ISSN 2307-8960 (online)

World Journal of *Clinical Cases*

World J Clin Cases 2024 January 16; 12(2): 236-465

Published by Baishideng Publishing Group Inc

W J C C

World Journal of
Clinical Cases

Contents

Thrice Monthly Volume 12 Number 2 January 16, 2024

Contents

World Journal of Clinical Cases

Thrice Monthly Volume 12 Number 2 January 16, 2024

World Journal of Clinical Cases

Thrice Monthly Volume 12 Number 2 January 16, 2024

Contents

ABOUT COVER

Editorial Board Member of *World Journal of Clinical Cases*, Xin Ye, MD, Professor, Department of Oncology, The First Affiliated Hospital of Shandong First Medical University, Jinan 250014, Shandong Province, China. yexintaian2020@163.com

AIMS AND SCOPE

The primary aim of *World Journal of Clinical Cases* (*WJCC*, *World J Clin Cases*) is to provide scholars and readers from various fields of clinical medicine with a platform to publish high-quality clinical research articles and communicate their research findings online.

WJCC mainly publishes articles reporting research results and findings obtained in the field of clinical medicine and covering a wide range of topics, including case control studies, retrospective cohort studies, retrospective studies, clinical trials studies, observational studies, prospective studies, randomized controlled trials, randomized clinical trials, systematic reviews, meta-analysis, and case reports.

INDEXING/ABSTRACTING

The *WJCC* is now abstracted and indexed in Science Citation Index Expanded (SCIE, also known as SciSearch®), Journal Citation Reports/Science Edition, Current Contents®/Clinical Medicine, PubMed, PubMed Central, Reference Citation Analysis, China Science and Technology Journal Database, and Superstar Journals Database. The 2023 Edition of Journal Citation Reports® cites the 2022 impact factor (IF) for *WJCC* as 1.1; IF without journal self cites: 1.1; 5-year IF: 1.3; Journal Citation Indicator: 0.26; Ranking: 133 among 167 journals in medicine, general and internal; and Quartile category: Q4.

RESPONSIBLE EDITORS FOR THIS ISSUE

Production Editor: *Hua-Ge Yu*; **Production Department Director:** *Xu Guo*; **Editorial Office Director:** *Jin-Lei Wang*.

NAME OF JOURNAL
World Journal of Clinical Cases

ISSN
ISSN 2307-8960 (online)

LAUNCH DATE
April 16, 2013

FREQUENCY
Thrice Monthly

EDITORS-IN-CHIEF
Bao-Gan Peng, Salim Surani, Jerzy Tadeusz Chudek, George Kontogeorgos, Maurizio Serati

EDITORIAL BOARD MEMBERS
https://www.wjgnet.com/2307-8960/editorialboard.htm

PUBLICATION DATE
January 16, 2024

INSTRUCTIONS TO AUTHORS
https://www.wjgnet.com/bpg/gerinfo/204

GUIDELINES FOR ETHICS DOCUMENTS
https://www.wjgnet.com/bpg/GerInfo/287

GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH
https://www.wjgnet.com/bpg/gerinfo/240

PUBLICATION ETHICS
https://www.wjgnet.com/bpg/GerInfo/288

PUBLICATION MISCONDUCT
https://www.wjgnet.com/bpg/gerinfo/208

ARTICLE PROCESSING CHARGE
https://www.wjgnet.com/bpg/gerinfo/242

STEPS FOR SUBMITTING MANUSCRIPTS
https://www.wjgnet.com/bpg/GerInfo/239

ONLINE SUBMISSION
https://www.f6publishing.com

World Journal of Clinical Cases

Submit a Manuscript: https://www.f6publishing.com

World J Clin Cases 2024 January 16; 12(2): 256-266

DOI: 10.12998/wjcc.v12.i2.256

ISSN 2307-8960 (online)

ORIGINAL ARTICLE

Retrospective Study

Exploration of cardiac rehabilitation nursing for elderly patients with myocardial infarction based on individualized cardiac rehabilitation

Hua-Ning Liu, Bo Gao

Specialty type: Medicine, research and experimental

Provenance and peer review: Unsolicited article; Externally peer reviewed.

Peer-review model: Single blind

Peer-review report's scientific quality classification

Grade A (Excellent): 0
Grade B (Very good): 0
Grade C (Good): C
Grade D (Fair): 0
Grade E (Poor): 0

P-Reviewer: Chiu HW, Taiwan

Received: November 7, 2023
Peer-review started: November 7, 2023
First decision: November 16, 2023
Revised: November 24, 2023
Accepted: December 25, 2023
Article in press: December 25, 2023
Published online: January 16, 2024

Hua-Ning Liu, Department of Geriatrics, General Hospital of the YangTze River Shipping, Wuhan Brain Hospital, Wuhan 430015, Hubei Province, China

Bo Gao, Department of Cardiology, Suizhou Central Hospital, Affiliated Hospital of Hubei University of Medicine, Suizhou 441300, Hubei Province, China

Corresponding author: Hua-Ning Liu, Department of Geriatrics, General Hospital of the YangTze River Shipping, Wuhan Brain Hospital, No. 5 Huiji Road, Jiangan District, Wuhan 430015, Hubei Province, China. bigliu007@hotmail.com

Abstract

BACKGROUND
Myocardial infarction is a high-risk condition prevalent among the elderly population, often leading to adverse clinical manifestations such as reduced cardiopulmonary function, anxiety, and depression post-surgery. Consequently, cardiac rehabilitation holds immense importance in mitigating these complications.

AIM
To evaluate the effect of individualized cardiac rehabilitation on blood pressure variability (BPV) and baroreflex sensitivity (BRS) in elderly patients with myocardial infarction.

METHODS
A cohort of 74 elderly patients diagnosed with myocardial infarction and admitted to our hospital between January 2021 and January 2022 were subjected to random selection. Subsequently, all patients were divided into two groups, namely the research group (n = 37) and the control group (n = 37), utilizing the number table method. The control group received conventional drug treatment and nursing guidance intervention, while the study group underwent individualized cardiac rehabilitation in addition to the interventions received by the control group. All patients were continuously intervened for 12 wk, and the BPV of these two groups in the 1st wk (T0), the 4th wk (T1) and the 12th wk (T2) were compared, BRS, changes in cardiopulmonary function measures, and adverse cardiovascular events.

RESULTS
Of 24 h diastolic BPV, 24 h systolic BPV, carbon dioxide ventilation equivalent slope of the research group were lower than those of the control group at T1 and

T2, BRS, peak heart rate and systolic blood pressure product, 1 min heart rate recovery were higher than those of the control group, and the incidence of adverse events in the research group was lower than that of the control group, the difference was statistically significant ($P < 0.05$).

