

# 神经根型颈椎病椎间孔内神经根受压的原因分析及减压方式选择

陈学明<sup>1,2</sup>, 冯世庆<sup>1</sup>, 许崧杰<sup>2</sup>, 崔利宾<sup>2</sup>, 袁鑫<sup>2</sup>, 刘亚东<sup>2</sup>, 赵鹏<sup>2</sup>, 于振山<sup>2</sup>

(1 天津医科大学总医院骨科 300052 天津市; 2 首都医科大学附属北京潞河医院骨科 101149 北京市)

**【摘要】** 目的: 分析神经根型颈椎病患者椎间孔内神经根受压的原因, 选择合理的减压方式。方法: 2010 年 1 月~2013 年 8 月, 我院共收治神经根型颈椎病患者 178 例, 其中 56 例为椎间孔内神经根受压所致的单侧神经根型颈椎病, 术前 VAS 评分为  $8.99 \pm 1.01$  分 (7~10 分); 颈椎功能障碍指数 (NDI) 为  $41.15 \pm 7.12$  分 (37~49 分)。根据术前影像学资料判断椎间孔内神经根受压的原因分为 3 组: 单纯椎间盘压迫, 14 例 (A 组); 单纯骨性压迫, 22 例 (B 组); 混合压迫 (椎间盘+骨性压迫), 20 例 (C 组)。A 组切除椎间盘至钩椎关节, 适当扩大椎间孔, 取出突出髓核; B、C 组切除椎间盘至钩椎关节后, 将钩突基底内磨平, 充分显露钩突后部、上位椎体后下角及钩椎关节间隙, 刮除上位椎体后下角及部分增生的钩突。减压后均行椎间植骨内固定。使用 Surgimap 软件测量患者术前颈椎双斜位 X 线片上病变节段的双侧椎间孔面积, 将健侧与患侧的椎间孔面积进行对比。比较 3 组患者术前及末次随访时 VAS 评分和 NDI, 同时比较 3 组的手术时间、术中出血量和术后住院时间。结果: 3 组患者术前健侧椎间孔面积无显著性差异 ( $P > 0.05$ ), B 组和 C 组的患侧椎间孔面积均较 A 组明显狭窄 ( $P < 0.05$ ); B 组和 C 组无显著性差异 ( $P > 0.05$ ); B 组和 C 组的患侧椎间孔面积均较各自的对侧椎间孔面积明显狭窄 ( $P < 0.05$ ); 而 A 组患侧椎间孔面积较对侧无明显狭窄 ( $P > 0.05$ )。3 组患者均顺利完成手术, B、C 组与 A 组相比术中出血量较多, 手术时间和术后住院天数较长 ( $P < 0.05$ ); B 组与 C 组比较无显著性差异 ( $P > 0.05$ )。术后 3 组患者均无神经症状加重、感染及脑脊液漏等并发症发生。56 例患者均获得随访, 随访时间  $27.2 \pm 8.9$  个月 (12~52 个月), 3 组术前 VAS 评分和 NDI 比较无显著性差异 ( $P > 0.05$ ), 末次随访时亦无显著性差异 ( $P > 0.05$ ); 3 组末次随访时与术前比较均有显著性差异 ( $P < 0.05$ )。结论: 术前根据影像学资料分析神经根型颈椎病患者椎间孔内神经根受压的原因, 进行针对性的减压手术可取得良好效果。

**【关键词】** 神经根型颈椎病; 椎间孔; 前路减压

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**The causes analysis and decompression mode choice for the cervical spondylotic radiculopathy with nerve root compression in foramen/CHEN Xueming, FENG Shiqing, XU Songjie, et al/Chinese Journal of Spine and Spinal Cord, 2015, 25(2): 103-108**

