·临床研究·

视神经脊髓炎谱系疾病患者步态分析及跌倒风险评价

丛卉 袁望舒 刘颖 王含 徐雁

【摘要】 **目的** 比较视神经脊髓炎谱系疾病患者与正常对照者的步态、平衡功能和行走能力，评价视神经脊髓炎谱系疾病患者的跌倒风险。**方法** 共12例视神经脊髓炎谱系疾病患者和9例性别、年龄相匹配的正常对照者，采用德国RehaWatch步态分析系统测定步态周期参数（包括步频、步时、步长、步速、步行各时相对称性），Berg平衡量表（BBS）评价平衡功能，起立-行走计时测验（TUGT）、站起测验和走直线步态测验（TGT）评价行走能力。**结果** 与正常对照者相比，视神经脊髓炎谱系疾病患者步态周期中步频减慢（t = - 5.354，P = 0.000）、步时延长（t = 4.045，P = 0.005）、步长减小（t = - 7.243，P = 0.000）、步速减慢（t = - 10.161，P = 0.000）、支撑相对称性（t = - 2.220，P = 0.050）和单脚支撑对称性（t = - 2.359，P = 0.020）降低，以及TUGT测验计时增加（t = 3.197，P = 0.024），TGT测验步数减少（Z = - 1.544，P = 0.049）。BBS量表中静态平衡相关项目（包括无支持站立、无靠背坐位等）评分较高比例明显高于动态平衡相关项目（包括站立位从地面捡起物品等）。**结论** 视神经脊髓炎谱系疾病患者步态周期参数异常，平衡功能下降，尤以动态平衡显著，存在跌倒风险，可以通过增强下肢肌力和平衡功能等予以改善。

【关键词】 视神经脊髓炎； 步态； 运动障碍

Gait analysis and evaluation of fall risk in patients with neuromyelitis optica spectrum disorders

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【**Abstract**】 **Objective** To investigate the time-distance parameters of gait, balance function and mobility performance in patients with neuromyelitis optica spectrum disorders (NMOSDs) compared with healthy subjects, so as to evaluate the fall risk in NMOSDs patients. **Methods** Twelve patients with NMOSDs and 9 healthy subjects with matched age and sex were enrolled in this study. The time-distance parameters of gait (including cadence, stride duration, stride length, gait velocity, symmetry of phases) were assessed using RehaWatch Gait Analysis System. The fall risk was evaluated by Berg Balance Scale (BBS), Timed Up and Go Test (TUGT), Chair Rising Test (CRT) and Tandem Gait Test (TGT). **Results** Compared with control group, patients in NMOSDs group had slower cadence (t = - 5.354, P = 0.000), prolonged stride duration (t = 4.045, P = 0.005), lower stride length (t = - 7.243, P = 0.000), slower gait velocity (t = - 10.161, P = 0.000), decreased symmetry of stance phase (t = - 2.220, P = 0.050) and symmetry of single support phase (t = - 2.359, P = 0.020), spent more seconds in performing TUGT (t = 3.197, P = 0.024) and finished fewer numbers of steps on TGT (Z = - 1.544, P = 0.049). In BBS, items related to static balance (including nonsupported stand and sit) got higher scores than items related to dynamic balance (including picking up something on the floor when standing). **Conclusions** NMOSDs patients had abnormal time-distance parameters in gait cycle, decreased balance function, especially dynamic balance, and higher fall risk. They can be improved by enhancing muscle force of lower limb and balance function.