CONCLUSION

In this study, we found that after individualized cardiac rehabilitation in elderly patients with myocardial infarction, BPV and BRS can be effectively improved, cardiac function is significantly enhanced, and a better prognosis is obtained.

Key Words: Individualized cardiac rehabilitation; Myocardial infarction; Variability in blood pressure; Baroreflex sensitivity

Core Tip: Myocardial infarction is a high-risk disease in the elderly, and reasonable cardiac rehabilitation nursing measures are extremely important. This paper aims to evaluate the effect of individualized cardiac rehabilitation on blood pressure variability (BPV) and baroreflex sensitivity (BRS) in elderly patients with myocardial infarction. Through randomized controlled trials and individualized cardiac rehabilitation, it was found that after individualized cardiac rehabilitation treatment, the BPV and BRS of elderly patients with myocardial infarction could be effectively improved, the cardiac function was significantly enhanced, and the prognosis was better. The results show that this nursing mode has important clinical nursing value.

Citation: Liu HN, Gao B. Exploration of cardiac rehabilitation nursing for elderly patients with myocardial infarction based on individualized cardiac rehabilitation. *World J Clin Cases* 2024; 12(2): 256-266

URL: https://www.wjgnet.com/2307-8960/full/v12/i2/256.htm

DOI: https://dx.doi.org/10.12998/wjcc.v12.i2.256

INTRODUCTION

Myocardial infarction refers to an acute condition in which the coronary arteries were blocked, the heart muscle ischemia had been caused necrosis, and the cardiac function was impaired. According to the 2021 Cardiovascular Health and Disease Report of China[1], the mortality rate of acute myocardial infarction in the urban areas of China from 2002 to 2018 increased from 16.46/100000 to 62.33/100000. In addition, the mortality rate in this realm of China has been increased year by year. It is important to explore the more effective intervention options for myocardial infarction. At present, the commonly used treatment options for patients with myocardial infarction include the drug treatment, surgical treatment and other programs. Drug therapy and surgery can exert good therapeutic effects, but there are obvious side effects of drug treatment[2], while the surgical treatment such as percutaneous coronary implantation (PCI) is expensive and unaffordable. In further situation, some patients will have the decreased cardiopulmonary function, anxiety and depression after this kind of surgery, which affects the patients' life quality pretty much[3]. In recent years, the cardiac rehabilitation has gradually entered the field of clinicians' research and the concerns of patients' treatment.

The main contents of individualized cardiac rehabilitation include the comprehensive use of a variety of clinical strategies to help patients recover body functions under the premise of determining the patient's cardiopulmonary function, including the assessment of health status, the guiding training of exercise intensity and exercise mode, the guidance of diet and lifestyle, as well as the improvement of patients' compliance, making them to take drugs and to monitor their various health indicators in a regular manner. According to above methods, they can enhance the patient's quality of life, strengthen the patient's psychological state, make them back to the normal social life, and effectively prevent the recurrence of various cardiovascular events[4]. The core of cardiac rehabilitation is aerobic exercise, which is performed according to an individualized exercise program when implementing cardiac rehabilitation exercise prescriptions[5]. Previous studies have shown that cardiac rehabilitation exercises are of great help in improving myocardial blood perfusion and enhancing cardiac function[6].

Blood pressure variability (BPV) is considered a new risk factor for cardiovascular disease. Previous studies have found that BPV will be a new independent risk factor for coronary atherosclerotic heart disease (coronary heart disease), myocardial infarction, stroke, heart failure, and all-cause mortality[7]. Systolic BPV (SBPV) has also been associated with the incidence of all-cause mortality, coronary heart disease, and stroke in numerous observational studies[8]; in addition, SBPV has shown that SBPV is an independent predictor factor of all-cause mortality, cardiovascular incidence, cardiovascular mortality, coronary heart disease, and stroke[9]. Recently, Soh *et al*[10] demonstrated that after the percutaneous coronary intervention (PCI) in patients with acute ST-segment elevation myocardial infarction (STEMI), interclinic SBPV is associated with an increased incidence of adverse clinical outcomes in patients with PCI after STEMI. Baroreflex sensitivity (BRS) is an important indicator of quantitative assessment of autonomic function, which can objectively reflect the cardiac vagal regulation caused by increased blood pressure[11]. A large number of previous studies have found that BRS is closely related to the risk of cardiovascular and the cerebrovascular events and the mortality in patients[12,13]. Based on this, this study aimed to investigate the effect of individualized cardiac rehabilitation on BPV and BRS when applied to elderly patients with myocardial infarction.

MATERIALS AND METHODS

Study population

In this single-center and randomized controlled trial (RCT), we randomly selected 74 patients with myocardial infarction admitted to our hospital from January 2021 to January 2022. Inclusion criteria: (1) Met the relevant diagnostic criteria for myocardial infarction[14]; (2) The stable condition, clear consciousness, walking easily; and (3) Age ≥ 60 years. Exclusion criteria: (1) The acute left heart failure, acute exacerbation of chronic cardiac insufficiency, the killip class in 3-4 of cardiac function, congenital heart disease, hypertrophic cardiomyopathy, restrictive cardiomyopathy, vasculitis, dilated cardiomyopathy, acute myocarditis, aortic syndrome, acute pulmonary embolism, hypertension grade 3 very high-risk group blood pressure higher than 200/100 mmHg; (2) Other arrhythmias such as atrial fibrillation, atrial premature beat, atrioventricular block, ventricular arrhythmias; (3) The diseases of the musculoskeletal system such as joints and spine; and (4) Myocardial infarction with cerebral infarction, uremia, acute gastrointestinal bleeding, acute chronic obstructive pulmonary disease, pneumothorax, poor compliance or psychiatric disorders. This study was approved by the hospital's ethics committee, and patient-level family members gave informed consent.

Rehabilitation program

The control group was given the conventional medical treatment (aspirin enteric-coated tablets, clopidogrel tablets or ticagrelor tablets, atorvastatin calcium tablets or rosuvastatin calcium tablets, metoprolol sustained-release tablets, benazepril tablets, or perindopril tablets), and during the hospitalization observation period, the routine exercise guided by the routine nursing interventions, such as walking accompanied by others, *etc.* On the basis of the control group, the research group completed the 6-min walking test, and the exercise plate test within the first week of hospitalization, measured the maximum target heart rate and exercise tolerance, and formulated an individualized exercise prescription that accurately meets the actual situation of the patient according to the above data: (1) Exercise form: Warm up for 10 min to brisk walking (4-6 km/h) for 20-30 min, relax for 5-10 min; (2) Exercise intensity: Heart rate is kept within the target heart rate range; the self-feeling is subtly harder; and (3) Exercise frequency: At least once every other day. The patient's exercise intensity is measured by the target heart rate law, that is, the heart rate during exercise is 60%-80% of the maximum target heart rate, and the heart rate control requirements of the oral β blockers can be lower than that of those without oral β blockers. What should be paid attention to when implementing the exercise of cardiac rehabilitation: Patients should carry the heart rate oximeters, wear sports bracelets or sports watches, and dynamically monitor their heart rate at any time; carrying a record of their name and address, family number, name of their illness, and first-aid medicines such as nitrates (such as nitroglycerin tablets). If chest tightness, chest pain and other symptoms occur during exercise, stop exercising immediately, and take nitroglycerin tablets under the tongue, and tell the family in time to avoid accidents.

