17%), one had chest distress (2.17%), two had hypodynamia (4.35%), and one had abdominal distension (2.17%), with a total incidence of adverse reactions of 15.22%. In the control group, two patients had arrhythmia (4.35%), three had angina pectoris (6.52%), two had chest pain (4.35%), two had chest dis-

Table 1. General clinical data of the two groups, n (%) ($\bar{x}$ ± SD)

Category	Study group (n = 46)	Control group (n = 46)	t/χ^2 value	*P* value
Sex			0.177	0.674
Male	25 (54.35)	27 (58.70)		
Female	21 (45.65)	19 (41.30)		
Age (years)	64.54 ± 6.75	65.12 ± 6.72	0.413	0.681
Weight (kg/cm^2)	24.41 ± 1.37	24.87 ± 1.43	1.575	0.119
Education level			1.784	0.616
With primary school diploma or below	5 (10.87)	3 (6.52)		
With junior diploma	11 (23.91)	14 (30.43)		
With high school diploma or technical secondary school diploma	16 (34.78)	19 (30.43)		
With junior college diploma and above	14 (30.43)	10 (21.74)		
Marital status			0.425	0.514
Married	31 (67.39)	28 (60.87)		
Widowed or divorced	15 (32.61)	18 (39.13)		
Place of residence			1.725	0.189
Rural area	27 (58.70)	33 (71.74)		
Urban area	19 (41.30)	13 (28.26)		
Occupation			0.175	0.676
Manual workers	26 (56.52)	24 (52.17)		
Mental workers	20 (43.48)	22 (47.83)		
Course of disease (Y)			0.577	0.749
<1	8 (17.39)	10 (21.74)		
>1-5	23 (50.00)	24 (52.17)		
>5	15 (32.61)	12 (26.09)		
Family history of coronary heart disease			0.183	0.669
Yes	29 (63.04)	27 (58.70)		
No	17 (36.96)	19 (41.30)		
Combined with chronic disease or not			0.192	0.662
Yes	15 (32.61)	17 (36.96)		
No	31 (67.39)	29 (63.04)		
Smoking history			0.198	0.657
Yes	32 (69.57)	30 (65.22)		
No	14 (30.43)	16 (34.78)		
Drinking history			1.311	0.252
Yes	30 (65.22)	35 (76.09)		
No	16 (34.78)	11 (23.91)		
History of hypertension			0.791	0.374
Yes	29 (63.04)	33 (71.74)		
No	17 (36.96)	13 (28.26)		

tress (4.35%), three had hypodynamia (6.52%), and three had abdominal distension (6.52%), with a total incidence of adverse reactions of 34.78%. The study group showed lower total incidence of adverse reactions than the control group (P<0.05; **Table 5**).

The study group exhibited higher postoperative quality of life than the control group

The study group exhibited higher postoperative quality of life (reflected by the items PF, RP, BP, GH, VT, SF, RE, and MH of the SF-36 scale) than the control group (P<0.05; **Table 6**).

Discussion

CHD is a serious cardiovascular disease and is a common cause of death; it occurs due to a myocardial function lesion or shortage of blood and oxygen caused by the occlusion or stenosis of the coronary artery [17-19]. CHD is a result of interaction among various risk factors, and coronary atherosclerosis causing malignant vas-

Table 2. Comparison of general materials postoperatively between the two groups ($\bar{x}$ ± SD)

	Study group (n = 46)	Control group (n = 46)	t	P
Postoperative hospital stay (days)	11.25 ± 1.87*	12.44 ± 1.34	3.508	0.001
Mechanical ventilation time (h)	13.45 ± 1.60*	22.14 ± 1.31	28.500	<0.001
ICU stay (h)	69.87 ± 1.59*	82.74 ± 1.67	37.860	<0.001

Note: Compared with the control group postoperatively, *P<0.05.

