Anterolateral Cervical Foraminotomy in the Management of Unilateral Spondylotic Radiculopathy

ABDEL-ALIM RAGAB, M.D.; NASSER EL-GHANDOUR, M.D.; AHMED HEGAZY M.D. and MOHAMED EL-MAGHRABY, M.Sc.
The Department of Neurosurgery, Faculty of Medicine, Cairo University

Abstract

Objective: This study details assessment of the indications, safety, efficacy and complications of anterolateral cervical foraminotomy for treatment of cervical spondylotic radiculopathy.

Patients and Methods: A prospective study conducted on fourteen patients with unilateral cervical spondylotic radiculopathy confirmed by clinical and radiological data, refractory to non-surgical measures for at least 6 months in the period between October 2010 and November 2012, patients were operated upon at Cairo University Hospitals and Al-Haram hospital. Outcome of patients was categorized according to Odom’s criteria.

Results: Average age of presentation was 44.3 years, male to female ratio was 2.5:1 and average duration of symptoms was 12.5 months. 7 cases had right sided radiculopathy and 7 cases had left sided radiculopathy. The most common presenting symptom after brachialgia was neck pain (78.6%); the most common sign was motor weakness (42.9%). Most common operated level was C4-5 (35.7%). Excellent and good outcomes of patients were obtained in 92.86%. The mean follow-up period was 16.5 months with no recurrence, instability, progressive kyphosis, vertebral collapse nor other late complications like adjacent segment disease.

Conclusion: Anterolateral cervical foraminotomy seem to be an effective surgical procedure for the treatment of unilateral radiculopathy caused by foraminally encroaching osteophytes, herniated disc, or other lesions with comparable results to the conventional anterior cervical discectomy and fusion.

Key Words: Cervical spine – Cervical spondylosis – Cervical radiculopathy – Anterolateral cervical foraminotomy.

Introduction

CERVICAL radiculopathy is a neurologic condition characterized by dysfunction of a cervical spinal nerve, the roots of the nerve, or both. It usually presents with pain, sensory loss, motor dysfunction, or reflex changes in the affected nerve root distribution without evidence of spinal cord dysfunction. The most common cause of cervical radiculopathy is foraminal encroachment of the spinal nerve due to a combination of factors, including a soft or calcified lateral disc displacement and spondylitis. Other causes, including tumors of the spine and spinal infections, are infrequent [1].

Anterior cervical spine approaches were developed in the 1950s as the mechanism of disease and the pathophysiology of radiculopathy was better defined. In the 1970s, the use of the operating microscope and microsurgical techniques for cervical spine surgery were popularized. More recently, spinal instrumentation developed for the treatment of traumatic instability’s has been used in patients with cervical spondylosis to do radical decompressions, provide spinal stability, and enhance bone healing [2].

The conventional anterior cervical approaches use the surgical plane between medially trachea and laterally great vessels (carotid and jugular vein); and view the spine almost in face. These approaches can be called as anteromedial. On the other hand, anterolateral approach retracts the great vessels medially, uses a more lateral angle of view, and views the spine obliquely [3-10].

Anterolateral cervical foraminotomy involves direct decompression of the nerve root just as the conventional anterior cervical discectomy and fusion does, but does not require bone fusion or postoperative immobilization. In addition, Anterolateral cervical foraminotomy preserves the motion unit anatomically as well as functionally [7].
Patients and Methods

This is a prospective study conducted on fourteen patients with cervical spondylotic radiculopathy. Patients were selected in the study if: They had unilateral radiculopathy confirmed by clinical and radiological data, refractory to non-surgical measures for at least 6 months. Patients were not included in the study if; they had central soft disc prolapsed, preoperative lysthesis >2 millimeter between any two contiguous vertebrae, cervical myelopathy, bilateral radiculopathy; or if they had a contraindication of anesthesia. In the period between October 2010 and November 2012, patients were operated upon at Cairo University hospitals and Al-Haram Hospital by an anterolateral cervical foraminotomy approach. Patients were followed-up on an outpatient basis for a period ranging from one to two years.

Pre-operative assessment:
- History: Including personal, social, medical, past and family history. Present history, stressing on analysis of brachialgia, neck pain, shoulder pain, interscapular pain, sensory manifestations and motor weakness.
- Clinical examination: A complete thorough general and neurological examination was performed, including the following:
  a. Motor system examination; including tone, power and reflexes.
  b. Sensory system examination; including radicular hypothesia, Parathesias and deep sensations.
- Radiological assessment:
  • Plain X-rays of the cervical spine were done for all cases, including antero-posterior view, dynamic views to assess stability, oblique views for foraminal and facet details and the standard lateral view to assess curvature, sagittal rotation and alignment.
  • Computerized tomography and MRI of the cervical spine.

