·临床研究·

远程辅助居家心脏康复对经皮冠状动脉介入治疗后患者血压和血脂的影响

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【摘 要】 **目的** 探讨远程监督和指导的居家心脏康复治疗对行经皮冠状动脉介入(PCI)术冠心病患者血压和血脂的影响。**方法** 入选2016年1月至2018年3月解放军总医院第一医学中心心血管内科门诊PCI术后冠心病患者266例,随机数表法分为研究组(远程辅助居家心脏康复组)和对照组,每组133例。对照组接受基础的二级预防健康教育和药物治疗,研究组在此基础上依据运动处方进行居家心脏康复,同时接受以智能手机为媒介的来自康复医师、技师和护士的远程心率监督和康复指导。随访患者12个月,比较2组患者康复前后血压和血脂水平。应用SPSS 17.0统计软件对数据进行分析。依据数据类型采用t检验或χ^2检验进行组间比较。多重线性回归分析血压和血脂变化的独立影响因素。**结果** 相比康复前,研究组患者康复后收缩压[(123.7±13.7)和(128.2±14.5)mmHg(1 mmHg=0.133 kPa)]和舒张压[(77.6±11.1)和(80.7±10.3)mmHg]下降,收缩压达标比例[72.9%(97/133)和58.6%(78/133)]增高,低密度脂蛋白胆固醇水平[(1.64±0.42)和(1.90±0.59)mmol/L]明显下降,达标比例明显升高[42.1%(56/133)和26.3%(35/133)];对照组患者康复后收缩压达标比例[48.1%(64/133)和59.4%(79/133)]降低,低密度脂蛋白胆固醇水平[(2.23±0.84)和(2.03±0.80)mmol/L]明显增高,达标比例[17.3%(23/133)和22.6%(30/133)]明显下降,2组患者康复后舒张压达标比例[63.2%(84/133)和50.4%(67/133);51.9%(69/133)和45.1%(60/133)]均增高,差异均有统计学意义。研究组相比对照组患者康复后收缩压[(-4.6±14.5)和(0.2±15.0)mmHg]和低密度脂蛋白胆固醇下降程度[(-0.26±0.54)和(0.20±0.63)mmol/L]大,差异均有统计学意义(P均<0.05)。多重线性回归分析结果表明远程辅助居家心脏康复(P=0.006)和年龄(P=0.010)是收缩压变化的独立影响因素,远程辅助居家心脏康复(P<0.001)和二氧化碳通气当量(P=0.007)是低密度脂蛋白胆固醇变化的独立影响因素。**结论** 远程辅助的居家心脏康复可明显降低PCI术后冠心病患者收缩压和低密度脂蛋白胆固醇水平,提高收缩压和低密度脂蛋白胆固醇的达标率,有助于血压和血脂的控制。

【关键词】 心脏康复;经皮冠状动脉介入;危险因素
【中图分类号】 R541 【文献标志码】 A 【DOI】 10.11915/j.issn.1671-5403.2019.10.158

Effect of tele-monitored home-based cardiac rehabilitation on blood pressure and lipids in patients with coronary heart disease after percutaneous coronary intervention

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【**Abstract**】 **Objective** To investigate the effect of tele-monitored home-based cardiac rehabilitation on blood pressure and lipid in patients with coronary heart disease undergoing percutaneous coronary intervention (PCI). **Methods** A total of 266 patients from January 2016 to March 2018 in our department with coronary heart disease after PCI were enrolled. They were randomly divided into study group (tele-monitored home-based cardiac rehabilitation group) and control group, with 133 cases in each group. The control group received the basic 2-level prevention health education and drug therapy. On the basis of these treatments, the study group received exercise prescription and remote heart rate supervision and rehabilitation guidance from rehabilitation physicians, technicians and nurses with aid of smart phones. The patients were followed up for 12 months, and the blood pressure and lipid levels before and after rehabilitation were compared between the 2 groups. SPSS statistics 17.0 was used to analyze the data. Student's t test or

