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· 论 著 ·

## 霍夫曼征对颈椎退变性疾病患者临床表现和术后功能恢复的预测价值

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**[摘要]** **目的** 探究霍夫曼征在颈椎退变性疾病中的临床应用价值。**方法** 回顾性分析2017年6月至2019年1月在我科接受颈椎前路减压融合术的104例颈椎退变性疾病患者资料,包括霍夫曼征阳性患者49例、阴性患者55例,术后随访至少12个月。评估两组患者的一般临床表现、临床体征、MRI影像学特征、术前临床评分、围手术期并发症和术后神经功能恢复情况。采用ROC曲线评估霍夫曼征与术前临床评分的关系。**结果** 与霍夫曼征阴性组相比,霍夫曼征阳性组患者多表现为术前脊髓高信号,术前日本骨科协会(JOA)评分和Nurick评分较差( $P$ 均 $<0.05$ )。ROC曲线分析结果显示,霍夫曼征预测术前JOA评分的灵敏度为85.29%,特异度为42.22%,AUC为0.666(95%CI 0.547~0.785,  $P=0.012$ );预测Nurick评分的灵敏度为67.65%,特异度为75.56%,AUC为0.731(95%CI 0.618~0.845,  $P<0.01$ )。JOA亚项评分分析结果显示,与霍夫曼征阴性组相比,霍夫曼征阳性组患者的术前上肢运动功能和下肢感觉功能均较差( $P$ 均 $<0.01$ )。ROC曲线分析结果显示,霍夫曼征预测上肢运动功能的灵敏度为47.06%,特异度为80.00%,AUC为0.679(95%CI 0.561~0.798,  $P=0.007$ );预测下肢感觉功能的灵敏度为44.12%,特异度为84.45%,AUC为0.660(95%CI 0.536~0.783,  $P=0.016$ )。两组患者围手术期并发症发生率差异无统计学意义。与霍夫曼征阴性组相比,霍夫曼征阳性组患者术后末次随访时神经功能恢复率较低,上肢运动功能和下肢感觉功能均较差( $P$ 均 $<0.05$ )。**结论** 霍夫曼征能够反映颈椎退变性疾病患者的术前临床表现和术后功能恢复状态,尤其对预测上肢运动和下肢感觉功能恢复有较高的临床价值。

**[关键词]** 霍夫曼征; 颈椎退变性疾病; 临床表现; 诊断; 治疗

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### Role of Hoffmann sign in predicting the clinical manifestation and postoperative functional recovery of patients with degenerative cervical disorder

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**[Abstract]** **Objective** To explore the clinical value of Hoffmann sign in patients with degenerative cervical disorder. **Methods** The clinical data of 104 patients with degenerative cervical disorder who underwent anterior cervical decompression and fusion in our department from Jun. 2017 to Jan. 2019 were retrospectively analyzed, including 49 Hoffmann sign-positive patients and 55 Hoffmann sign-negative patients. The patients were followed up for at least 12 months. The general clinical manifestations, clinical signs, magnetic resonance imaging (MRI), preoperative clinical scores, perioperative complications and postoperative neurological function recovery were evaluated. The correlations between Hoffmann sign and preoperative clinical scores were evaluated by the receiver operating characteristic (ROC) curve. **Results** Compared with the Hoffmann sign-negative group, the patients in the Hoffmann sign-positive group had more hyperintense spinal cord and worse preoperative Japanese Orthopaedic Association (JOA) and Nurick scores (all  $P<0.05$ ). ROC curve analysis showed that the sensitivity, specificity and area under curve (AUC) of Hoffmann sign were 85.29%, 42.22% and 0.666 (95% confidence interval [CI] 0.547-0.785,  $P=0.012$ ) in predicting preoperative JOA score and were 67.65%, 75.56% and 0.731 (95% CI 0.618-0.845,  $P<0.01$ ) in predicting Nurick score, respectively. JOA score in isolation analysis showed that the upper limb motor function and lower limb sensory function of the patients were worse in the Hoffmann sign-positive group than in the Hoffmann sign-negative group (both  $P<0.01$ ). ROC curve analysis showed that the sensitivity, specificity and AUC of Hoffmann sign were 47.06%, 80.00% and 0.679 (95% CI 0.561-0.798,  $P=0.007$ ) in

