

· 技术创新 ·

开放获取

胸椎黄韧带骨化内镜下保留关节突减压[△]

黄保华¹, 胡江², 钟远鸣¹, 张家立¹, 暴晓航²

(1. 广西中医药大学第一附属医院, 广西南宁 530011; 2. 广西中医药大学, 广西南宁 530200)

摘要: [目的] 介绍胸椎黄韧带骨化内镜下保留关节突减压的手术治疗技术和初步临床结果。[方法] 24 例胸椎黄韧带骨化患者采用上述手术治疗, 采用俯卧位, 局部麻醉+静脉麻醉, C 形臂 X 线机透视引导下环锯锚定病椎关节突内侧椎板, 接入内镜系统可视下环切同侧椎板, 显露硬脊膜, 配合椎板咬骨钳、磨钻进一步切除椎板的头尾两端, 跨越棘突根部切除对侧椎板, 同时分离切除椎管内黄韧带及骨化物。减压至硬脊膜两侧边缘, 骨化物头尾两端 1 cm 以上, 见硬脊膜搏动, 彻底止血, 术毕。[结果] 患者均顺利完成手术, 术中无硬脊膜撕裂及神经、血管损伤等严重并发症。与术前相比, 术后 3 个月、末次随访时, VAS 评分 [(6.2±0.9), (1.6±0.7), (1.5±0.5), $P<0.001$]、ODI 评分 [(55.4±8.2), (18.6±3.1), (8.5±1.2), $P<0.001$] 显著改善, 改良 Macnab 疗效评定标准优良率为 83.3%。[结论] 胸椎黄韧带骨化内镜下保留关节突减压术, 可术中保留双侧关节突, 并可充分减压椎管, 避免后期医源性不稳, 是一种安全有效的术式。

关键词: 胸椎黄韧带骨化, 内镜, 微创减压

中图分类号: R687 **文献标志码:** A **文章编号:** 1005-8478 (2024) 09-0851-04

Endoscopic decompression with facet process preservation for thoracic ossification of ligamentum flavum // HUANG Bao-hua¹, HU Jiang², ZHONG Yuan-ming¹, ZHANG Jia-li¹, BAO Xiao-hang². 1. The First Affiliated Hospital, Guangxi University of Traditional Chinese Medicine, Nanning 530011, China; 2. Guangxi University of Traditional Chinese Medicine, Nanning 530200, China

Abstract: [Objective] To introduce the surgical techniques and preliminary outcomes of endoscopic decompression with facet process preservation for thoracic ossification of ligamentum flavum. [Methods] A total of 24 patients underwent abovementioned surgical treatment for thoracic ossification of ligamentum flavum. The patient was paced in prone position, and local anesthesia combined with intravenous anesthesia were used. Under C-arm fluoroscopy, a trephine was inserted onto the facet process medial margin of the affected segment. As the endoscopic system was connected, partial ipsilateral laminectomy was conducted to expose the dura with the visualizing trephine. By using laminar rongeur and grinding drill, the ipsilateral lamina was completely resected cephalocaudally. Furthermore, the contralateral lamina was removed under the base of the spinous process, and the ossified ligamentum flavum involving the spinal canal were separated and excised gradually to finish decompression to both sides of the dural edge, 1 cm above and below of the ossified ligament to regain dural pulsation. After complete hemostasis, the incision was closed in layers. [Results] All the patients were operated successfully with no serious complications, such as dural tear, nerve and blood vessel injury. Compared with those preoperatively, VAS score [(6.2±0.9), (1.6±0.7), (1.5±0.5), $P<0.001$], ODI score [(55.4±8.2), (18.6±3.1), (8.5±1.2), $P<0.001$] significantly improved 3 months postoperatively and at the latest follow-up. Based on the modified Macnab's criteria, the excellent and good rate of clinical outcomes was of 83.3%. [Conclusion] This endoscopic decompression with facet process preservation for thoracic ossification of ligamentum flavum is a safe and effective surgical procedure with advantage of sufficient decompression of the spinal canal and avoiding iatrogenic segmental instability in the later stage.