收稿日期: 2019-09-01; **接受日期**: 2019-09-26
基金项目: 国家重点研发计划(2018YFC2000600)
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Chi-square test was employed to compare the data between groups. Multiple linear regression analysis was applied to analyze the independent influencing factors of blood pressure and lipid changes. **Results** In the study group, rehabilitation resulted in significant declines in systolic blood pressure [SBP, (123.7±13.7) *vs* (128.2±14.5) mmHg] and diastolic blood pressure [DBP, (77.6±11.1) *vs* (80.7±10.3) mmHg], with increased proportion of those meeting SBP standard [72.9% (97/133) *vs* 58.6% (78/133)], and in low-density lipoprotein cholesterol (LDL-C) level [(1.64±0.42) *vs* (1.90±0.59) mmol/L], with larger proportion of normal level [42.1% (56/133) *vs* 26.3% (35/133)]. While, in the control group, the proportion of the patients meeting the SBP standard was decreased [48.1% (64/133) *vs* 59.4% (79/133)], and the LDL-C level [(2.23±0.84) *vs* (2.03±0.80) mmol/L] was increased, with less patients meeting the standard [17.3% (23/133) *vs* 22.6% (30/133)]. The proportions of the patients meeting DBP standard were increased in both groups [63.2% (84/133) *vs* 50.4% (67/133), 51.9% (69/133) *vs* 45.1% (60/133)]. More significant changes were seen in the declines of SBP [(−4.6±14.5) *vs* (0.2±15.0) mmHg] and LDL-C level [(−0.26±0.54) *vs* (0.20±0.63) mmol/L] in the study group than the control group. Multiple linear regression analysis showed that tele-monitored home-based cardiac rehabilitation (P = 0.006) and age (P=0.010) were independent influencing factors of SBP changes, and tele-monitored home-based cardiac rehabilitation (P<0.001) and carbon dioxide ventilation equivalent (P=0.007) were independent influencing factors for LDL-C changes. **Conclusion** Tele-monitored home-based cardiac rehabilitation significantly reduces SBP and LDL-C in patients with coronary heart disease after PCI, improves the proportions of those meeting the standards, and helps the control of blood pressure and blood lipid.

【Key words】 cardiac rehabilitation; percutaneous coronary intervention; risk factors

This work was supported by the National Key R&D Program of China (2018YFC2000600).

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冠状动脉粥样硬化性心脏病(简称冠心病)治疗环节中,除了经皮冠状动脉介入(percutaneous coronary intervention,PCI)术和基础药物治疗等,心血管疾病危险因素的控制也是重要一环[1]。血压和血脂等危险因素的良好控制对减慢病情进展、防止病情复发和并发症的发生有重要作用[2],因此也是冠心病一级和二级预防的重要目标。运动康复是冠心病患者的重要辅助治疗,可提高患者运动耐量,改善症状,降低血脂水平,从而改善生活质量和降低死亡率,已作为一项重要措施纳入冠心病患者二级预防治疗中[3]。冠心病以及行PCI治疗的人数逐年增多,但由于医疗中心的数量、距离等原因,使得依赖医疗机构的心脏康复治疗覆盖率和参与率并不尽人意[4,5],因此相对方便、灵活的居家心脏康复受到越来越多的重视。目前针对居家心脏康复模式的康复效果及其对血压和血脂等危险因素的影响尚存在争议[6,7],为此本研究对远程监督和指导的居家心脏康复治疗方式对PCI术后冠心病患者血压和血脂的影响进行了探讨。

1 对象与方法

1.1 研究对象

本研究为单中心随机对照试验,入选2016年1月至2018年3月解放军总医院第一医学中心心血管内科门诊PCI术后冠心病患者266例,随机数表法分为研究组(远程辅助居家心脏康复组)和对照组,每组133例。纳入标准:(1)符合中华人民共和国卫生行业标准冠心病诊断标准[8];(2)PCI术后时间>3 d;(3)认知功能正常;(4)具备基本运动条件,无身体慢性疼痛;(5)年龄18~80岁。排除标准:(1)严重心肺功能不全及代谢紊乱;(2)精神障碍和认知功能异常无法配合者;(3)合并活动性肺结核和肿瘤;(4)患其他影响运动的疾病;(5)不同意入组。本研究方案经本院伦理委员会审核批准,所有患者均签署知情同意书。

