

· 临床研究 ·

中频电刺激联合下肢功率自行车对肌少症患者的治疗效果

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【摘要】目的 探讨中频电刺激联合下肢功率自行车治疗方案对肌少症患者的治疗效果。**方法** 纳入2017年9月至2020年2月宜宾市第二人民医院老年医学科住院期间诊断为肌少症94例患者的临床资料。按照治疗方式不同,分为2组。研究组患者46例,给予中频电刺激联合下肢功率自行车治疗;对照组患者48例,不做其他特殊运动处理。4周后评估2组患者治疗前后握力、Berg平衡量表(BBS)评分、移动能力指数(MRMI)评分、简易体能状况量表(SPPB)评分及老年失能评分变化,检测中性粒细胞百分比、C反应蛋白(CRP)、超敏C反应蛋白(hs-CRP)变化。采用SPSS 23.0软件进行数据分析。根据数据类型,组间比较分别采用 t 检验及 χ^2 检验。**结果** 治疗4周后,观察组握力与治疗前比较差异无统计学意义[(12.72±1.59)和(10.03±1.38) kg, $P>0.05$]; BBS评分、SPPB评分与治疗前比较,差异有统计学意义[(24.76±4.16)和(17.38±2.90)分、(4.13±0.72)和(2.15±0.48)分, $P<0.05$]; MRMI评分、老年失能评分与治疗前及对照组比较,差异均有统计学意义[(27.57±2.74)和(20.37±2.10)和(20.58±1.47)分、(117.62±12.57)和(93.39±8.74)和(102.26±13.67)分, $P<0.05$]。治疗4周后,研究组患者中性粒细胞百分比变化与治疗前比较差异无统计学意义[(60.29±3.55)%和(64.30±4.03)%, $P>0.05$]; CRP与治疗前比较差异有统计学意义[(13.56±0.90) vs (16.29±2.07) mg/L, $P<0.05$]; hs-CRP与治疗前及对照组比较,差异均有统计学差异[(4.06±0.94)和(5.31±0.87)和(5.42±0.73) mg/L, $P<0.05$]。**结论** 中频电刺激联合下肢功率自行车可以改善肌少症患者的移动能力、平衡功能、体能状况以及肌少症患者体内的炎症状态,使肌少症患者临床获益。

【关键词】 肌少症; 中频电刺激; 下肢功率自行车

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Therapeutic effect of medium-frequency electrical stimulation and leg cycle ergometer training for sarcopenia patients

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【Abstract】 Objective To investigate the therapeutic effect of medium-frequency electrical stimulation and leg cycle ergometer training (LCETT) for sarcopenia patients. **Methods** Included in the study were 94 sarcopenia patients in the Department of Geriatrics of Yibin Municipal Second People's Hospital from September 2017 to February 2020, who were divided into study group ($n=46$) and control group ($n=48$). The study group was treated with medium-frequency electrical stimulation and LCETT and the control group without. The two groups were evaluated 4 weeks later for the change in grip strength, Berg Balance Scale (BBS), modified rivermead mobility index (MRMI), short physical performance battery (SPPB), senile disability score, percentage of neutrophils [NEUT (%)], C-reactive protein (CRP) and high-sensitivity C-reactive protein (hs-CRP). SPSS 23.0 was used for statistical analysis. Data comparison between two groups was performed using t -test or χ^2 test depending on data type. **Results** After 4-week treatment, no statistical difference was found in grip strength in the study group [(12.72±1.59) vs (10.03±1.38) kg, $P>0.05$], and significant differences were found in BBS score [(24.76±4.16) vs (17.38±2.90) points], SPPB score [(4.13±0.72) vs (2.15±0.48) points; $P<0.05$ for both]. MRMI and senile disability scores were statistically different in the study group before and after treatment and between two groups after the treatment [(27.57±2.74) vs (20.37±2.10) vs (20.58±1.47) points, (117.62±12.57) vs (93.39±8.74) vs (102.26±13.67) points; $P<0.05$ for all]. After 4-week treatment, the percentage of neutrophils had no significant change [(60.29±3.55)% vs (64.30±4.03)%, $P>0.05$]; CRP had significant change [(13.56±0.90) vs (16.29±2.07) mg/L, $P<0.05$]; and hs-CRP were significantly different as compared with that before treatment and of the control group [(4.06±0.94) vs (5.31±0.87) vs

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(5.42 ± 0.73) mg/L, $P < 0.05$]. **Conclusion** Medium-frequency electrical stimulation combined with LCETT can improve the mobility, equilibrium, performance status, and inflammatory state in the sarcopenia patients, bringing clinical benefits for sarcopenia patients by strengthening the muscles and enhancing muscular functions.