Key words: thoracic ossification of ligament flavum, endoscopy, minimally invasive decompression

胸椎黄韧带骨化 (thoracic ossification of the ligamentum flavum, TOLF) 是导致胸椎管狭窄和胸椎脊髓受压的常见原因^[1], 好发于 40~60 岁, 男性多于女性^[2], 可表现为下肢无力、发僵、间歇性跛行或并发腰腿疼痛等, 严重时可导致截瘫。临床容易误诊和漏

诊, 需要早期诊断和治疗。早期脊髓病变减压是治疗的关键^[3, 16]。目前的治疗方法分为传统的开放手术和微创内镜手术^[3-5]。经皮脊柱内镜技术因手术创伤小、组织剥离少、住院时间短、椎旁肌损伤小以及可降低术后不稳被广泛推广^[6-8, 19]。临床上一些学者尝

DOI:10.3977/j.issn.1005-8478.2024.09.15

△基金项目: 2020 年广西医疗卫生适宜技术开发与推广应用项目 (编号: S202049)

作者简介: 黄保华, 主任医师, 研究方向: 脊柱疾病的微创治疗, (电子信箱) 20hbh@163.com

试采用经皮脊柱内镜进行椎板切除和椎管减压技术^[9-12, 17, 18], 手术减压方式采用一侧入路双侧减压, 破坏一侧关节突, 加之 TOLF 主要发生于下胸段, 以 T₉~T₁₂ 最常见, 下胸段处于稳定的胸椎向不稳定的腰椎区域转变, 该节段脊柱活动度大, 并且缺乏来自胸腔的支持, 因此容易导致该部位不稳和黄韧带再骨化。针对上述不足, 本科采用脊柱内镜保留部分关节突手术方式进行半椎板切除和椎管减压技术, 取得满意的疗效, 报告如下。

1 手术技术

1.1 术前准备

所有患者术前常规检查, 拍摄胸椎 MRI (图 1a)、胸椎 CT (图 1b, 1c), 明确病变部位与侵犯范围。评估麻醉风险, 排除手术禁忌证。

1.2 麻醉与体位

所有患者均采用局部麻醉辅助静脉麻醉, 采用俯卧位, 折叠手术床位, 屈膝屈髋位, 胸腹部稍悬空状态。

1.3 手术操作

本研究由同一组医师完成手术, 根据术前计划确定减压范围和节段。C 形臂 X 线机术前定位手术节段并做好手术标识, 标记棘突中线和减压节段水平线, 椎弓根内侧缘旁开 2 cm 为手术通道进针点。常规消毒铺巾, 采用局麻+静脉麻醉, 深筋膜和椎板背侧应充分浸润麻醉。切开 1 cm 左右的横行切口, 钝性导杆插入至椎板背部, 逐级插入扩张导管, 插入镜外环锯环切关节突内侧椎板背侧锚定位置, C 形臂 X 线机正侧位透视环锯位置满意 (图 1d)。经镜外环锯置入内镜系统, 清除和分离椎板背部的软组织, 暴露椎板背侧骨质, 可视下进行椎板背侧骨质环切, 当镜下可见环锯带动骨质旋转时逐步退出环锯, 取出环锯内骨质, 将环锯含住半环骨质再次进行环切, 用钳子将游离的骨质取出, 配合椎板咬骨钳、镜下动力磨钻进一步切除椎板、扩大椎管, 椎板背侧骨质到达骨化物上下 1 cm 以上, 用镜下工具分离切除椎管黄韧带及骨化黄韧带。跨越棘突根部越过中线和黄韧带背侧, 使用镜下磨钻磨去对侧的椎板、关节突内侧缘及骨化黄韧带, 到达对侧硬膜边缘 (图 1e)。再次探查椎管上下缘和硬脊膜两侧边缘。彻底止血后术毕, 全层缝合, 止血垫压迫止血, 逐层缝合切口。

1.4 术后处理

术后常规予以甘露醇、地塞米松、神经营养药物, 术后即可开始踝泵、直腿抬高锻炼, 术后第 1 d 戴腰围下地, 术后 2 d 复查 CT、MRI, 术后第 3 d 出院。术后 3、6 个月、1 年、2 年门诊随访。