1.2 方法

1.2.1 研究流程 入组时收集患者基本信息、既往史、手术信息、心脏超声、基础血压和血脂及相关化验结果和心肺运动试验结果。依据心肺运动试验结果,由心脏康复医师制定运动处方。研究组患者接受二级预防健康教育和运动指导,并依据运动处方进行居家心脏康复,通过运动手环等便携心率监测设备结合智能手机,实时监测心率并传送至心脏康复中心平台,接受来自康复医师、技师和护士的远程心率监督和定期康复指导[9,10]。对照组患者仅接受二级预防健康教育。12个月后随访患者,再次测量血压和血脂等结果。血压<130/80 mmHg(1 mmHg=0.133 kPa)达标[3],低密度脂蛋白胆固醇<1.8 mmol/L达标[11]。

1.2.2 运动处方 依据美国运动医学会指南制定运动处方[12],设定目标心律=静息心率+(60%~70%)×(最大心率−静息心率),如果得出心率值高于无氧域心率,则将无氧域心率设定为目标心率。运动方案包括以目标心律为限的有氧运动(快步走或踏车)、伸

展运动、阻抗和平衡训练,以及进行以上训练前后的热身和放松活动。有氧和伸展运动频率为每周 5~6 次,阻抗和平衡训练每周 2~3 次[12]。

1.3 统计学处理

应用 SPSS 17.0 统计软件对数据进行分析。计量资料用均数±标准差($\bar{x}\pm s$)表示,组间比较采用 t 检验或配对 t 检验。计数资料用例数(百分率)表示,组间比较用 χ^2 检验。血压和血脂变化的独立影响因素分析采用多重线性回归分析。$P<0.05$ 为差异有统计学意义。

2 结 果

2.1 2 组患者基线资料比较

2 组患者年龄、性别、职业、体质量指数(body mass index,BMI)、吸烟史、超声指标、手术指标、服用药物比例等差异无统计学意义($P>0.05$)。研究组相比对照组患者既往运动史和合并糖尿病比例高,最大代谢当量、峰值千克摄氧量、无氧域千克摄氧量低,二氧化碳通气当量高,差异具有统计学意义($P<0.05$;表 1)。

表 1 2 组患者基线资料比较

Table 1 Comparison of baseline data between two groups ($n=133$)