Operative technique:
Anesthetic considerations and patient positioning:
At the day of surgery and before induction of general anesthesia, the patient is asked to actively flex and extend the head. This allows the anesthetist to determine the range of flexion or extension allowed during intubation without aggravation of the patient’s symptoms. After induction of general anesthesia with endotracheal intubation, the patient is placed between the shoulders to allow for extension of the neck.

Skin incision and soft tissue dissection:
A transverse skin incision is made ipsilateral to the lesion (Fig. 4). The platysma is divided along the line of the incision, and the dissection is deepened using both sharp and blunt dissection to retract the great vessels medially, use a more lateral angle of view to view the spine obliquely.

The prevertebral fascia is opened, and the correct level is confirmed using a lateral fluoroscopic imaging. The ipsilateral longus colli is stripped laterally to expose the medial half of the transverse process above and below the disc space.

The contralateral longus colli is dissected from the vertebral body approximately 2 to 3mm laterally (just enough for insertion of a self-retaining retractor blade beneath it). The teeth of the self-retaining retractor blades are then placed beneath the dissected longus colli muscles. The anesthetist is asked to deflate the endotracheal balloon, and then reinflate it at a lower pressure, allowing the balloon to move away from the retractor blade (This helps to avoid indirect injury to the recurrent laryngeal nerve by stretching or pressure). Identification of bony entry site on the anterior aspect of the cervical spine and bone drilling (Fig. 5).

Starting drilling at the most lateral 8mm of the intervertebral disc, and inferior 5mm portion of the upper level vertebral body (The anterior portion of the uncinate process is not removed). A 2mm cutting drill bit is used. The drill bit is changed to a diamond drill as one advance. The uncovertebral junction not entered in the anterior two-thirds of the foraminotomy tract. The transverse diameter of the hole is approximately 8-9mm, and the vertical diameter of the hole varies with the height of the disc spaces in different vertebral levels (approximately 10mm) (Figs. 6,7).

At the posterior one-third of the foraminotomy hole, the uncovertebral junction is entered and the posterior portion of the lateral uncinate process, which often represents the pathological element compressing the nerve root, is removed. The rostral and caudal lips of the posterior uncovertebral junction are also removed. Final removal of the compressive uncovertebral osteophytes is done using a 1mm footplate Kerrison. Identification of the lateral border of the posterior longitudinal ligament (PLL) shows that the posterior border of the uncinate process is reached. Since the PLL partly covers the proximal parts of the nerve roots,
its lateral border must be excised, preferably using a micro hook and a 1mm footplate Kerrison to expose the lateral border of the ipsilateral spinal cord. The root can then be exposed from its origin to its entrance into the neural foramen. If there is no ruptured herniated disc fragment behind the PLL, this will be the end of the nerve root decompression.

**Closure and postoperative management:**
After copious wound irrigation, the walls of the wound are checked for any bleeding, which is then controlled. The platysma layer is closed with interrupted 3-0 Vicryl suture and the skin is closed with a running subcuticular 4-0 Vicryl suture. The suture line is reinforced with Steri-Strips. A neck collar is not used. All patients were to be discharged at 24 hours post-operative and to resume normal daily activity at 3 weeks post-operative.

Fig. (1): Pre-operative lateral plain X-ray.

Fig. (2): Pre-operative T2-weighted sagittal MRI scan.

Fig. (3): Pre-operative CT scan, axial cut, at C6-7.

Fig. (4): Intraoperative transverse skin incision mark.

Fig. (5): (A) Bony entry of antrolateral foraminotomy [1] & (B) 3D CT scan show bone entry.
Postoperative follow-up:

Patients were routinely seen immediate post operatively before discharge and at regular follow-up intervals of 2 weeks and then 3, 6 and 12 months and subsequently every 6 months. Outcome was determined for recording at least one-year post operatively.

(Table 1): Outcome of patients was categorized according to Odom’s criteria [11] into the following categories.

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Excellent: All preoperative symptoms relieved, abnormal signs unchanged or improved.</td>
</tr>
<tr>
<td>2</td>
<td>Good: Minimum persistence of preoperative symptoms, abnormal signs unchanged or improved.</td>
</tr>
<tr>
<td>3</td>
<td>Fair: Definite relief of some preoperative symptoms, others unchanged or slightly improved.</td>
</tr>
<tr>
<td>4</td>
<td>Poor: Signs and symptoms unchanged.</td>
</tr>
</tbody>
</table>

Radiological follow-up:

Plain X-rays and thin slice CT scan with sagittal, coronal and 3D reconstruction.