**【Abstract】 Objectives:** To analyze the reasons of nerve root compression in foramen in patients with cervical spondylotic radiculopathy, and to provide rational methods for decompression. **Methods:** From January 2010 to August 2013, 178 patients with cervical spondylotic radiculopathy were admitted in our hospital, and 56 of them had unilateral cervical spondylotic radiculopathy with nerve root compression in foramen. Preoperative VAS was 7-10 (average,  $8.99 \pm 1.01$ ) and NDI was 37-49 (average,  $41.15 \pm 7.12$ ). According to preoperative radiological data, the patients were divided into three groups based on the reasons of nerve root compression in foramen: simple disc compression, 14 cases (group A); simple bony compression, 22 cases (group B); mixed compression, 20 cases (group C). In group A, cervical discs plus uncovertebral joints were removed, and the affected foramen was slightly enlarged. In group B and C, after the removal of uncovertebral joint, the medial part of the uncinate process was spurred to fully expose the posterior edge of uncinate process, as well as the inferior and posterior edge of the upper vertebra and the uncovertebral joint space. After that, the inferi-

第一作者简介: 男 (1966-), 主任医师, 医学硕士, 研究方向: 脊柱外科

电话: (010) 69543901-2041 E-mail: xuemingchen@sina.com

通讯作者: 冯世庆 E-mail: fengsq@hotmail.com

or-posterior osteophyte of the upper vertebra and the hyperosteo-geny part of uncinat process were also spurred. Bone grafting, fusion and internal fixation were performed for all patients after decompression. The bilateral foraminal area of the corresponding segment was measured in double oblique X-ray by Surgimap software, and the comparison between foraminal area of the affected side and the contralateral side was performed. Preoperative and final follow-up VAS and NDI scores of three groups were compared respectively. Operation time, blood loss and hospital stay of the three groups were also compared. **Results:** Preoperative foraminal area on the contralateral side of the three groups showed no significant difference. Foraminal area on the affected side of group B and C was smaller than that of group A, while group B and group C had no difference. For group B and C, foraminal area on the affected side was smaller than that on the contralateral side, while foraminal area of group A on the affected side showed no difference with that on the contralateral side. Compared with group B and C, group A had younger age, less blood loss, shorter operation time and long hospital stay. No significant difference was found between group B and C. No neurological deterioration, infection or cerebrospinal fluid leakage was found. Fifty-six patients had a follow-up time of over 12 months, with a mean follow-up time of  $27.2 \pm 8.9$  months (range, 12–52 months). There was no significant difference in VAS or NDI score among three groups at preoperation and final follow-up. VAS and NDI of the three groups at the final follow-up were significantly different with those at preoperation. **Conclusions:** Based on different reasons causing nerve root compression in cervical foramen, targeted decompression procedure may lead to satisfactory clinical outcomes for cervical spondylotic radiculopathy.

**【Key words】** Cervical spondylotic radiculopathy; Intervertebral foramen; Anterior decompression

**【Author's address】** Department of Orthopedic Surgery, Tianjing Medical University General Hospital, Tianjing, 300052, China; Department of Orthopedic Surgery, Luhe Hospital, Capital Medical University, Beijing, 101149, China

神经根型颈椎病(cervical spondylotic radiculopathy, CSR)是指一个或多个颈神经根受压或/和受刺激引起的一侧或双侧上肢根性疼痛的颈椎退行性疾病,其主要致病因素是突出髓核和增生的骨赘对神经根的压迫<sup>[1]</sup>。长期以来,该病多以保守治疗为主<sup>[2-3]</sup>,但对存在上肢顽固性疼痛、肌力减退且经保守治疗无效者近年来多行手术治疗<sup>[4]</sup>。颈椎管内髓核突出压迫引起的 CSR 经前路减压治疗少有争议,但对椎间孔内压迫引起 CSR 的手术方式选择尚存在争论,不同方法各有利弊<sup>[5-10]</sup>。2010 年 1 月~2013 年 8 月,我科对 56 例椎间孔内存在压迫的 CSR 患者依据压迫类型进行针对性前路椎间孔内神经根减压手术治疗,取得了良好疗效,报告如下。