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predicting upper limb motor function and were 44.12%, 84.45% and 0.660 (95% CI 0.536-0.783,  $P=0.016$ ) in predicting lower limb sensory function, respectively. There was no significant difference in the incidence of perioperative complications between the 2 groups. At the final follow-up, the postoperative functional recovery rate was lower, and the upper limb motor function and lower limb sensory function of the patients were worse in the Hoffmann sign-positive group than in the Hoffmann sign-negative group (all  $P<0.05$ ). **Conclusion** Hoffmann sign can be used as a reliable clinical index to reflect the preoperative clinical presentation and postoperative functional recovery of patients with degenerative cervical disorder, especially to predict the recovery of upper limb motor function and lower limb sensory function.

[Key words] Hoffmann sign; degenerative cervical disorders; clinical manifestations; diagnosis; treatment

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颈椎退变性疾病是55岁以上人群最常见的颈椎病之一,临床上主要表现为脊髓的慢性压迫<sup>[1-2]</sup>。在病理学上,随着患者颈椎退变性疾病的进展,骨赘形成、韧带组织硬化、椎间盘退变和突出等一系列改变都会造成脊髓的慢性压迫性损伤<sup>[2]</sup>。颈椎退变性疾病患者常常表现为反射亢进、肢体麻木、上肢感觉障碍和放射性症状<sup>[3]</sup>,这些神经功能损伤明显降低了患者的独立生活能力和生活质量。

MRI是临床上诊断颈椎退变性疾病的重要手段。然而,MRI检查往往需要较长的预约时间和较昂贵的费用,多数患者在首诊时只有普通的颈椎X线片。还有部分患者早期临床症状不明显,从而延误诊疗。因此,寻找一个能够反映脊髓损伤状态的可靠指标,不仅能使患者防患于未然,而且对于预测患者术后的恢复有重要价值。

霍夫曼征由Curschmann在1911年首次提出,其意义在后来的几十年中被进一步丰富<sup>[4]</sup>。研究发现,霍夫曼征阳性能够提示上运动神经元损害<sup>[5]</sup>。霍夫曼征属于一种神经病理反射,常见于脑血管疾病等,也可见于颈椎病变。对于颈椎病患者,霍夫曼征阳性往往提示颈脊髓损伤,一般同时伴有肌张力高、持物或走路不稳等锥体束征表现。研究表明霍夫曼征能够有效反映颈椎脊髓压迫情况<sup>[6]</sup>,但一些颈椎退变性疾病患者并未表现出霍夫曼征<sup>[7-8]</sup>。本研究主要探究霍夫曼征与颈椎退变性疾病患者术前临床表现的关系及其对预测术后恢复的价值。

## 1 资料和方法

1.1 病例资料 回顾性分析2017年6月至2019年1月在我院接受颈椎前路减压融合术的201例颈椎退变性疾病患者的临床资料。纳入标准:(1)患者具有典型的颈椎脊髓压迫症状(上肢无力和麻木、手指灵活度降低、下肢行走不稳、神经性疼

痛、大小便障碍及异常病理反射等)<sup>[2]</sup>;(2)保守治疗6个月以上,患者症状无明显改善甚至加重;(3)临床资料记录完整;(4)不合并胸椎或腰椎部位的疾病;(5)MRI检查提示神经组织压迫。排除标准:(1)曾因其他疾病(创伤、感染或肿瘤)而行脊柱手术;(2)具有胸椎或腰椎神经组织压迫性症状;(3)伴有其他神经系统疾病,如帕金森病或阿尔茨海默病;(4)患有先天性或后天性脊柱畸形。本研究通过我院伦理委员会审批。

1.2 术前临床表现评估 患者临床常规体征检查包括霍夫曼征<sup>[3]</sup>、巴宾斯基征<sup>[9]</sup>、膝反射和跟腱反射,均由2位具有至少4年临床工作经验的脊柱外科主治医师在入院后2h内、不知晓患者最初临床诊断和术前影像学信息的情况下独立完成。最终的诊断取决于2位医师一致的诊断结果,如果存在分歧则由1位脊柱外科主任医师做出最后决定。