Item	Study group	Control group	t/χ^2	P value
Age(years, $\bar{x}\pm s$)	56.7±10.0	56.5±9.0	−0.174	0.862
Male[n(%)]	117(88.0)	115(86.5)	0.135	0.713
Manual workers[n(%)]	37(27.8)	30(22.6)	0.978	0.323
BMI(kg/m^2, $\bar{x}\pm s$)	26.1±3.2	26.3±2.9	0.478	0.633
WHR($\bar{x}\pm s$)	0.93±0.06	0.93±0.05	1.000	0.318
History of exercise[n(%)]	88(66.2)	70(52.6)	5.051	0.025
History of smoking[n(%)]	102(76.7)	100(75.2)	0.082	0.774
Comorbidities[n(%)]				
MI	48(36.1)	48(36.1)	0.000	1.000
Hypertension	72(54.1)	73(54.9)	0.000	0.989
Hyperlipidemia	76(57.1)	90(67.7)	2.666	0.103
Diabetes mellitus	36(27.1)	22(16.5)	4.619	0.032
LVEF(%, $\bar{x}\pm s$)	56.4±8.7	58.4±9.7	1.337	0.183
Wall motion abnormality/ventricular aneurysm [n(%)]	11(8.3)	12(9.0)	0.855	0.355
LVEDD(mm, $\bar{x}\pm s$)	46.2±5.0	46.4±4.8	0.319	0.750
IVS(mm, $\bar{x}\pm s$)	10.7±1.3	10.6±1.1	−0.192	0.848
Number of stents(n, $\bar{x}\pm s$)	2.5±1.6	2.2±1.3	−1.918	0.056
Untreated stenosis[n(%)]	73(54.9)	69(51.9)	0.326	0.568
Drugs of taking[n(%)]				
Anti-platelet	132(99.2)	128(96.2)	1.535	0.215
Statins	96(72.2)	92(69.2)	0.303	0.859
β-receptor blockers	70(52.6)	65(48.9)	0.003	0.955
ACEI/ARB	29(21.8)	20(15.0)	1.257	0.262
Nitrates	45(33.8)	46(34.6)	0.379	0.538
Diltiazem	28(21.1)	24(18.0)	0.071	0.790
Trimetazidine	44(33.1)	35(26.3)	0.583	0.445
MET_{max}($\bar{x}\pm s$)	5.34±1.32	5.69±1.29	2.174	0.031
Peak of VO_2/kg[ml/(kg·min), $\bar{x}\pm s$]	18.7±4.6	19.9±4.5	2.174	0.031
Heart rate reserve(beats/min, $\bar{x}\pm s$)	29.3±17.5	31.3±19.3	0.893	0.373
Peak oxygen pulse(ml/beat, $\bar{x}\pm s$)	11.5±4.8	12.1±3.6	1.212	0.227
VO_2-AT/kg[ml/(kg·min), $\bar{x}\pm s$]	13.8±4.5	14.8±3.8	2.069	0.040
VE/VCO_2($\bar{x}\pm s$)	25.73±3.90	24.60±4.97	2.069	0.040
$\Delta VO_2/\Delta WR$[ml/(min·W), $\bar{x}\pm s$]	11.35±2.47	11.81±3.06	1.341	0.181

BMI: body mass index; WHR: waist hip ratio; MI: myocardial infarction; LVEF: left ventricular ejection fraction; LVEDD: left ventricular end diastolic dimension; IVS: interventricular septal thickness; ACEI: angiotensin converting enzyme inhibitor; ARB: angiotensin Ⅱ receptor blockers; MET_{max}: maximal metabolism equivalents; VO_2: oxygen uptake; AT: anaerobic threshold; VE: minute ventilation; VCO_2: carbon dioxide production; VE/VCO_2: carbon dioxide production equivalent; $\Delta VO_2/\Delta WR$: VO_2 difference/work rate difference.

2.2 2组患者居家康复前后血压水平的比较

相比康复前,研究组患者康复后收缩压和舒张压下降($P<0.001$,$P=0.003$),差异具有统计学意义;对照组患者康复后收缩压变化不明显,舒张压有下降趋势,但差异均无统计学意义($P>0.05$);研究组患者康复后收缩压达标比例增高($P<0.001$),对照组患者康复后收缩压达标比例降低($P=0.014$),2组患者康复后舒张压达标比例均增高($P=0.017$,$P<0.001$),差异均有统计学意义。研究组患者康复后收缩压下降程度相比对照组大,差异有统计学意义($P=0.009$);舒张压下降程度相比对照组差异无统计学意义($P>0.05$;表2)。

2.3 2组患者居家康复前后血脂相关指标水平的比较

相比康复前,研究组患者康复后低密度脂蛋白胆固醇水平明显下降($P<0.001$),达标比例明显升高($P=0.001$),对照组患者康复后低密度脂蛋白胆固醇水平明显增高($P=0.013$),达标比例明显下降($P=0.003$),差异均有统计学意义。研究组患者康复后低密度脂蛋白胆固醇下降程度较对照组高,差异有统计学意义($P<0.001$)。研究组患者康复后甘油三酯、总胆固醇、尿酸和同型半胱氨酸均有下降趋势,但差异无统计学意义,且康复后的下降幅度研究组和对照组差异亦无统计学意义($P>0.05$;表3)。

2.4 血压和血脂变化的影响因素分析

多重线性回归分析结果表明远程辅助居家心脏康复($P=0.006$)和年龄($P=0.010$)是收缩压变化的独立影响因素,远程辅助居家心脏康复($P<0.001$)和二氧化碳通气当量($P=0.007$)是低密度脂蛋白胆固醇变化的独立影响因素(表4)。