## 1 临床资料

### 1.1 一般资料

2010 年 1 月~2013 年 8 月,我科收治神经根型颈椎病患者 178 例,其中颈椎间孔内神经根受压所致的神经根型颈椎病患者 56 例,男 18 例,女 38 例,年龄  $50.8 \pm 5.9$  岁(32~67 岁);病程  $15.0 \pm 3.2$  个月(3~30 个月)。患者均存在反复发作的单侧上肢疼痛、麻木伴颈肩疼痛不适;上肢感觉异常 48

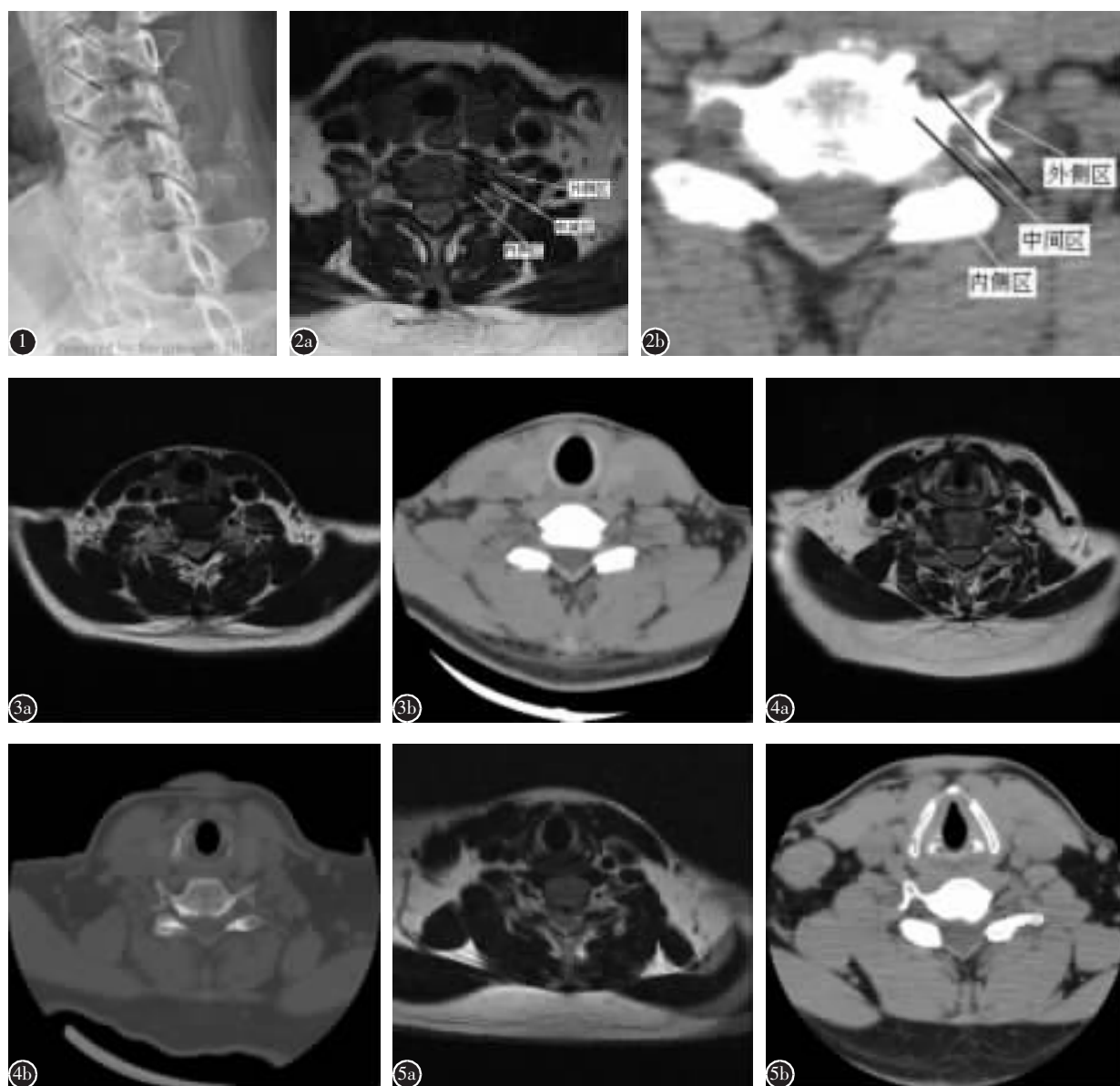
例,肌力减退 36 例,反射异常 40 例,Spurling 试验阳性 42 例,引颈试验阳性 24 例,病理征均阴性。术前 VAS 评分为  $8.99 \pm 1.01$  分(7~10 分);颈椎功能障碍指数(NDI)为  $41.15 \pm 7.12$ (37~49 分)。