【**Key words**】 Neuromyelitis optica; Gait; Movement disorders

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视神经脊髓炎谱系疾病(NMOSDs)是中枢神经系统炎症性疾病,以免疫介导的脱髓鞘和轴索损伤为特征,主要累及视神经和脊髓,反复发作、进行性加重,最终导致严重功能障碍[1]。视神经脊髓炎谱系疾病运动系统相关症状主要表现为肢体无力、感觉缺失[2],进而影响平衡功能和行走能力,然而目前相关定量研究较少。本研究比较视神经脊髓炎谱系疾病患者与正常对照者的步态、平衡功能和行走能力,以期评价视神经脊髓炎谱系疾病患者的跌倒风险。

资料与方法

一、临床资料

1. 纳入标准 (1)视神经脊髓炎谱系疾病的诊断符合2015年诊断标准[3]。(2)本研究经北京协和医院道德伦理委员会审核批准,所有患者或其家属均知情同意并签署知情同意书。

2. 排除标准 无法独立行走10 m;伴其他神经系统疾病和肌肉骨骼系统疾病。

3. 一般资料 (1)视神经脊髓炎谱系疾病组(NMOSDs组):选择多发性硬化(MS)和视神经脊髓炎谱系疾病数据库[4](由北京协和医院神经科建立于2011年)中2016年1–10月在北京协和医院就诊的视神经脊髓炎谱系疾病患者共12例,均为女性;年龄28~67岁,平均为(43.83±13.33)岁;发病年龄6~60岁,中位年龄34.52(29.71,52.02)岁;病程0.17~22.00年,中位病程3.13(0.65,11.52)年;病变位于脊髓1例(8.33%),大脑和脊髓1例(8.33%),视神经和脊髓4例(33.33%),脑干和脊髓3例(25%),视神经、脑干和脊髓1例(8.33%),大脑、脑干和脊髓1例(8.33%),视神经、大脑、脑干和脊髓1例(8.33%)。(2)正常对照组(对照组):选择同期在我院进行体格检查的健康志愿者共9例,可独立行走10 m,无其他神经系统疾病和肌肉骨骼系统疾病;均为女性,年龄26~70岁、平均(49.33±16.54)岁。两组受试者性别(Fisher确切概率法:$P=1.000$)和年龄($t=-0.814$,$P=0.436$)差异无统计学意义。

二、研究方法

1. 步态分析 采用RehaWatch步态分析系统(德国Hasomed GmbH公司)对两组受试者进行步态分析,观察指标包括步频、步时、步长、步速和步行各时相对称性,其中,对称性的计算公式为对称性指数(SI)=最小值(左侧或右侧)/最大值(左侧或右侧)×100%[5],理想值为100%。

2. 平衡功能和行走能力评价 采用Berg平衡量表(BBS)评价平衡功能,起立-行走计时测验(TUGT)、站起测验(CRT)和走直线步态测验(TGT)评价行走能力。(1)BBS量表[6]:广泛应用于存在平衡障碍的患者群体中[6-9],具有良好的信度和效度。包括坐位站起、无支持站立、无靠背坐位、站立位坐下、转移、无支持闭目站立、双脚并拢站立、站立位上肢前伸、站立位从地面捡起物品、站立位转身向后看、360°转身、无支持站立时将单脚放在台阶上、单脚在前的无支持站立和单脚站立共14项内容,每项内容分为0~4分,总评分56分,评分越低、平衡功能越差。其中,41~56分为低跌倒风险,21~40分为中跌倒风险,≤20分为高跌倒风险。(2)TUGT测验[10-13]、CRT测验[11]和TGT测验[11]:是简单、快速、定量评价行走能力的方法,主要用于评价平衡障碍患者和老年人行走能力。TUGT测验嘱患者坐在靠背椅上,距离座椅3 m的地面上有一粗线标记,患者靠于椅背,以最快速度起身、向前走3 m、双脚越过粗线标记后转身、回到座椅前、转身坐下并靠于椅背,记录背部离开椅背到背部再次靠到椅背的时间,所用时间越短、平衡功能和行走能力越佳。CRT测验嘱患者坐在座椅上,双手扶对侧肩膀,以最快速度连续坐位、站起5次,记录离开座椅至5次结束后再次接触座椅的时间,所用时间越短、平衡功能越佳。TGT测验嘱患者站立位,沿地面一直线双脚交替向前、无间距连续行走8步,记录能够平稳完成的步数,所完成的步数越多、平衡功能越佳。

