

Trans-axillary approach in surgery for thoracic outlet syndrome

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ABSTRACT

Background. Thoracic outlet syndrome may be due to various reasons and be classified as neurogenic, arterial, and venous thoracic outlet syndrome. The surgical treatment of neurogenic thoracic outlet syndrome can be performed using either a trans-axillary or a supraclavicular approach. The aim of this study is to report on such patients operated in a single institution by a single thoracic surgeon using trans-axillary approach. **Methods.** The patient files were screened for patients operated due to neurogenic thoracic outlet syndrome related symptoms between September 1, 2002 and April 1, 2015 in the Department of Thoracic Surgery of Bursa Yuksek Ihtisas Training and Research Hospital. **Results.** There were 22 female and five male patients with an average age of 31.9 ± 11.7 years. The most common symptom was pain in the affected limb and shoulder ($n=29$). Of the diagnostic maneuvers abduction external rotation (Roos) test was the most frequently found positive test ($n=27$). Nerve conduction velocity studies revealed an average ulnar nerve conduction velocity of 62.7 ± 6.6 m/s. Limited pneumothorax uneventfully resolved in 2 days was seen following 12 operations. **Conclusion.** We conclude that trans-axillary approach may provide good exposure with favorable opportunity to excise the 1st and the cervical rib, and neurolysis with a low rate of complication.

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Keywords: Thoracic outlet syndrome, surgery, trans-axillary approach

Introduction

Thoracic outlet syndrome (TOS) may be due to various reasons including bone anomalies, aberrant muscle and soft tissue structures, trauma and even malignancies involving the area. According to patient complaints and symptoms, TOS can be classified as neurogenic (NTOS), arterial (ATOS), and venous TOS

(VTOS) [1-6]. ATOS and VTOS may require correction of vascular anomalies and are beyond the scope of this study. NTOS presents a challenge in treatment as the real reason is not always clear. Nevertheless, the surgical treatment of NTOS comprises resection of the first rib, anomalous soft

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tissue structures, and the cervical rib, if present, using either a trans-axillary or a supraclavicular approach [1, 2, 4-12].

The aim of this study is to report on the NTOS patients operated in a single institution by a single thoracic surgeon (SY) using trans-axillary approach, and compare the findings with literature.

Methods

Data Recruitment

After Institutional Review Board approval, the patient files were screened for patients operated due to NTOS related symptoms between September 1, 2002 and April 1, 2015 in the Department of Thoracic Surgery of Bursa Yuksek Ihtisas Training and Research Hospital. The patient demographics such as age, gender, affected side, symptoms, results of TOS diagnostic maneuvers, presence of cervical rib, results of nerve conduction velocity (NCV) studies, operation side, operation type, early complications, and length of postoperative hospital stay were noted from the files.

Treatment Algorithm for NTOS

All patients applied to our department with complaints indicating TOS are examined for TOS maneuvers, sent for PA chest x-ray, AP and lateral cervical x-rays, and NCV studies. Patients diagnosed as probable NTOS are first referred to the Neurosurgery Department to exclude trap neuropathies and cervical discopathies. The patients are then referred to the Department of Physical Therapy and Rehabilitation for a three-month course of medical treatment. We reserve surgical treatment for NTOS patients did not benefit from the medical treatment or got worse and those willing to undergo operation as the only means of treatment.

Operative Technique

Under general anesthesia, all patients were placed with the affected side up and the arm fixed to a designated arm holder. We used trans-axillary incision to reach the first rib. The front end of the 1st rib was first incised using a Sauerbruch-Frey first rib shear. Then the muscles, their tendons, and any aberrant soft tissue were dissected and the rib is excised as a whole, disarticulated at the rear end. Then the cervical rib, if present is excised, as well. Following hemostasis, a 19

F silicone drain is placed in the operation site and is attached to a drainage bag. The layers are than sutured using absorbable materials. On the first postoperative day, a chest x-ray and AP cervical x-ray is performed.

Statistical Analysis

For statistical analysis we used MedCalc Statistical Software version 15.2.2 (MedCalc Software bvba, Ostend, Belgium; registered to S.Y.)

Results

Thirty-six operations were performed on 31 patients for NTOS within the aforementioned period. Four case files were missing. The remaining 32 operations were performed on a total of 27 patients. There were 22 female and five male patients (F:M ratio was 5.4:1) with an average age of 31.9±11.7 years (range 17-63 years). Demographic data and clinical characteristics of the patients are shown in Table 1.