病例纳入标准:椎间孔前内侧骨性或/和椎间盘压迫引起的单侧神经根型颈椎病。排除标准:椎管内及椎间孔后侧压迫引起的神经根型颈椎病;颈椎外病变(胸廓出口综合征、网球肘、腕管综合征、肘管综合征、肩周炎和肱二头肌腱鞘炎等)所致以上肢疼痛为主的疾患。

### 1.2 影像资料

全部病例常规行正侧位、双斜位 X 线片及 CT、MRI 检查。在双斜位 X 线上测量患者病变节段两侧椎间孔的面积(图 1),通过 CT 及 MRI 观察致压物的位置、性质及与横突孔的关系(图 2)。

根据椎间孔内神经根受压的原因分为 3 组:A 组,单纯椎间盘压迫,MRI 示椎间盘突入椎间孔内压迫神经根(图 3),14 例;B 组,单纯骨性压迫,MRI 示椎间孔内低信号致压物,CT 示致压物为椎体后缘增生的骨赘(图 4),22 例;C 组,混合压迫,即椎间盘压迫+骨性压迫,MRI 显示椎间孔内不均匀信号致压物,CT 示椎体后缘骨赘增生,并伴有椎间盘的突出(图 5),20 例。



**图 1** 采用 Surgimap 软件测量颈椎双斜位 X 线片上椎间孔面积 **图 2** MRI(2a)及 CT(2b)轴位像示左侧椎间孔内软性(椎间盘)压迫,外侧毗邻椎动脉 **图 3** 患者女,42 岁,左上肢疼痛、麻木 6 个月 **a** 术前 MRI 示椎间盘向左侧突出,左侧神经根受压 **b** 术前 CT 显示无明显骨性压迫 **图 4** 患者女,67 岁,右上肢疼痛 3 个月 **a** 术前 MRI 示右侧椎间孔内低信号的致压物 **b** 术前 CT 可见致压物为椎体后缘增生的骨赘 **图 5** 患者男,61 岁,左上肢麻木、疼痛 4 个月,加重 10d **a** 术前 MRI 示左侧椎间孔内可见不均匀信号的致压物 **b** 术前 CT 显示椎体后缘骨赘增生,并伴有椎间盘突出

**Figure 1** Using Surgimap software, area of foramen was measured on bilateral oblique X-ray film **Figure 2** Axial view of MRI(2a) and CT(2b) showed soft compression from intervertebral disc in the left foramen, which was adjacent to the medial side of vertebral artery **Figure 3** A 42-year-old woman who had the trouble of pain and numbness in left upper limb for 6 months **a** Pre-op MRI showed left herniation of intervertebral disc, and left nerve root was compressed **b** Pre-op CT showed no obvious bony compression **Figure 4** A 67-year-old woman who had severe pain in right upper limb for 3 months **a** Pre-op MRI showed compression in right foramen with low signal intensity **b** Pre-op CT showed osteophyte at the posterior part of vertebral body **Figure 5** A 61-year-old man who had pain and numbness in left upper limb for 4 months, deteriorated for 10 days **a** Pre-op MRI showed compression in left foramen with nonuniform signal intensity **b** Pre-op CT showed osteophyte at the posterior part of vertebral body, combined with disc herniation