3. 统计分析方法 采用SPSS 19.0统计软件进行数据处理与分析。计数资料以相对数构成比(%)或率(%)表示,采用Fisher确切概率法。正态性检验采用Kolmogorov-Smirnov检验,方差齐性检验采用Levene检验。呈正态分布的计量资料以均数±标准差($\bar{x}\pm s$)表示,采用两独立样本的t检验;呈非正态分布的计量资料以中位数和四分位数间距[$M(P_{25},P_{75})$]表示,采用Mann-Whitney U检验。以$P\leq 0.05$为差异具有统计学意义。

结 果

一、步态分析

与对照组相比,NMOSDs组患者步态周期中步频减慢($P=0.000$)、步时延长($P=0.005$)、步长减小($P=0.000$)、步速减慢($P=0.000$)、支撑相对称性

表1 两组受试者步态周期各项参数的比较($\bar{x} \pm s$)

Table 1. Comparison of time-distance parameters in gait cycle between 2 groups ($\bar{x} \pm s$)

Item	Control (N = 9)	NMOSDs (N = 12)	*t* value	*P* value
Cadence (step/min)	116.52 ± 7.25	98.25 ± 11.33	- 5.354	0.000
Stride duration (s)	1.05 ± 0.09	1.24 ± 0.15	4.045	0.005
Stride length (m)	1.32 ± 0.11	0.94 ± 0.20	- 7.243	0.000
Gait velocity (m/s)	1.12 ± 0.16	0.69 ± 0.17	- 10.161	0.000
Symmetry of stance phase (%)	98.92 ± 0.52	96.02 ± 4.54	- 2.220	0.050
Symmetry of mid stance phase (%)	95.40 ± 3.02	92.77 ± 5.27	- 1.420	0.166
Symmetry of pre-swing phase (%)	93.83 ± 4.93	86.62 ± 12.60	- 1.636	0.091
Symmetry of initial double support phase (%)	94.29 ± 5.78	88.79 ± 8.42	- 1.411	0.109
Symmetry of single support phase (%)	97.59 ± 1.41	90.74 ± 8.66	- 2.359	0.020
Symmetry of final double support phase (%)	92.09 ± 5.83	90.07 ± 9.20	- 0.483	0.570
Symmetry of minimum foot angle (%)	95.67 ± 3.16	89.65 ± 11.61	- 1.125	0.148
Symmetry of maximum foot angle (%)	89.36 ± 6.33	80.05 ± 17.58	- 1.762	0.116

NMOSDs, neuromyelitis optica spectrum disorders, 视神经脊髓炎谱系疾病

表2 两组受试者平衡功能和行走能力的比较

Table 2. Comparison of balance function and mobility performance between 2 groups

Group	N	BBS ($\bar{x} \pm s$, score)	TUGT ($\bar{x} \pm s$, s)
Control	9	53.83 ± 1.84	8.05 ± 1.58
NMOSDs	12	44.17 ± 10.36	19.58 ± 8.94
t value		- 2.174	3.197
P value		0.082	0.024
Group	N	CRT ($\bar{x} \pm s$, s)	TGT [*M* (P_{25}, P_{75}), step]
Control	9	9.88 ± 2.17	7.00 (5.50, 8.00)
NMOSDs	12	16.38 ± 10.66	3.50 (0.00, 7.75)
t or *Z* value		1.436	- 1.544
P value		0.211	0.049

Mann-Whitney *U* test for comparison of TGT, and two-independent-sample *t* test for comparison of BBS, TUGT and CRT。NMOSDs, neuromyelitis optica spectrum disorders, 视神经脊髓炎谱系疾病; BBS, Berg Balance Scale, Berg平衡量表; TUGT, Timed Up and Go Test, 起立-行走计时测验; CRT, Chair Rising Test, 站起测验; TGT, Tandem Gait Test, 走直线步态测验