1.3 临床评分和围手术期并发症评估 所有患者术后随访至少12个月。采用视觉模拟量表(visual analogue scale, VAS)评估患者的疼痛症状。采用日本骨科协会(Japanese Orthopaedic Association, JOA)评分、Nurick评分和颈椎功能障碍指数(neck disability index, NDI)评分评价神经功能症状,并计算JOA评分、Nurick评分和NDI评分改善率:JOA评分改善率(%)=(术后JOA评分-术前JOA评分)/(17-术前JOA评分)×100%, Nurick评分和NDI评分改善率(%)=(术前评分-术后评分)/术前评分×100%。为了探究霍夫曼征对于患者术前神经功能的影响,进一步分析JOA亚项(上肢和下肢运动功能、上肢和下肢感觉功能、躯干感觉功能、膀胱功能)评分。记录患者围手术期并发症的发生情况。

1.4 统计学处理 应用GraphPad Prism 8软件进行统计学分析。呈正态分布的计量资料以 $\bar{x}\pm s$ 表示,

两组间比较采用独立样本  $t$  检验。呈偏态分布的计量资料以中位数（范围）表示，两组间比较采用 Mann-Whitney  $U$  检验。计数资料以例数和百分数表示，两组间比较采用  $\chi^2$  检验。采用 ROC 曲线评估霍夫曼征预测术前临床评分的价值。检验水准（ $\alpha$ ）为 0.05。

## 2 结果

2.1 一般资料 共 104 例患者入组，其中霍夫曼征阳性组 49 例，男 36 例、女 13 例，年龄为 54（32~77）岁；霍夫曼征阴性组 55 例，男 32 例、女 23 例，年龄为 56（28~78）岁。由表 1 可见，两组患者的性别、年龄、随访时间差异均无统计学意义（ $P$  均  $>0.05$ ）；相比霍夫曼征阴性组，霍夫曼征阳性组患者术前有较长的临床症状周期（ $P < 0.01$ ）；关于脊髓压迫水平，两组患者均以  $C_{4/5}$  和  $C_{5/6}$  节段最常见；与霍夫曼征阴性组相比，霍夫曼征阳性组患者具有更高比例的膝反射亢进、跟腱

反射亢进和脊髓高信号影（ $P$  均  $<0.05$ ）；在临床诊断方面，霍夫曼征阳性组脊髓型颈椎病 31 例（63.3%）、颈椎管狭窄症 12 例（24.5%）、神经根型颈椎病 6 例（12.2%），霍夫曼征阴性组脊髓型颈椎病 12 例（21.8%）、颈椎管狭窄症 33 例（60.0%）、神经根型颈椎病 10 例（18.2%），两组患者术前临床诊断差异有统计学意义（ $P < 0.01$ ）。  
2.2 术前临床评分 相比霍夫曼征阴性组，霍夫曼征阳性组患者术前有较差的 JOA 评分和 Nurick 评分（ $P < 0.05$ ），但两组患者术前 VAS 评分和 NDI 评分比较差异均无统计学意义（ $P$  均  $>0.05$ ，表 1）。ROC 曲线分析结果（图 1）显示，霍夫曼征可作为患者术前 JOA 和 Nurick 评分的预测指标，其预测术前 JOA 评分的灵敏度为 85.29%，特异度为 42.22%，AUC 为 0.666（95% CI 0.547~0.785， $P=0.012$ ）；预测 Nurick 评分的灵敏度为 67.65%，特异度为 75.56%，AUC 为 0.731（95% CI 0.618~0.845， $P < 0.01$ ）。

表 1 霍夫曼征阳性和阴性组颈椎退变性疾病患者的术前一般资料  
Tab 1 Preoperative general information of patients with degenerative cervical disorder in Hoffmann sign-positive and -negative groups