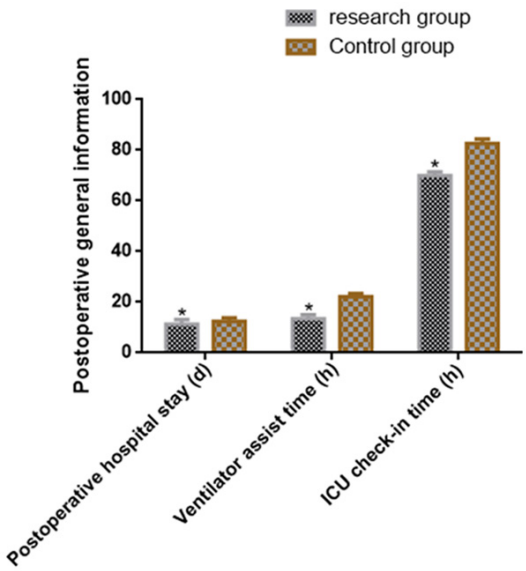

Figure 1. Comparison of general materials postoperatively between the two groups. The study group required shorter postoperative hospital stay, mechanical ventilation time, and postoperative stay in the intensive care unit (ICU) than the control group (all P<0.05). Note: Compared with the control group postoperatively, *P<0.05.

cular endothelial inflammation reaction is an important underlying mechanism [20]. In the last decade, percutaneous coronary intervention and coronary artery bypass grafting have been widely adopted as effective measures for myocardial ischemia alleviation and ventricular function preservation in patients with CHD and have shown different clinical manifestations [21].

Coronary artery bypass grafting, the most common elective surgery, can improve patients' postoperative quality of life and effectively reduce heart-related mortality; it is often indicated for patients with coronary artery diseases and has shown good efficacy in patients with angina pectoris [22]. Percutaneous coronary intervention can lower the incidence of reperfusion injury, including myocardial stunning, myocardial necrosis, and reperfusion arrhythmias, in the treatment of coronary diseases by effectively recovering myocardial perfusion and improving the heart contractile synchrony and cardiac function. Furthermore, it can remedy the myocardium by helping restore epicardium bleeding [23, 24]. Spadaccio et al. showed that coronary artery bypass grafting was superior to percutaneous coronary intervention in treating coronary diseases and that it was the best revascularization strategy for reducing mortality and revascularization risk [25]. Sá et al. indicated that coronary artery bypass grafting remains to be the best choice for left major arterial diseases because it contributes to higher postoperative survival rate and is associated with less demand for new surgery than percutaneous coronary intervention [26]. In the present study, the study group required shorter postoperative hospital stay, mechanical ventilation time, and postoperative stay in ICU than the control group, indicating that coronary artery bypass grafting was more effective than percutaneous coronary intervention in shortening postoperative hospital stay and stay in ICU and in reducing patients' respiratory disorders. Postoperatively, the study group showed better operation indices and lower myocardial injury marker levels than the control group, indicating that coronary artery bypass grafting is more helpful than percutaneous coronary intervention in recovering the myocardium. Regarding adverse reactions, both groups showed different degrees of adverse reactions, but the incidence of adverse reactions was lower in the study group than in the control group, indicating that coronary artery bypass grafting can reduce adverse reactions to a certain extent, with higher safety than percutaneous coronary intervention. Quality of life has always been an important parameter in the assessment of the prognosis of various diseases; hence, this study further followed up patients in both groups in terms of their quality of life [27]. The results showed that

Table 3. Comparison of operative indices between the two groups, n (%) ($\bar{x}$ ± SD)

Category	Study group (n = 46)	Control group (n = 46)	χ^2 value	*P* value
Vessel recanalization rate (%)	96.20 ± 7.90*	65.80 ± 6.10	20.660	<0.001
Residual arterial stenosis degree >20% (number of cases %)	6 (13.04)	17 (36.96)	7.014	0.001
LVEF score (points)	52.21 ± 5.72*	44.18 ± 3.36	8.210	<0.001
Incidence of imperfect ST-segment resolution (the number of cases %)	7 (15.22)	16 (34.78)	4.696	0.030

Note: Compared with the control group postoperatively, *P<0.05.

Table 4. Comparison of myocardial injury markers between the two groups ($\bar{x}$ ± SD)

Group	n	Cardiac troponin I (ng/mL)		Creatine kinase isoenzyme (ng/mL)	
		Preoperatively	Postoperatively	Preoperatively	Postoperatively
Study group	46	0.67 ± 0.38	0.13 ± 0.15*,#	11.55 ± 2.38	3.45 ± 0.89*,#
Control group	46	0.65 ± 0.37	0.32 ± 0.21#	11.53 ± 2.37	6.93 ± 1.04#
t		0.256	4.993	0.040	17.24
P		0.799	<0.001	0.968	<0.001

Note: Compared with the control group postoperatively, *P<0.05; compared with the control group postoperatively, #P<0.05.

