·临床研究论著·

弧度显微剪应用于全椎板切除术治疗多节段胸椎 黄韧带骨化的疗效分析

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【摘要】目的 评估弧度显微剪在全椎板切除术治疗多节段胸椎黄韧带骨化症(thoracic ossification of ligamentum flavum, TOLF)并硬膜粘连的临床疗效和安全性。方法 回顾性分析 2013 年 1 月至 2018年3月惠州市中心人民医院采用全椎板切除术治疗多节段 TOLF 并硬膜粘连的病人 30 例,分为尖刀 片组(15 例)和弧度显微剪组(15 例)。记录并比较两组病人的术中出血量、手术时间、围手术期并发症、 改良日本骨科协会(Japanese Orthopaedic Association, JOA)评分及其神经功能恢复率。结果 尖刀片组 和弧度显微剪组的随访时间分别为(13.2±1.4)个月、(12.8±2.4)个月。尖刀片组的手术时间和术中出血 量分别为(261±45)min、(563±201)ml,显著高于弧度显微剪组的(203±38)min、(493±139)ml,组间比 较,差异均有统计学意义(*t*=4.161,*P* < 0.001;*t*=6.817,*P* < 0.001)。尖刀片组发生脑脊液渗漏6例,弧度显 微剪组脑脊液渗漏1例,两组的脑脊液漏发生率比较,差异有统计学意义(*x*=4.658,*P*=0.031)。两组病人 的末次随访JOA评分均较术前显著提高,但两组病人术前JOA、末次随访JOA及神经恢复率比较,差异均 无统计学意义。结论 弧度显微剪全椎板切除术治疗多节段 TOLF 并硬膜粘连是一种安全有效的治疗 方式,与尖刀片分离的手术方式相比,缩短了手术时间,减少了术中出血量,降低了脑脊液漏发生率。

【关键词】 胸椎;黄韧带骨化;显微剪;全椎板切除术;减压术,外科

Application of radian microscissors in en bloc laminectomy for the treatment of multilevel thoracic ossification of ligamentum flavum. WU Jia-wen¹, CAO Yong², HUANG Yu-liang¹, DUAN Chun-yue², WANG Dejia¹, CHEN Jin-biao¹, TONG Guo-qiang³, YIN Sheng-yun³. ¹Department of Spine Surgery, Huizhou Municipal Central Hospital, Huizhou 516001, China; ²Department of Spine Surgery, Xiangya Hospital of Central South University, Changsha 410008, China; ³Department of Orthopaedics, the Fifth Division Hospital of Xinjiang Production and Construction Corps, Bole 833400, China

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[Abstract] Objective To evaluate safety and effectiveness of the application of radian microscissors in en bloc laminectomy for the treatment of multilevel thoracic ossification of ligamentum flavum (TOLF). **Methods** A retrospective analysis was performed on 30 patients with multilevel TOLF and dural adhesion underwent section Cap uncovering en bloc laminectomy surgery from January 2013 to March 2018 in the Huizhou Municipal Central Hospital. The patients were divided into sharp blade group (15 cases) and radian microscissors group (15 cases). Intraoperative bleeding volume, operation time, perioperative complications, improved Japanese Orthopaedic Association (JOA) score and neurological function recovery rate were recorded and compared between the two groups. **Results** The follow-up time in the sharp blade group and the radian microscissors group was (13.2 ± 1.4) months and (12.8 ± 2.4) months, respectively. The operation time and intraoperative bleeding volume in the sharp blade group were (261 ± 45) min and (563 ± 201) ml, respectively, which were significantly increased as compared with those in the radian microscissors group [(203±38) min and (493 ± 139) ml] (t=4.161, P < 0.001; t=6.817, P < 0.001). Perioperative complications included early neurological deterioration, wound infection and leakage of cerebrospinal fluid (6 in the sharp blade group and 1 in the radian microscissors group), and incidences of these complications in the sharp blade group was significantly higher than in the radian microscissors group (χ^2 =4.658, P=0.031). Although final JOA score in

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both groups significantly increased, differences in preoperative JOA, final JOA and neurological recovery rate between the two groups were not significant. **Conclusion** Application of radian microscissors in section Cap uncovering en bloc laminectomy surgery for the treatment of multilevel TOLF can effectively achieve neurological functional recovery in patients, with favorable efficacy and safety in reducing both operation time and intraoperative blood loss and the incidence of cerebrospinal fluid leakage compared with the application of sharp blade.