### 1.3 手术方法

均采用气管插管全麻。根据责任节段确定颈前路手术切口位置,依次切开各层至椎体前方,透视下定位,于责任节段椎间盘相邻椎体骨膜下剥离,并将患侧颈长肌内侧边缘部分切除至钩椎关节内侧以充分显露,A 组患者切除椎间盘至钩椎关节,适当扩大椎间孔,以便取出突出髓核,探查椎间孔无压迫后完成减压;B、C 组患者切除椎间盘至钩椎关节后,以直径 4~5mm 磨钻将钩突基底部内侧磨平,充分显露钩突后部、上位椎体后下角及钩椎关节间隙,用大小不等的正、反向刮勺自内向外上方逐渐刮除上位椎体后下角及部分增生的钩突,直至椎间孔通畅,完成神经根减压。紧贴骨面减压以避免或减少出血,如术中出血用蘸凝血酶的明胶海绵压迫 5min,减压后均行椎间隙植入自体髂骨或椎间融合器植骨,并行前路钛板内固定。

### 1.4 观察项目及评价指标

记录手术时间、出血量及术后住院天数;末次随访时对患者进行上肢疼痛的 VAS 评分和 NDI 评定。

### 1.5 统计学方法

所有数据采用 SPSS 17.0 软件分析。计量资料采用  $\bar{x} \pm s$  表示。应用单因素方差分析分别比较 3 组患者健侧及患侧的椎间孔面积,两两比较使用 LSD-*t* 检验,采用配对 *t* 检验比较组内健侧及患侧的椎间孔面积。3 组资料中患者年龄、手术时间、术中出血量、术后住院天数、术前及末次随访时的 NDI 和 VAS 评分等计量资料的组间比较采用单因素方差分析,两两比较采用 LSD-*t* 检验。术前数据均经正态分布检验后再进行统计分析。 $P < 0.05$  为差异有统计学意义。

## 2 结果

术前 3 组患者病变节段的椎间孔面积见表 1。3 组健侧椎间孔面积无显著性差异( $P > 0.05$ ),B 组和 C 组患侧椎间孔面积均较 A 组明显狭窄( $P < 0.05$ );而 B 组和 C 组间无显著性差异( $P > 0.05$ );B 组和 C 组患侧椎间孔面积均较各自的健侧椎间孔面积明显狭窄( $P < 0.05$ );而 A 组患侧椎间孔面积较健侧无明显狭窄( $P > 0.05$ )。

患者均顺利完成手术,术中出血量、手术时间、术后住院天数见表 2。A 组手术时间和术后住

院天数较 B、C 组短,出血量较 B、C 组少( $P < 0.05$ );B、C 组之间无显著性差异( $P > 0.05$ )。术后 3 组患者均无神经症状加重、感染及脑脊液漏等并发症发生。56 例患者均获得随访,随访时间  $27.2 \pm 8.9$  个月(12~52 个月),术前和末次随访时 3 组患者的 VAS 评分和 NDI 见表 3,3 组术前 VAS 评分和 NDI 均无显著性差异;末次随访时与术前比较均有显著性改善,3 组间比较均无显著性差异( $P > 0.05$ )。

## 3 讨论

### 3.1 颈椎间孔及其内致压物分类的临床意义

郭世绂等<sup>[5]</sup>将颈神经根走行的区域分为根管段(内侧段)、椎动脉段(中间段)和前支管段(外侧段);其中根管段四壁均为骨性组织,在钩椎骨赘增生或椎间盘突出时易受到压迫。Ebraheim 等<sup>[11]</sup>将颈椎间孔和颈神经沟(cervical nerve groove)分为 3 个区:内侧区(椎弓根区)、中间区(椎动脉孔区)和外侧区,内侧区与颈椎间孔相一致,该区与神经根型颈椎病的病因密切相关。Tanaka 等<sup>[12]</sup>将内侧区分为入口区和出口区。颈椎间孔近似漏斗形,其入口区最为狭窄,内为锥形神经根鞘,因椎间盘退变、钩突及关节突增生,椎间孔更易狭窄压迫神经根,因此椎间孔的结构特点在神经根型颈椎病的病因学中起着更为重要的作用<sup>[11,12]</sup>。与颈椎管内髓核突出压迫引起的 CSR 相比,椎间孔内压迫容易被忽视,造成漏诊。