Evaluation methods

BPV: Spacelabs90217 ambulatory blood pressure monitor was used to monitor the blood pressure level of the control group before and after treatment the next day and the AMI group. The daytime detection time is 08:00-22:00, the night detection time is 22:00-08:00, blood pressure is measured and recorded once every half hour, BPV is calculated as the standard deviation of systolic or diastolic blood pressure, and the diastolic BPV (24DBPSD) and 24 h SBPV (24SBPSD) of each group are counted.

BRS: The machine used to measure the BRS in this study is the continuous finger pulse pressure measuring instrument (Finometer, Finapres Medical systems, Netherlands). The patient did not take tea, coffee or other irritating food and beverages on the day of the examination, did not smoke 30 minutes before the examination, and emptied the bladder. The research subject laying quietly and flat, being measured the circumference of the second knuckle of the middle finger of the right hand with a special soft ruler, selecting a special pressure-sensing finger sleeve that matched it, wearing a cuff 1-2 cm on the elbow socket of the right arm to detect blood pressure, and connecting the finger sleeve and sleeving with the signal receiving end. Preheating and stepping up the machine and entering the patient's personal information, including age, gender, height, weight, *etc.* Starting the measurement when all prepares are readied, firstly performing the physiological correction, and measuring the blood pressure of the right upper extremity twice, and correcting the finger pulse signal simulated blood pressure. After the pulse wave is stable and the physiological correction is completed (about 10 min), the detection will be officially started. Taking the supine position, instructing the patient to breathe calmly, avoiding severe coughing, moving or loud specking, and continuously collecting information for 5 min. The built-in analysis software (Beatscope) was used to derive continuous systolic blood pressure, diastolic blood pressure, heart rate, and calculating the BRS in the lying position, taking the above average.

Cardiopulmonary function indicators: After the start of intervention, T0, T1 and T2 were subjected to the cardiopulmonary exercise test in these two groups, and the changes of the peak heart rate and systolic blood pressure product (peak RPP), the 1 min heart rate recovery (HRR1), and the carbon dioxide ventilation equivalent slope (VE/V_{CO2} slope) were collected and compared. The process of cardiopulmonary exercise test: The exercise cardiopulmonary function test instrument produced by the Italian company COSMED is used to implement it with the help of power bicycles. Patients were smoke-free, liquor, tea and coffee 12 h before the test. Before testing, the gas flow, capacity and concentration are calibrated. The patient takes the riding position and adjusts the seat height. Connecting a 12-lead ECG, blood pressure monitor, and finger oximeter, wearing a mask, and checking that there are no air leaks before connecting to the gas analysis system. According to the individualized indicators of patients, a ramp-type power ramp test (Ramp) protocol of 10-20 W/min was selected. First resting for 3 min, then pedaling at 60 ± 5 r/min zero load for 3 min, continue to exercise at this speed, during which the treadmill power increases rampantly at a speed of 10-20 W/min, until any of the indications for termination of symptomatic restrictive exercise test are reached, then the exercise load is unloaded.

Adverse cardiovascular events: After the patients were discharged from the hospital after the intervention, these two groups of patients were followed up for six months, and the adverse cardiovascular events such as arrhythmia, angina pectoris, and myocardial infarction were statistically counted, and the incidence differences between these two groups were compared.

Statistical analysis

SPSS22.0 statistical software was used to analyze and process the collected data. The measurement data were confirmed to conform to the homogeneity of variance and approximately obey the normal distribution after the homogeneity test and normality test, expressed by the mean ± SD, *t*-test and repeated measurement design ANOVA, counting data expressed as percentages, χ^2 test and rank sum test, and the difference was statistically significant in $P < 0.05$.

RESULTS

Baseline demographics and clinical characteristics

A total of 74 elderly patients with myocardial infarction were included in this study. Among them, the average age is 68.64 ± 7.36 years old, the average body mass index body mass index (BMI) is 24.52 ± 2.03 kg/m², and the average Gensini score is (55.95 ± 3.41) points. There are 60.81% men, 39.19% women, and 67.56% patients There was a history of smoking in the past, 74.32% of the patients underwent PCI, 45.94% of the patients were complicated with hypertension, 29.72% of the patients were complicated with diabetes, 78.37% of the patients had previously used β-blockers, and 33.78% of the patients had previously used diuretics. 70.27% of the patients used ACEI drugs in the past, and 6.75% of the patients used CCB drugs in the past. In addition, 74.32% of the patients were Killip classI, and 25.68% of the patients were Killip class II.

Compared with the control group, there were no significant differences in age, gender, BMI, smoking history, PCI, hypertension, diabetes, the Killip classification, the Gensini score, and medication history in the research group ($P > 0.05$) (Table 1).

BPV variations

The differences in the inter-group comparison and the time comparison of 24DBPSD and 24SBPSD between these two groups were statistically significant ($P < 0.05$), while the differences in their interactive comparison of inter-groups*time between these two groups were not statistically significant ($P > 0.05$). Compared 24DBPSD and 24SBPSD at T0 in these two groups, there were no significant difference ($P > 0.05$). When T1 and T2, 24DBPSD and 24SBPSD were lower than those when T0 in the same group, the difference was statistically significant ($P < 0.05$). When 24DBPSD and 24SBPSD at T1 and T2 of the research group were lower than those of the control group, and the differences were statistically significant ($P < 0.05$) (Table 2, Figure 1).

BRS variations

The differences between the inter-group comparison of BRS and the time comparison of BRS in these two groups were statistically significant ($P < 0.05$), while the differences between the interactive comparison of inter-group and time in these groups was not statistically significant ($P > 0.05$). There was no significant difference in the comparison of BRS between these two groups at T0 ($P > 0.05$). The BRS at T1 and T2 in these two groups were higher than the BRS at T0 in the same group, and the difference was statistically significant ($P < 0.05$). BRS in T1 and T2 were higher than those in the control group, and the difference was statistically significant ($P < 0.05$) (Table 3, Figure 2).