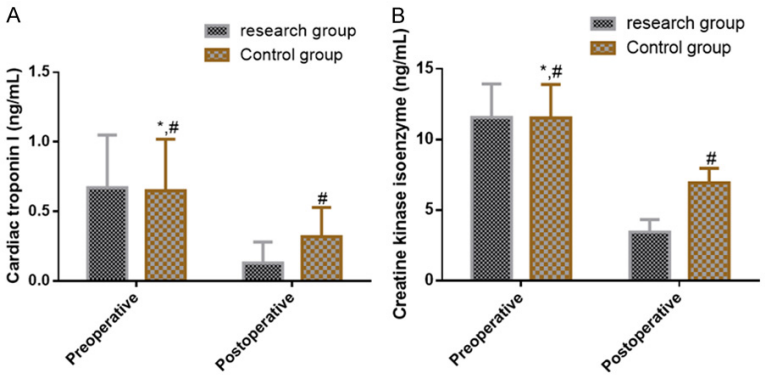

Figure 2. Comparison of myocardial injury markers pre- and postoperatively between the two groups. Preoperative myocardial injury markers levels in the two groups were not significantly different (P>0.05). Both groups showed lower cardiac troponin I (A) and creatine kinase isoenzyme (B) postoperatively (both P>0.05). The study group showed lower cardiac troponin I (A) and creatine kinase isoenzyme (B) levels than the control group postoperatively (both P<0.05). Note: Compared with the control group postoperatively, *P<0.05; compared with the control group preoperatively, #P<0.05.

the study group exhibited higher postoperative quality of life (reflected by items PF, RP, BP, GH, VT, SF, RE, and MH) than the control group, indicating that coronary artery bypass grafting was more effective than percutaneous coronary intervention in improving the quality of life of patients with CHD. Thus, the results of this study and other studies show that coronary artery bypass grafting is superior to percutaneous coronary intervention for CHD treatment because it can shorten the postoperative hospital stay and postoperative stay in ICU and can reduce respiratory disorder in patients. Furthermore, it can more effectively improve clinical symptoms, help recover the myocardium, and reduce the incidence of adverse reactions to some extent to improve patients' quality of life.

This study chose participants in strict accordance with the inclusion and exclusion criteria; thus, clinical baseline data between the study and control groups were not significantly different, ensuring the preciseness and reliability of the study results. Although this study confirmed that coronary artery bypass grafting is superior to percutaneous coronary intervention in patients with CHD, with better clinical efficacy, it did not conduct prognosis follow-up on patients and did not obtain follow-up statistics on survival time; thus, it has certain limitations. These inadequacies need to be considered in future research to further corroborate the study results.

In summary, coronary artery bypass grafting is superior to percutaneous coronary intervention for CHD treatment with better clinical efficacy because it can shorten the postoperative hospital stay, improve myocardial recovery with

Table 5. Comparison of the incidence of adverse reactions postoperatively between the two groups, n (%)

Category	Study group (n = 46)	Control group (n = 46)	χ^2 value	*P* value
Arrhythmia	1 (2.17)	2 (4.35)	0.345	0.557
Angina pectoris	2 (4.35)	3 (6.52)	0.212	0.646
Chest pain	1 (2.17)	2 (4.35)	0.345	0.557
Chest distress	1 (2.17)	2 (4.35)	0.345	0.557
Hypodynamia	2 (4.35)	3 (6.52)	0.212	0.646
Abdominal distension	1 (2.17)	3 (6.52)	1.045	0.307
Total incidence of adverse reactions	7 (15.22)	16 (34.78)	4.696	0.030

Table 6. Comparison of postoperative quality of life between the two groups ($\bar{x} \pm SD$)

Quality of life score	Study group (n = 41)	Control group (n = 41)	t value	*P* value
PF	82.69 ± 13.97*	71.93 ± 11.48	4.036	0.001
RP	75.71 ± 17.87*	64.28 ± 13.18	3.491	0.001
BP	86.07 ± 14.39*	77.23 ± 11.77	3.225	0.002
GH	66.25 ± 11.28*	58.27 ± 16.33	2.727	0.008
VT	80.61 ± 10.08*	71.78 ± 12.65	3.703	0.001
SF	83.28 ± 12.93*	69.26 ± 13.28	5.130	<0.001
RE	85.27 ± 18.92*	74.18 ± 17.13	2.947	0.004
MH	78.04 ± 10.96*	66.18 ± 11.13	5.150	<0.001

Note: Compared with the control group postoperatively, *P<0.05.

lower incidence of postoperative adverse reactions, and can more effectively improve patients' quality of life. Therefore, coronary artery bypass grafting is worthy of clinical application.