颈椎 X 线正位、双斜位片可观察钩突高度并

表 1 3 组患者颈椎双斜位 X 线片上双侧颈椎间孔面积 ( $\bar{x} \pm s$ , mm<sup>2</sup>)

Table 1 Bilateral foraminal area measured on double oblique radiographs of cervical spine

|                                                                  | 健侧<br>Contralateral side | 患侧<br>Affected side      |
|------------------------------------------------------------------|--------------------------|--------------------------|
| 单纯椎间盘压迫组<br>(A 组)<br>Cervical disc oppression<br>group (Group A) | 44.76±12.43              | 43.95±10.34 <sup>①</sup> |
| 单纯骨性压迫组(B 组)<br>Bone oppression group<br>(Group B)               | 50.10±10.57              | 31.31±5.93 <sup>②</sup>  |
| 混合压迫组(C 组)<br>Combined group (Group<br>C)                        | 52.37±13.15              | 35.33±6.46 <sup>②</sup>  |

注:①与同组健侧比较  $P < 0.05$ ;②与 A 组比较  $P < 0.05$

Note: ①Compared with that on the contralateral side,  $P < 0.05$ ;

②Compared with group A,  $P < 0.05$

表 2 3 组患者手术时间、术中出血量、术后住院天数比较 ( $\bar{x} \pm s$ )

Table 2 Comparison of operation time, intraoperative blood loss, and postoperative hospital days in three groups of patients

|                                                 | 例数<br>Number | 年龄(岁)<br>Age            | 手术时间(min)<br>Operation time | 术中出血量(ml)<br>Blood loss  | 术后住院天数(d)<br>Hospital days |
|-------------------------------------------------|--------------|-------------------------|-----------------------------|--------------------------|----------------------------|
| 椎间盘压迫组(A组)<br>Disc oppression group(group A)    | 14           | 42.57±4.54              | 119.29±28.21                | 37.14±29.14              | 4.79±0.89                  |
| 骨性压迫组(B组)<br>Bone oppression group(group B)     | 22           | 52.91±7.07 <sup>①</sup> | 151.91±58.85 <sup>①</sup>   | 63.86±27.25 <sup>①</sup> | 7.09±1.77 <sup>①</sup>     |
| 混合压迫组(C组)<br>Combined oppression group(group C) | 20           | 54.20±6.71 <sup>①</sup> | 133.00±29.49 <sup>①</sup>   | 64.50±32.52 <sup>①</sup> | 7.60±1.81 <sup>①</sup>     |

注:①与 A 组比较  $P < 0.05$ Note: ①Compared with group A,  $P < 0.05$ 表 3 3 组患者术前及末次随访时的 VAS 评分和 NDI ( $\bar{x} \pm s$ )

Table 3 Comparison of NDI and VAS in three groups preoperatively and at the final follow-up

|                                                 | 例数<br>Number | VAS 评分<br>VAS score |                          | NDI                |                          |
|-------------------------------------------------|--------------|---------------------|--------------------------|--------------------|--------------------------|
|                                                 |              | 术前<br>Preoperative  | 末次随访时<br>Final follow-up | 术前<br>Preoperative | 末次随访时<br>Final follow-up |
| 椎间盘压迫组(A组)<br>Disc oppression group(group A)    | 14           | 9.14±0.86           | 1.71±0.83 <sup>①</sup>   | 41.42±7.70         | 4.14±1.87 <sup>①</sup>   |
| 骨性压迫组(B组)<br>Bone oppression group(group B)     | 22           | 9.09±0.75           | 1.77±0.75 <sup>①</sup>   | 40.91±6.84         | 3.73±2.00 <sup>①</sup>   |
| 混合压迫组(C组)<br>Combined oppression group(group C) | 20           | 8.80±1.01           | 1.80±0.68 <sup>①</sup>   | 41.25±6.04         | 3.50±1.85 <sup>①</sup>   |