Changes in cardiopulmonary function indicators

The differences in the inter-group comparison and the time comparison of peak RPP, HRR1, VE/VCO_2 slope in these two groups were statistically significant ($P < 0.05$) but the interactive comparison of inter-group and time in these elements of these two groups were not statistically significant ($P > 0.05$). Compared with peak RPP, HRR1 and VE/VCO_2 slope at T0, there was no significant difference between these two groups ($P > 0.05$). The difference was statistically significant when peak RPP and HRR1 were higher than those in the same group at T0, but VE/VCO_2 slope were lower than those in the same group at T0, in both groups at T1 and T2 ($P < 0.05$). The peak RPP and HRR1 were higher in the study group than those in the control group at T1 and T2, and VE/VCO_2 slope were lower than those in the control group, and the difference was statistically significant ($P < 0.05$) (Table 4, Figure 3).

Adverse cardiovascular events

The follow-up results showed that the incidence of adverse events such as angina, arrhythmia, and reinfarction in the study group was 5.40% (2/37), and the incidence of adverse event in the control group was 27.02% (10/37), and the

Table 1 Baseline demographic data and clinical characteristics [*n* (%), mean ± SD]

Item	Research group (*n* = 37)	Control group (*n* = 37)	$t/\chi^2/Z$	*P* value
Age (yr)	68.36 ± 7.19	68.92 ± 7.62	0.325	0.746
Gender			0.056	0.811
Man	22 (59.46)	23 (62.16)		
Woman	15 (40.54)	14 (37.84)		
BMI (kg/m²)	24.69 ± 2.12	24.35 ± 1.94	0.719	0.474
Smoking history	26 (70.27)	24 (29.73)	0.246	0.619
The PCI surgery	27 (72.97)	28 (75.67)	0.070	0.790
Complication				
Hypertension	18 (48.65)	16 (43.24)	0.217	0.640
Diabetes	10 (27.02)	12 (32.43)	0.258	0.610
The Killip classification				
The I class	28 (75.67)	27 (72.97)	0.235	0.797
The II class	9 (24.32)	10 (27.02)		
The Gensini score	55.75 ± 3.82	56.16 ± 2.99	0.514	0.608
Medication history				
β-blockers	28 (75.67)	30 (81.08)	0.318	0.572
Diuretic	12 (32.43)	13 (35.13)	0.060	0.805
ACEI	25 (67.56)	27 (72.97)	0.258	0.610
CCB	2 (5.40)	3 (8.10)	0.214	0.643

BMI: Body mass index; PCI: Percutaneous coronary intervention; ACEI: Angiotension converting enzyme inhibitors; CCB: Calcium channel blockers.

Table 2 The blood pressure variability variations (mean ± SD)

Item	Time	Research group (*n* = 37)	Control group (*n* = 37)	*F/P* value[1]	*F/P* value[2]	*F/P* value[3]
24DBPSD	T0	8.45 ± 0.62	8.57 ± 0.43	6.592/0.010	50.410/< 0.001	0.039/0.961
	T1	8.02 ± 0.23[a,b]	8.14 ± 0.25[b]			
	T2	7.83 ± 0.31[a,b]	7.98 ± 0.27[b]			
24SBPSD	T0	11.56 ± 1.05	11.74 ± 1.11	6.232/0.013	28.710/< 0.001	0.184/0.831
	T1	11.02 ± 0.79[a,b]	11.35 ± 0.58[b]			
	T2	10.48 ± 0.61[a,b]	10.79 ± 0.57[b]			

[a]$P < 0.05$, compared with the control group.
[b]$P < 0.05$, compared with T0.
[1]The inter-group comparison.
[2]The time comparison.
[3]The interactive comparison between inter-group time.
24DBPSD: 24 h diastolic blood pressure variability; 24SBPSD: 24 h systolic blood pressure variability.

incidence of adverse event in the study group was lower than that in the control group, and the difference was statistically significant ($\chi^2 = 6.365$, $P = 0.011$) (Figure 4).

DISCUSSION

In this study, when the research group T1 and T2, 24DBPSD, 24SBPSD and VE/VCO_2 slope were lower than those in the control group. BRS, peak RPP and HRR1 were higher than those in the control group, and the incidence of adverse event

Table 3 The baroreflex sensitivity variation (mean ± SD, ms/mmHg)

Group	*n*	T0	T1	T2
Research group	37	4.38 ± 2.24	7.04 ± 2.56[a,b]	8.02 ± 3.54[a,b]
Control group	37	4.51 ± 2.32	5.82 ± 2.47[b]	6.12 ± 3.87[b]
F/P value[1]		6.542/0.011		
F/P value[2]		16.450/< 0.001		
F/P value[3]		2.344/0.098		

[a]*P*< 0.05, compared with the control group.
[b]*P* < 0.05, compared with T0.
[1]The inter-group comparison.
[2]The time comparison
[3]The interactive comparison between inter-group time.

Table 4 The changes in cardiopulmonary function indicators (mean ± SD)

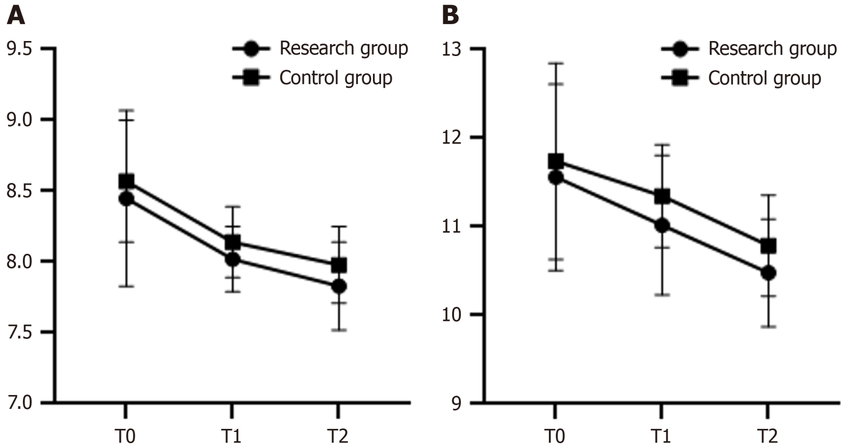
Item	Time	Research group (*n* = 37)	Control group (*n* = 37)	*F/P* value[1]	*F/P* value[2]	*F/P* value[3]
Peak RPP (beat mmHg/100)	T0	151.36 ± 31.74	151.53 ± 30.39	5.482/0.020	6.732/0.001	1.512/0.223
	T1	165.53 ± 24.67[a,b]	154.96 ± 20.43			
	T2	174.07 ± 25.92[a,b]	160.02 ± 20.15[b]			
HRR1 (beat/min)	T0	13.02 ± 3.18	13.11 ± 3.46	7.079/0.008	15.040/< 0.001	1.964/0.142
	T1	16.74 ± 5.45[a,b]	14.19 ± 5.25			
	T2	18.68 ± 5.37[a,b]	16.03 ± 5.32			
VE/VCO_2 slope	T0	31.21 ± 3.88	31.34 ± 3.52	10.110/0.001	30.900/< 0.001	2.369/0.096
	T1	28.44 ± 3.76[a,b]	30.27 ± 3.05			
	T2	25.29 ± 3.38[a,b]	27.96 ± 4.02[b]			

[a]*P* < 0.05, compared with the control group.
[b]*P* < 0.05, compared with T0.
[1]The inter-group comparison.
[2]The time comparison.
[3]The interactive comparison between inter-group time.
Peak RPP: Peak heart rate and systolic blood pressure product; HRR1: 1 min heart rate recovery; VE/VCO_2 slope: Carbon dioxide ventilation equivalent slope.

in the research group were lower than those in the control group, and the difference was statistically significant ($P < 0.05$). This shows that individualized cardiac rehabilitation can effectively improve BPV and BRS in elderly patients with myocardial infarction, enhance cardiac function and improve prognosis.