Item	Negative $N=55$	Positive $N=49$	Statistic	$P$ value
Gender, $n$ (%)			$\chi^2=2.676$	0.102
Male	32 (58.2)	36 (73.5)		
Female	23 (41.8)	13 (26.5)		
Age/year, median (range)	56 (28-78)	54 (32-77)	$U=846.5$	0.859
Duration of symptoms/month, median (range)	4.0 (0.5-120.0)	12.0 (1.0-156.0)	$U=846.5$	0.001
Clinical diagnosis, $n$ (%)			$\chi^2=18.911$	$<0.01$
Cervical spondylotic myelopathy	12 (21.8)	31 (63.3)		
Cervical spinal stenosis	33 (60.0)	12 (24.5)		
Cervical spondylotic radiculopathy	10 (18.2)	6 (12.2)		
Follow-up period/month, $\bar{x} \pm s$	16.0 $\pm$ 3.9	16.7 $\pm$ 5.2	$t=0.582$	0.563
Knee hyperreflexia, $n$ (%)	34 (61.8)	48 (98.0)	$\chi^2=20.294$	$<0.01$
Achilles tendon hyperreflexia, $n$ (%)	15 (27.3)	35 (71.4)	$\chi^2=20.240$	$<0.01$
Compressed level, $n$ (%)				
$C_{2/3}$	5 (9.1)	0	$\chi^2=4.680$	0.059
$C_{3/4}$	36 (65.5)	31 (63.3)	$\chi^2=0.054$	0.816
$C_{4/5}$	44 (80.0)	42 (85.7)	$\chi^2=0.591$	0.442
$C_{5/6}$	51 (92.7)	46 (93.9)	$\chi^2=0.055$	0.815
$C_{6/7}$	39 (70.9)	24 (49.0)	$\chi^2=5.218$	0.022
Intramedullary hyperintensity, $n$ (%)	20 (36.4)	29 (59.2)	$\chi^2=5.416$	0.027
Clinical score				
JOA score, $\bar{x} \pm s$	12.3 $\pm$ 2.8	10.8 $\pm$ 2.7	$t=2.092$	0.040
Nurick score, median (range)	2.0 (1.0-5.0)	3.0 (1.0-5.0)	$U=411.0$	$<0.01$
NDI score, median (range)	18.0 (5.0-33.0)	18.0 (4.0-33.0)	$U=736.5$	0.781
VAS score, median (range)	4.0 (0.0-10.0)	4.0 (0.0-10.0)	$U=660.5$	0.292

JOA: Japanese Orthopaedic Association; NDI: Neck disability index; VAS: Visual analogue scale.

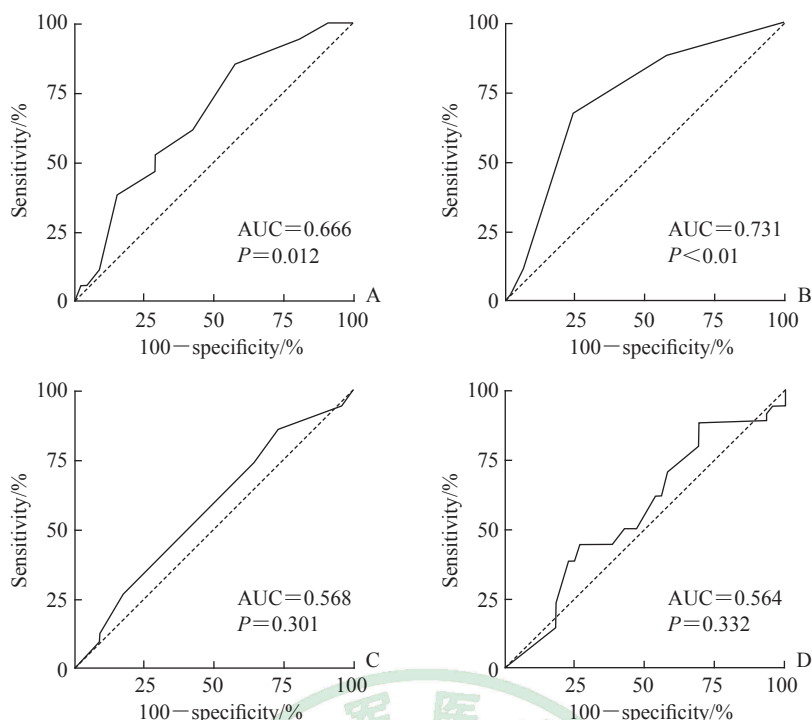


图1 霍夫曼征预测颈椎退变性疾病患者术前临床评分的ROC曲线

Fig 1 ROC curves of Hoffmann sign in predicting preoperative clinical scores of patients with degenerative cervical disorder

A: ROC curve of Hoffmann sign in predicting JOA score; B: ROC curve of Hoffmann sign in predicting Nurick score; C: ROC curve of Hoffmann sign in predicting VAS score; D: ROC curve of Hoffmann sign in predicting NDI score. ROC: Receiver operating characteristic; JOA: Japanese Orthopaedic Association; VAS: Visual analogue scale; NDI: Neck disability index; AUC: Area under curve.

