

## ESCVS article - Vascular general

# Endoscopic assisted transaxillary first rib resection<sup>☆</sup>

Adel Abdellaoui\*, Manal Atwan, Fergus Reid, Paul Wilson

Royal Lancaster Infirmary, Ashton Road, Lancaster, LA1 4RP, UK

Received 5 January 2007; received in revised form 22 May 2007; accepted 29 June 2007

### Abstract

**Objectives:** Endoscopic assisted transaxillary first rib resection is a novel approach in the management of thoracic outlet syndrome. It allows safe identification of the different structures. The objective of our study is to assess the outcome of surgical treatment of thoracic outlet syndrome using this technique. **Methods:** Between May 1999 and October 2005, 28 endoscopic assisted transaxillary first rib resections were performed on 20 patients with thoracic outlet syndrome in our vascular unit. This retrospective study included 14 females and 6 males with ages ranging between 16 and 53 years (median 37 years). **Results:** Prior to the operation, all patients had C spine X-ray and 45% (nine patients) had nerve conduction studies prior to the operation. Duration of symptoms ranged between 1 month and 15 years (median 36 months). Fifty-five percent of patients had neurological symptoms, 30% had mixed symptoms and only 15% had venous or arterial symptoms. Eight patients were given bilateral first rib excision. The average time between the two operations was 17.5 months (median 12 months). The postoperative stay in hospital ranged between 2 and 8 days (median 5 days). Follow-up ranged between 1 and 64 months (median 8 months). Eighty-two percent of patients (23 resections) had complete resolution of symptoms. Eighteen percent (5 resections) did not show any improvement of symptoms following surgery. Three complications were recorded, including haemothorax, bleeding and brachial plexus injury. The latter was due to traction injury during the operation. **Conclusions:** Endoscopic assisted transaxillary first rib resection is a safe and effective procedure in the management of thoracic outlet syndrome. It also offers a great opportunity for teaching.

© 2007 Published by European Association for Cardio-Thoracic Surgery. All rights reserved.

**Keywords:** Thoracic outlet syndrome; Cervical rib syndrome; Endoscopy

### 1. Introduction

Thoracic outlet syndrome (TOS) is a clinical condition due to compression of the neurovascular structures, such as brachial plexus and subclavian vessels, during their course between the neck and axilla.

Sir Ashley Cooper [1] was the first to describe TOS in 1821. In 1903, Bramwell [2] recognised the first rib as the cause of this syndrome but Murphy [3] was the first one to resect it in 1910.

By the late 1950s this operation had lost its popularity, as it was concluded that the compression of the neurovascular structures occur at multiple sites [1] and patients did not do well after first rib resection. In 1966, Roos performed the first transaxillary first rib resection with good results [4].

The ideal surgical approach remains controversial; some authors suggest that the transaxillary one provides a good exposure to the first rib, but that it does not allow an adequate exposure of the other structures that are important in the pathophysiology of TOS [3]. Qvarfordt et al. recommended a combined approach, anterior for the

scaleneotomy, and transaxillary for the removal of the first rib [5].

Our aim is to evaluate the results of a novel technique using endoscopy during transaxillary first rib resection, which allows a safe first rib resection and scaleneotomy, due to a better visualisation of the different structures, thereby decreasing the risk of accidental injury to any structure.

### 2. Methods

Between May 1999 and October 2005, 28 endoscopic assisted transaxillary first rib resections were performed on 20 patients with thoracic outlet syndrome in our vascular unit.

This retrospective study included 14 females and 6 males with ages ranging between 16 and 53 years (median 37 years).

All records were obtained. Data charts were organised into different categories: demography, symptoms, investigations, indication for surgery, operative details, complications, time between operations in bilateral cases, and follow-up.

The diagnosis of thoracic outlet syndrome was established by two different surgeons. Patients with neurogenic TOS were first managed conservatively and operated on only after failure of conservative management (analgesia, phy-

<sup>☆</sup> Presented at the 55th International Congress of the European Society for Cardiovascular Surgery, St Petersburg, Russian Federation, May 11–14, 2006.

\*Corresponding author. Tel.: +44 7906 004953; fax: +44 1752 315300.

