Extensive supraclavicular rib resection and scalenectomy in neurogenic type of thoracic outlet compression syndrome

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Background
The majority of patients with thoracic outlet compression syndrome present with vague upper limb pain and paresthesia and lack clear evidence of compression on investigations and are known as the 'disputed Neurogenic type'.

Patients and methods
We retrospectively reviewed 39 patients (eight bilateral) who underwent 47 operations to evaluate the prognosis, outcome, and complications of surgical treatment of the disputed neurogenic type of thoracic outlet syndrome by extensive anterior supraclavicular decompression with complete excision of the first rib, the cervical rib and/or an elongated transverse process of C7 as well as scalenectomy and excision of any anomalous fibromuscular bands.

Results
Results were graded on the basis of symptomatic improvement. Excellent results were reported in 24 (51%) operations, good results in 18 (38%), and fair results in five (11%) operations. None of our patients considered their operation as a failure. There were no major complications; however, recurrence of symptoms occurred in three (6.5%) patients after an average of 19 months.

Conclusion
This procedure was found to be successful, with a low rate of complications and recurrence.

Keywords:
supraclavicular rib resection, scalenectomy, compression syndrome

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Introduction

Thoracic outlet compression syndrome (TOCS) is a clinical syndrome resulting from compression of the brachial plexus and subclavian vessels at the thoracic outlet, which represents the junction between the upper limb, neck and thorax, and presents with varying symptoms [1].

It can present with a variety of symptoms related to vascular and/or neurogenic entrapment. Some patients present with clear signs of arterial compression, venous obstruction, or C8 and T1 root compression and have positive findings in standard investigations. However, the majority of patients present with vague upper limb pain, paresthesia, and other symptoms and lack clear evidence of compression on investigations and were labeled as the 'disputed Neurogenic type' of TOCS by Wilbourn [2].

The disputed Neurogenic type of TOCS is the most common type and is reported to represent between 95 and 98% of patients diagnosed with TOCS [2–5]. It is one of the most complicated entities with respect to both diagnosis and treatment. Diagnostic tests such as electromyography (EMG) and nerve conduction studies (NCS), cervical radiography, Doppler imaging, computerized tomography, and magnetic resonance are not specific for TOCS. In those overwhelming majority of patients, the diagnosis is one of exclusion and often is based on clinical diagnostic criteria alone [2–4].

Conservative nonoperative treatment including medical treatment, lifestyle modifications, occupational therapy as well as physiotherapy involving scalene stretching, first rib relaxation, and nerve gliding exercises is attempted as the initial treatment in patients with TOCS, with improved symptoms in most cases. However, surgical decompression of the brachial plexus is suggested as the optimal treatment in patients who do not benefit from conservative treatment [5].

Many surgical treatment options such as resection of the cervical rib, resection of the first rib, scalenotomy or resection of the scalene tendon, anomalous structures, or pectoral muscles using either posterior, transaxillary, supraclavicular, or infraclavicular approaches have been attempted [3,4,6].

Results of operative treatment of TOCS are difficult to objectively assess because there are no solid preoperative diagnostic criteria and no standardized mean of patient assessment. Analysis of the complication rates and outcomes after surgery are not well established in most of the published studies. The objective of our study

was to evaluate the functional prognosis, outcome, and complications of surgical treatment of disputed neurogenic type of TOCS patients treated by extensive release, rib resection, and scalenectomy, mainly through an anterior supraclavicular approach.

Patients and methods

We retrospectively reviewed the data charts and clinical outcomes of a total of 39 patients diagnosed as disputed neurogenic type of TOCS who underwent 47 operations (eight patients were bilaterally operated) for the treatment of TOCS in our hospital between 2001 and May 2007. The average duration of symptoms before the operation was 32 months (with a range of 18 months– years), whereas the average duration of postoperative follow-up was 37 months (with a range of 30 months–5 years).

Most of them were female patients (32 patients representing 82%) and only seven (18%) were male patients with a mean age of 23 years (range 16–39 years).

The diagnosis of disputed neurogenic type of TOCS was established on the basis of careful analysis of signs and symptoms, as well as vascular, neurologic, and physical examination. The most important presenting symptom was pain, which was localized in the arm (100%), shoulder (70%), neck (30%), head (16%), and chest wall (11%). Paresthesia was present in 70% of our patients, easy fatigability of the arm in 30%, especially with activities requiring arm elevation, sense of coldness in 11%, and cyanosis in 9% of patients. We performed four provocative and compression tests — namely, Adson's test (modified by Rayan) [7,8], the elevated arm stress test described by Roos [9], the costoclavicular (Halstead) maneuver [10], and Wright's hyperabduction maneuver [11,12]. One or more of these tests were found to duplicate the symptoms of the patient. All patients were examined clinically and radiologically to exclude cervical spine pathology.