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Disclosure of conflict of interest

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References

[1] Kazmi N and Gaunt TR. Diagnosis of coronary heart diseases using gene expression profiling; stable coronary artery disease, cardiac ischemia with and without myocardial necrosis. PLoS One 2016; 11: e0149475.

[2] Sanchis-Gomar F, Perez-Quilis C, Leischik R and Lucia A. Epidemiology of coronary heart disease and acute coronary syndrome. Ann Transl Med 2016; 4: 256.

[3] Shrivastava AK, Singh HV, Raizada A and Singh SK. C-reactive protein, inflammation and coronary heart disease. Egyptian Heart Journal 2015; 67: 89-97.

[4] Stelzle D, Shah ASV, Anand A, Strachan FE, Chapman AR, Denvir MA, Mills NL and Mcallister DA. High-sensitivity cardiac troponin I and risk of heart failure in patients with suspected acute coronary syndrome: a cohort study. Eur Heart J Qual Care Clin Outcomes 2017; 67: 1327-1327.

[5] Zewinger S, Kleber ME, Tragante V, Mccubrey RO, Schmidt AF, Direk K, Laufs U, Werner C, Koenig W and Rothenbacher D. Relations between lipoprotein(a) concentrations, LPA genetic variants, and the risk of mortality in patients with established coronary heart disease: a molecular and genetic association study. Lancet Diabetes Endocrinol 2017; 5: 534-543.

[6] Lozonschi L, Kohmoto T, Osaki S, De Oliveira NC, Dhingra R, Akhter SA and Tang PC. Coronary bypass in left ventricular dysfunction and differential cardiac recovery. Asian Cardiovasc Thorac Ann 2017; 25: 586-593.

[7] Velazquez EJ, Lee KL, Jones RH, Al-Khalidi HR, Hill JA, Panza JA, Michler RE, Bonow RO, Doenst T, Petrie MC, Oh JK, She L, Moore VL, Desvigne-Nickens P, Sopko G and Rouleau JL; STICHES Investigators. Coronary-artery bypass surgery in patients with ischemic cardiomyopathy. N Engl J Med 2016; 374: 1511-1520.

[8] Kowalewski M, Pawliszak W, Raffa GM, Malvindi PG, Kowalkowska ME, Zaborowska K, Kowalewski J, Tarelli G, Taggart DP and Anisimowicz L. Safety and efficacy of miniaturized extracorporeal circulation when compared with off-pump and conventional coronary artery bypass grafting: evidence synthesis from a comprehensive Bayesian-framework network meta-analysis of 134 randomized controlled trials involving 22 778 patients. Eur J Cardiothorac Surg 2016; 49: 1428-1440.

[9] Martínez-González B, Reyes-Hernández CG, Quiroga-Garza A, Rodríguez-Rodríguez VE, Esparza-Hernández CN, Elizondo-Omaña RE and Guzmán-López S. Conduits used in coronary artery bypass grafting: a review of morphological studies. Ann Thorac Cardiovasc Surg 2017; 23: 55-65.

[10] Valaker I, Norekval TM, Raholm MB, Nordrehaug JE, Rotevatn S and Fridlund B; CONCARD Investigators. Continuity of care after percutaneous coronary intervention: the patient's perspective across secondary and primary care settings. Eur J Cardiovasc Nurs 2017; 16: 444-452.

[11] Shroff A, Kupfer J, Gilchrist IC, Caputo R, Speiser B, Bertrand OF, Pancholy SB and Rao SV. Same-day discharge after percutaneous coronary intervention: current perspectives and strategies for implementation. JAMA Cardiol 2016; 1: 216-23.

[12] Eleuteri E, Di Stefano A, Giordano A, Corra U, Tarro Genta F, Gnemmi I and Giannuzzi P. Prognostic value of angiopoietin-2 in patients with chronic heart failure. Int J Cardiol 2016; 212: 364-368.

