

经皮脊柱内镜手术的相关问题

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随着脊柱手术器械及手术方法的不断发展和创新, 脊柱微创手术(minimally invasive spine surgery, MISS)目前已成为脊柱手术的重要手术理念。虽然传统的脊柱融合或非融合手术已广泛应用于治疗椎间盘突出症或椎管狭窄症等退

行性病变, 但此类传统开放手术存在手术创伤大、术中并发症较多及术后恢复时间较长等缺点。如何保证达到或接近传统开放手术治疗效果, 并同时尽可能降低正常软组织的创伤, 这是 MISS 的主要手术目标及手术的局部原则^[1]。经皮脊柱内镜手术(percutaneous endoscopic spine surgery, PESS)作为脊柱微创手术的一种, 因手术创伤小、术后恢复时间短及良好的临床效果, 目前已广泛应用于颈椎、胸椎及腰椎的退行性病变^[2-7]。笔者就经皮脊柱内镜的历史发展、手术器械与技术的改进、经皮脊柱内镜手术的原则与理念等有关问题认识, 结合本期刊出的几篇文章^[8-13]进行交流。

1 经皮脊柱内镜技术的历史和发展

回顾经皮脊柱内镜技术的历史, 其发展过程可简单概括为 3 个阶段: 灵感(inspiration), 创造(invention), 创新(innovation)^[14]。由于传统开放手术的诸多缺点, 早期的术者致力于探寻一种创伤小的直接靶向到椎间盘的手术方式或手术入路。1973 年 Kambin 首次报道了使用 Craig 套管的经皮后外侧入路非直视下椎管间接减压术——经皮髓核切除术^[15], 并随后引入了直径 5 mm 套管以利于椎间盘髓核组织的充分减压^[16-17]。Kambin 等^[18]于 1988 年首

次描述了椎间盘突出髓核组织的内镜直视画面, 并提出了出口神经根、走行神经根与下位椎体上终板所围成的“安全三角”(Kambin's triangle)^[15], 该理论为脊柱内镜器械的改良及手术入路的创新提供了解剖学基础。Yeung 等^[19]首先发明出 YESS (Yeung Endoscopic Spine System) 脊柱内镜系统, 提出 YESS 技术, 并将其用于治疗腰椎间盘突出症。随后 Hoogland 等^[20]在 YESS 内镜基础上提出了 THESSYS (Thomas Hoogland Endoscopic Spine System) 系统, 并采用椎间孔入路治疗 280 例腰椎间盘突出症, 取得满意的临床效果。再随后经皮脊柱内镜逐渐应用于颈、胸、腰椎退行性病变的治疗中。

2 经皮脊柱内镜手术器械及手术技术的改进

早期进行的经皮脊柱内镜手术, 在处理骨及关节突部分切除时, 环锯的使用通常是在 C 形臂 X 线透视引导下结合手感的“盲”锯。随后改进为内镜下可视的镜外环锯操作, 如文杰等^[9]报道的全内镜 I See 技术, 可以可视化镜下进行关节突成形。常规的经皮脊柱内镜工作通道直径为 4 mm 左右, 在一定程度上限制了处理骨与关节软组织等工具(如磨钻)的尺寸, 手术效率受到一定影响。目前经皮脊柱内镜器械厂家推出各种大直径、大通道的经皮内镜系统, 工作通道直径可达 5 mm 以上, 可配合更大尺寸的椎板钳与磨钻头等使用, 大大提高了部分患者减压术的手术效率。邱峰等^[8]报道了经 Delta 通道孔镜治疗神经根型颈椎病相关应用经验。

近 10 年来, 经皮脊柱内镜手术在操作技术上不断创新及改进, 提高了手术的安全性及疗效, 并成为经皮脊柱内镜手术适应证不断扩大的重要基础。常晓盼等^[12]提出“分区法”颈椎间孔切开, 并总结了相关经验。