JOA亚项评分分析结果(表2)显示,与霍夫曼征阴性组相比,霍夫曼征阳性组患者的术前上肢运动功能和下肢感觉功能均较差( $P$ 均 $<0.01$ )。预测下肢运动功能的灵敏度为79.41%,特异度为44.44%,AUC为0.629(95%CI 0.506~0.753, $P=0.007$ );预测下肢感觉功能的灵敏度为44.12%,特异度为84.45%,AUC为0.660(95%CI 0.536~0.783, $P=0.016$ )。预测上肢运动功能的灵敏度为47.06%,特异度为80.00%,AUC为0.679(95%CI 0.561~0.798,P=0.007)。

表2 霍夫曼征阳性和阴性组颈椎退变性疾病患者的术前JOA亚项评分

Tab 2 Preoperative JOA score in isolation of patients with degenerative cervical disorder in Hoffmann sign-positive and -negative groups

Item	Negative N=55	Positive N=49	Statistic	P value
Upper limb				
Motor function, $\bar{x} \pm s$	2.9 $\pm$ 0.6	2.4 $\pm$ 0.6	$t=3.518$	0.001
Sensory function, median (range)	0.0 (0.0-2.0)	0.0 (0.0-1.0)	$U=674.0$	0.269
Lower limb				
Motor function, median (range)	3.0 (0.0-4.0)	3.0 (2.0-4.0)	$U=663.0$	0.293
Sensory function, median (range)	2.0 (0.0-3.0)	1.0 (0.0-2.0)	$U=521.0$	0.009
Sensory function of trunk, median (range)	2.0 (0.0-3.0)	2.0 (0.0-2.0)	$U=747.0$	0.832
Bladder function, median (range)	3.0 (1.0-3.0)	3.0 (1.0-3.0)	$U=719.0$	0.493

JOA: Japanese Orthopaedic Association.

2.3 术后临床评分和围手术期并发症情况 末次随访时,霍夫曼征阳性组患者的JOA评分和Nurick评分及其恢复率与霍夫曼征阴性组相比均较差( $P$ 均 $<0.05$ ),但两组患者的NDI评分和VAS评分差异均无统计学意义( $P$ 均 $>0.05$ ,表3)。JOA

亚项评分分析结果显示,霍夫曼征阳性组患者末次随访时上肢运动功能和下肢感觉功能得分与霍夫曼征阴性组患者相比均较低[3.5(2.0~4.0)分 vs 4.0(3.0~4.0)分、2.0(0.0~2.0)分 vs 2.0(1.0~3.0)分],差异均有统计学意义( $P$ 均 $<0.05$ );而上

肢感觉功能和下肢运动功能得分与霍夫曼征阴性组相比 [1.0 (0.0~2.0) 分 vs 2.0 (0.0~2.0) 分、4.0 (2.0~4.0) 分 vs 4.0 (2.0~4.0) 分] 差异均无统计学意义 ( $P$ 均 $>0.05$ )。对于围手术期并发症,霍夫曼征阳性组 3 例患者出现 C<sub>5</sub> 神经根麻痹, 3 例表现出轴性疼痛, 5 例出现吞咽困难, 2 例表现出

声音嘶哑, 1 例出现神经功能恶化; 霍夫曼征阴性组患者中 1 例出现 C<sub>5</sub> 神经根麻痹, 3 例表现出轴性疼痛, 4 例出现吞咽困难, 2 例表现出声音嘶哑, 1 例出现神经功能恶化; 两组患者围手术期并发症的发生率差异无统计学意义 ( $P>0.05$ , 表 3)。