Patients underwent cervical and shoulder radiography to detect bony abnormalities, as well as MRI examination of the cervical spine and the brachial plexus. EMG and NCS were carried out in all patients to rule out other pathologies facilitating the differential diagnosis process, as EMG and NCS are usually negative in patients with TOCS [3,13].

Indication for surgery included the failure of proper conservative treatment measures to manage the patients' symptoms secondary to the brachial plexus and peripheral nerve compression for 3–6 months.

The surgical treatment consisted of an extensive anterior supraclavicular decompression in all patients with complete extraperiosteal excision of the first rib or the cervical rib and/or an elongated transverse process of C7 if present (Fig. 1), making sure not to leave any remnant, as well as release and excision of the lower part of anterior and middle scalene muscles and any anomalous fibromuscular bands. This was performed through a transverse incision 1.5 cm above and parallel to the middle third of the clavicle.

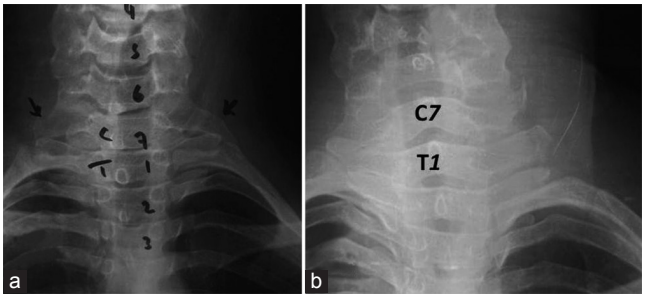
In six (13%) operations the incision was extended infraclavicularly vertically downwards in the deltopectoral groove 3–5 cm, and the pectoralis major was elevated from the clavicle and the pectoralis minor was released from the coracoids to expose the infraclavicular plexus. Infraclavicular plexus exploration was performed when no definite compression was detected supraclavicularly for fear that the compression would be located deep to the pectoralis minor, which is known as neurogenic pectoralis minor syndrome. We were more inclined to perform this infraclavicular exploration in patients presenting with symptoms involving upper-trunk compression.

A total of 11 (23%) patients had a cervical rib (Fig. 2) or elongated transverse process of C7, whereas fibromuscular bands (Fig. 3) were observed in 19 (40%) patients.

Before wound closure, the pleura was inspected and tested for any tears; none were found in our series. The skin was closed after insertion of a drain, which is usually removed 24–48 h later. Patients were discharged after 2 days if no complications developed. The patients were encouraged to begin gentle stretching and range of motion exercises of the neck and shoulder on the day of surgery and in the early postoperative period, which were gradually increased as tolerated.

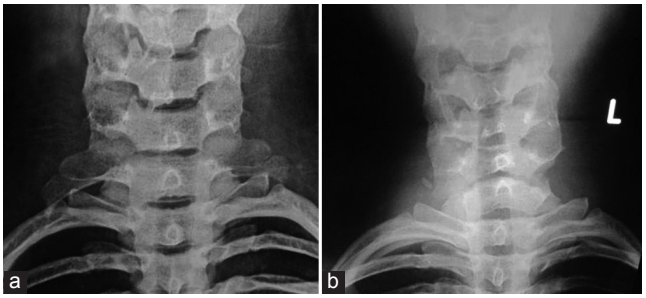
Patients were instructed to perform vigorous range of motion exercises for the neck and shoulder at least

Figure 1



(a) Bilateral elongated transverse processes of C7 in a preoperative radiograph. (b) Postoperative radiograph after excision of the transverse process of C7 and the first rib on the left side.

Figure 2



(a) Bilateral cervical ribs preoperative radiograph. (b) Postoperative radiograph after bilateral excision of the cervical ribs.

4–5 times per day for up to 1 year postoperatively, in an attempt to minimize and stretch the scar tissue and provide early gliding of the brachial plexus and subclavian vessels.

In the eight patients operated bilaterally, the average duration between the two operations was 8.7 months, with a range between 4 and 26 months.

