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# 低频电刺激结合康复训练对脊髓损伤神经源性膀胱患者排尿症状、膀胱功能及生活质量的影响*

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**摘要 目的:**探讨低频电刺激结合康复训练对脊髓损伤(SCI)诱发神经源性膀胱(NB)患者排尿症状、膀胱功能及生活质量的影响。**方法:**选取2017年3月~2019年12月期间我院收治的SCI诱发NB患者97例,根据随机数字表法分为对照组(n=48)和研究组(n=49),对照组患者予以康复训练,研究组在对照组基础上联合低频电刺激,比较两组患者排尿症状、膀胱功能、生活质量及并发症发生情况。**结果:**两组治疗2周后、治疗4周后日膀胱内压力、24 h单次排尿量、排尿次数、膀胱容量均较治疗前增加,且研究组高于对照组($P$<0.05);残余尿量均较治疗前下降,且研究组低于对照组($P$<0.05)。两组治疗2周后、治疗4周后膀胱功能积分均较治疗前下降,且研究组低于对照组($P$<0.05)。两组治疗4周后情感职能、躯体疼痛、精神健康、活力、生理职能、生理机能、健康状况、社会功能维度评分均升高,且研究组高于对照组($P$<0.05)。研究组并发症总发生率低于对照组($P$<0.05)。**结论:**低频电刺激结合康复训练治疗SCI诱发NB患者,可有效改善患者排尿症状,提高其膀胱功能及生活质量,同时还可减少并发症发生率,具有一定的临床应用价值。

**关键词:**低频电刺激;康复训练;脊髓损伤;神经源性膀胱;排尿症状
**中图分类号:**R651.2;R694.6;Q64 **文献标识码:**A **文章编号:**1673-6273(2020)15-2863-05

# Effects of Low Frequency Electrical Stimulation Combined with Rehabilitation Training on Micturition Symptoms, Bladder Function and Quality of Life of Neurogenic Bladder Patients with Spinal Cord Injury*

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**ABSTRACT Objective:** To investigate the effect of low frequency electrical stimulation combined with rehabilitation training on micturition symptoms, bladder function and quality of life of neurogenic bladder (NB) patients induced by spinal cord injury (SCI). **Methods:** 97 patients with NB induced by SCI in our hospital from March 2017 to December 2019 were selected, patients were divided into control group (n=48) and study group (n=49) according to the method of random number table. The patients in the control group were given rehabilitation training. The study group was combined with lowfrequency electrical stimulation on the basis of the control group. The urination symptoms, bladder function, quality of life and complications of the two groups were compared. **Results:** 2 weeks and 4 weeks after treatment, the number of Intravesical pressure, 24 h single micturition volume, times of micturition, bladder volume in the two groups increased compared with before treatment, and study group was higher than control group ($P$<0.05). The residual urine volume was lower than that before treatment, study group was lower than control group ($P$<0.05). 2 weeks and 4 weeks after treatment, the bladder function scores of the two groups were lower than before treatment, study group was lower than control group ($P$<0.05). The scores of emotional function, physical pain, mental health, vitality, physiological function, physiological function, health status and social function in the two groups increased, study group were higher than control group ($P$<0.05). The total incidence of complications in the study group was lower than that in the control group ($P$<0.05). **Conclusion:** Low frequency electrical stimulation combined with rehabilitation training can effectively improve the symptoms of micturition, improve the bladder function and quality of life of patients with NB induced by SCI, at the same time, and it can reduce the incidence of complications, and have a high clinical application value.