($P = 0.050$)和单脚支撑对称性($P = 0.020$)降低且差异有统计学意义,而其他步态周期参数组间差异无统计学意义(均$P > 0.05$,表1)。

二、平衡功能和行走能力评价

与对照组相比,NMOSDs组患者TUGT测验计时增加($P = 0.024$)、TGT测验步数减少($P = 0.049$)且差异有统计学意义,而BBS评分和CRT测验计时组间差异无统计学意义(均$P > 0.05$,表2)。

NMOSDs组患者BBS量表结果显示,静态平衡相关项目(包括无支持站立、无靠背坐位等)评分较高(3和4级)比例明显高于动态平衡相关项目(包括站立位从地面捡起物品等);此外,双脚并拢站立、站立位从地面捡起物品、单脚在前的无支持站立和单脚站立共4项内容中均存在不能完成的患者。

讨 论

视神经脊髓炎谱系疾病特征性表现为急性发作的双侧视神经炎或短期内相继出现的视神经炎,以及横贯性脊髓炎(TM),其中,脊髓炎常引起肢体无力、感觉减退和膀胱功能障碍[14],可能于数周或数月后不同程度恢复[15]。视神经脊髓炎谱系疾病女性发病率是男性的10倍[16]。由于其自然病程出现反复发作[2],可以导致运动障碍和感觉障碍累积加重,进而影响患者平衡功能和行走能力,可能存在跌倒风险。

本研究纳入的研究对象均为女性,无性别偏倚,从侧面提示女性视神经脊髓炎谱系疾病发病率高于男性的流行病学特点。步态分析结果显示,NMOSDs组患者步态周期中步频、步长和步速低于对照组,步时长于对照组,提示视神经脊髓炎谱系疾病患者行走能力明显下降,可能与病变累及脊髓致肌力下降有关;步行各时相对称性如支撑相对称性和单脚支撑对称性均低于对照组,考虑单脚支撑相对于下肢肌力的要求较步态周期的其他时相更高,亦可能与肌力下降有关。平衡功能和行走能力评价结果显示,NMOSDs组患者BBS评分(44.17 ± 10.36)分,低于正常参考值(56分),提示视神经脊髓炎谱系疾病患者平衡功能下降,特别是动态平衡和需要单侧下肢支撑的相关项目评分较低。Demura等[17]研究显示,视神经脊髓炎谱系疾病患者发生的姿势性不稳定与深感觉障碍密切相关,这也可能是视神经脊髓炎谱系疾病患者平衡功能下降的原因之一。NMOSDs组患者TUGT测验计时长于、TGT测验步数少于对照组,提示视神经脊髓炎谱系疾病患者存在较高的跌倒风险[6,10-12,18-20];尽管两组受试者CRT测试计时差异无统计学意义,但NMOSDs组患者CRT测验计时为(16.38 ± 10.66)秒,高于正常参考值(10秒),仍提示视神经脊髓炎谱系疾病患者跌

倒风险增加[21],亦提示下肢肌力下降[22-23]。因此,本研究结果提示视神经脊髓炎谱系疾病患者的跌倒风险高于正常对照者,应通过增强下肢肌力和平衡功能等予以改善,以减少跌倒事件及由此继发的功能障碍。

本研究仅观察视神经脊髓炎谱系疾病患者步态周期中时间和距离参数、平衡功能和行走能力,样本量较小,疾病未分层,且步态分析中未测定动力学参数、未连续观察,故视神经脊髓炎谱系疾病患者步态异常原因等相关信息尚待进一步研究。

视神经脊髓炎谱系疾病患者步态周期中时间和距离参数存在异常,步行各时相对称性尚可,可能与肌力下降有关;平衡功能下降,尤以动态平衡显著,同时存在跌倒风险,可以通过增强下肢肌力和平衡功能等予以改善。

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