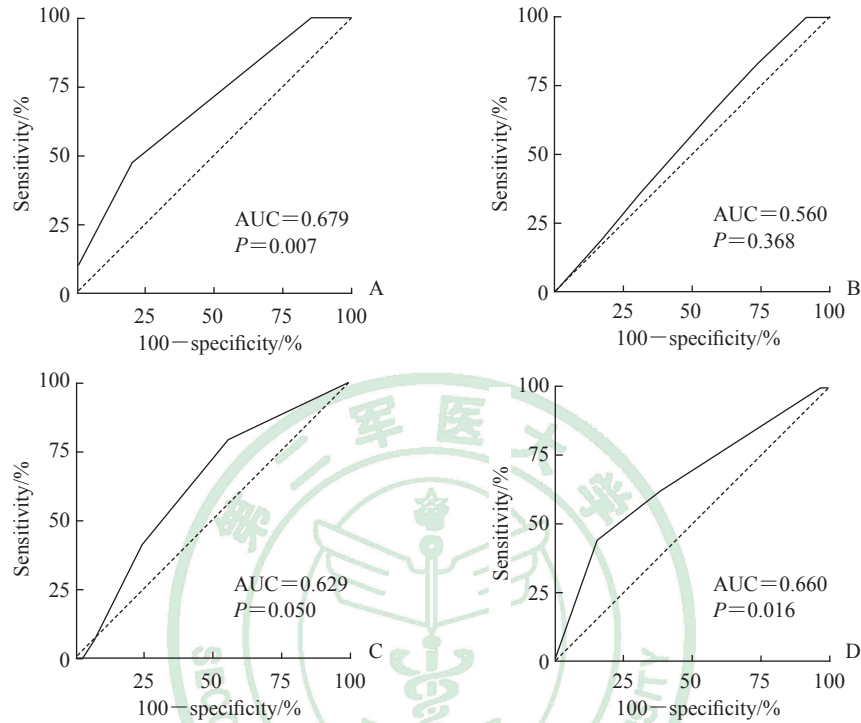


图 2 霍夫曼征预测颈椎退变性疾病患者术前 JOA 亚项评分的 ROC 曲线

**Fig 2 ROC curves of Hoffmann sign in predicting JOA score in isolation of patients with degenerative cervical disorder**  
 A: ROC curve of Hoffmann sign in predicting upper limb motor function; B: ROC curve of Hoffmann sign in predicting upper limb sensory function; C: ROC curve of Hoffmann sign in predicting lower limb motor function; D: ROC curve of Hoffmann sign in predicting lower limb sensory function. JOA: Japanese Orthopaedic Association; ROC: Receiver operating characteristic; AUC: Area under curve.

表 3 霍夫曼征阳性和阴性组颈椎退变性疾病患者术后末次随访时临床评分和围手术期并发症

**Tab 3 Clinical scores at final follow-up and perioperative complications of patients with degenerative cervical disorder in Hoffmann sign-positive and -negative groups**

Item	Negative N=55	Positive N=49	Statistic	P value
Clinical score, median (range)				
JOA score	16.0 (13.0-17.0)	15.0 (7.0-17.0)	$U=540.5$	0.021
Nurick score	0.0 (0.0-5.0)	1.0 (0.0-3.0)	$U=340.0$	$<0.01$
VAS score	2.0 (0.0-8.0)	2.0 (0.0-8.0)	$U=669.0$	0.313
NDI score	6.0 (0.0-22.0)	7.0 (0.0-30.0)	$U=742.5$	0.826
Recovery rate/%, median (range)				
JOA score	75.0 (40.1-100.0)	63.0 (17.0-100.0)	$U=532.0$	0.017
Nurick score	100.0 (0.0-100.0)	36.5 (0.0-100.0)	$U=386.0$	$<0.01$
NDI score	63.0 (27.4-100.0)	58.0 (15.3-100.0)	$U=672.0$	0.359
Complication, n (%)			$\chi^2=0.762$	0.944
C <sub>5</sub> nerve palsy	1 (1.8)	3 (6.1)		
Axial pain	3 (5.5)	3 (6.1)		
Dysphagia	4 (7.3)	5 (10.2)		
Hoarseness	2 (3.6)	2 (4.1)		
Neurological deterioration	1 (1.8)	1 (2.0)		

JOA: Japanese Orthopaedic Association; VAS: Visual analogue scale; NDI: Neck disability index.