**Key words:** Low frequency electrical stimulation; Rehabilitation training; Spinal cord injury; Neurogenic bladder; Micturition symptoms
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## 前言

神经源性膀胱(NB)是指控制排尿功能的中枢神经系统或周围神经受到损害,进而引起膀胱尿道功能障碍的一种疾病[1]。脊髓损伤(SCI)是引起 NB 的主要原因之一,当机体神经环路损伤时,易引发 NB,产生尿潴留及尿不畅等症状,若未能及时予以治疗,可诱发泌尿系统并发症,如肾衰竭、上尿路损害等,严重者甚至导致患者死亡[2,3]。现临床有关 SCI 诱发 NB 的治疗方案尚未完全统一,主要集中于药物、外科手术及膀胱功能康复训练等,其中药物治疗存在不良反应大的不足,外科手术则会对机体造成创伤, 因此临床中多以膀胱功能康复训练为主,但仍疗效一般,无法达到预期的治疗效果[4-6]。低频电刺激是将超低脉宽的低频电流输入人体靶向治疗点,继而促进神经系统功能重建以改善患者症状的一种治疗方式[7-9]。本研究通过对我院收治的部分 SCI 诱发 NB 患者给予低频电刺激结合康复训练治疗,取得了较好的疗效,现整理报道如下。

## 1 资料与方法

### 1.1 一般资料

纳入标准:(1)经临床表现、影像学检查确诊为 SCI;(2)伴有 NB 症状;(3) 患者及其家属知情本研究且签署了同意书;(4)患者意识清晰,生命体征平稳。排除标准:(1)既往行膀胱造漏术手术损伤者;(2)意识不清或有精神疾病无法配合治疗者;(3)因前列腺增生或其他疾病导致排尿障碍;(4)心脑等重要脏器严重疾病者。选取 2017 年 3 月 ~2019 年 12 月期间我院收治的 SCI 诱发 NB 患者 97 例, 根据随机数字表法分为对照组(n=48)和研究组(n=49),其中研究组男 27 例,女 22 例,年龄 25~50 岁,平均(43.19±4.25)岁;损伤节段包括颈椎 20 例,胸椎 15 例,腰椎 14 例;SCI 病程 3~10 月,平均(6.57±0.96)月。对照组男 28 例,女 20 例,年龄 27~53 岁,平均(42.91±4.67)岁;损伤节段包括颈椎 19 例,胸椎 16 例,腰椎 13 例;SCI 病程 2~9 月,平均(6.29±0.87)月。两组患者一般资料对比未见统计学差异($P$>0.05),组间具有可比价值。本次研究已通过我院伦理学委员会批准进行。

### 1.2 方法

两组均接受膀胱康复训练治疗,具体如下:(1)规律的饮水计划:要求患者晨起至 20:00 每隔 2 小时饮水 200～250 mL,期间若进食流质、粥、汤、果汁等,应减去相应分量的水分。平均每天总入液量控制为 1500-2000 mL 左右。(2)清洁间歇导尿,为患者建立膀胱充盈排泄规律。(3)盆底肌功能训练。指导患者在立、卧或站位下进行尿道和肛门主动收缩训练,收缩与放松持续时间分别 5~10s,20 组 / 次,每日 5 次。(4)诱导排尿训练:a.利用条件反射诱导排尿。可以离床患者,协助患者坐于坐厕,让患者听流水声。需要卧床患者,放置便器,用温热毛巾外敷膀胱区域或者用温水冲洗会阴部,边冲边轻轻按摩患者膀胱膨隆区域。b.开塞露塞肛诱导排尿。采用开塞露塞肛,促使逼尿肌收缩,内括约肌松弛从而达到排尿。(5)肛门括约肌训练:指导患者主动进行肛门牵拉的训练,医务人员使用中指或食指两个指节,戴上指套润滑后,分别朝 3 点、6 点、9 点、12 点四个方向进行牵拉,促使盆底肌、尿道括约肌痉挛缓解,每次牵拉收缩持续时间控制在 10s 左右,训练 10 次为 1 组,每日 5 组。上述膀胱康复训练持续治疗 4 周。研究组在膀胱康复训练的基础上联合低频电刺激治疗,具体如下:选择深圳市力合医疗器械有限公司生产的 LGT-1000B 低频电子脉冲膀胱治疗仪, 其中膀胱近顶部侧壁贴两个电极片,耻骨、肚脐连线膀胱顶下缘及骶尾关节处贴两个电极片,接通电源。电刺激期间,设置为患者能耐受的最大电流强度,以适量肌肉收缩为宜。1 次 /d,4 次 / 周,持续治疗 4 周。