3 讨 论

世界卫生组织发布的《心血管危险因素评价和处理指南》指出,运动锻炼与心血管疾病的发生率和病死率密切相关,既可治疗亦可预防心血管疾病。目前以运动康复为核心的心脏康复已成为冠心病患者PCI术后二级预防的一项重要治疗方法[3],但受客观条件的限制,各种医疗中心的心脏康复治疗普及率并不高[4,5],而居家心脏康复因缺乏医护人员的监督和指导,康复效果更是参差不齐。随着通讯技术的发展,远程监控下的居家心脏运动康复开始出现,

表2 2组患者居家康复前后血压的比较

Table 2 Comparison of blood pressure before and after home rehabilitation between two groups ($n=133$)

Group	SBP (mmHg, $\bar{x}\pm s$)	T-SBP [n(%)]	DBP (mmHg, $\bar{x}\pm s$)	T-DBP [n(%)]
Study				
Before rehabilitation	128.2±14.5	78(58.6)	80.7±10.3	67(50.4)
12 months after rehabilitation	123.7±13.7*	97(72.9)*	77.6±11.1*	84(63.2)*
Difference	−4.6±14.5#		−3.2±11.9	
Control				
Before rehabilitation	128.5±14.9	79(59.4)	81.2±10.4	60(45.1)
12 months after rehabilitation	128.7±12.7	64(48.1)*	80.0±9.9	69(51.9)*
Difference	0.2±15.0		−1.3±10.9	

SBP: systolic blood pressure; T-SBP: target-reached systolic blood pressure; DBP: diastolic blood pressure; T-DBP: target-reached diastolic blood pressure. Compared with before rehabilitation, *$P<0.05$; compared with control group, #$P<0.05$. 1 mmHg = 0.133 kPa.

表3 2组患者居家康复前后血脂相关指标水平的比较

Table 3 Comparison of blood lipid related indicators before and after home rehabilitation between two groups ($n=133$)

Group	LDL-C (mmol/L, $\bar{x}\pm s$)	TC (mmol/L, $\bar{x}\pm s$)	TG (mmol/L, $\bar{x}\pm s$)	UA (μmol/L, $\bar{x}\pm s$)	Hcy (μmol/L, $\bar{x}\pm s$)	T-LDL-C [n(%)]
Study						
Before rehabilitation	1.90±0.59	3.32±0.72	1.46±0.82	348.9±75.2	14.2±4.9	35(26.3)
12 months after rehabilitation	1.64±0.42*	3.20±0.74	1.38±0.84	342.0±73.2	13.5±3.7	56(42.1)*
Difference	−0.26±0.54#	−0.13±0.76	−0.08±0.71	−6.9±55.5	−0.7±3.2	
Control						
Before rehabilitation	2.03±0.80	3.54±0.98	1.52±1.04	350.0±83.8	15.4±5.9	30(22.6)
12 months after rehabilitation	2.23±0.84*	3.69±1.21	1.60±1.15	339.9±85.6	14.1±6.3	23(17.3)*
Difference	0.20±0.63	0.15±1.03	0.08±0.80	−10.2±75.4	−1.2±5.4	

LDL-C: low-density lipoprotein cholesterol; T-LDL-C: target-reached low-density lipoprotein cholesterol; TC: total cholesterol; TG: triglycerides; UA: uric acid; Hcy: homocysteic acid. Compared with before rehabilitation, *$P<0.05$; compared with control group, #$P<0.05$.

表 4 多重线性回归分析血压和血脂变化的独立影响因素

Table 4 Multiple linear regression analysis of independent influencing factors of blood pressure and blood lipid change

Factor	SBP			LDL-C		
	r	95%*CI*	*P* value	*r*	95%*CI*	*P* value
Tele-HBCR	−5.362	−9.181−−1.542	0.006	−0.436	−0.630−−0.241	<0.001
Age	−0.260	−0.458−−0.062	0.010	−	−	−
VE/VCO_2	−	−	−	−0.030	−0.052−−0.008	0.007

SBP: systolic blood pressure; LDL-C: low-density lipoprotein cholesterol; VE/VCO_2: carbon dioxide production equivalent; Tele-HBCR: tele-monitored home-based cardiac rehabilitation. −: no data.