3 经皮脊柱内镜手术的原则与理念

笔者认为经皮脊柱内镜手术器械及手术技术的创新与改进应当以对脊柱相关结构解剖及其病理的理解为基础^[1], 应坚持“对神经组织的无创, 对关节软骨、韧带软组织的微创, 对皮肤与骨组织的小创”这一原则^[1]。基于对脊柱相关组织在手术创伤后修复的病理过程、修复能力及对脊柱功能的影响, 若必须牺牲某部分组织才得以完成手术时, 应首选牺牲骨组织^[1]。经皮脊柱内镜在治疗颈椎疾病入路方式的演变及手术技术的改进, 很好的诠释了该原则。如 Ahn 等^[21]在 2020 年一项前路经椎间隙经皮脊柱内镜颈椎间盘切除术 (anterior percutaneous endoscopic cervical discectomy, APECD) 与颈椎前路间盘切除减压融合术 (anterior cervical discectomy and fusion, ACDF) 的队列研究中发现, APECD 可以取得与 ACDF 相同的临床效果, 并且具有手术时间短、住院时间短等优势。有文献^[22]报道了 120 例颈椎前路内镜患者的手术疗效, 随访时间为 2 年, 无并发症发生, 手术优良率 89%。但 APECD 通过正常椎间盘组织至椎体后缘、椎间孔等处取出突出的椎间盘髓核, 对该节段的正常椎间盘组织存在一定的损伤, 对该节段运动单元的稳定性存在一定影响。Ahn 等^[23]在对 38 例 APECD 的平均 28.6 个月的随访中发现, 平均椎间盘高度下降了 11.2%。为减少颈椎前路经椎间隙入路对正常椎间盘组织的破坏, 陈亮等^[24]探讨了前路经椎体入路治疗神经根型颈椎病的可行性, 通过对 4 具尸体标本的颈椎椎体穿刺、磨钻形成骨性通道, 可成功取出椎体后方突出的髓核组织, 术后 CT 证实骨性通道未塌陷。随后我们报道了^[25] 1 例 C_{4,5} 节段的前路经椎体入路经皮脊柱内镜治疗颈椎间盘突出, 详细介绍了颈椎体入路的手术技术, 认为该术式临床上安全、可行。虽然前路经椎体入路可安全有效的取出突出的椎间盘髓核组织, 但术后仍有椎体高度及椎间隙高度下降的可能^[26]。对于颈椎后路经皮脊柱内镜椎间盘切除术 (posterior percutaneous endoscopic cervical discectomy, p-PECD), 为做到对脊髓神经组织的无创, 在 Key-hole 入路的基础上, Liao 等^[7]引入“克氏针锚定技术 (vertical anchoring technique)”, 降低了手术时间及术中透视时间, 可一定程度地降低学习曲线。为了进一步减少关节突的破坏, 国内学者对 p-PECD 技术进行改良, Liu 等^[27]提出“Lamina-hole”技术, 以椎弓根上内缘的凸面为磨钻的起始点, 避免损伤小关节突及脊柱功能单位。在内镜手术减压神经根时, 为减少术中器械对神经根的牵拉刺激, Xiao 等^[28]提出“Modified Key-hole”技术, 采用后路经部分椎弓根入路治疗 84 例

颈椎间盘突出, 取得了良好的临床效果。同样, Yu 等^[29]通过经后路磨除部分椎弓根、椎体后壁的“Trench”技术, 可成功取出中央型、旁中央型突出的椎间盘髓核组织。

经皮脊柱内镜手术需注意上述原则的同时, 手术方式及手术入路的选择亦应做到手术打击在机体内环境稳态可调控范围内, 确保血生化指标、生命体征、炎症代谢指标等基本稳定。

经皮脊柱内镜手术治疗脊柱疾患, 特别是老年患者, 应遵循多学科诊疗模式 (Multi-disciplinary treatment, MDT)。患者入院后, 主管医师与老年病科、营养科医师等共同评估患者整体状况, 老年患者衰弱程度、预期寿命、内脏功能、入院前肌肉骨骼系统功能状况及营养状态等。随后根据脊柱疾患, 在可能的多种诊疗方案中, 选择适当的微创手术方案。然后由麻醉科评估该微创手术的麻醉风险、选择具体的麻醉方式。术者和麻醉科医生根据手术复杂程度、手术时间、患者的依从性等决定是否采取分期分次手术。

经皮脊柱内镜手术还应注重围手术期的疼痛管理, 提升患者的手术体验, 减少患者的心理应激, 做到人文关怀。

4 经皮脊柱内镜手术的适应症

钱济先^[30]在“椎间孔技术的发展和未来”报道中已经详细的探讨了经皮脊柱内镜在颈椎、胸腰、腰椎的具体应用及临床适应症。笔者认为经皮脊柱内镜器械的改进及手术技术的不断创新, 术者不断积累的手术经验及患者对经皮脊柱内镜微创手术的需求, 促进了经皮脊柱内镜手术的发展, 经皮脊柱内镜手术的适应症也在不断的扩大, 其适应症已由椎间盘突出症扩大到脊柱退行性病变、感染甚至肿瘤, 如极外侧椎间盘突出^[31-33]、复发性椎间盘突出^[34-35]、椎间盘脱出游离^[36-39]、椎间盘炎症^[40]、盘源性腰痛^[30]及脊柱肿瘤^[41-42]等。可以预计在不远的将来, 80% 脊柱手术患者, 可采用经皮脊柱内镜手术或内镜辅助下的手术方式。