### 1.3 观察指标

(1)记录两组患者治疗前、治疗 2 周后、治疗 4 周后的排尿症状指标,包括:膀胱内压力、日排尿次数、24 h 单次排尿量、残余尿量、膀胱容量。其中残余尿量及膀胱容量均通过膀胱容量测定仪测量;膀胱内压力采用尿流动力学检查评定。24 h 单次排尿量通过收集两组患者 24h 尿量,取平均值测定。(2)记录两组患者治疗前、治疗 2 周后、治疗 4 周后的膀胱功能积分。其中 0 分:通过反射可自行排尿,排尿及终止排尿受意识控制,残余尿量＜50 mL;1 分:通过反射刺激能自行排尿,排尿及终止排尿缓慢但受意识控制,残余尿量为 50~150 mL;2 分:经反射刺激能排尿, 排尿及终止排尿不完全受意识控制, 残余尿量 150～250 mL;3 分:不能通过反射刺激自行排尿,排尿及终止排尿不受意识控制,膀胱容量低于 400 mL[10]。(3)采用生活质量调查简表(SF-36)[11]评价患者治疗前、治疗 4 周后的生活质量,其中 SF-36 包括情感职能、躯体疼痛、精神健康、活力、生理职能、生理机能、健康状况、社会功能这 8 个维度,每个维度均为 100 分,分数越高,生活质量越好。(4)记录两组患者治疗 4 周后的肾功能损害发生率、尿路感染发生率及泌尿系统造影异常发生率。

### 1.4 统计学方法

数据分析采用 SPSS24.0 软件进行, 计量资料以 ($\bar{x}\pm s$)表示,实施 t 检验,计数资料以[n(%)]表示,实施 $x^2$ 检验,检验标准设置为 $\alpha$=0.05。

## 2 结果

### 2.1 两组排尿症状比较

两组治疗前日排尿次数、残余尿量、24 h 单次排尿量、膀胱内压力、膀胱容量比较差异均无统计学意义($P$>0.05);两组治疗 2 周后、治疗 4 周后日膀胱内压力、24 h 单次排尿量、排尿次数、膀胱容量均较治疗前增加,且研究组高于对照组($P$<0.05);残余尿量均较治疗前降低,且研究组低于对照组($P$<0.05);详见表 1。

### 2.2 膀胱功能比较

两组治疗前膀胱功能积分比较无差异($P$>0.05);两组治疗 2 周后、治疗 4 周后膀胱功能积分均较治疗前下降,且研究组低于对照组($P$<0.05);详见表 2。

### 2.3 两组生活质量比较

两组治疗前情感职能、躯体疼痛、精神健康、活力、生理职能、生理机能、健康状况、社会功能维度评分比较差异无统计学意义($P$>0.05);两组治疗 4 周后情感职能、躯体疼痛、精神健康、活力、生理职能、生理机能、健康状况、社会功能维度评分均升高,且研究组高于对照组($P$<0.05);详见表 3。

表 1 两组排尿症状比较($\bar{x}\pm s$)

Table 1 Comparison of micturition symptoms between the two groups($\bar{x}\pm s$)