【Key words】 sarcopenia; medium-frequency electrical stimulation; leg cycle ergometer training

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肌少症是增龄相关性疾病,国际肌少症工作组将肌少症定义为与增龄相关的进行性、全身肌量减少和(或)肌强度下降或肌肉生理功能减退^[1]。肌少症由于其对患病率、死亡率与卫生保健费用支出的影响,已逐渐成为一个全球性问题。肌少症不仅严重影响老年人的生活质量,甚至缩短老年人的寿命^[2]。肌少症的防治措施主要包括运动的改善、营养的调整以及相关药物的使用。目前各个指南均推荐运动疗法用于肌少症患者,但如何运动、运动强度怎样及时间多长均没有提及。下肢功率自行车曾在卒中后功能康复训练中使用,而中频电刺激疗法对提高膝关节肌群爆发力和耐力起到一定的作用^[3]。故本研究旨在探讨中频电刺激联合下肢功率自行车运动康复方案对肌少症患者的治疗疗效。

1 对象与方法

1.1 研究对象

收集2017年9月至2020年2月在宜宾市第二人民医院老年医学科住院的肌少症患者94例。肌少症的诊断根据2016年肌少症共识推荐的标准纳入^[4]。排除标准:(1)长期日常生活能力(activities of daily living, ADL)重度依赖;(2)疾病急性期;(3)肿瘤姑息医疗;(4)摄食障碍。所有纳入研究患者若合并内科常见疾病,如高血压、糖尿病、冠心病及脑卒中等,则待相应疾病稳定后纳入研究。根据患者意愿将所有患者分为研究组($n = 46$ 例)和对照组($n = 48$ 例)。所有研究对象均签署知情同意书。

1.2 方法

对照组不做与治疗相关的其他特殊运动康复处理;研究组给予中频电刺激联合下肢功率自行车组治疗,中频电刺激(频率为5 kHz)20 min, 2次/d+下肢功率自行车治疗(20 N·m+主动运动模式)20 min, 2次/d,观察疗程为30 d。评估各组患者治疗前及治疗后4周握力、Berg平衡量表(Berg Balance scale, BBS)评分、移动能力指数(modified rivermead mobility index, MRMI)评分、老年失能评分及简易体能状况量表(the short physical performance battery, SPPB)评分等资料。采用血常规分析仪检测治疗前后中性粒细胞百分比、C反应蛋白

(C-reactive protein, CRP)及超敏C反应蛋白(high-sensitivity C-reactive protein, hs-CRP)变化。主动运动和运动天数均超过80%的患者纳入研究,运动质量由康复医师观察控制。

1.3 统计学处理

采用SPSS 23.0统计软件进行数据分析。计量资料用均值±标准差($\bar{x} \pm s$)表示,采用 t 检验;计数资料用例数(百分率)表示,采用 χ^2 检验。 $P < 0.05$ 为差异有统计学意义。

2 结果

2.1 2组患者一般资料比较

研究组男性27例,女性19例;对照组男性26例,女性22例。2组患者一般资料比较,差异均无统计学意义(均 $P > 0.05$;表1)。

2.2 治疗前后2组患者康复运动指标比较

治疗4周后,观察组握力与治疗前比较差异无统计学意义($P > 0.05$);BBS评分、MRMI评分、老年失能评分及SPPB评分与治疗前比较,差异有统计学意义($P < 0.05$);观察组MRMI评分及老年失能评分与对照组比较,差异有统计学意义($P < 0.05$;表2)。

2.3 治疗前后2组炎症指标的比较

治疗4周后,研究组患者的中性粒细胞百分比变化与治疗前比较差异无统计学意义($P > 0.05$);CRP及hs-CRP与治疗前比较,差异均有统计学意义(均 $P < 0.05$);hs-CRP与对照组比较,差异有统计学意义($P < 0.05$;表3)。