5 总结与展望

目前经皮脊柱内镜手术技术已经基本成熟, 并在脊柱减压术中取得了良好的临床效果, 但其在脊柱重建等方面仍需进一步的探寻。在提高手术效率方面的手术技术也需要进一步创新和改进。经皮脊柱内镜手术器械在不断改进及创新的同时, 也应控制其价格, 使更多的医疗单位及科室享受到脊柱微创手术带来的福利。

由于学习曲线陡峭, 初学者应具备扎实的临床解剖学基础, 并需经过严格、系统、规范化的脊柱内

镜手术培训, 进而熟练掌握经皮脊柱内镜系统及手术器械的使用, 才能更好地开展和推广经皮脊柱内镜手术。

参考文献

- [1] 邓忠良. 从机体内环境稳态理解微创脊柱外科手术的内涵与原则[J]. 中华创伤杂志, 2015, 31(10): 865-867.
DENG ZL. Understanding the connotation and principles of minimally invasive spine surgery from the steady state of the body environment[J]. Zhonghua Chuang Shang Za Zhi, 2015, 31(10): 865-867. Chinese.
- [2] Ruetten S, Komp M, Merk H, et al. A new full-endoscopic technique for cervical posterior foraminotomy in the treatment of lateral disc herniations using 6.9-mm endoscopes: prospective 2-year results of 87 patients[J]. Minim Invasive Neurosurg, 2007, 50(4): 219-226.
- [3] Ruetten S, Komp M, Merk H, et al. Full-endoscopic cervical posterior foraminotomy for the operation of lateral disc herniations using 5.9-mm endoscopes: a prospective, randomized, controlled study[J]. Spine (Phila Pa 1976), 2008, 33(9): 940-948.
- [4] Choi KY, Eun SS, Lee SH, et al. Percutaneous endoscopic thoracic discectomy; transforaminal approach[J]. Minim Invasive Neurosurg, 2010, 53(1): 25-28.
- [5] Ahn Y. Transforaminal percutaneous endoscopic lumbar discectomy: technical tips to prevent complications[J]. Expert Rev Med Devices, 2012, 9(4): 361-366.
- [6] Kim CH, Kim KT, Chung CK, et al. Minimally invasive cervical foraminotomy and discectomy for laterally located soft disk herniation[J]. Eur Spine J, 2015, 24(12): 3005-3012.
- [7] Liao C, Ren Q, Chu L, et al. Modified posterior percutaneous endoscopic cervical discectomy for lateral cervical disc herniation: the vertical anchoring technique[J]. Eur Spine J, 2018, 27(6): 1460-1468.
- [8] 邱峰, 张贤, 李小军, 等. 经 Delta 通道椎间孔镜治疗神经根型颈椎病[J]. 中国骨伤, 2020, 33(5): 397-401.
QIU F, ZHANG X, LI XJ, et al. Treatment of cervical spondylotic radiculopathy with posterior intervertebral foraminal discectomy via Delta channel[J]. Zhongguo Gu Shang/China J Orthop Trauma, 2020, 33(5): 397-401. Chinese with abstract in English.
- [9] 文杰, 张辉, 宋玉鑫, 等. 全内镜 I See 技术治疗单节段退行性腰椎管狭窄症[J]. 中国骨伤, 2020, 33(5): 401-405.
WEN J, ZHANG H, SONG YX, et al. Full endoscopic I See technique for the treatment of single-segment degenerative lumbar spinal stenosis[J]. Zhongguo Gu Shang/China J Orthop Trauma, 2020, 33(5): 401-405. Chinese with abstract in English.
- [10] 蒋勇, 何升华, 赖居易, 等. 经皮脊柱内镜两种入路治疗 L₅S₁ 椎间盘突出症的疗效分析[J]. 中国骨伤, 2020, 33(5): 406-413.
JIANG Y, HE SH, LAI JY, et al. Analysis on clinical effects of two surgical approaches in percutaneous spinal endoscopy for L₅S₁ disc herniation[J]. Zhongguo Gu Shang/China J Orthop Trauma, 2020, 33(5): 406-413. Chinese with abstract in English.
- [11] 罗科锋, 蒋国强, 卢斌, 等. 经椎间孔镜下椎间孔成形术治疗单纯腰椎管侧方出行区狭窄[J]. 中国骨伤, 2020, 33(5): 420-425.
LUO KF, JIANG GQ, LU B, et al. Percutaneous transforaminal endoscopic foraminoplasty for simple lumbar spinal lateral exit-zone stenosis[J]. Zhongguo Gu Shang/China J Orthop Trauma, 2020, 33(5): 420-425. Chinese with abstract in English.