Results

Clinical data:

The average duration of symptoms was 12.5 months ranging from 6 to 24 months and median duration of symptoms was 12 months. The most common symptoms were radicular pain (100%) followed by neck pain (78.6%). The most common signs were motor weakness (42.9%). 50% of our cases had right sided radiculopathy and 50% had left sided radiculopathy.

Radiological data:

According to X-ray criteria; 5 cases had a normal cervical lordotic curve (35.7%), 6 cases had a straight cervical spine (42.8%) and 3 cases had a reversed cervical curve (21.4%).

Operative data:

A total of 14 spinal levels were operated, the most common level affected in this series was C4-5 presented in 5 cases (35.7%), followed by C5-6 level presented in 4 cases (28.5%), 3 cases with C3-4 (21.4%) and 2 case with C6-7 affection (14.3%). Operative time at this study ranged from 45 to 60 minutes with a mean of 52.5 and standard deviation 32.724 minutes.
Table (2): Patients’ clinical, radiographic, and operative data.

<table>
<thead>
<tr>
<th>Patient no.</th>
<th>Age (Yr) /Sex</th>
<th>Duration of symptoms (mo)</th>
<th>Radiculopathy (side)</th>
<th>Neck pain</th>
<th>Cervical curve</th>
<th>Level of operation</th>
<th>Follow-up (mo)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>49/Female</td>
<td>12</td>
<td>+/Left</td>
<td>+</td>
<td>Straight</td>
<td>C6-7</td>
<td>24</td>
</tr>
<tr>
<td>2</td>
<td>40/Male</td>
<td>8</td>
<td>+/Right</td>
<td>+</td>
<td>Straight</td>
<td>C3-4</td>
<td>21</td>
</tr>
<tr>
<td>3</td>
<td>44/Male</td>
<td>18</td>
<td>+/Left</td>
<td>–</td>
<td>Lordotic</td>
<td>C4-5</td>
<td>21</td>
</tr>
<tr>
<td>4</td>
<td>49/Male</td>
<td>8</td>
<td>+/Left</td>
<td>+</td>
<td>Kyphotic</td>
<td>C5-6</td>
<td>18</td>
</tr>
<tr>
<td>5</td>
<td>40/Female</td>
<td>18</td>
<td>+/Left</td>
<td>–</td>
<td>Straight</td>
<td>C4-5</td>
<td>18</td>
</tr>
<tr>
<td>6</td>
<td>38/Female</td>
<td>6</td>
<td>+/Right</td>
<td>–</td>
<td>Lordotic</td>
<td>C6-7</td>
<td>15</td>
</tr>
<tr>
<td>7</td>
<td>51/Male</td>
<td>6</td>
<td>+/Right</td>
<td>+</td>
<td>Kyphotic</td>
<td>C4-5</td>
<td>15</td>
</tr>
<tr>
<td>8</td>
<td>36/Male</td>
<td>12</td>
<td>+/Left</td>
<td>+</td>
<td>Lordotic</td>
<td>C5-6</td>
<td>15</td>
</tr>
<tr>
<td>9</td>
<td>44/Female</td>
<td>24</td>
<td>+/Right</td>
<td>+</td>
<td>Straight</td>
<td>C3-4</td>
<td>18</td>
</tr>
<tr>
<td>10</td>
<td>43/Male</td>
<td>12</td>
<td>+/Right</td>
<td>+</td>
<td>Lordotic</td>
<td>C4-5</td>
<td>15</td>
</tr>
<tr>
<td>11</td>
<td>44/Male</td>
<td>12</td>
<td>+/Right</td>
<td>+</td>
<td>Straight</td>
<td>C5-6</td>
<td>15</td>
</tr>
<tr>
<td>12</td>
<td>41/Male</td>
<td>8</td>
<td>+/left</td>
<td>+</td>
<td>Lordotic</td>
<td>C4-5</td>
<td>12</td>
</tr>
<tr>
<td>13</td>
<td>40/Male</td>
<td>7</td>
<td>+/Left</td>
<td>+</td>
<td>Kyphotic</td>
<td>C3-4</td>
<td>12</td>
</tr>
<tr>
<td>14</td>
<td>61/Male</td>
<td>24</td>
<td>+/Right</td>
<td>+</td>
<td>Straight</td>
<td>C5-6</td>
<td>12</td>
</tr>
</tbody>
</table>

Complications:

Three patients developed Horner’s syndrome, which resolved in a period ranging from 2 weeks to month post-operative.

Outcome of patients was categorized according to Odom’s criteria (Table 3).