3 讨论

随着增龄的发生,虚弱及肌肉质量下降逐渐显现,这会给很多人带来不利影响(比如跌倒、骨折及死亡风险增加等),而当肌少症出现时,这种不利影响更加明显^[5]。肌少症是老年人生理功能逐渐减退的重要原因和表现之一,它不仅会增加老年人的住院率及医疗花费,严重影响老年人的生活质量,甚至缩短老年人的寿命^[6,7]。肌少症和骨质疏松症相伴出现被统称为活动障碍综合征(dysmobility syndrome)^[8],而与骨质疏松症相比,肌少症近10年来才逐渐受到重视。

表 1 2组患者一般资料比较

Table 1 Comparison of general data between two groups ($\bar{x}\pm s$)

Item	Study group(<i>n</i> =46)	Control group(<i>n</i> =48)	<i>P</i> value
Age(years)	78. 17±1. 77	77. 85±1. 54	0. 78
WBC(×10 ⁹ /L)	6. 68±0. 40	6. 23±0. 55	0. 90
NEUT(%)	68. 22±2. 73	64. 30±4. 03	0. 71
HGB(g/L)	119. 94±3. 93	119. 31±6. 14	0. 96
AST(U/L)	31. 23±3. 15	31. 23±3. 15	0. 58
ALT(U/L)	25. 01±3. 78	23. 05±4. 58	0. 60
ALB(g/L)	36. 72±1. 13	38. 14±0. 84	0. 46
PA(g/L)	164. 12±13. 84	197. 08±16. 65	0. 19
UA(mmol/L)	295. 25±23. 87	307. 89±32. 15	0. 71
SCr(μmol/L)	77. 72±6. 29	92. 12±22. 78	0. 10
BUN(mmol/L)	6. 40±0. 52	6. 63±0. 74	0. 56
Cholesterol(mmol/L)	4. 13±0. 24	4. 49±0. 43	0. 33
TG(mmol/L)	1. 46±0. 17	1. 56±0. 28	0. 97
LDL-C(mmol/L)	2. 16±0. 18	2. 49±0. 31	0. 24
HDL-C(mmol/L)	1. 23±0. 06	1. 20±0. 07	0. 32
Grip(kg)	10. 03±1. 38	9. 56±1. 37	0. 87
BBS(points)	17. 38±2. 90	17. 84±1. 96	0. 06
MRMI(points)	20. 37±2. 10	19. 69±2. 18	0. 15
Senile disability scores (points)	93. 39±8. 74	96. 71±9. 52	0. 76
SPPB(points)	2. 15±0. 48	2. 11±0. 37	0. 09

WBC: white blood cell; NEUT: neutrophil; HGB: hemoglobin; AST: aspartate transaminase; ALT: alanine transaminase; ALB: albumin; PA: precursor albumin; UA: uric acid; SCr: serum creatinine; BUN: blood urea nitrogen; TG: triglycerides; LDL-C: low-density lipoprotein cholesterol; HDL-C: high-density lipoprotein cholesterol; BBS: Berg Balance scale; MRMI: modified rivermead mobility index; SPPB: short physical performance battery.

表 2 治疗前后 2 组患者康复运动情况比较

Table 2 Comparison of rehabilitation exercise data between two groups ($\bar{x}\pm s$)

Group	<i>n</i>	Grip(kg)	BBS scores (points)	MRMI scores (points)	Senile disability scores(points)	SPPB scores (points)
Study	46					
Before treatment		10. 03±1. 38	17. 38±2. 90	20. 37±2. 10	93. 39±8. 74	2. 15±0. 48
After treatment		12. 72±1. 59	24. 76±4. 16 *	27. 57±2. 74 **	117. 62±12. 57 **	4. 13±0. 72 *
Control	48					
Before treatment		9. 56±1. 37	17. 84±1. 96	19. 69±2. 18	96. 71±9. 52	2. 11±0. 37
After treatment		11. 16±1. 37	17. 43±2. 83	20. 58±1. 47	102. 26±13. 67	3. 12±0. 81

BBS: Berg Balance scale; MRMI: modified rivermead mobility index; SPPB: short physical performance battery. Compared with before treatment, **P*<0.05; compared with control group, #*P*<0.05.