- [12] 常晓盼, 梅伟, 杨勇, 等. 分区法椎间孔切开在颈椎后路内镜手术中的应用[J]. 中国骨伤, 2020, 33(5): 426-429.
CHANG XP, MEI W, YANG Y, et al. Application of "Zoning Method" foraminotomy in posterior cervical endoscopic surgery[J]. Zhongguo Gu Shang/China J Orthop Trauma, 2020, 33(5): 426-429. Chinese with abstract in English.
- [13] 王峰, 鞠晓聪, 宋若光. 椎间孔镜下治疗高位腰椎间盘突出症的临床疗效及技术特点[J]. 中国骨伤, 2020, 33(5): 430-434.
WANG F, JU XC, SONG RG. Clinical efficacy and technical characteristics of percutaneous endoscopic lumbar discectomy in the treatment of upper lumbar disc herniation[J]. Zhongguo Gu Shang/China J Orthop Trauma, 2020, 33(5): 430-434. Chinese with abstract in English.
- [14] Telfeian AE, Veeravagu A, Oyelese AA, et al. A brief history of endoscopic spine surgery[J]. Neurosurg Focus, 2016, 40(2): E2.
- [15] Kambin P. Arthroscopic Microdiscectomy: Minimal Intervention Spinal Surgery[M]. Urban & Schwarzenberg; Humana Press, 1990.
- [16] Kambin P, Sampson S. Posterolateral percutaneous suction-excision of herniated lumbar intervertebral discs. Report of interim results[J]. Clin Orthop Relat Res, 1986, (207): 37-43.
- [17] Kambin P, Brager M. Percutaneous posterolateral discectomy. Anatomy and mechanism[J]. Clin Orthop Relat Res, 1987, (223): 145-154.
- [18] Kambin P, Nixon J, Chait A, et al. Annular protrusion: pathophysiology and roentgenographic appearance[J]. Spine (Phila Pa 1976), 1988, 13: 671-675.
- [19] Yeung A, Tsou P. Posterolateral endoscopic excision for lumbar disc herniation: Surgical technique, outcome, and complications in 307 consecutive cases[J]. Spine (Phila Pa 1976), 2002, 27: 722-731.
- [20] Schubert M, Hoogland T. Endoscopic transforaminal nucleotomy with foraminoplasty for lumbar disk herniation[J]. Oper Orthop Traumatol, 2005, 17: 641-661.
- [21] Ahn Y, Keum HJ, Shin SH. Percutaneous endoscopic cervical discectomy versus anterior cervical discectomy and fusion; a comparative cohort study with a five-year follow-up[J]. J Clin Med, 2020, 9(2): E371.
- [22] Ahn Y, Lee SH, Lee SC, et al. Factors predicting excellent outcome of percutaneous cervical discectomy: analysis of 111 consecutive cases[J]. Neuroradiology, 2004, 46(5): 378-384.
- [23] Ahn Y, Lee SH, Shin SW. Percutaneous endoscopic cervical discectomy: clinical outcome and radiographic changes[J]. Photomed Laser Surg, 2005, 23(4): 362-368.
- [24] 陈亮, 肖福涛, 楚磊, 等. 经椎体入路经皮内镜下颈椎间盘髓核摘除术的可行性研究[J]. 中华解剖与临床杂志, 2015, 1: 32-35.
CHEN L, XIAO FT, CHU L, et al. Feasibility study of percutaneous endoscopic cervical nucleus pulpectomy under the vertebral approach[J]. Zhonghua Jie Pou Yu Lin Chuang Za Zhi, 2015, 1: 32-35. Chinese.
- [25] Deng ZL, Chu L, Chen L, Yang JS. Anterior transcorporeal approach of percutaneous endoscopic cervical discectomy for disc herniation at the C₄-C₅ levels: a technical note[J]. Spine J, 2016, 16(5): 659-666.
- [26] Yu KX, Chu L, Yang JS, et al. Anterior transcorporeal approach to