E-mail address: adel.abdellaoui@gmail.com (A. Abdellaoui).

© 2007 Published by European Association for Cardio-Thoracic Surgery

siotherapy) for at least 6 weeks. Failure of conservative treatment meant no improvement of symptoms that would interfere with quality of life of the patient.

### 2.1. Surgical technique

The operation is performed under general anaesthesia with a single endotracheal tube. The patient is positioned in a lateral thoracotomy position with the arm elevated to expose the axilla. The surgeon and the assistant are positioned on the same side of the incision with the operating surgeon facing the axilla directly. It is important that the assistant keeps the arm under traction for better exposure, but we recommend relaxing the arm intermittently to prevent any traction injury to the brachial plexus (Fig. 1).

A short transverse incision, about 6–7 cm long, is made at the lower limit of the hair line, between the pectoralis major anteriorly and the latissimus dorsi posteriorly. The plane is then developed using blunt dissection and preserving the intercostals brachial nerve. A camera is then introduced with the different instruments through the same incision.

After the identification of the different structures (Video 1) the first rib is dissected free, dividing scalene and intercostals muscles. In patients with cervical rib the latter should be excised at the same time as the first rib. Extra care is taken at all times to prevent any injury to the brachial plexus and subclavian vessels. Fibrous bands are sometimes encountered and are divided (Fig. 2).

Then the first rib is divided posteriorly and anteriorly under direct vision and any sharp bony edges need to be smoothed. A drain is left in situ if there is breach of the pleura. The drain is secured with a stitch and the wound is closed with a subcuticular suture. A chest X-ray is then performed in the recovery room.

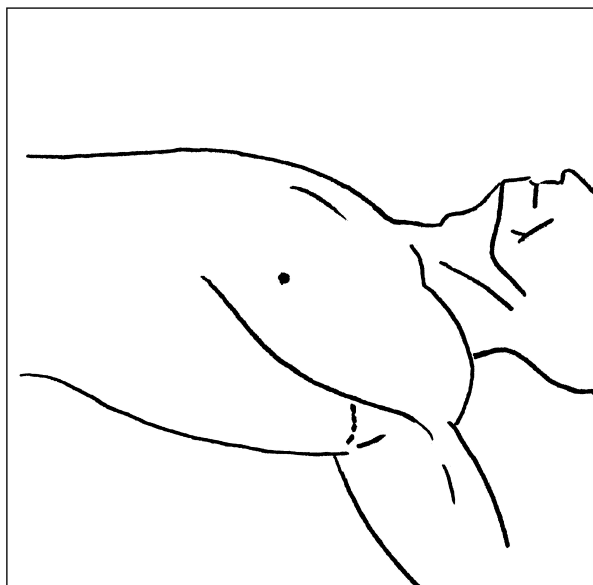
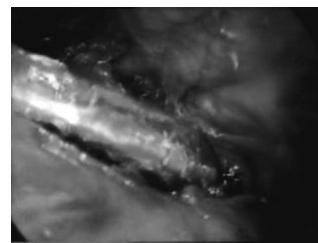


Fig. 1. Site of Incision.



Video 1. Showing the anatomy at the thoracic outlet and a dissected first rib prior to its resection.

### 3. Results

Prior to the operation, all patients had a C spine X-ray. Nine patients (45%) had nerve conduction studies. Nine patients (45%) had cervical ribs. Two patients had history of trauma. Duration of symptoms ranged between 1 month and 15 years (median 36 months). Fifty-five percent (11/20) of patients had neurological symptoms, 30% (6/20) had mixed symptoms and only 15% (3/20) had venous or arterial symptoms. The Roos Test was positive in 45% (9/20) of patients.

Eight patients had bilateral first rib excision, and the average time between the two operations was 17.5 months (median 12 months). Sixty-eight percent (19/28) of excisions needed a chest drain during the operation due to breach of the pleura. The drain was inserted through the same axillary incision. The postoperative stay in hospital ranged between 2 and 8 days (median five days).