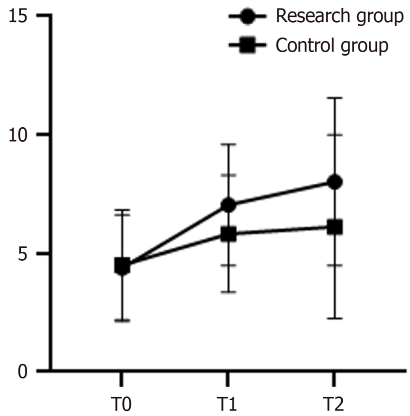
The post-myocardial infarction cardiac autonomic dysfunction is closely related to the occurrence of sudden cardiac death[15], manifested by increased sympathetic activity, decreased ventricular fibrillation value, decreased vagus nerve activity, and weakened protective effect on the heart, resulting in malignant ventricular arrhythmias, accounting for about 50% of patients who died early after myocardial infarction[16]. In addition, increased vagal tone in the heart can cause hyperpolarization of pacing cells and a slowdown in the rate of automatic depolarization, resulting in a decrease in heart rate. In experimental animals[17], stimulation of the vagus nerve elicits a short delay (approximately 150 ms) in cardiac chronotropic response. When sympathetic tension increases, the norepinephrine released by nerve endings acts on each ion channel, increasing the automatic depolarization rate of pacing cells during diastolic and accelerating the heart rate. The heart rate responds to changes in sympathetic tone with a long delay (about 1-2 s) and reaches a steady state about 30-60 s after the change. As a result, the heart responds much more rapidly to the vagus nerve, and the heart rate changing effect of the baroreflex is primarily mediated by the vagus nerve[18]. Studies in normal people have shown that the time difference from elevated arterial pressure to reflex bradycardia is approximately 475 ms, *i.e.*, adjustment can be completed in one cardiac cycle[19]. In some pathological states, the mechanism of baroreflex is abnormal, impairing its tensile effect on cardiovascular regulation, resulting in increased sympathetic tone and decreased vagal tone.

BPV refers to the degree to which blood pressure fluctuates over a certain period of time. BPV has been strongly associated with adverse cardiovascular outcomes in the literature[20,21]. Potential mechanisms may include: First, increased BPV may be associated with stiffness and decreased compliance of large arteries; second, sympathetic activity is



DOI: 10.12998/wjcc.v12.i2.256

Figure 1 The blood pressure variability variations. A: 24 h diastolic blood pressure variability; B: 24 h systolic blood pressure variability.



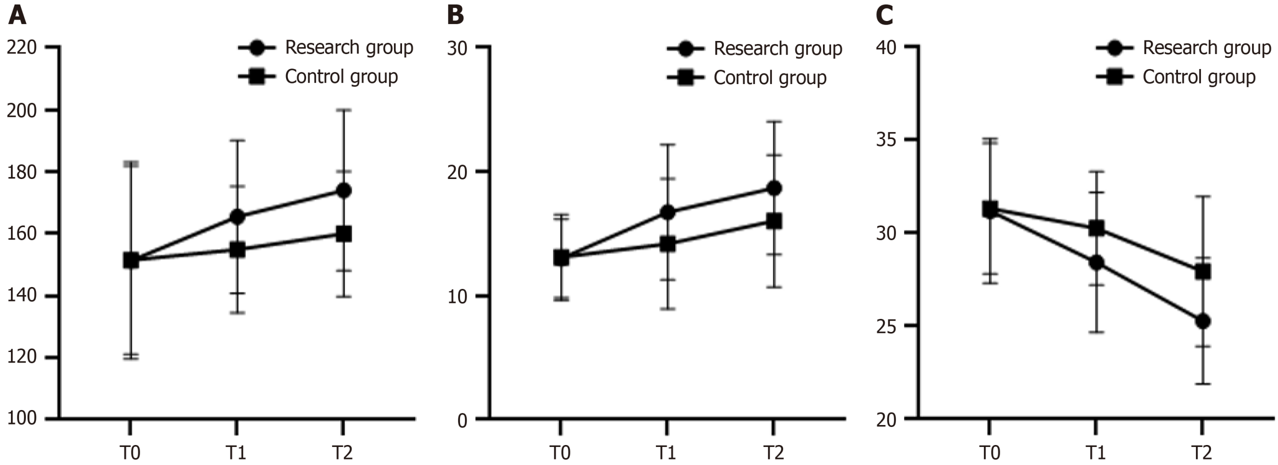
DOI: 10.12998/wjcc.v12.i2.256

Figure 2 The baroreflex sensitivity variations.

associated with BPV, and may be a determinant of BPV. The temporary instability in blood pressure may reflect the increased sympathetic activity with increased vascular risk; third, limited animal experimental data suggest that increased BPV leads to endothelial damage, activation of the renal angiotensin system, and accelerated apoptosis of cardiomyocytes, leading to end-organ damage.

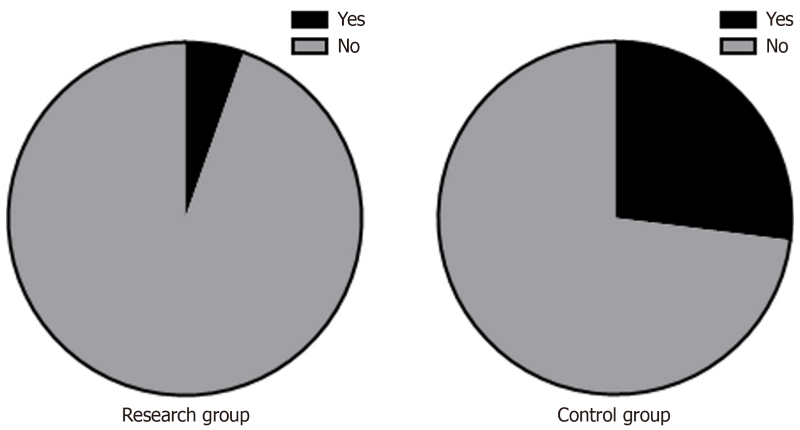
BRS, on the other hand, reflects the balance of autonomic nerves. Decreased BRS indicates a loss of sympathetic vagus balance and decreased vagus modulation. Experiments by Cerati and Schwartz[22] demonstrated that BRS can quantitatively reflect the regulatory ability of the vagus nerve of the heart. They made an acute experimental myocardial ischemia in cats to record the activity of a single vagus nerve fiber in their heart. Of the 17 cats, 9 developed ventricular fibrillation during myocardial ischemia and 8 did not. Benfrine injection increased blood pressure, causing an increase in reflex cardiac vagal nerve impulses, and the number of increases in the non-ventricular fibrillation group was signi-ficantly higher than those in the ventricular fibrillation group (+246+/66% *vs* +80+/14%, $P < 0.025$). In other studies, both in patients with congestive heart failure[23] and in animal models[24], significant reductions in BRS were accompanied by increased sympathetic activity in the vascular bed innervating skeletal muscle or increased norepinephrine spillover (representing renal sympathetic activity), suggesting that in some cases, BRS also reflects the sympathetic activity.