- percutaneous endoscopic cervical discectomy for single-level cervical intervertebral disk herniation: case series with 2-year follow-up[J]. *World Neurosurg*, 2019, 122: e1345–e1353.
- [27] Liu C, Liu K, Chu L, et al. Posterior percutaneous endoscopic cervical discectomy through lamina-hole approach for cervical intervertebral disc herniation[J]. *Int J Neurosci*, 2019, 129(7): 627–634.
- [28] Xiao CM, Yu KX, Deng R, et al. Modified K-hole percutaneous endoscopic surgery for cervical foraminal stenosis: partial pediclectomy approach[J]. *Pain Physician*, 2019, 22(5): E407–E416.
- [29] Yu KX, Chu L, Chen L, et al. A novel posterior trench approach involving percutaneous endoscopic cervical discectomy for central cervical intervertebral disc herniation[J]. *Clin Spine Surg*, 2019, 32(1): 10–17.
- [30] 钱济先. 椎间孔镜技术的发展和未来[J]. *中国骨伤*, 2018, 31(4): 297–301.
- QIAN JX. Development and future of transforaminal endoscopic spine system[J]. *Zhongguo Gu Shang/China J Orthop Trauma*, 2018, 31(4): 297–301. Chinese.
- [31] Ahn Y. Percutaneous endoscopic decompression for lumbar spinal stenosis[J]. *Expert Rev Med Devices*, 2014, 11(6): 605–616.
- [32] Lew S, Mehalic T, Fagone K. Transforaminal percutaneous endoscopic discectomy in the treatment of far-lateral and foraminal lumbar disc herniations[J]. *J Neurosurg*, 2001, 94(2 Suppl): 216–220.
- [33] Liao Z, Chen W, Wang C. Transforaminal percutaneous endoscopic surgery for far lateral lumbar intervertebral disk herniation[J]. *Orthopedics*, 2014, 37: e717–e727.
- [34] Hoogland T, van den Brekel-Dijkstra K, Schubert M, Miklitz B. Endoscopic transforaminal discectomy for recurrent lumbar disc herniation: a prospective, cohort evaluation of 262 consecutive cases[J]. *Spine (Phila Pa 1976)*, 2008, 33: 973–978.
- [35] Ruetten S, Komp M, Merk H, et al. Recurrent lumbar disc herniation after conventional discectomy: a prospective, randomized study comparing full-endoscopic interlaminar and transforaminal versus microsurgical revision[J]. *J Spinal Disord Tech*, 2009, 22(2): 122–129.
- [36] Tsou P, Yeung C, Yeung A. Posterolateral transforaminal selective endoscopic discectomy and thermal annuloplasty for chronic lumbar discogenic pain: a minimal access visualized intradiscal surgical procedure[J]. *Spine J*, 2004, 4: 564–573.
- [37] Yeom K, Choi Y. Full endoscopic contralateral transforaminal discectomy for distally migrated lumbar disc herniation[J]. *J Orthop Sci*, 2011, 16: 263–269.
- [38] Choi G, Prada N, Modi H, et al. Percutaneous endoscopic lumbar hemiectomy for high-grade down-migrated L₄–L₅ disc through an L₅–S₁ interlaminar approach: a technical note[J]. *Minim Invasive Neurosurg*, 2010, 53: 147–152.
- [39] Jasper G, Francisco G, Telfeian A. Endoscopic transforaminal discectomy for an extruded lumbar disc herniation[J]. *Pain Physician*, 2013, 16: E31–E35.
- [40] Ito M, Abumi K, Kotani Y, et al. Clinical outcome of posterolateral endoscopic surgery for pyogenic spondylodiscitis: results of 15 patients with serious comorbid conditions[J]. *Spine (Phila Pa 1976)*, 2007, 32: 200–206.
- [41] Joo Y, Ok W, Baik S, et al. Removal of a vertebral metastatic tumor compressing the spinal nerve roots via a singleport, transforaminal, endoscopic approach under monitored anesthesia care[J]. *Pain Physician*, 2012, 15: 297–302.
- [42] Telfeian A, Choi D, Aghion D. Transforaminal endoscopic surgery under local analgesia for ventral epidural thoracic spinal tumor: case report[J]. *Clin Neurol Neurosurg*, 2015, 134: 1–3.

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