2 临床资料

2.1 一般资料

2018 年 10 月—2022 年 6 月在广西中医药大学第一附属医院就诊、符合纳入排除标准的患者 24 例。男 15 例, 女 9 例; 年龄 42~65 岁, 平均 (50.6±5.1) 岁, 均为单一节段: T_{8/9} 节段 4 例, T_{9/10} 节段 6 例, T_{10/11} 节段 8 例, T_{11/12} 节段 6 例。采用局部麻醉+静脉麻醉下内镜下保留关节突减压术式。

2.2 初步结果

24 例均采用局部麻醉辅助静脉麻醉, 顺利完成手术, 术中无硬脊膜撕裂及胸髓、胸神经、大血管损伤, 手术时间 70~160 min, 平均 (95.2±16.6) min, 住院时间为 4~16 d, 平均 (8.6±3.2) d。伤口均愈合良好, 术后未发生切口感染、脑脊液漏、双下肢深静脉血栓及需二次翻修手术者。

术后随访 8~26 个月, 1 例患者术后症状加重, 经 3 个月治疗后恢复。VAS 评分由术前的 (6.2±0.9) 分, 显著改善至术后 3 个月的 (1.6±0.7) 分, 末次随访时为 (1.5±0.5) 分, 差异有统计学意义 ($P<0.001$)。ODI 评分由术前的 (55.4±8.2), 显著改善至术后 3 个月的 (18.6±3.1)、末次随访的 (8.5±1.2), 差异有统计学意义 ($P<0.001$); 根据改良 Macnab 疗效评定标准, 本组优 12 例, 良 8, 可 4 例, 优良率为 83.3%。

术后影像显示骨化黄韧带完全切除, 脊髓减压良好 (图 1f~1h)。

3 讨论

胸椎黄韧带骨化是导致胸椎管狭窄最常见的病因, 可引起一系列脊髓、神经压迫症状和体征。一经确诊应尽早手术解除压迫。传统椎板切除/成形术创伤较大, 出血较多, 骨结构丢失较多, 甚至造成胸椎后凸畸形^[4, 13]。脊柱内镜治疗具有创伤小、出血少、恢复快等优点。Ruetten 等^[14]和 An 等^[10]报道胸椎黄韧带骨化患者行脊柱内镜手术, 取得较好的临床疗效。Yang 等^[6]对比脊柱内镜与传统开窗手术治疗胸椎黄韧带骨化症, 两者均取得了良好的疗效。