[Key words] Thoracic vertebrae; Ossification of ligamentum flavum; Microscissors; Laminectomy; Decompression, surgical

胸椎黄韧带骨化症(thoracic ossification of the ligamentum flavum, TOLF)是胸段脊髓病的罕见病因^[1], 在日本人群中多发,在韩国和中国也均有报道^[2,3]。 TOLF具有遗传易感性,并受到外界力学微环境影 响。相对于颈椎和腰椎而言,胸椎的运动是有限的, 导致TOLF生物力学机制在本质上有别于过度活动 而导致的颈椎和腰椎的退变过程^[4,5]。然而,TOLF 确切的病理生理学机制至今尚未被阐明。TOLF常 累及下胸段(T₉~T₁₂),其典型病理学特征为黄韧带肥 厚和纤维组织的骨化,可导致胸椎管狭窄,临床表现 为功能步态丧失和痉挛性麻痹等症状^[6],且会随着 脊髓受压的程度加重呈现渐进性的发展。

TOLF是一种进展缓慢的疾病,不过一旦出现神 经系统症状,进展则较为迅速,需尽快进行手术治 疗。据报道,手术治疗时间的延迟是导致TOLF手 术不良结局的关键因素^[7],常见的手术治疗方式包 括后路的全椎板切除术、椎板开窗成形术、半椎板切 除术等^[79],但由于患病率较低,目前研究报道较少, 不同手术技术治疗TOLF继发性胸椎脊髓病的安全 性和有效性尚不清楚;同时,硬膜撕裂伴脑脊液漏形 成等常见并发症的发生率较高^[10]。

相较于孤立的TOLF,跳跃性及连续性多节段 TOLF则更为罕见^[4]。2013年1月至2018年3月,我 们采用超声骨刀联合带弧度显微剪进行"分段揭盖 式"全椎板切除术治疗了15例多节段TOLF并硬膜 粘连病人,并与同期行尖刀片分离手术的15例多节 段TOLF并硬膜粘连病人比较,探讨两种手术方式 的临床疗效。

资料与方法

一、纳入与排除标准

纳入标准:①胸椎X线片、MRI和(或)CT扫描 证实为TOLF诊断;②3个及以上节段受累;③伴有 硬膜粘连;④采用超声骨刀联合带弧度显微剪或尖 刀片分离进行"分段揭盖式"全椎板切除术。

排除标准:①合并脊柱肿瘤;②强直性脊柱炎;

③感染;④胸椎后纵韧带骨化症(ossification of the posterior longitudinal ligament, OPLL)及胸椎间盘突出病史;⑤既往脊柱手术病史。

二、一般资料

惠州市中心人民医院收治的30例多节段TOLF 病人纳入研究,TOLF主要累及节段分布在T₃~T₁₂水 平。按手术操作程序分为尖刀片组和弧度显微剪 组,均进行"分段揭盖式"全椎板切除术。尖刀片组 15例,男6例,女9例;年龄为(55.4±3.2)岁。弧度显 微剪组15例,男5例,女10例;年龄为(54.2±2.9) 岁。两组病人术前一般资料比较,差异均无统计学 意义(P均>0.05,表1)。

表1 30 例病人术前的一般资料										
指标	尖刀片组 (15例)	弧度显微剪组 (15例)	<i>t</i> (<i>X</i> ²)值	P值						
性别(例)										
男	6	5	0.144	0.704						
女	9	10	0.144							
合并高血压(例)	5	4	0.662	0.493						
合并糖尿病(例)	6	7	0.735	0.594						
主要症状(例)										
躯干及下肢感觉疼痛和 感觉障碍	14	13		0.805						
下肢发力运动功能障碍	13	11	0.945							
括约肌功能障碍	2	2								
TOLF横断面CT分型(例)										
外侧型	6	5		0.594						
加长型	3	4	0.725							
融合型	5	4	0.735							
结节型	1	2								
TOLF矢状面CT分型(例)										
连续型	9	8	0.010	0.695						
不连续型	6	7	0.812							
硬膜骨化(例)	6	5	0.703	0.685						
JOA评分(ā±s,分)	5.2±1.9	5.1±2.0	0.862	0.623						
年龄(x±s,岁)	55.4±3.2	54.2±2.9	0.354	0.235						
症状持续时间(x±s,月)	23.1±12.4	22.6±9.8	0.234	0.198						