注:①与同组术前比较  $P < 0.05$ Note: Compared with preoperative,  $P < 0.05$ 

测量椎间孔的面积。本研究中,我们测量了所有患者术前颈椎双斜位 X 线片上病变节段双侧椎间孔的面积,发现 B 组和 C 组的患侧椎间孔面积均较 A 组明显狭窄( $P < 0.05$ );而 B 组和 C 组间无明显差异( $P > 0.05$ );B 组和 C 组患侧椎间孔面积均较各自的健侧椎间孔面积明显狭窄( $P < 0.05$ );而 A 组患侧椎间孔面积较健侧无明显狭窄( $P > 0.05$ )。颈椎双斜位 X 线片对于诊断骨性颈椎间孔狭窄有重要的参考意义。然而单一的 X 线检查难以明确椎间孔内神经根致压物的性质,而 CT、MRI 可以清楚显示椎间孔的形态及致压物的大小和性质,其中 CT 对骨性压迫显示优于 MRI,而 MRI 显示软性压迫优于 CT,并可显示有无椎管内压迫。三者联合检查可以准确判断致压物性质及范围,结合症状及体征更有利于诊断。本组病例均为椎间孔内(即 Ebraheim 所描述的内侧区)压迫,其中单纯椎间盘突出压迫 14 例,单纯骨性压迫 22 例,椎间盘突出合并骨性压迫 20 例。依据上述资料将颈椎间孔内致压物分为 3 种类型有助于制定减压策略,对责任节段椎间孔彻底减压,预防致压物残余致术后症状残留以及椎动脉损伤等并发症。

### 3.2 椎间孔减压术式选择

前路钩突切除可彻底减压,但影响手术节段稳定性、创伤较大、出血较多,且更易伤及椎动脉<sup>[13-16]</sup>。本组患者分为单纯椎间盘突出组(A组)、单纯骨性压迫组(B组)和混合压迫组(C组)3组,根据每组致压物特点,制定不同的手术策略。A组因无骨性压迫,只需对椎间孔进行适当减压即可较为容易地摘除突出髓核,解除压迫,其手术时间及出血量均明显低于其他两组,且恢复快、术后住院时间短。B、C组均存在骨性颈椎间孔狭窄,术中利用 4~5mm 磨钻磨除压迫部分,扩大椎间孔,同时保留大部分钩椎关节,对于 C 组患者尚需用钩状神经剥离器探查,清除突出的髓核,充分减压。B、C 两组患者因均存在骨性压迫,需要对椎间孔进行较大范围的减压,手术难度较 A 组大。术后 3 组患者临床症状缓解明显,末次随访时 VAS 评分和 NDI 与术前相比差异有显著性,但 3 组间的 VAS 评分和 NDI 无显著性差异,表明术前准确评估神经根受压原因、术中彻底切除致压物、充分减压神经根均可获得良好疗效;相比钩突的全部切除,本组患者保留了钩突大部,保持了手术节段的即刻稳定性,可避免相关手术并发症。但前路手术

只适用于颈神经根前方存在压迫者,对神经根后方存在压迫者(如关节突增生)应行后路手术<sup>[4,8]</sup>。

### 3.3 术前、术中注意事项

颈椎前路手术可伤及神经根及椎动脉<sup>[6]</sup>,伤及椎动脉虽不常见但后果严重<sup>[17]</sup>。本组病例未发生该并发症,我们认为术前、术中应注意:(1)不同节段的神经根与椎间盘、上位椎体后下角及钩突的关系不同<sup>[12]</sup>,颈椎间孔出口毗邻椎动脉,各节段钩突尖与椎动脉之间的间隙不等,平均 $4.32 \pm 0.84\text{mm}$ <sup>[18]</sup>,术前应仔细阅读 MRI 及 CT 重建影像,了解钩突与椎动脉的关系及致压物与椎动脉的距离,手术时不超越该距离是充分减压又避免椎动静脉损伤的有效办法。(2)显露要充分,调整光源,直视下减压,避免盲目操作造成神经根或/和椎动静脉损伤。(3)使用神经探子间断探查椎间孔,避免过度减压造成损伤。

总之,术前根据影像学资料分析神经根型颈椎病患者椎间孔内神经根受压的原因,进行针对性的减压手术可取得良好效果。

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(英文编审 蒋欣/贾丹彤)

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