[13] Khan AR, Golwala H, Tripathi A, Riaz H, Kumar A, Flaherty MP and Bhatt DL. Meta-analysis of percutaneous coronary intervention versus coronary artery bypass grafting in left main coronary artery disease. Am J Cardiol 2017; 119: 1949-1956.

[14] Lassen J. Percutaneous coronary intervention for coronary bifurcation disease: consensus from the first 10 years of the European Bifurcation Club meetings. EuroIntervention 2016; 12: 38-46.

[15] Shavadia J, Norris CM, Graham MM, Verma S, Ali I and Bainey KR. Symptomatic graft failure and impact on clinical outcome after coronary artery bypass grafting surgery: results from the alberta provincial project for outcome assessment in coronary heart disease registry. Am Heart J 2015; 169: 833-840.

[16] SCOT-HEART investigators. CT coronary angiography in patients with suspected angina due to coronary heart disease (SCOT-HEART): an open-label, parallel-group, multicentre trial. Lancet 2015; 385: 2383-2391.

[17] Deckers K, Schievink SHJ, Rodriquez MMF, van Oostenbrugge RJ, van Boxtel MPJ, Verhey FRJ and Köhler S. Coronary heart disease and risk for cognitive impairment or dementia: systematic review and meta-analysis. PLoS One 2017; 12: e0184244.

[18] Chen R, Xiao Y, Chen M, He J, Huang M, Hong X, Liu X, Fu T, Zhang J and Chen L. A traditional chinese medicine therapy for coronary heart disease after percutaneous coronary intervention: a meta-analysis of randomized, double-blind, placebo-controlled trials. Biosci Rep 2018; 38: BSR20180973.

[19] Tang Y, Ke ZP, Peng YG and Cai PT. Co-expression analysis reveals key gene modules and pathway of human coronary heart disease. J Cell Biochem 2018; 119: 2102-2109.

[20] Ji X, Yang Z, Li C, Jia E, Xu Z, Sheng Z, Cao K and Ma W. The changes of Hs-CRP and WBC count after percutaneous coronary intervention in different types of coronary heart diseases. The Journal of Biomedical Research 2008; 22: 246-249.

[21] Pang Z, Zhao W and Yao Z. Cardioprotective effects of nicorandil on coronary heart disease patients undergoing elective percutaneous coronary intervention. Med Sci Monit 2017; 23: 2924-2930.

[22] Ursulescu A, Baumann P, Ferrer MT, Contino M, Romagnoni C, Antona C and Padró Fernández JM. Optilene, a new non-absorbable monofilament is safe and effective for CABG anastomosis. OPTICABG - a prospective international, multi-centric, cohort study. Ann Med Surg (Lond) 2018; 35: 13-19.

[23] Meng Y, Zong L, Zhang Z, Han Y and Wang Y. Evaluation of changes in left ventricular structure and function in hypertensive patients with coronary artery disease after PCI using real-time three-dimensional echocardiography. Exp Ther Med 2018; 15: 1493-1499.

[24] Lyu T, Zhao Y, Zhang T, Zhou W, Yang F, He Q, Yuan A, Yao T, Pu J and He B. Effect of statin pretreatment on myocardial perfusion in patients undergoing primary percutaneous coronary intervention: a systematic review and meta-analysis. Clin Cardiol 2013; 36: E17-24.

[25] Spadaccio C and Benedetto U. Coronary artery bypass grafting (CABG) vs. percutaneous coronary intervention (PCI) in the treatment of mul-

tivessel coronary disease: quo vadis? -a review of the evidences on coronary artery disease. Ann Cardiothorac Surg 2018; 7: 506-515.

[26] Sá MPBO, Soares AF, Miranda RGA, Araújo ML, Menezes AM, Silva FPV and Lima RC. CABG surgery remains the best option for patients with left main coronary disease in comparison with PCI-DES: meta-analysis of randomized controlled trials. Braz J Cardiovasc Surg 2017; 32: 408-416.

[27] Bonaccio M, Di Castelnuovo A, Costanzo S, Persichillo M, De Curtis A, Cerletti C, Donati MB, de Gaetano G and Iacoviello L; MOLI-SANI Study Investigators. Health-related quality of life and risk of composite coronary heart disease and cerebrovascular events in the Moli-sani study cohort. Eur J Prev Cardiol 2018; 25: 287-297.