Cardiac rehabilitation exercise therapy is to improve lifestyle, by appropriate activities and exercise, especially moderate intensity aerobic exercise, to reduce, eliminate and improve the adverse effects of absolute bed rest, in order for patients to recover their physical health faster and better, while receiving the five major prescriptions to improve patients' awareness of the disease, reasonable arrangement of nutritional combination, avoid staying up late overwork, improve psychological quality, in order to get a real sense of rehabilitation[25]. In this study, individualized cardiac rehabilitation can significantly improve BPV and BRS, and its pathophysiology may be based on: When patients have coronary artery occlusion or stenosis, myocardial cells will be ischemic and hypoxic, cardiomyocyte necrosis and apoptosis in a short period of time, vagus nerve and sympathetic nerve can't get normal nutrient supply, regulatory function is correspondingly impaired, and the risk of malignant arrhythmias and sudden cardiac death will increase. Numerous studies have shown that cardiac rehabilitation exercises can improve cardiovascular endothelial function, increase coronary collateral circulation, increase coronary perfusion, and improve exercise tolerance in patients[26,27]. The ischemia and hypoxia of cardiomyocytes are significantly improved, which enhances the activity of cardiac autonomic regulation, helps



DOI: 10.12998/wjcc.v12.i2.256

Figure 3 The changes in cardiopulmonary function indicators. A: Peak heart rate and systolic blood pressure product; B: 1 min heart rate recovery; C: Carbon dioxide ventilation equivalent slope.



DOI: 10.12998/wjcc.v12.i2.256

Figure 4 Incidence rate of adverse events after treatment.

to promote the recovery of cardiac function, improves myocardial contractility, and increases ventricular diastolic filling.

Grässler *et al*[28] found that exercise can increase heart rate variability in older adults. Other studies have found that heart rate variability indexes were significantly increased in the group of patients with coronary heart disease who had physical activity habits[29]. In a six-year RCT study of middle-aged adults, routine light to moderate-intensity exercise improved autonomic function[30]. Exercise can reflexively increase the activity of the cerebral cortex and hypothalamus, make the sympathetic nerve and vagus nerve in a higher state of equilibrium, strengthen the regulatory effect of autonomic nerves on cardiac function, improve the myocardial ischemic state of patients with coronary heart disease, increase oxygen supply, enhance myocardial contractility, and increase cardiac output[31]. The corresponding increase of stroke volume (SV) and output per minute (CO) can increase systemic blood flow, transport more oxygen and nutrients to various organs and tissues of the body, increase oxygen utilization, and improve cardiopulmonary fitness[32]. On the other hand, the increase of SV and CO enhances coronary perfusion and promotes the cardiac autonomic regulatory[33]. Cardiac rehabilitation exercises improve the patient's cardiopulmonary function, and regulate the balance state of the sympathetic and vagus nerves by improving the patient's exercise tolerance, thereby restoring normal heart rate oscillation function and reducing the incidence of malignant arrhythmias and sudden cardiac death[34].

There are some limitations in this study. The insufficient sample size of the participants included in this study and the failure to further clarify and exclude factors that may affect BPV and BRS, these may have biased the results. It is necessary to further expand the sample size, improve the research, and further analyze and discuss the research results.

CONCLUSION

In summary, individualized cardiac rehabilitation in patients with myocardial infarction can significantly improve BPV and BRS, improve cardiac function and prognostic outcomes. These results can be applied in practice to provide new therapeutic targets for clinical decision-making of myocardial infarction.

ARTICLE HIGHLIGHTS

Research background

The rapid development of medicine, such as myocardial infarction, cerebral apoplexy, severe trauma and cancer difficult severe patients can save survival, but at the same time left down different degrees of dysfunction and disability, dysfunction and disability is surgery and drugs is difficult to work, which highlights the importance of rehabilitation and rehabilitation care.

Research motivation

Individualized rehabilitation care can effectively improve the depressed mood and quality of life of elderly myocardial infarction patients.

Research objectives

This study aims to assess the impact of personalized cardiac rehabilitation on blood pressure variability and baroreflex sensitivity in geriatric patients diagnosed with myocardial infarction.

Research methods

Implement individualized cardiac rehabilitation based on routine pharmacotherapy and nursing-guided interventions.

Research results

Data on the implementation of individualized rehabilitation treatments are significantly better than usual care interventions.

Research conclusions

Myocardial infarction is a kind of high-risk disease in the elderly, so cardiac rehabilitation is of great significance.

Research perspectives

Patients who have experienced myocardial infarction may exhibit negative affective states following surgery, which can impede their progress in physical rehabilitation. Therefore, conducting research on cardiac rehabilitation holds significant importance.

ACKNOWLEDGEMENTS

I would like to express my gratitude to all those helped me during the writing of this thesis. I acknowledge the help of my colleagues, they have offered me suggestion in academic studies.

FOOTNOTES

Co-first authors: Hua-Ning Liu and Bo Gao.

Author contributions: Liu HN and Gao B designed the research, contributed new reagents/analytic tools, analyzed the data, and wrote the paper; and all authors were involved in the critical review of the results and have contributed to, read, and approved the final manuscript. Liu HN and Gao B contributed equally to this work as co-first authors equally to this work. The reasons for designating Liu HN and Gao B as co-first authors are threefold. First, the research was performed as a collaborative effort, and the designation of co-first authors authorship accurately reflects the distribution of responsibilities and burdens associated with the time and effort required to complete the study and the resultant paper. This also ensures effective communication and management of post-submission matters, ultimately enhancing the paper's quality and reliability. Second, the overall research team encompassed authors with a variety of expertise and skills from different fields, and the designation of co-first authors reflects this diversity well. This also promotes the most comprehensive and in-depth examination of the research topic, ultimately enriching readers' understanding by offering various expert perspectives. Third, Liu HN and Gao B contributed efforts of equal substance throughout the research process. The choice of these researchers as co-first authors acknowledges and respects this equal contribution, while recognizing the spirit of teamwork and collaboration of this study. In summary, we believe that designating Liu HN and Gao B as co-first authors are fitting for our manuscript as it accurately reflects our team's collaborative spirit, equal contributions, and diversity.