The follow-up of patients ranged between 1 and 64 months (median 8 months). Eighty-two percent (23/28) of the resections resulted in complete resolution of symptoms. The success rate was 73% in patients with cervical ribs (8/11 resections). Eighteen percent (5/28) of resections did not show any improvement of symptoms following surgery, of which one patient showed initial improvement of symptoms which recurred after heavy lifting, and another was referred to a tertiary centre where a second rib was removed so follow-up was not at our hospital.

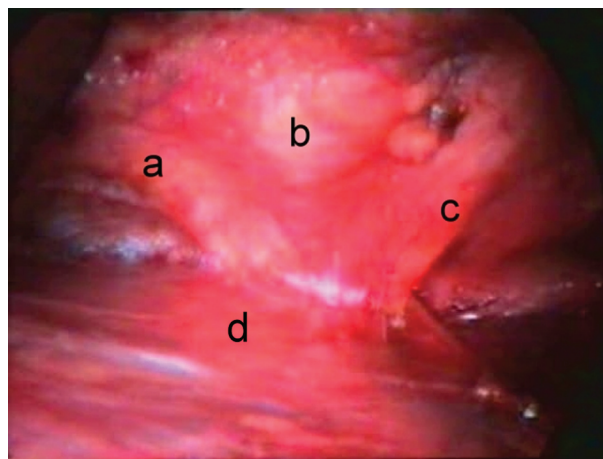


Fig. 2. Thoracic outlet structures: (a) Subclavian vein, (b) Subclavian artery, (c) Brachial plexus, (d) First rib.

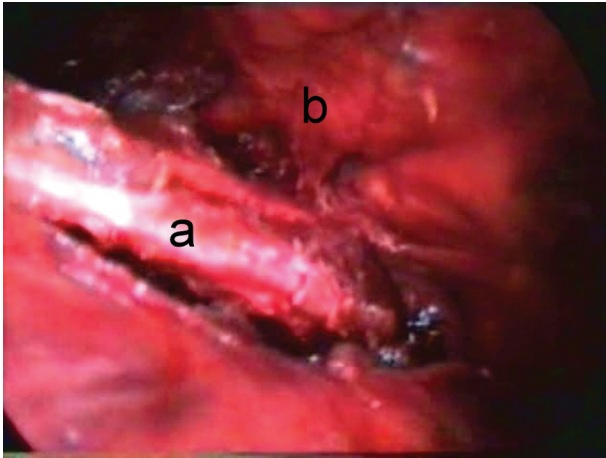


Fig. 3. Dissected first rib: (a) First rib, (b) Thoracic outlet structures.

Three complications were recorded, including haemothorax, venous bleeding that required a blood transfusion, and brachial plexus injury. The latter was due to traction injury during the operation as the lower trunk of the brachial plexus was tightly stretched over the first rib. This patient required regular analgesia and physiotherapy; she was followed up for 3 years and was still complaining of paresthesia, loss of sensation in the territory of T1 and weakness in the small muscles of the hand.

#### 4. Discussion

There is still debate about the efficacy of the surgical management of neurogenic TOS, where conservative management should be tried for at least six weeks [6–9]. For patients managed surgically, the success rate ranges between 59 and 90% [6, 9–16]. In our sample, 82% of patients had complete resolution of symptoms, which is in accordance with other published studies.

Only one patient had a permanent damage to the brachial plexus. Nerve conduction studies in this case showed partial axonal damage. We believe that this injury occurred during traction of the arm that was abducted and elevated, rather than a direct injury. The brachial plexus in this patient was found to be tightly stretched over the first rib and extra care was taken to prevent any damage to it during the operation (Fig. 3).

The diagnosis of TOS remains a challenging one, especially neurogenic TOS where there is no specific test to confirm it. Our patients were seen by two different surgeons and chest X-rays were performed in all patients to identify any cervical ribs. Nerve conduction studies were performed in some patients to rule out nerve entrapment at the elbow or the wrist.

There is still controversy about the best surgical approach. It is important that the choice is effective and safe, with a low rate of complications. The anterior supraclavicular approach provides the best exposure to the neurovascular structures and first rib, but there is a higher risk of damage of the long thoracic and phrenic nerves, and the patient will be left with a cosmetically undesirable scar. The transaxillary approach, on the other hand, has an excellent

cosmetic result, but with an increased risk of traction injury of the brachial plexus. Sometimes, because of the exposure, control of the bleeding is difficult [4, 17] Degeorges et al. [16] did not find any difference of outcome between the two approaches.