| Groups | Time | Number of daily micturition(n/d) | Residual urine volume(mL) | 24 hours of single micturition(ml) | Bladder pressure ($mmH_2O$) | Bladder volume (mL) |
|---|---|---|---|---|---|---|
| Control group (n=48) | Before treatment | 2.26±0.31 | 291.74±16.82 | 46.12±7.61 | 12.92±2.98 | 329.15±16.12 |
| | 2 weeks after treatment | 3.45±0.52[a] | 262.76±17.73[a] | 73.44±7.66[a] | 16.06±2.48[a] | 368.25±17.48[a] |
| | 4 weeks after treatment | 4.96±0.34[ab] | 237.39±20.27[ab] | 91.76±10.23[ab] | 20.18±2.31[ab] | 394.97±20.64[ab] |
| Study group(n=49) | Before treatment | 2.21±0.29 | 289.85±18.33 | 45.79±6.29 | 12.62±2.27 | 328.04±18.36 |
| | 2 weeks after treatment | 4.87±0.38[ac] | 234.38±17.06[ac] | 99.74±7.82[ac] | 22.81±2.76[ac] | 402.67±17.73[ac] |
| | 4 weeks after treatment | 6.79±0.43[abc] | 202.76±16.72[abc] | 134.68±12.79[abc] | 26.45±2.52[abc] | 454.73±16.64[abc] |

表 2 两组膀胱功能比较($\bar{x}\pm s$,分)

Table 2 Comparison of bladder function between the two groups($\bar{x}\pm s$, scores)

| Groups | Before treatment | 2 weeks after treatment | 4 weeks after treatment |
|---|---|---|---|
| Control group(n=48) | 2.97±0.26 | 2.35±0.21[a] | 1.78±0.19[ab] |
| Study group(n=49) | 2.92±0.21 | 1.86±0.24[a] | 1.23±0.14[ab] |
| t | 1.043 | 10.693 | 16.254 |
| *P* | 0.300 | 0.000 | 0.000 |

Note: compared with before treatment, [a]$P<0.05$; compared with 2 weeks after treatment,[b]$P<0.05$.

表 3 两组生活质量比较($\bar{x}\pm s$,分)

Table 3 Comparison of quality of life between the two groups($\bar{x}\pm s$, scores)

| Groups | Time | Emotional function | Physical pain | Mental health | Vitality | Physiological function | Physiological function | Health status | Social function |
|---|---|---|---|---|---|---|---|---|---|
| Control group)n=48) | Before treatment | 46.89±6.30 | 53.27±7.24 | 51.27±7.24 | 55.37±6.83 | 51.27±8.26 | 55.73±6.46 | 54.58±7.32 | 50.28±6.86 |
| | 4 weeks after treatment | 71.09±7.27[a] | 73.19±7.75a | 74.13±6.26[a] | 72.57±7.32[a] | 74.31±7.16[a] | 72.87±7.23[a] | 76.05±6.25[a] | 72.47±8.21[a] |
| Study group (n=49) | Before treatment | 46.26±7.41 | 53.66±7.34 | 50.93±8.68 | 54.95±7.92 | 50.96±7.73 | 55.44±7.66 | 55.06±7.48 | 50.75±7.48 |
| | 4 weeks after treatment | 85.14±7.13[ab] | 83.18±7.73[ab] | 84.92±7.62[ab] | 88.28±7.34[ab] | 86.54±7.25[ab] | 85.14±7.35[ab] | 86.95±7.48[ab] | 88.37±8.61[ab] |

Note: compared with before treatment, [a]$P<0.05$; compared with control group, [b]$P<0.05$.

### 2.4 并发症发生情况比较

研究组并发症总发生率低于对照组($P<0.05$);详见表 4。

## 3 讨论

近年来，随着各种医疗条件的改善和医疗技术的进步,临床中针对 SCI 患者的治疗效果已经有了显著提升,但绝大多数 SCI 患者仍无法彻底治愈,常存在感觉、运动及自主神经等功能障碍,SCI 造成的影响可伴随终身,严重降低其生活质量[12-14]。

表 4 两组并发症发生情况比较例(%)

Table 4 Comparison of complications between the two groups n(%)

| Groups | Urinary tract infection | Renal function damage | Abnormal urography | Total incidence rate |
|---|---|---|---|---|
| Control group(n=48) | 4(8.33) | 6(12.50) | 5(10.42) | 15(31.25) |
| Study group(n=49) | 2(4.08) | 2(4.08) | 1(2.04) | 5(10.20) |
| $\chi^2$ | | | 5.562 | |
| *P* | | | 0.010 | |