Results

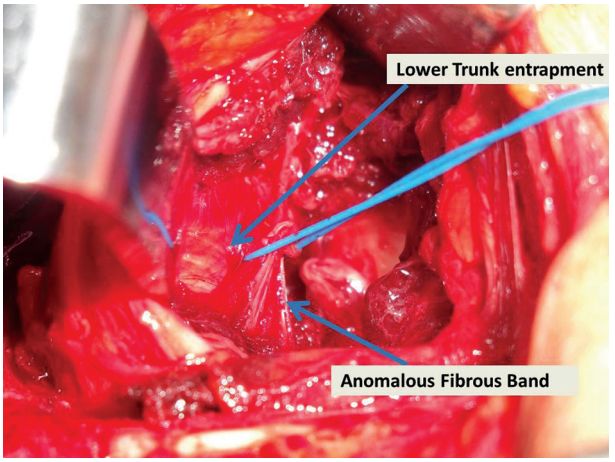
Results were graded on the basis of symptomatic improvement into four grades: excellent, good, fair, and failed [13–15]. The result was considered excellent if all symptoms had disappeared, good if major symptoms had disappeared but a few remained, fair if there was improvement but one or more of the major symptoms persisted, and failed if symptoms had worsened or if the relief from symptoms was not enough to consider the operation worthwhile. An excellent result was reported in 24 (51%) operations, a good result was reported in 18 (38%) operations, and fair result was reported in five (11%) operations. None of our patients considered their operation as a failure. In the eight patients operated bilaterally, only one patient reported both operations to be of excellent result. The other seven patients operated bilaterally reported an excellent result in their first operation, whereas in the second operation the result was good to fair.

Complications

There were several minor wound problems; three patients developed hematoma/seroma, which was drained by the early removal of one or two sutures, but only one of them developed superficial wound infection and required repeated dressings and antibiotic treatment.

There were no major arterial or venous injuries, no pneumothorax, and no phrenic or long thoracic nerve injuries, although one patient developed mild brachial plexus traction palsy.

Figure 3



An anomalous fibrous band compressing the lower trunk.

Three patients reported significant amount of pain in the early postoperative period. Of them, two patients responded well to medical and physical therapy, whereas the third patient did not improve until he had a stellate ganglion block. On follow-up, there was recurrence of symptoms in three (6.5%) patients after an average duration of 19 months from surgery (range 13–35 months). Two of these patients related the recurrence of symptoms to a traumatic event and all of them responded well to medical and physical therapy and none needed reoperation.

Discussion

In our series, excellent and good results were reported in 42 (89%) operations, and none of our patients reported poor results. Our results are comparable if not better than those reported for similar studies especially those utilizing the transaxillary approach [1,5,16,17] or the supraclavicular approach [13]. They reported a poor surgical result in 4–18% of their patients [1,5,16,17].

In our study we had only one (2%) case of superficial wound infection and two (4%) cases of hematoma/seroma, whereas Karamustafaoglu *et al.* [5] reported a 3% infection rate and only 0.8% hematoma. This increased infection may be due to the proximity of the transaxillary approach to the axilla, and the decreased hematoma rate may be due to the dependent position of the wound.

There were no nerve injuries reported in our series, although Cheng and Stoney [18] reported a 5% rate of nerve injuries with supraclavicular approach, whereas

Sanders and Pearce [15] reported 2.6% incidence of brachial plexus injuries with first rib resection. None of our patients complained of the cosmetic appearance of the scar. This may be because of the dressing habits of Egyptian women who routinely cover their necks.

The operative findings in our study were rather similar to other reports. Cervical ribs were reported in 3–30% of patients [4,5,19,20]; in our study, 11 (23%) patients had cervical rib or elongated transverse process of C7, whereas fibromuscular bands were observed in 19 (40%) patients.

In our study we found that seven of our eight patients who were operated on bilaterally, reported a less favorable outcome for their second operation. We have not come across other studies that have reported or commented on the results of bilateral cases. We believe that such a disparity in bilateral results may be attributed to one or more of the following explanations: increased patient expectations in the second operation; the first operation performed on the more symptomatic arm, thus bringing a bigger impact of improvement; and/or the patient being less compliant with rest and rehabilitation in the second operation.

We have also reported a low rate of recurrence of symptoms (in three patients representing 6.5% of our operations) in an average follow-up of 37 months in comparison with a higher recurrence rate of more than 15% in 1–2 years in a study by Sanders and Pearce [15] and Qvarfordt *et al.* [21]. This may be due to the more extensive nature of the release we performed supraclavicularly in our study as also reported by Cheng and Stoney [18] and Atasoy [22]. We also acknowledge our need of a longer follow-up period to assess the incidence of long-term recurrence, although 80% of recurrence of symptoms were reported to occur in the first 2 years after surgery [23].