注:JOA为日本骨科协会,采用改良JOA评分

三、手术操作

30 例病人均在脊髓神经电生理检测下行分段 全椎板切除术。手术采用俯卧位,置于弓形架上。 在关节突与椎板交界处暴露靶板以及位于靶节附近 尾侧和头侧的单层椎板,先行后路椎弓根螺钉固定, 在尾椎板下缘和上缘均行棘上和棘间韧带切除,确 定切除椎板左右界(关节内1/3连线)及上下界(椎 板结合部),采用超声骨刀进行分段椎板切除,术中 发现硬脑膜通常附着在已骨化的黄韧带上,黄韧带 与硬脑膜粘连严重。

为了避免硬膜撕裂,尖刀片组采用尖刀片进行 分离,弧度显微剪组采用带弧度显微剪分离粘连的 骨化的黄韧带和硬膜,采用分段揭盖法将椎板进行 揭盖(图1)。如出现硬膜撕裂,则用硬脑膜片进行 硬脑膜缺损的修补,放置引流管,逐层关闭伤口并进 行缝合。

四、影像学评估和临床疗效评估

记录并比较两组病人的实际受累节段及减压范围、术中出血量、手术时间及围手术期并发症。

每位病人在手术前后都接受了CT扫描和MRI 检查。采用单盲法,两名独立的专业放射科医生通 过术后影像学资料评估两组病人脊髓减压的效果。

采用改良的日本骨科协会(Japanese Orthopaedic Association, JOA)评分评估病人术后神经功能恢 复情况,神经功能恢复率=(末次随访 JOA 评分-术 前 JOA 评分)/(11-术前 JOA 评分)×100%。神经功 能恢复率为75%~100%者为优,50%~74%者为良, 25%~49%者为中,小于25%者为差。

五、统计学分析

所有数据采用 SPSS 18.0 统计学软件(IBM 公 司,美国)进行统计分析。术中出血量、手术时间、 JOA 评分的组内比较或组间比较采用独立样本 *t* 检 验,脑脊液漏发生率的组间比较采用皮尔森的χ²检 验。*P* < 0.05 为差异有统计学意义。

结 果

所有病人均获得了随访。尖刀片组随访(13.2±1.4)个月,弧度显微剪组随访(12.8±2.4)个月。

共有132节段胸椎被累及,其中尖刀片组63例, 弧度显微剪组69例;72.7%(96/132)的受累节段位 于下胸段,其中尖刀片组为71.4%(45/63),弧度显微 剪组为73.9%(51/69)(图2)。尖刀片组的减压范围



图1 弧度显微剪"分段揭盖式"全椎板切除术操作流程 a:操作示意图;b:术前CT可见多节段不连续TOLF;c:分段揭盖法分离的椎板和黄韧带复合体



为3~6个节段,平均4.8个节段;弧度显微剪组的减 压范围为3~7个节段,平均5.1个节段。

尖刀片组的手术时间和术中出血量分别为 (261±45)min、(563±201)ml,显著高于弧度显微剪 组的(203±38)min、(493±139)ml,两组间比较,差 异均有统计学差异(*t*=4.161,*P*<0.001;*t*=6.817,*P*<0.001)。所有病例手术结束后均未出现早发或迟发 神经功能恶化。尖刀片组发生脑脊液渗漏6例,术 后留置伤口引流管至脑脊液引流清亮,术后5d拔 管,引流管口闭合;弧度显微剪组脑脊液渗漏1例, 两组的脑脊液漏发生率比较,差异有统计学意义(*x*²=4.658,*P*=0.031)。所有病人切口均愈合,无伤口深 部感染发生。术后3个月,两组的JOA评分均较术前有所恢复,末次随访时的JOA评分进一步提升,但两组病人术前JOA、末次随访JOA及神经恢复率比较,差异均无统计学意义(表2)。典型病例资料见图3。

讨 论

TOLF的特点表现为成熟的黄韧带发生异位骨化,其具体机制不明。成骨因素和机械应力被认为与TOLF韧带骨化有关^[11,12],黄韧带和硬脑膜压缩之间的机械应力是引起骨化的原因。随着脊柱的屈曲和伸展,硬化黄韧带与硬脑膜之间的摩擦导致了局