表 3 治疗前后 2 组患者炎症指标的比较

Table 3 Comparison of inflammatory indexes between two groups ($\bar{x}\pm s$)

Group	<i>n</i>	NEUT(%)	CRP (mg/L)	hs-CRP (mg/L)
Study	46			
Before treatment		64. 30±4. 03	16. 29±2. 07	5. 31±0. 87
After treatment		60. 29±3. 55	13. 56±0. 90 *	4. 06±0. 94 **
Control	48			
Before treatment		68. 22±2. 73	17. 33±1. 92	6. 08±0. 99
After treatment		66. 71±4. 98	19. 90±2. 91	5. 42±0. 73

NEUT: neutrophils; CRP: C-reactive protein; hs-CRP: high-sensitivity C-reactive protein. Compared with before treatment, **P*<0.05, compared with the control group, #*P*<0.05.

研究显示,运动是获得和保持肌量和肌力最为有效的手段之一^[4]。老年骨骼肌减少症主要表现为大型、高能量及Ⅱ型肌纤维萎缩^[9],这些肌纤维萎缩可通过力量训练来解决。老年人进行阻抗运动能显著增加肌肉量、肌肉强度和肌肉质量^[10]。采用主动运动和被动活动、肌肉训练与康复相结合的手段,可达到增加肌量和肌力、改善运动能力和平衡能力、进而减少骨折的目的^[11]。通过耐力训练,老年人可以减缓、抑制或逆转退化性骨骼肌减少症^[9,12,13]。

下肢功率自行车训练提供患者以节律性、重复性训练,引发肌肉的活动,可进行主(被)动训练、耐力训练及协调性训练等。研究发现,下肢功率自行

车训练可明显地改善早期脑卒中患者的平衡能力、步行功能、下肢运动功能和 10 m 步行速度^[14]。中频电刺激治疗仪利用经调制的 1~10 kHz 中频脉冲电流作用于患者局部皮下深处,从而使肌肉出现无规则和有规则的收缩运动,具有锻炼骨骼肌的功能。中频电刺激疗法对提高人体膝关节肌群相对平均峰力矩、相对平均功率和降低疲劳指数有明显的效果,对提高膝关节肌群爆发力和耐力起到一定的作用^[4]。

本研究发现,通过使用中频电刺激联合下肢功率自行车训练的方法,肌少症患者的 BBS 评分、MRMI 评分及 SPPB 评分与治疗前比较,差异有统计学意义;MRMI 评分与对照组相比差异有统计学差异,与既往研究结果一致^[11-14]。中频电刺激联合下肢功率自行车训练的方法可有效改善肌少症患者的平衡功能、移动能力以及体能状况,达到治疗目的。通过康复运动的干预,肌少症患者的老年失能评分也较治疗前明显改善,老年失能评分与治疗前及对照组相比差异有统计学意义,提示中频电刺激联合下肢功率自行车训练不仅可应用于肌少症患者,也可应用于对失能患者的预防及改善。而本研究中,握力方面无统计学意义,握力主要反映前臂和手部的屈肌力量,我们所选择的运动主要在下肢,提示我们可以通过对上肢的训练达到握力的提升。

既往研究也发现,肌少症患者血 CRP 水平升高,C 反应蛋白与肌肉含量、肌肉强度(握力)有关,而中性粒细胞/淋巴细胞比例升高是肌少症的独立预测因素^[15,16]。本研究发现,通过在肌少症患者中应用中频电刺激联合下肢功率自行车治疗方法,患者的 CRP 与治疗前相比差异有统计学差异,hs-CRP 与治疗前及对照组比较差异均有统计学意义。因此,康复运动的方法可改善肌少症患者体内的炎症状态。而在中性粒细胞比例方面,本研究显示无统计学意义,这可能需要更大样本量的人群进行比较。

综上,中频电刺激联合下肢功率自行车训练可以改善肌少症患者的移动能力、平衡功能、体能状况及肌少症患者体内的炎症状态,达到改善肌肉强度及肌肉功能的目的,使肌少症患者获益。

【参考文献】

- [1] Fielding RA, Vellas B, Evans WJ, *et al.* Sarcopenia: an undiagnosed condition in older adults. Current consensus definition; prevalence, etiology, and consequences. International Working Group on Sarcopenia[J]. J Am Med Dir Assoc, 2011, 12(4): 249-256. DOI: 10.1016/j.jamda.2011.01.003.
- [2] Landi F, Cruz-Jentoft AJ, Liperoti R, *et al.* Sarcopenia and mortality risk in frail older persons aged 80 years and older: results from the SIRENTE study[J]. Age Ageing, 2013, 42(2): 203-209. DOI: 10.1093/ageing/afs194.