NB 作为 SCI 的主要并发症之一，会使患者因膀胱功能障碍而表现出异常的排尿症状，其发生原因可能在于尿潴留造成膀胱充盈膨胀，造成黏膜充血、水肿，加上膀胱内尿液潴留时间过长，导致细菌大量滋生、繁殖，增加尿路感染发生风险，进而诱发 NB[15-17]。此外，SCI 诱发 NB 后还可引起败血症、肾功能不全等，加重病情，甚至导致患者死亡。国内外的研究资料均表明 [18,19]，SCI 诱发 NB 患者的膀胱功能及症状变化均是影响其治疗效果和生存质量的主要因素。针对 SCI 诱发 NB 患者的主要治疗目标为改善临床症状、保护肾功能、减少上尿路的损害、改善膀胱功能，并通过减少并发症来提高其生活质量[20]。既往常规的治疗方法是膀胱功能训练结合间歇导尿，但是这种方法必须将导尿管长期留置于膀胱内，易增加并发症的发生率，最终致使膀胱的容量减小，疗效不甚理想[21]。而低频电刺激治疗对感觉、运动神经都有强的刺激作用，近年来已逐渐应有于 SCI 诱发 NB 的辅助治疗中[22]。

本研究结果显示，低频电刺激结合康复训练治疗 SCI 诱发 NB 患者，可有效改善患者排尿症状及膀胱功能。其作用机制可能如下：低频电刺激可解除脊髓排尿中枢的抑制，诱导排尿反射，使逼尿肌持续收缩，尿道括约肌扩张，进而促进尿液排出，降低膀胱内压力，减少膀胱内残余尿量[23,24]。此外，低频电刺激可兴奋膀胱神经，进而有效改善膀胱局部的血液循环，促进膀胱排尿功能恢复[25]。当机体膀胱功能正常时，其具备低压储存和意愿排泄这两方面的功能，同时呈周期性变换。而低频电刺激具有选择性激活骶神经根中支配膀胱逼尿肌的直径较小副交感神经的作用，骶神经根主要包含支配尿道括约肌的粗大神经纤维和支配膀胱逼尿肌的细小神经纤维以及下肢肌肉的神经纤维，低频电刺激时可先激活粗大神经纤维，其次再激活细胞的神经纤维，故而在治疗时，尿道括约肌总是先于膀胱逼尿肌收缩，导致前者压力高于后者，膀胱无法排除尿液。而当电刺激结束后，尿道压力立即下降，而膀胱压力可缓慢下降，在这段时间内排尿可刺激膀胱功能恢复，从而改善排尿症状[26-28]。此外，两组患者生活质量均有所改善，且低频电刺激结合康复训练治疗者的改善效果更佳。推测其原因为低频电刺激具有安全、有效、无创、廉价等优势，且治疗期间设定多种安全装置：过流保护、短路保护、过压保护、输出强度自动锁定装置，可更为精确的控制对患者的电刺激，促进其功能恢复。治疗过后患者症状得到显著改善，有效促进膀胱反射性机制的建立，使疾病对患者日常生活及功能的影响随着病情的缓解而减轻，同时还能树立起患者战胜疾病的信心[29]。另外，低频电刺激结合康复训练治疗可有效减少 SCI 诱发 NB 患者的并发症，这主要是因为低频电刺激结合康复训练治疗可有效缓解患者的各种症状，减少机体组织受到的压迫且可改善新陈代谢、减轻受损组织水肿等，最终推进受损部位循环修复，并进一步减少并发症发生风险[30]。

综上所述，低频电刺激结合康复训练治疗 SCI 诱发 NB 患者，可有效改善患者排尿症状，提高其膀胱功能及生活质量，同时还可减少并发症发生率，具有一定的临床应用价值。

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