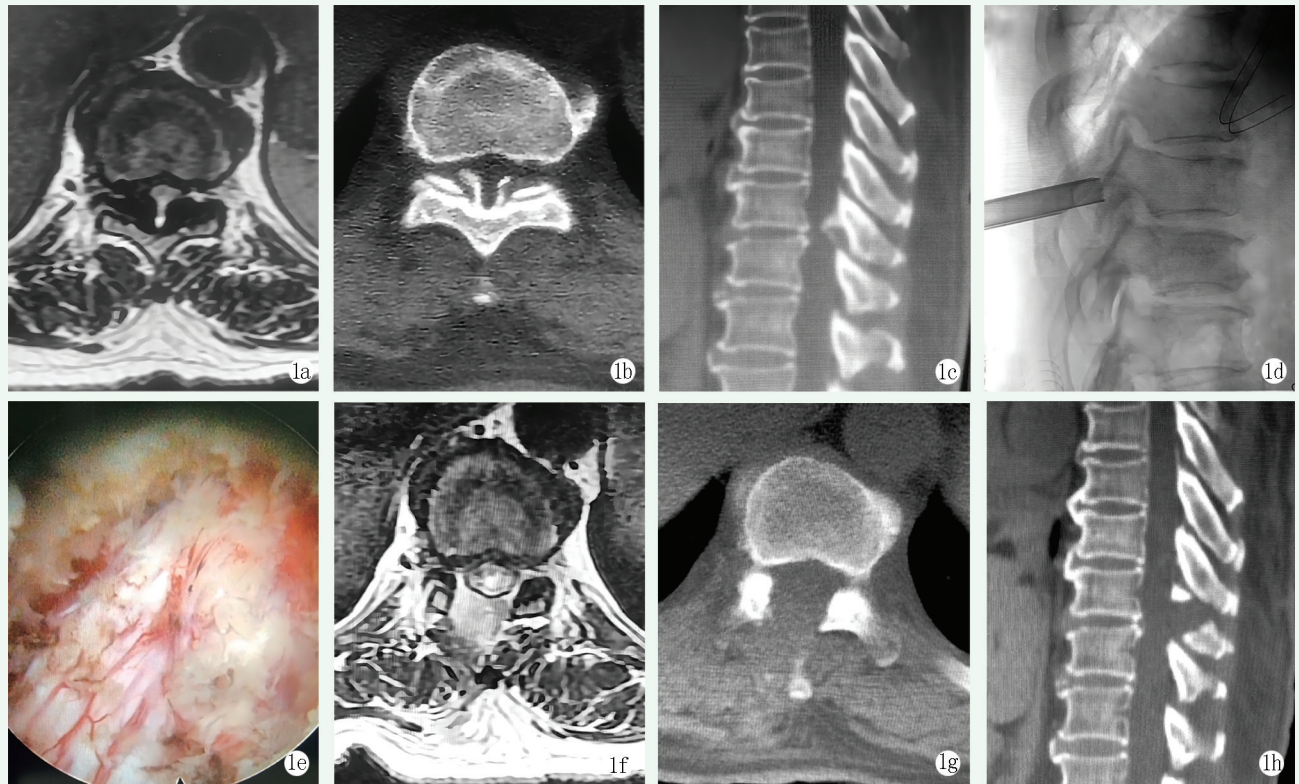


图 1. 患者男性, 56 岁。1a, 1b: 术前胸椎 MRI、CT 横断位提示 T_{10/11} 黄韧带骨化, 脊髓压迫; 1c: 术前胸椎 CT 矢状位提示“鸟嘴”样骨化; 1d: 术中 C 形臂 X 线机透视下置入环锯; 1e: 术中显示骨化黄韧带彻底切除; 1f~1h: 术后复查 MRI、CT 提示骨化黄韧带切除, 硬脊膜恢复正常形态, 两侧关节突完整保留。

Figure 1. A 56-year-old male. 1a, 1b: Preoperative transverse thoracic MRI and CT revealed T_{10/11} ossified ligamentum flavum that compressed spinal cord; 1c: Sagittal thoracic CT before operation indicated beak-like ossification; 1d: A trephine was placed under intraoperative C-arm fluoroscopy; 1e: Intraoperative endoscopic finding after complete resection of the ossified ligamentum flavum; 1f~1h: Postoperative MRI and CT indicated the ossified ligamentum flavum removed completely, the dura returned to normal shape, and bilateral facet process intact.

在本研究中, 根据改良 Macnab 疗效评定标准优良率为 83.3%, 与 He 等^[15]报道脊柱内镜治疗的 TOLF 患者优良率为 87.5% 相当。该术式有如下特点: (1) 采用局部麻醉, 辅助静脉麻醉, 相比单纯使用局部麻醉, 术中舒适体验感更好; 相对全身麻醉, 患者可及时反馈, 起到实时的类似神经电生理监测的作用; (2) 使用镜外可视环锯环切椎板, 增加椎板切除的效率。环切时应避免环切第一锯在压迫椎管最严重区域, 当第一锯环切后, 显露硬脊膜后再逐个环切椎板, 同时配合椎板咬骨钳和磨钻逐步扩大椎管。Miao 等^[11]报道胸椎黄韧带骨化患者采用内镜下一侧关节突的切除, 逐步向压迫严重区域切除, 这样可保证手术的安全性, 但破坏了一侧关节突, 后期稳定存在一定隐患。为此本研究术前设计保留双侧关节突, 极大程度保留了胸椎的稳定性。术中将环锯锚定棘突根部, 即先环切脊髓中央正后方椎板, 这样相比文献报道先切除关节突, 存在比较大的手术风险。采用局部麻醉, 使患者自我监测, 同时在可视下环切椎板,