Institutional review board statement: This study protocol was approved by the Suizhou Central Hospital.

Informed consent statement: All the families have voluntarily participated in the study and have signed informed consent forms.

Conflict-of-interest statement: All the authors report no relevant conflicts of interest for this article.

Data sharing statement: Data generated from this investigation are available upon reasonable quest from the corresponding author.

Open-Access: This article is an open-access article that was selected by an in-house editor and fully peer-reviewed by external reviewers.

Country/Territory of origin: China

ORCID number: Hua-Ning Liu 0009-0009-0136-4037.

S-Editor: Wang JJ
L-Editor: A
P-Editor: Xu ZH

REFERENCES

1 **Writing committee of the report on cardiovascular health and diseases in China**. Report on Cardiovascular Health and Diseases in China 2021: An Updated Summary. *Biomed Environ Sci* 2022; **35**: 573-603 [PMID: 35945174 DOI: 10.3967/bes2022.079]

2 **Zhao J**, Zeng Y, Shen X. Efficacy and safety of early initiation of Sacubitril/Valsartan in patients after acute myocardial infarction: A meta-analysis. *Clin Cardiol* 2021; **44**: 1354-1359 [PMID: 34464468 DOI: 10.1002/clc.23717]

3 **Zhang JZ**, Wu HL, Chang PF, Huang KL. [Therapeutic effect of auriculotherapy with miniature bian needle on anxiety in the patients after percutaneous coronary intervention]. *Zhen Ci Yan Jiu* 2021; **46**: 880-884 [PMID: 34698464 DOI: 10.13702/j.1000-0607.200934]

4 **Zanini M**, Nery RM, de Lima JB, Buhler RP, da Silveira AD, Stein R. Effects of Different Rehabilitation Protocols in Inpatient Cardiac Rehabilitation After Coronary Artery Bypass Graft Surgery: A RANDOMIZED CLINICAL TRIAL. *J Cardiopulm Rehabil Prev* 2019; **39**: E19-E25 [PMID: 31343586 DOI: 10.1097/HCR.0000000000000431]

5 **Thomas RJ**, Beatty AL, Beckie TM, Brewer LC, Brown TM, Forman DE, Franklin BA, Keteyian SJ, Kitzman DW, Regensteiner JG, Sanderson BK, Whooley MA. Home-Based Cardiac Rehabilitation: A Scientific Statement From the American Association of Cardiovascular and Pulmonary Rehabilitation, the American Heart Association, and the American College of Cardiology. *Circulation* 2019; **140**: e69-e89 [PMID: 31082266 DOI: 10.1161/CIR.0000000000000663]

6 **Rahmani R**, Niyazi S, Sobh-Rakhshankhah A, Guazzi M, Mazaheri R, Hashemi N, Khoddami-Vishteh HR. Effects of a Cardiac Rehabilitation Program Versus Usual Care on Cardiopulmonary Function in Patients With Cardiac Syndrome X. *J Cardiopulm Rehabil Prev* 2020; **40**: 41-47 [PMID: 31869312 DOI: 10.1097/HCR.0000000000000439]

7 **Izar MC**, Fonseca FAH. Blood Pressure Variability and Cardiovascular Risk in ELSA-Brasil: A Potential Surrogate Marker for Predicting Mortality and Cardiovascular Outcomes? *Arq Bras Cardiol* 2022; **119**: 512-513 [PMID: 36287406 DOI: 10.36660/abc.20220525]

8 **Bakkar NZ**, El-Yazbi AF, Zouein FA, Fares SA. Beat-to-beat blood pressure variability: an early predictor of disease and cardiovascular risk. *J Hypertens* 2021; **39**: 830-845 [PMID: 33399302 DOI: 10.1097/HJH.0000000000002733]

9 **Stevens SL**, Wood S, Koshiaris C, Law K, Glasziou P, Stevens RJ, McManus RJ. Blood pressure variability and cardiovascular disease: systematic review and meta-analysis. *BMJ* 2016; **354**: i4098 [PMID: 27511067 DOI: 10.1136/bmj.i4098]

10 **Soh MS**, Park JS, Seo KW, Yang HM, Lim HS, Choi BJ, Choi SY, Yoon MH, Hwang GS, Tahk SJ, Shin JH. Visit-to-visit systolic blood pressure variability in patients with ST-elevation myocardial infarction predicts long-term cardiovascular outcomes. *J Hum Hypertens* 2019; **33**: 259-266 [PMID: 30778130 DOI: 10.1038/s41371-019-0176-0]

11 **Moštak I**, Višnjić N, Junaković A, Krbot Skorić M, Habek M. Comparison of baroreflex sensitivity indices with standard tests of autonomic nervous system function. *J Neurol Sci* 2021; **426**: 117473 [PMID: 33984549 DOI: 10.1016/j.jns.2021.117473]

12 **Tomoto T**, Repshas J, Zhang R, Tarumi T. Midlife aerobic exercise and dynamic cerebral autoregulation: associations with baroreflex sensitivity and central arterial stiffness. *J Appl Physiol (1985)* 2021; **131**: 1599-1612 [PMID: 34647828 DOI: 10.1152/japplphysiol.00243.2021]

13 **Hissen SL**, Macefield VG, Brown R, Taylor CE. Sympathetic baroreflex sensitivity is inversely related to vascular transduction in men but not women. *Am J Physiol Heart Circ Physiol* 2019; **317**: H1203-H1209 [PMID: 31675259 DOI: 10.1152/ajpheart.00501.2019]

14 **Thygesen K**, Alpert JS, Jaffe AS, Chaitman BR, Bax JJ, Morrow DA, White HD; Executive Group on behalf of the Joint European Society of Cardiology (ESC)/American College of Cardiology (ACC)/American Heart Association (AHA)/World Heart Federation (WHF) Task Force for the Universal Definition of Myocardial Infarction. Fourth Universal Definition of Myocardial Infarction (2018). *J Am Coll Cardiol* 2018; **72**: 2231-2264 [PMID: 30153967 DOI: 10.1016/j.jacc.2018.08.1038]

15 **Manolis AA**, Manolis TA, Apostolopoulos EJ, Apostolaki NE, Melita H, Manolis AS. The role of the autonomic nervous system in cardiac arrhythmias: The neuro-cardiac axis, more foe than friend? *Trends Cardiovasc Med* 2021; **31**: 290-302 [PMID: 32434043 DOI: 10.1016/j.tcm.2020.04.011]