Table (3): Outcome of patients.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>No. (14)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>11</td>
<td>78.57</td>
</tr>
<tr>
<td>Good</td>
<td>2</td>
<td>14.28</td>
</tr>
<tr>
<td>Fair</td>
<td>1</td>
<td>7.14</td>
</tr>
<tr>
<td>Poor</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Nine cases of patients (64.29%) had lost cervical lordosis and one case of them (7.14%) had fair outcome.

The follow-up period in this series varied from 12 to 24 months with a mean of 16.5 months and median of 17 months with ±3.306 standard deviation. During follow-up period, there have been no incidence of recurrence, instability, progressive kyphosis, vertebral body collapse nor other late complications like adjacent segment disease as measured by dynamic flexion and extension views.

Discussion

After the introduction of the anterior cervical discectomy approach in the early 50s by Smith and Robinson, an era of wide use of the approach with or without fusion began for the treatment of cervical spondylotic myelopathy and radiculopathy. The treatment was well conceived in principle, with the idea of direct anterior decompression of the offending pathology, but it had the original disadvantages of loss of disc height for discectomy without fusion and fusion of a mobile motion segment [12].

In our study male to female ratio was 2.5:1, age ranged between 36 and 61 years with an average of 44.3 years. The average duration of symptoms was 12.5 months (range 6-24 months) and the most common symptom beside radicular pain (100%) was neck pain (78.6%).

Choi et al., noted in their 20 patients, a prospective case series operated for cervical radiculopathy by anterior cervical foraminotomy. They reported a male predominance with a male to female ratio of 3:1 with an age average of 48.7 years (range 37-74 years). The average duration of symptoms was 19.8 months (range 0.5-96 months) and also the most common symptom beside radicular pain (100%) was neck pain (80%) [12].
In our study, the most common signs were motor weakness (42.5%), and sensory loss (28.6%), while Choi et al., the most common signs were motor weakness (80%), and sensory loss (25%) [12].

In our series, the most common operated level was C4-5 (35.7%) followed by C5-6 (28.5%), but Chang et al., 2011 noted in their series, the most common operated level was C5-6 (51%) followed by C6-7 (31%) on approaching cervical spondylotic radiculopathy by posterior cervical inclinatory foraminotomy [13].

In our study; excellent and good outcome of patients were 92.86% and one patient (7.14%) had a fair outcome showed relieve of their motor weakness, paresthesia and numbness within 2 months and no patients had poor outcome according to Odom’s criteria.

Park et al., reported 89% of patients (n=44) with excellent and good results operated for radiculopathy by anterolateral foraminotomy at 60 months follow-up [14] while Kim and Kim reported 86.4% of patients with excellent and good results operated for radiculopathy by posterior foraminotomy at 24-66 months follow-up [15].

Conclusions:

Anterolateral foraminotomy is a good alternative to conventional anterior cervical discectomy and fusion in selected cases for the treatment of unilateral radiculopathy caused by posterolateral osteophytes or herniated hard disc.

The initial results with this technique have been encouraging, but a long-term assessment with large number of cases and more data collection were needed to judge the true potential and benefits of this technique particularly for adjacent segment disease at the cranial and caudal segments and aggravation of degeneration at the operated level.

References

التوسيع الميكروسكوبى الأمامي للثقبة الفقرية العنقية لعلاج الأمراض التنكسية
للفرص العنقية السطحية الضاغطة على جذور الأعصاب العنقية من جانب واحد

الهدف: دراسة تقييم وسلامة ومتابعة التوسيع الأمامي للثقبة الفقرية العنقية لإزالة الضغط عن جذور الأعصاب العنقية من جانب واحد.

وذلك نتيجة الانزلاق الغضروفى العنقى الجانبي أو ضيق الثقبة الفقرية العنقية.

أساليب الدراسة: شملت الدراسة أربعة عشرة مريضا متوسط اعمارهم 44.3 عاماً وتم التدخل الجراحي مابين أكتوبر 2010 إلى نوفمبر 2012. وقد كان متوسط فترة المتابعة للحالات ستة عشر شهراً ونصف ولم تحدث أية مضاعفات أثناء فترة المتابعة وقد تم استنباط النتائج النهائية للحالات بعد أثني عشر شهراً من إجراء الجراحة.

وقد كانت النتائج النهائية كالأتي:
- حالات ممتازة: 75٪
- حالات جيدة: 14.28٪
- حالات متوسطة: 7.14٪
- حالات ضعيفة: لا يوجد

الخلاصة: التوسيع الميكروسكوبى الأمامي للثقبة الفقرية العنقية هو علاج جراحي فعال وأمن لإزالة الضغط عن جذور الأعصاب العنقية من جانب واحد وذك نتيجة الانزلاق الغضروفى العنقى الجانبي أو ضيق الثقبة الفقرية العنقية.