直至骨块随环锯转动, 过程中避免施加环切的压力, 也可分层环切, 切至最内侧骨板, 使用磨钻开窗, 待水介质进入椎管后, 硬脊膜与骨块有空间后再使用椎板咬骨钳逐步切除减压。

综上所述, 该术式治疗胸椎黄韧带骨化症是创伤小、康复快的安全术式, 尤其是术中在保留双侧关节突情况下, 仍然可以对椎管进行充分减压, 彻底切除骨化黄韧带, 避免后期可能出现医源性不稳或后凸畸形。

参考文献

- [1] Zhao Y, Xiang Q, Jiang S, et al. Prevalence, diagnosis, and impact on clinical outcomes of dural ossification in the thoracic ossification of the ligamentum flavum: a systematic review [J]. *Eur Spine J*, 2023, 32 (4): 1245-1253. DOI: 10.1007/s00586-023-07625-4.
- [2] Mori K, Kasahara T, Mimura T, et al. Prevalence, distribution, and morphology of thoracic ossification of the yellow ligament in Japanese: results of CT-based cross-sectional study [J]. *Spine (Phila Pa 1976)*, 2013, 38 (19): E1216-E1222. DOI: 10.1097/BRS.

- 0b013e31829e018b.
- [3] Machino M, Sakai K, Yoshii T, et al. Treatment for the thoracic ossification of the posterior longitudinal ligament and ossification of the ligamentum flavum [J]. *J Clin Med*, 2022, 11 (16) : 4690. DOI: 10.3390/jcm11164690.
- [4] 冯法博, 孙垂国, 陈仲强, 等. “揭盖式”胸椎管后壁切除术治疗单节段胸椎黄韧带骨化症的疗效及其影响因素 [J]. *中国脊柱脊髓杂志*, 2014, 24 (7) : 585-592. DOI: 10.3969/j.issn.1004-406X.2014.07.03.
- Feng FB, Sun CG, Chen ZQ, et al. The effect and influencing factors of posterior thoracic canal dissection in the treatment of single segment ossification of the thoracic ligament flavum [J]. *Chinese Journal of Spine and Spinal Cord*, 2014, 24 (7) : 585-592. DOI: 10.3969/j.issn.1004-406X.2014.07.03.
- [5] Lin YP, Lin R, Chen S, et al. Thoracic full-endoscopic unilateral laminotomy with bilateral decompression for treating ossification of the ligamentum flavum with myelopathy [J]. *Ann Transl Med*, 2021, 9 (12) : 977. DOI: 10.21037/atm-21-2181.
- [6] Yang FK, Li PF, Dou CT, et al. Comparison of percutaneous endoscopic thoracic decompression and posterior thoracic laminectomy for treating thoracic ossification of the ligamentum flavum: a retrospective study [J]. *BMC Surg*, 2022, 22 (1) : 85. DOI: 10.1186/s12893-022-01532-z.
- [7] Kotheeranurak V, Tangdamrongtham T, Lin GX, et al. Comparison of full-endoscopic and tubular-based microscopic decompression in patients with lumbar spinal stenosis: a randomized controlled trial [J]. *Eur Spine J*, 2023, 32 (8) : 2736-2747. DOI: 10.1007/s00586-023-07678-5.
- [8] Chen KT, Choi KC, Shim HK, et al. Full-endoscopic versus microscopic unilateral laminotomy for bilateral decompression of lumbar spinal stenosis at L4-L5: comparative study [J]. *Int Orthop*, 2022, 46 (12) : 2887-2895. DOI: 10.1007/s00264-022-05549-0.
- [9] 李岳飞, 李瑞, 王光林, 等. 后路经皮内镜减压治疗胸椎黄韧带骨化症 [J]. *中国矫形外科杂志*, 2020, 15 (28) : 1390-1395. DOI: 10.3977/j.issn.1005-8478.2020.15.11.
- Li YF, Li R, Wang GL, et al. Posterior percutaneous endoscopic decompression for thoracic vertebrae with ossification of ligamentum flavum [J]. *Orthopedic Journal of China*, 2020, 15 (28) : 1390-1395. DOI: 10.3977/j.issn.1005-8478.2020.15.11.