研究表明结合了远程监控技术的居家心脏运动康复对患者心肺功能的改善和在医疗中心进行的心脏运动康复治疗效果相当[9,10]。本研究采用了远程辅助的居家心脏运动康复治疗模式,探讨了该模式对冠心病患者危险因素的影响,证实相较普通药物治疗和教育,该模式可帮助降低冠心病患者的收缩压和低密度脂蛋白胆固醇水平,而对尿酸和同型半胱氨酸等水平的影响并不明显。

运动康复对血压的影响原因为运动时骨骼肌耗氧量和血流量需求增加,大量毛细血管扩张可引起外周血管阻力降低。另外,长期规律的运动康复可调节自主神经系统,提高迷走神经张力,降低交感神经兴奋性,从而促进外周血管舒张,缓解小动脉痉挛,降低外周血管阻力[13],同时还可通过增加心房利钠肽水平促进汗液和尿液排泄,减少水钠潴留和血容量,降低血压[14]。研究表明高血压患者经运动处方治疗后,患者血压显著降低并维持稳定[15]。PCI 术后不稳定型心绞痛患者运动康复后的血压较干预前明显下降[7],本研究结果与其结果一致,接受远程辅助居家心脏康复患者的收缩压平均下降约 4.5 mmHg,而对照组康复前后并无明显变化,是否进行远程辅助居家心脏康复作为独立危险因素影响血压变化,提示该模式有利于冠心病患者 PCI 术后血压的控制。

血液中脂质成分过高,心肌细胞摄入的脂肪酸就会增加,当心肌细胞摄取的脂肪酸量超过其氧化能力,多余的脂肪酸以总胆固醇的形式储存在心肌细胞中,其中一部分代谢为甘油二酯、神经酰胺等中间代谢产物,这些多余的脂质及中间代谢产物在心肌细胞内聚集会引起心肌脂毒性,进而造成心肌细胞凋亡和心脏收缩功能障碍等不可逆损伤。运动康复可增强体内脂肪的代谢,降低血液中致动脉粥样硬化的低密度脂蛋白胆固醇等脂质成分水平,Magalhges 等[16]的研究证实运动锻炼可降低血脂水平。本研究证实远程辅助居家心脏康复可显著降低低密度脂蛋白胆固醇水平,是否进行远程辅助居家心脏康复作为独立危险因素影响低密度脂蛋白胆固醇水平变化,提示该模式有利于冠心病患者 PCI 术后低密度脂蛋白胆固醇水平的控制。

另外多重线性回归分析结果提示二氧化碳通气当量可能也是影响低密度脂蛋白胆固醇下降程度的独立因素。二氧化碳通气当量是分钟通气量和二氧化碳排出量的比值,反应肺的换气功能,比值越高,肺的换气功能越差[17]。Cirillo 等[18]发现低密度脂蛋白胆固醇与肺通气功能呈负相关,可能与其引起体内氧化应激反应有关。研究也表明慢性阻塞性肺疾病患者低密度脂蛋白胆固醇水平异常[19]。睡眠呼吸暂停低通气综合征也被广泛证实可引起血脂紊乱[20]。但尚无研究明确肺换气功能与低密度脂蛋白胆固醇的关系及其可能的机制。二氧化碳通气当量是否影响低密度脂蛋白胆固醇代谢以及如何影响尚需进一步研究。

综上所述,远程辅助的居家心脏康复可明显降低冠心病患者 PCI 术后收缩压和低密度脂蛋白胆固醇水平,并明显提高收缩压和低密度脂蛋白胆固醇的达标率,是收缩压和低密度脂蛋白胆固醇变化的独立影响因素,有助于血压和血脂的控制。

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(编辑: 王彩霞)