- [3] 张飞,刘一平.中频电刺激对膝关节肌群等速肌力相关指标影响的实验研究[J].吉林体育学院学报,2010,(6):64-66. Zhang F, Liu YP. The influence of medium frequency electric stimulation to related targets of knee joint isokinetic muscle strength[J]. J Jilin Inst Phys Educ, 2010, (6): 64-66.
- [4] 中华医学会骨质疏松和骨矿盐疾病分会.肌少症共识[J].中华骨质疏松和骨矿盐疾病杂志,2016,9(3):215-227. Osteoporosis and Bone Mineral Salt Diseases Branch of Chinese Medical Association. Sarcopenia consensus[J]. Chin J Osteoporosis Bone Miner Res, 2016, 9(3): 215-227.
- [5] Macheek SB. Mechanisms of sarcopenia; motor unit remodeling and muscle fibre type shifts with ageing[J]. J Physiol, 2018, 596(16): 3467-3468. DOI: 10.1113/JP276586.
- [6] Gupta S, Dhillon RJS, Hasni S. Sarcopenia; a rheumatic disease? [J]. Rheum Dis Clin North Am, 2018, 44(3): 393-404. DOI: 10.1016/j.rdc.2018.03.001.
- [7] Yalcin A, Aras S, Atmis V, *et al.* Sarcopenia and mortality in older people living in a nursing home in Turkey[J]. Geriatr Gerontol Int, 2017, 17(7): 1118-1124. DOI: 10.1111/ggi.12840.
- [8] Edwards MH, Gregson CL, Patel HP, *et al.* Muscle size, strength, and physical performance and their associations with bone structure in the Hertfordshire Cohort Study[J]. J Bone Miner Res, 2013, 28(11): 2295-2304. DOI: 10.1002/jbmr.1972.
- [9] Nilwik R, Snijders T, Leenders M, *et al.* The decline in skeletal muscle mass with aging is mainly attributed to a reduction in type II muscle fiber size[J]. Exp Gerontol, 2013, 48(5): 492-498. DOI: 10.1016/j.exger.2013.02.012.
- [10] Hasten DL, Pak-Loduca J, Obert KA, *et al.* Resistance exercise acutely increases MHC and mixed muscle protein synthesis rates in 78-84 and 23-32 yr olds[J]. Am J Physiol Endocrinol Metab, 2000, 278(4): E620-E626. DOI: 10.1152/ajpendo.2000.278.4.E620.
- [11] Nelson ME, Fiatarone MA, Morgami CM, *et al.* Effects of high-intensity strength training on multiple risk factors for osteoporotic fractures. A randomized controlled trial[J]. JAMA, 1994, 272(24): 1909-1914. DOI: 10.1001/jama.1994.03520240037038.
- [12] Verdijk LB, Snijders T, Drost M, *et al.* Satellite cells in human skeletal muscle: from birth to old age[J]. Age (Dordr), 2014, 36(2): 545-547. DOI: 10.1007/s11357-013-9583-2.
- [13] Frontera WR, Meredith CN, O'Reilly KP, *et al.* Strength conditioning in older men: skeletal muscle hypertrophy and improved function[J]. J Appl Physiol (1985), 1988, 64(3): 1038-1044. DOI: 10.1152/jappl.1988.64.3.1038.
- [14] 倪常耕.下肢功率自行车训练对早期脑卒中病人步行能力影响[D].湖北:武汉体育学院,2016:6-7. Ni CG. Effect of leg cycle ergometer training on walking ability in the early phase of stroke patients[D]. Wuhan Sports University, 2016:6-7.
- [15] Öztürk ZA, Kul S, Türkbeyler IH, *et al.* Is increased neutrophil lymphocyte ratio remarking the inflammation in sarcopenia? [J]. Exp Gerontol, 2018, 110: 223-229. DOI: 10.1016/j.exger.2018.06.013.
- [16] Cesari M, Kritchevsky SB, Baumgartner RN, *et al.* Sarcopenia, obesity, and inflammation — results from the trial of Angiotensin Converting Enzyme Inhibition and Novel Cardiovascular Risk Factors Study[J]. Am J Clin Nutr, 2005, 82(2): 428-434. DOI: 10.1093/ajcn.82.2.428.