Table 1. Patients' demographic data and clinical characteristics

Variables	Patients n (%)
Gender	
Female	27 (84.4)
Male	5 (15.6)
Affected Side	
Right	19 (59.4)
Left	13 (40.6)
Symptoms at admission	
Pain	29 (90.6)
Numbness	25 (78.1)
Frustration	14 (43.8)
TOS Maneuvers	
Abduction external rotation (Roos)	27 (84.4)
Hyperabduction (Wright)	20 (62.5)
Adson's	16 (50)
Costoclavicular (Halstead)	13 (40.6)
Operation type	
First rib resection	18 (56.3)
First and cervical rib resection	14 (43.8)

The most common symptom was pain in the affected limb and shoulder (n=29), followed by paresthesia (n=25), and frustration of the affected extremity (n=14). Of the diagnostic maneuvers, abduction external rotation (Roos) test was the most frequently found positive test (n=27 patients, 84.4%). Hyperabduction (Wright) test was positive in 20 patients (62.5%), Adson test was positive in 16 (50%), and costoclavicular (Halstead) test was positive in 13



Figure 1A. Cervical anteroposterior (AP) X-ray shows cervical rib (arrow) on the left side in a female patient.



Figure 1B. Cervical AP x-ray view (arrow) of the same patient following operation.

patients (40.6%). In cervical x-rays, 14 patients had cervical ribs (Figures 1A and B).

NCV studies revealed an average ulnar nerve conduction velocity of 62.7 ± 6.6 m/s (range 50-73 m/s). In eight patients NCV was 70 m/s and higher. The operation side was right in 14, and left in 8, and bilateral in five patients. All bilateral cases were female. In 18 operations the first rib and accompanying soft tissue structures were resected, whereas in 14 operations the accessory cervical rib was resected as well (Figure 2).



Figure 2. An image of surgically removed first rib and cervical rib in the same patient.

Limited pneumothorax uneventfully resolved in 2 days was seen following 12 operations, and venous injury was encountered in 2 operations, repaired immediately using prolene sutures. Postoperative average length of hospital stay was 3.7 ± 0.9 days

(range 2-6 days).

Discussion

Since first described in 1956 by Peet, TOS still presents a treatment challenge for the physicians. TOS may be due to many reasons affecting the area including bony anomalies, presence of anomalous soft tissue structures, fractures, inflammation, and local invasion of malignancies [1, 4-6, 10-12]. In our series 14 patients had cervical rib, and eight patients had overgrown C7 transverse process. None of our patients had malignancy.

TOS affects mostly young, working people. The great majority of cases are within the 2nd and the 4th decades [2-4, 7-9, 12]. Although some reports indicate a slight preference, female patients are more common [3, 4, 7-9, 12]. In our series the average age was 31.9 ± 11.7 years, and there was a female predominance as 5.4:1.

NTOS patients are usually referred to the physician due to pain, frustration during exertion, numbness, and paleness of the affected upper limb [2-4, 6-9, 11, 12]. The most common symptoms were pain in the affected limb and shoulder ($n=29$), paresthesia ($n=25$), and frustration of the affected extremity ($n=14$) in our series.

There are several diagnostic maneuvers including Adson's, Wright's, Roos', and Halstead's [1, 4, 8, 12]. The main purpose of all these maneuvers is to squeeze the vessels and nerve bundle between the bony and

soft tissue to provoke the symptoms. Unfortunately none of these maneuvers is of pathognomonic value. Of all these tests, we found the Roos' test as the most valuable as we had the most positive results in patients using this test (see Table 1).

NCV studies reflect the neural status to some extent, but most authors advocate not to rely on such studies as in many patients the results are normal [1-3, 7, 12]. Normal ulnar nerve NCV is 70-72 m/s. Some authors prefer to operate right away on patients with NCV results lower than 60 m/s, and refer the patients with NCV results over 60 m/s for physiotherapy [2, 8, 9, 11]. We referred all patients for a three-month period of physiotherapy prior to operation regardless the NCV results.

There are several reports debating whether operate or not the TOS patients [4]. Yet, the treatment of choice is recommended as physiotherapy followed by surgery [1, 2, 5, 6, 8, 12]. Surgical removal of the anomalous structures is mostly performed using either trans-axillary or supraclavicular approach [1, 2, 5-12].

Although some surgeons report excellent results using supraclavicular approach, some of their patients have ATOS and VTOS requiring vascular surgery [1, 4]. Others advocate trans-axillary approach especially in female patients [3, 5-10]. Trans-axillary approach provides adequate surgical exposure for resection of the first rib, the cervical rib, if present, the soft tissue structures and membranes, and neurolysis in experienced hands. Complications are rare and limited to pneumothorax, vascular injury, nerve injury, and wound infection [1, 3-12]. In our series all patients were operated using trans-axillary approach. We experienced pneumothorax in 12, and vascular injury in 2 patients. Our routine application of Blake silicone drain following resection resolved the pneumothorax without any consequences. Vascular injuries were repaired during the operation using prolene sutures.

The limitations of the study

The limitations of our study include the small number of patients and the lack of follow up, especially postoperative NCV studies and outcome questionnaires. Further studies with larger number of patients with close follow-up may provide more valuable information regarding efficacy of this surgical approach.

Conclusions

We believe that supraclavicular approach may provide a good exposure of the vascular structures, leading to good to excellent outcomes. However, we believe that trans-axillary approach provides good enough exposure with favorable opportunity to excise the 1st and the cervical rib, and neurolysis with a low rate of complication.

Conflict of interest

The authors disclosed no conflict of interest during the preparation or publication of this manuscript.

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