为进一步探究霍夫曼征与术后神经功能恢复的关系,根据JOA评分的恢复率将患者分为恢复率 $\geq 75\%$ 和 $< 75\%$ 两组,分别为53例和51例。如表4所示,与JOA评分恢复率 $\geq 75\%$ 组相比,JOA评分恢复率 $< 75\%$ 组患者表现出较高的霍夫曼征阳

性率和脊髓高信号发生率( $P$ 均 $< 0.05$ ),较差的术前JOA评分和JOA亚项评分( $P$ 均 $< 0.01$ ),以及较差的Nurick评分和NDI评分( $P$ 均 $< 0.01$ ),表明术后神经功能恢复与术前神经功能状态关系密切。

表4 基于JOA评分恢复率分组的颈椎退变性疾病患者的临床参数

Tab 4 Clinical parameters of patients with degenerative cervical disorder with different recovery rates of JOA score

Item	Recovery rate $< 75\%$ N=51	Recovery rate $\geq 75\%$ N=53	Statistic	P value
Hoffmann sign, n (%)			$\chi^2=5.506$	0.019
Positive	30 (58.8)	19 (35.8)		
Negative	21 (41.2)	34 (64.2)		
Duration of symptoms/month, median (range)	9.0 (0.5-156.0)	5.0 (0.5-120.0)	$U=688.0$	0.398
Intramedullary hyperintensity, n (%)	30 (58.8)	19 (35.8)	$\chi^2=5.506$	0.019
Preoperative clinical score				
JOA score, $\bar{x} \pm s$	9.6 $\pm$ 2.5	13.3 $\pm$ 1.7	$t=7.682$	$< 0.01$
Nurick score, $\bar{x} \pm s$	2.6 $\pm$ 1.0	1.9 $\pm$ 0.9	$t=3.220$	0.002
NDI score, median (range)	19.0 (5.0-42.0)	16.0 (4.0-33.0)	$U=502.0$	0.007
VAS score, median (range)	4.0 (0.0-10.0)	4.0 (0.0-10.0)	$U=761.0$	0.898
Preoperative JOA score in isolation				
Motor function of upper limb, median (range)	2.0 (1.0-3.0)	3.0 (1.0-4.0)	$U=356.0$	$< 0.01$
Motor function of lower limb, $\bar{x} \pm s$	2.6 $\pm$ 1.0	3.3 $\pm$ 0.8	$t=3.582$	0.001
Sensory function of upper limb, median (range)	0.0 (0.0-1.0)	0.0 (0.0-2.0)	$U=472.5$	$< 0.01$
Sensory function of lower limb, median (range)	0.0 (0.0-2.0)	2.0 (0.0-3.0)	$U=351.0$	$< 0.01$

JOA: Japanese Orthopaedic Association; NDI: Neck disability index; VAS: Visual analogue scale.

### 3 讨论

霍夫曼征阳性通常提示上运动神经元病变,然而其与脊髓损伤严重程度的关系目前仍存在争议。有研究发现,症状周期与脊髓损伤的严重程度密切相关,症状周期越短术前神经功能状态越好<sup>[10]</sup>。Basques等<sup>[11]</sup>发现症状周期6个月以上的患者术前神经功能状态一般较差。症状周期可能也是患者术后预后最重要的预测指标之一,术前症状周期越长,患者术后的神经功能恢复越差。Burneikiene等<sup>[12]</sup>研究发现患者术前症状周期越短术后神经功能恢复越满意,同时就诊5个月以内接受外科减压术的患者术后神经功能恢复更好。Tarazona等<sup>[13]</sup>通过多因素分析发现症状周期12个月以上的患者预后较差。Jenkins等<sup>[14]</sup>研究表明症状周期并不影响患者的术前神经功能状态和术后恢复,然而进一步评估患者的最小有临床意义的差值时发现推迟的手术治疗将延缓患者术后神经功能的恢复。本研究通过探究霍夫曼征与患者临床表现的关系发现,霍夫曼征阳性的患者术前神经功能症状周期较阴性者长,推测对脊髓更长时间的压迫往往造成更严重的

脊髓损伤,有可能损伤脊髓内部神经元结构,导致患者出现霍夫曼征。

多项研究曾探究霍夫曼征与临床结果的相关性。Houten和Noce<sup>[15]</sup>报道具有外科治疗指征的患者比保守治疗的患者发展为霍夫曼征阳性的风险更高。本研究结果显示霍夫曼征阳性的患者术前神经功能状态更差(JOA评分),这与既往文献报道<sup>[16]</sup>一致。进一步的ROC曲线分析表明霍夫曼征阳性对术前JOA评分有较高的灵敏度,对Nurick评分有较高的特异度。Grijalva等<sup>[16]</sup>报道霍夫曼征阳性可以预测脊髓压迫,具有较高的灵敏性。然而本研究进一步分析JOA亚项评分的结果显示,霍夫曼征阳性患者具有更差的术前上肢运动功能和下肢感觉功能,且霍夫曼征对该2项功能的预测能力较强。从解剖学角度,脊髓前束支配肢体的运动功能,脊髓丘脑侧束支配肢体的感觉功能,这2个功能单位束均位于脊髓的前侧部,提示霍夫曼征的产生与此解剖学部位有关。因此,我们认为霍夫曼征阳性可作为患者术前神经功能状态和手术指征的良好指标。但是具体是何种机制导致霍夫曼征仅与上肢运动及下肢感觉功能有关,目前难以明确。未来相关