The use of endoscopy for a transaxillary first rib excision has been described by Martinez et al. [18], where robotics were used in their 131 procedures. They also differed from our technique by the use of multiple incisions and the collapse of the lung; in our series we used a single incision and the lung was not collapsed.

We believe that using endoscopy during transaxillary first rib resection allows the surgeon to diagnose and deal with the cause of the compression. The risk of any injury is minimal and the bleeding can be controlled under direct vision. Better visualisation and identification of the different anatomical structures allows a safer dissection and also reduces the number of complications. This technique also offers a great opportunity for teaching.

#### References

- [1] Talmage DM, Lemke C. Thoracic outlet syndrome: how has it changed over centuries. *Top Clin Chiropr* 1999;6:39–50.
- [2] Bramwell E. Lesion of the first dorsal nerve root. *Rev Neurol Psychiatry* 1903;1:236–239.
- [3] Robicsek F, Eastman D. 'Above-under' exposure of the first rib: a modified approach for the treatment of thoracic outlet syndrome. *Ann Vasc Surg* 1997;11:304–306.
- [4] Roos DB. Transaxillary approach for first rib resection to relieve thoracic outlet syndrome. *Ann Surg* 1966;163:354–358.
- [5] Qvarfordt PG, Ehrenfeld WK, Stoney RJ. Supraclavicular radical scalenectomy and transaxillary first rib resection for the thoracic outlet syndrome. A combined approach. *Am J Surg* 1984;148:111–116.
- [6] Urschel HC Jr, Razzuk MA. Neurovascular compression in the thoracic outlet: changing management over 50 years. *Ann Surg* 1998;228:609–617.
- [7] Molina JE. Combined posterior and transaxillary approach for neurogenic thoracic outlet syndrome. *J Am Coll Surg* 1998;187:39–45.
- [8] Sellke FW, Kelly TR. Thoracic outlet syndrome. *Am J Surg* 1988;156:54–57.
- [9] Jamieson WG, Chinnick B. Thoracic outlet syndrome: fact or fancy? A review of 409 consecutive patients who underwent operation. *Can J Surg* 1996;39:321–326.
- [10] Green RM, McNamara J, Ouriel K. Long-term follow-up after thoracic outlet decompression: an analysis of factors determining outcome. *J Vasc Surg* 1991;14:739–745.
- [11] Hempel GK, Shutze WP, Anderson JF, Bukhari HI. 770 consecutive supraclavicular first rib resections for thoracic outlet syndrome. *Ann Vasc Surg* 1996;10:456–463.
- [12] Kieffer E, Jue-Denis P, Benhamou M, Richard T, Palombo D, Natali JR. Arterial complications in the thoracobrahial outlet syndrome. Surgical treatment of 38 cases. *Chirurgie* 1983;109:714–722.
- [13] Landry GJ, Moneta GL, Taylor LM Jr, Edwards JM, Porter JM. Long-term functional outcome of neurogenic thoracic outlet syndrome in surgically and conservatively treated patients. *J Vasc Surg* 2001;34:760–761.
- [14] Leffert RD, Perlmutter GS. Thoracic outlet syndrome. Results of 282 transaxillary first rib resections. *Clin Orthop Relat Res* 1999;368:66–79.
- [15] Sanders RJ, Haug CE, Pearce WH. Recurrent thoracic outlet syndrome. *J Vasc Surg* 1990;12:390–398; discussion 398–400.
- [16] Degeorges R, Reynaud C, Becquemin JP. Thoracic outlet syndrome surgery: long-term functional results. *Ann Vasc Surg* 2004;18:558–565.
- [17] Donaghy M, Matkovic Z, Morris P. Surgery for suspected neurogenic thoracic outlet syndromes: a follow up study. *J Neurol Neurosurg Psychiatry* 1999;67:602–606.
- [18] Martinez BD, Wiegand CS, Evans P, Gerhardinger A, Mendez J. Computer-assisted instrumentation during endoscopic transaxillary first rib resection for thoracic outlet syndrome: a safe alternate approach. *Vascular* 2005;13:327–335.