表2 两组病人术后的功能恢复情况											
分组 例数	改良JOA 评分(x±s,分)		油灰市総応有支(の)	神经功能恢复分级(例)							
	术前	术后3个月	末次随访	种空功能恢复举(%)	优	良	中	差			
尖刀片组	15	5.2±1.9	7.2±2.1*	$8.2 \pm 2.5^{*}$	56.3±21.5	6	8	1	0		
弧度显微剪组	15	5.1±2.4	7.3±2.6*	8.3±2.9*	55.9±23.5	7	6	2	0		
$t(\chi^2)$ 值	-	0.945	0.785	0.921	0.652	0.956					
P值	-	0.859	0.672	0.714	0.492	0.794					

注:与同组术前比较,*P<0.05



部炎症,进一步引起硬膜骨化[12-14]。

TOLF常导致胸段脊髓病变,骨化块的进展可加 重神经功能的恶化,脊髓压迫持续时间越长,神经功 能恢复越差。同时,TOLF通常累及范围较广,使得 定位诊断困难大,很难准确判定责任节段及各节段 分别引起的症状^[15,16]。椎板切除减压手术是TOLF 合并胸段脊髓病变的最佳治疗方案。按切除方法分 为分段椎板切除术和整块椎板切除术。蚕食法碎片 椎板切除术曾在TOLF中得以广泛应用,其平均神 经功能恢复率可达50%及以上^[17],然而由于枪钳反 复进入胸椎椎管,延长了手术时间,增加了手术大出 血、硬膜撕裂、神经功能恶化以及创面感染风险。椎 板开窗成形术可以有效减少对椎管内的干扰,但无 法避免椎板对脊髓的切割以及脊髓疝的形成,同时 残留的骨化黄韧带有进一步进展的可能^[9,17]。

椎板切除术治疗 TOLF 并硬膜粘连病人,最常见的并发症是分离减压过程中导致硬膜撕裂、形成脑脊液漏,发生率高达 60%^[18]。术中硬膜撕裂伤导致术后并发症相关的脑脊液持续渗漏、脑膜炎及伤口裂开的发生率也相应增加。Wang等^[19]描述了一种接近硬膜骨化的技术,在黏附点留下一片黄韧带碎片漂浮,然后用高速钻头研磨这片自由碎片,使其变薄。这种技术可以避免硬脑膜撕裂,同时将紧紧附着的硬脑膜与硬脑膜分离。然而,代价是脊椎减压的程度较低,其近期效果尚可,远期效果不良。

超声骨刀具有更高的切割精度和安全性,是安 全切除椎板和骨化块的有力工具^[20];其冷却系统在 连续使用时也可以防止脊髓受热导致的损伤;超声 提供气-血空化效应,有助于减少手术区域出血,其 清晰的手术视野可以保证手术的安全性^[21]。采用超 声骨刀进行椎板整体切除可以降低脊髓损伤风险, 避免脊髓疝的发生^[22]。当TOLF的病灶向外侧蔓延 时,采用超声骨刀可以将其减压宽度扩充,包绕至少 三分之一的关节突关节,同时避免对硬膜的损伤。

对于严重粘连的病人,我们采用带弧度显微剪 分离硬膜。从正常侧向病变侧进行分离,病变轻的 一侧向重的一侧分离,进行分段揭盖去除全椎板和 粘连骨化的黄韧带。与尖刀片分离相比,该手术方 式可以有效减少硬膜撕裂的发生,大幅降低感染及 神经功能迟发性恶化的风险,保证了手术的安全 性。同时,术中脊髓神经电生理检测可进一步提升 手术的安全性,有效监测术中减压对脊髓活动的影 响,降低术中脊髓损伤风险。

硬脊膜修补对于预防术后脑脊液渗漏及相关并

发症至关重要,可以使用筋膜、肌肉、脂肪、人造硬脑 膜、明胶海绵、纤维蛋白胶等材料进行修补。手术 中,我们采用人工硬脑膜修复缺损部位,并利用硬脊 膜缝合线进行密闭缝合,关闭椎旁肌、深筋膜和皮 肤,有效防止脑脊液渗漏,促进硬膜缺损的闭合。

对于多节段TOLF并硬膜粘连的病人,采用超 声骨刀联合带弧度显微剪进行"分段揭盖"式全椎板 切除术可以取得满意的临床疗效,与尖刀片分离的 方式相比,可以有效缩短手术时间,减少术中出血 量,并可以降低硬膜撕裂导致脑脊液漏的发生率。

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