Conclusion

We have found that the surgical treatment of disputed neurogenic type of TOCS patients with extensive release, rib resection, and scalenectomy through a supraclavicular approach to be an effective and successful procedure. It was also associated with a low rate of complications and recurrence.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

References

1 Han S, Yildirim E, Dural K, Ozisik K, Yazkan R, Sakinci U. Transaxillary approach in thoracic outlet syndrome: the importance of resection of the first-rib. Eur J Cardiothorac Surg 2003; 24:428–433.

2 Wilbourn AJ. In: Coutse D, ed. Thoracic outlet syndrome. Controversies in entrapment neuropathies. Rochester, MN: American Association of Electromyography and Electrodiagnosis; 1984. 28–39.

3 Jones KJ. Thoracic outlet compression syndrome. Green's operative hand surgery 5th ed. Elsevier Inc.; 2008 :1047–1073.

4 Fugate MW, Rotellini-Coltvet L, Freischlag JA. Current management of thoracic outlet syndrome. Curr Treat Options Cardiovasc Med 2009; 11:176–183.

5 Karamustafaoglu YA, Yoruk Y, Tarladacalisir T, Kuzucuoglu M. Transaxillary approach for thoracic outlet syndrome: results of surgery. Thorac Cardiovasc Surg 2011; 59:349–352.

6 Yavuzer S, Atinkaya C, Tokat O. Clinical predictors of surgical outcome in patients with thoracic outlet syndrome operated on via transaxillary approach. Eur J Cardiothorac Surg 2004; 25:173–178.

7 Rayan GM. Thoracic outlet syndrome. J Shoulder Elbow Surg 1998; 7:440–451.

8 Rayan GM, Jensen C. Thoracic outlet syndrome: provocative examination maneuvers in a typical population. J Shoulder Elbow Surg 1995; 4:113–117.

9 Roos DB. Thoracic outlet syndrome is underdiagnosed. Muscle Nerve 1990; 22:126–137.

10 Sunderland S. Disturbances of brachial plexus origin associated with unusual anatomical arrangements in the cervicobrachial region: the thoracic outlet syndrome. Nerves and muscle injuries. New York: Churchill Livingstone; 1978. 901–919.

11 Luoma A, Nelems B. Thoracic outlet syndrome: thoracic surgery perspective. Neurosurg Clin North Am 1991; 2:187–226.

12 MacKinnon SE, Novak CB. Evaluation of the patient with thoracic outlet syndrome. Semin Thorac Cardiovasc Surg 1996; 8:190–200.

13 Ciampi P, Scotti C, Gerevini S, De Cobelli F, Chiesa R, Fraschini G, Peretti GM. Surgical treatment of thoracic outlet syndrome in young adults: single centre experience with minimum three-year follow-up. Int Orthop 2011; 35:1179–1186.

14 Sanders RJ. Recurrent neurogenic thoracic outlet syndrome stressing the importance of pectoralis minor syndrome. Vasc Endovascular Surg 2011; 45:33–38.

15 Sanders RJ, Pearce WH. The treatment of thoracic outlet syndrome: a comparison of different operations. J Vasc Surg 1989; 10:626–634.

16 Toso C, Robert J, Berney T, Pugin F, Spiliopoulos A. Thoracic outlet syndrome: influence of personal history and surgical technique on longterm results. Eur J Cardiothorac Surg 1999; 16:44–47.

17 Sanders RJ. Results of the surgical treatment for thoracic outlet syndrome. Semin Thorac Cardiac Surg 1996; 8:221–227.

18 Cheng SWK, Stoney RJ. Supraclavicular reoperation for neurogenic thoracic outlet syndrome. J Vasc Surg 1994; 19:565–572.

19 Roos DB. Historical perspectives and anatomical considerations. Semin Thorac Cardiac Surg 1996; 8:183–189.

20 Sanders RJ, Hammond SL. Management of cervical ribs and anomalousfirst ribs causing neurogenic thoracic outlet syndrome. J Vasc Surg 2002; 36:51–56.

21 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.

22 Atasoy E. A hand surgeon's further experience with thoracic outlet compression syndrome. J Hand Surg Am 2010; 35:1528–1538.

23 Sanders RJ, Hammond SL, Rao NM. Thoracic outlet syndrome: a review. Neurologist 2008; 14:365–373.