16 **Yang HJ**, Kong B, Shuai W, Zhang JJ, Huang H. Knockout of MD1 contributes to sympathetic hyperactivity and exacerbates ventricular arrhythmias following heart failure with preserved ejection fraction *via* NLRP3 inflammasome activation. *Exp Physiol* 2020; **105**: 966-978 [PMID: 32240565 DOI: 10.1113/EP088390]

17 **Haberbusch M**, Kronsteiner B, Kramer AM, Kiss A, Podesser BK, Moscato F. Closed-loop vagus nerve stimulation for heart rate control evaluated in the Langendorff-perfused rabbit heart. *Sci Rep* 2022; **12**: 18794 [PMID: 36335207 DOI: 10.1038/s41598-022-23407-2]

18 **Capilupi MJ**, Kerath SM, Becker LB. Vagus Nerve Stimulation and the Cardiovascular System. *Cold Spring Harb Perspect Med* 2020; **10** [PMID: 31109966 DOI: 10.1101/cshperspect.a034173]

19 **Parati G**, Di Rienzo M, Mancia G. How to measure baroreflex sensitivity: from the cardiovascular laboratory to daily life. *J Hypertens* 2000; **18**: 7-19 [PMID: 10678538]

20 **Kaze AD**, Santhanam P, Erqou S, Yuyun M, Bertoni AG, Ahima RS, Echouffo-Tcheugui JB. Long-Term Variability of Blood Pressure, Cardiovascular Outcomes, and Mortality: The Look AHEAD Study. *Am J Hypertens* 2021; **34**: 689-697 [PMID: 33825813 DOI: 10.1093/ajh/hpaa210]

21 **Mallamaci F**, Tripepi G, D'Arrigo G, Borrelli S, Garofalo C, Stanzione G, Provenzano M, De Nicola L, Conte G, Minutolo R, Zoccali C.

Blood Pressure Variability, Mortality, and Cardiovascular Outcomes in CKD Patients. *Clin J Am Soc Nephrol* 2019; **14**: 233-240 [PMID: 30602461 DOI: 10.2215/CJN.04030318]
22 **Cerati D**, Schwartz PJ. Single cardiac vagal fiber activity, acute myocardial ischemia, and risk for sudden death. *Circ Res* 1991; **69**: 1389-1401 [PMID: 1934362 DOI: 10.1161/01.res.69.5.1389]
23 **Seravalle G**, Quarti-Trevano F, Dell'Oro R, Gronda E, Spaziani D, Facchetti R, Cuspidi C, Mancia G, Grassi G. Sympathetic and baroreflex alterations in congestive heart failure with preserved, midrange and reduced ejection fraction. *J Hypertens* 2019; **37**: 443-448 [PMID: 30020242 DOI: 10.1097/HJH.0000000000001856]
24 **Sano N**, Way D, McGrath BP. Renal norepinephrine spillover and baroreflex responses in evolving heart failure. *Am J Physiol* 1990; **258**: F1516-F1522 [PMID: 2360652 DOI: 10.1152/ajprenal.1990.258.6.F1516]
25 **Dibben GO**, Faulkner J, Oldridge N, Rees K, Thompson DR, Zwisler AD, Taylor RS. Exercise-based cardiac rehabilitation for coronary heart disease: a meta-analysis. *Eur Heart J* 2023; **44**: 452-469 [PMID: 36746187 DOI: 10.1093/eurheartj/ehac747]
26 **do Nascimento DM**, Machado KC, Bock PM, Saffi MAL, Goldraich LA, Silveira AD, Clausell N, Schaan BD. Cardiopulmonary exercise capacity and quality of life of patients with heart failure undergoing a functional training program: study protocol for a randomized clinical trial. *BMC Cardiovasc Disord* 2020; **20**: 200 [PMID: 32334527 DOI: 10.1186/s12872-020-01481-6]
27 **Borges JP**, Mendes FSNS, Rangel MVDS, Lopes GO, da Silva GMS, da Silva PS, Mazzoli-Rocha F, Saraiva RM, de Sousa AS, Tibirica E, Mediano MFF. Exercise training improves microvascular function in patients with Chagas heart disease: Data from the PEACH study. *Microvasc Res* 2021; **134**: 104106 [PMID: 33212111 DOI: 10.1016/j.mvr.2020.104106]
28 **Grässler B**, Thielmann B, Böckelmann I, Hökelmann A. Effects of different exercise interventions on heart rate variability and cardiovascular health factors in older adults: a systematic review. *Eur Rev Aging Phys Act* 2021; **18**: 24 [PMID: 34789148 DOI: 10.1186/s11556-021-00278-6]
29 **Jug B**, Vasić D, Novaković M, Avbelj V, Rupert L, Kšela J. The Effect of Aquatic Exercise Training on Heart Rate Variability in Patients with Coronary Artery Disease. *J Cardiovasc Dev Dis* 2022; **9** [PMID: 36005415 DOI: 10.3390/jcdd9080251]
30 **Tuomainen P**, Peuhkurinen K, Kettunen R, Rauramaa R. Regular physical exercise, heart rate variability and turbulence in a 6-year randomized controlled trial in middle-aged men: the DNASCO study. *Life Sci* 2005; **77**: 2723-2734 [PMID: 15978638 DOI: 10.1016/j.lfs.2005.05.023]
31 **Macagnan FE**, Feoli AMP, Russomano T. Acute Physical Effort Increases Sympathovagal Balance Responses to Autonomic Stimulation in Metabolic Syndrome. *Metab Syndr Relat Disord* 2019; **17**: 67-74 [PMID: 30325696 DOI: 10.1089/met.2018.0065]
32 **Li D**, Chen P, Zhu J. The Effects of Interval Training and Continuous Training on Cardiopulmonary Fitness and Exercise Tolerance of Patients with Heart Failure-A Systematic Review and Meta-Analysis. *Int J Environ Res Public Health* 2021; **18** [PMID: 34201804 DOI: 10.3390/ijerph18136761]
33 **Floras JS**, Ponikowski P. The sympathetic/parasympathetic imbalance in heart failure with reduced ejection fraction. *Eur Heart J* 2015; **36**: 1974-182b [PMID: 25975657 DOI: 10.1093/eurheartj/ehv087]
34 **Boyes NG**, Marciniuk DD, Haddad H, Tomczak CR. Autonomic cardiovascular reflex control of hemodynamics during exercise in heart failure with reduced ejection fraction and the effects of exercise training. *Rev Cardiovasc Med* 2022; **23**: 72 [PMID: 35229563 DOI: 10.31083/j.rcm2302072]

Published by **Baishideng Publishing Group Inc**
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA
Telephone: +1-925-3991568
E-mail: bpgoffice@wjgnet.com
Help Desk: https://www.f6publishing.com/helpdesk
https://www.wjgnet.com