的基础研究和解剖研究或许将有利于揭示霍夫曼征的具体发生机制及其与临床表征的关系。

脊髓损伤是颈椎退变性疾病的重要表现,常伴随异常的反射活动。Handal<sup>[17]</sup>报道所有反射亢进的患者均表现为霍夫曼征阳性和神经受压。本研究结果显示,表现为膝反射亢进或腱反射亢进的患者有更高的霍夫曼征阳性率。推测这些反射亢进和霍夫曼征可能与脊髓的上运动神经元病变有关。此外,MRI脊髓高信号也与脊髓损伤关系密切,本研究中霍夫曼征阳性患者的脊髓高信号发生率为59.2%(29/49),高于霍夫曼征阴性的患者(36.4%,20/55)。Nouri等<sup>[18]</sup>开展的一项前瞻性多中心研究结果显示霍夫曼征多出现在有严重脊髓压迫和脊髓高信号的患者。Rhee等<sup>[19]</sup>利用ROC曲分析霍夫曼征与Nurick评分的关系,结果显示霍夫曼征可作为评估颈椎脊髓病变的一个临床初筛工具。

本研究也评估了霍夫曼征与患者术后神经功能恢复的关系,在末次随访时,霍夫曼征阳性组患者的神经功能(JOA评分和Nurick评分)较阴性组差,JOA评分和Nurick评分的恢复率也较低,表明霍夫曼征可作为术后预后较差的一个预测指标。同时JOA亚项评分分析结果显示,霍夫曼征阳性组患者的术后上肢运动功能和下肢感觉功能恢复较阴性组差,结合JOA恢复率的分组分析结果(JOA恢复率<75%的患者JOA评分、NDI评分和Nurick评分均比JOA恢复率≥75%的患者差),提示临床神经功能恢复差与术前神经功能状态差的关系密切。

需要注意的是,霍夫曼征也可能出现在无症状患者,发生率为1.63%~2%<sup>[20-22]</sup>。所有个体在其一生中都有可能发生颈椎退行性改变,颈椎脊髓压迫和信号改变也可能存在于无症状患者或40岁以上的个体<sup>[23-25]</sup>。Boden等<sup>[26]</sup>曾报道在63例无症状患者中,约19%有椎间孔狭窄或椎间盘突出。Cook等<sup>[7]</sup>指出尽管常规的临床测试有更高的特异度,但灵敏度较低,很难作为常规筛选工具。说明仅依靠临床体格检查并不能做出最后诊断,对于疑似颈椎退变性疾病的患者,适当的影像学检查非常必要。

本研究存在以下局限性:(1)没有评估霍夫曼征在患者术后随访中的变化状态(消失还是持续存在),因此并不清楚霍夫曼征的变化是否与临

床恢复相关。(2)所有纳入的患者均进行了颈椎MRI检查,但是并未常规行脑部MRI检查。文献报道脑部损伤患者也可能出现霍夫曼征<sup>[6]</sup>。然而,Grijalva等<sup>[16]</sup>的回顾性研究显示91例霍夫曼征阳性的患者中仅2例存在脑部病变,提示霍夫曼征与脑部病变的关系并不密切。因此,对于霍夫曼征阳性而没有脊髓病变的患者,不建议常规行脑部MRI检查。(3)很多患者来我院初诊时,往往携带当地医院的影像学检查资料,导致临床检查和影像学检查时间不一致,也会对研究结果造成影响。

综上所述,霍夫曼征阳性的颈椎退变性疾病患者术前神经功能和术后恢复可能较差。霍夫曼征与上肢运动功能和下肢感觉功能的恢复关系密切,对它们有较好的预测价值。未来需要更高证据等级的研究和更长时间的随访来进一步探究霍夫曼征与颈椎退变性疾病患者神经功能的相关性。

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