- [10] An B, Li XC, Zhou CP, et al. Percutaneous full endoscopic posterior decompression of thoracic myelopathy caused by ossification of the ligamentum flavum [J]. *Eur Spine J*, 2019, 28 (3) : 492-501. DOI: 10.1007/s00586-018-05866-2.
- [11] Miao X, He D, Wu T, et al. Percutaneous endoscopic spine minimally invasive technique for decompression therapy of thoracic myelopathy caused by ossification of the ligamentum flavum [J]. *World Neurosurg*, 2018, 114: 8-12. DOI: 10.1016/j.wneu.2018.02.152.
- [12] 赵加庆, 于先凯, 赵子豪, 等. 单侧双通道内镜技术治疗胸椎黄韧带骨化症 [J]. *中国矫形外科杂志*, 2023, 31 (7) : 619-624. DOI: 10.3977/j.issn.1005-8478.2023.07.08.
- Zhao JQ, Yu XK, Zhao ZH, et al. Treatment of ossification of the thoracic ligamentum flavum by unilateral double-channel endoscopy [J]. *Orthopedic Journal of China*, 2023, 31 (7) : 619-624. DOI: 10.3977/j.issn.1005-8478.2023.07.08.
- [13] 鲁澜涛, 朱健, 孙凯强, 等. 胸椎黄韧带骨化症的手术治疗进展 [J]. *脊柱外科杂志*, 2021, 19 (5) : 341-346. DOI: 10.3969/j.issn.1672-2957.2021.05.011.
- Lu LT, Zhu J, Sun K, et al. Progress in surgical treatment of ossification of ligamentum flavum of thoracic vertebra [J]. *Journal of Spinal Surgery*, 2021, 19 (5) : 341-346. DOI: 10.3969/j.issn.1672-2957.2021.05.011.
- [14] Ruetten S, Hahn P, Oezdemir S, et al. Full-endoscopic uniportal decompression in disc herniations and stenosis of the thoracic spine using the interlaminar, extraforaminal, or transthoracic retropleural approach [J]. *J Neurosurg Spine*, 2018, 29 (2) : 157-168. DOI: 10.3171/2017.12.SPINE171096.
- [15] He JL, Du Q, Hu WD, et al. CT-based radiographic measurements and effectiveness estimates of full-endoscopic surgery in thoracic myelopathy caused by ossification of ligamentum flavum [J]. *BMC Surg*, 2023, 23 (1) : 84. DOI: 10.1186/s12893-023-01989-6.
- [16] Yamada T, Shindo S, Yoshii T, et al. Surgical outcomes of the thoracic ossification of ligamentum flavum: a retrospective analysis of 61 cases [J]. *BMC Musculoskelet Disord*, 2021, 22 (1) : 7. DOI: 10.1186/s12891-020-03905-y.
- [17] Machino M, Sakai K, Yoshii T, et al. Treatment for the thoracic ossification of the posterior longitudinal ligament and ossification of the ligamentum flavum [J]. *J Clin Med*, 2022, 11 (16) : 4690. DOI: 10.3390/jcm11164690.
- [18] Pan Q, Zhang Z, Zhu Y, et al. Zoning laminectomy for the treatment of ossification of the thoracic ligamentum flavum [J]. *Asian J Surg*, 2023, 46 (2) : 723-729. DOI: 10.1016/j.asjsur.2022.06.118.
- [19] Liu Y, Li X, Hou Y, et al. Surgical outcomes of percutaneous endoscopic thoracic decompression in the treatment of multi-segment thoracic ossification of the ligamentum flavum [J]. *Acta Neurochir (Wien)*, 2023, 165 (8) : 2131-2137. DOI: 10.1007/s00701-023-05603-9.

(收稿:2023-08-28 修回:2024-01-17)

(同行评议专家: 王丹, 赵志刚, 尹国栋, 刘汝专, 周先明)

(本文编辑: 闫承杰)