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Surgery for thoracic outlet syndrome: Holding a tiger by the tail?

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ABSTRACT

Objectives: In this study, the patients operated on for thoracic outlet syndrome were evaluated in terms of their presenting symptoms, physical examination findings, laboratory test results, complications, and the effectiveness of surgical treatment.

Patients and methods: Surgical procedures performed on 28 patients (21 females, 7 males; mean age: 32.4±11.7 years; range, 16 to 59 years) between June 2004 and March 2010 were included in the retrospective study. Demographic characteristics, occupation, complaints, time from symptom onset to surgery, postoperative follow-up data, and preoperative and postoperative ulnar nerve conduction velocity tests were recorded through careful review of medical records, operative reports, and patient interviews.

Results: Thirty-two surgical procedures were performed in total. Transaxillary surgery was performed in all cases. Electromyography examination results showed a significant improvement in nerve conduction velocity after surgery. Recurrence occurred in only three of 32 (9.4%) surgeries, and in one of these three cases, subsequent surgery was performed. According to clinical results, the success rate was 90.6%.

Conclusion: Complaints in thoracic outlet syndrome coincide with the period when physical activities are the most intense. It is observed that being a housewife has an important place in the etiology of disease in Türkiye. The optimal surgical approach through transaxillary route is valuable for the management of the disease.

Keywords: Brachial plexus, subclavian artery, subclavian vein, thoracic outlet syndrome.

Thoracic outlet syndrome (TOS) is the term that describes whole symptoms in locations including the neck, shoulder, and upper extremity that develop due to compression and irritation of the subclavian vein, subclavian artery, and brachial plexus in the thoracic outlet and costoclavicular region. The incidence of TOS is 3-80/1,000. It is generally observed in the 20 to 50 age group and in females.[1] Neurogenic or vascular symptoms develop as a result of compression of the neurovascular structures for various reasons while passing through the cervicoaxillary canal.[2] It is divided into arterial, venous, and neurological types according to the type of the leading symptoms.[1,2] A detailed history and comprehensive physical examination of the patient have an important place in the diagnosis. Provocative tests support the diagnosis. Diagnosis is reached in the light of radiological and electrophysiological examinations.[3]

Transaxillary surgery is the operative approach in which the first rib or cervical rib is excised and scalenectomy is performed. Supraclavicular and infraclavicular approaches, video-assisted thoracic surgery, robotic-assisted thoracic surgery, and posterior routes are other alternative surgical approaches.[1,4] Transaxillary intervention is widely used in the treatment of TOS, and success rates vary between 80% and 97%.[5-8] This study aimed to evaluate the effectiveness of surgical treatment of patients with TOS.

PATIENTS AND METHODS

Twenty-eight patients (21 females, 7 males; mean age: 32.4±11.7 years; range, 16 to 59 years)

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who underwent surgery with the diagnosis of TOS at the thoracic surgery clinic of the Siyami Ersek Education and Research Hospital between June 2004 and March 2010 were included in the retrospective study. The medical records, preoperative examinations [electromyography (EMG), upper extremity arterial Doppler ultrasonography, cervical computed tomography, and subclavian computed tomography angiography] and postoperative clinical follow-ups of the cases were evaluated retrospectively (Figure 1). Additionally, preoperative and postoperative clinical findings were noted to evaluate the effectiveness of the surgery. Preoperative and postoperative EMG ulnar nerve conduction velocity (UNCV) test values were recorded and compared. In our clinical approach, diagnostic criteria for TOS are provocation test positivity together with nerve compression compatible tests on EMG for neurogenic TOS and compression findings compatible with TOS on vascular Doppler for vascular TOS. Cases with complaints compatible with TOS and without any other pathological conditions that could cause these complaints were accepted as definite TOS. Cases with complaints compatible with TOS, without any other pathological conditions that could cause these complaints, and with EMG and vascular Doppler results that did not support TOS were considered as possible TOS. Patients with definite or possible TOS suspicion and whose other diseases were excluded in the differential diagnosis were first referred to the rehabilitation clinic and received physical therapy. Patients who did not receive the expected benefit from physical therapy and whose complaints affected their daily lives were operated on. The surgical technique we adopted and clinically applied in TOS was the transaxillary approach. Scalene muscle excision was performed in all patients, and the first rib was removed (Figures 2-4). If a cervical rib was detected, excision was performed.

All patients were called for follow-up at one year. Electromyography in neurogenic TOS and Doppler ultrasonography in vascular TOS were performed and compared with preoperative findings. Our criteria for improvement were the patient's statement

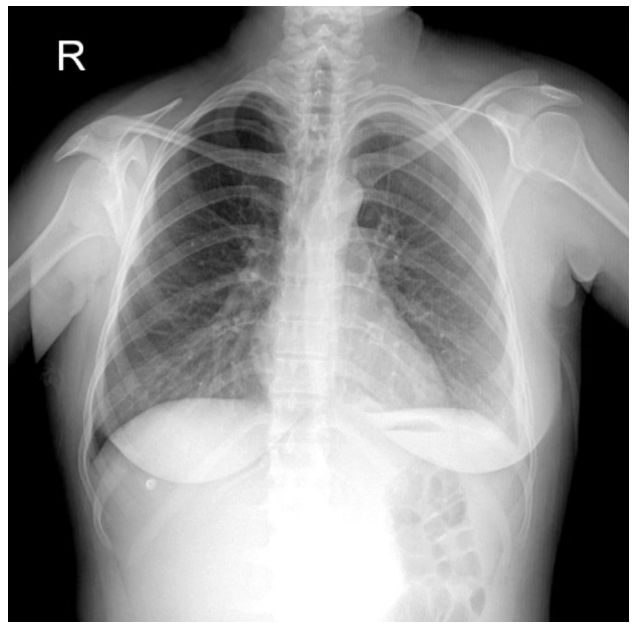

Figure 2. Postoperative chest X-ray.

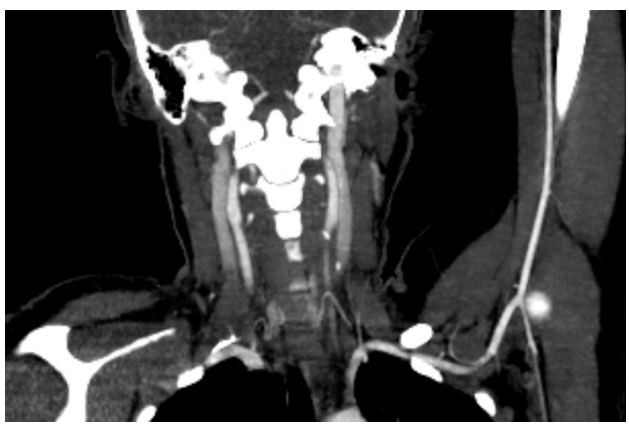

Figure 1. Computed tomography angiography shows compression of the subclavian artery between the first rib and the clavicle.

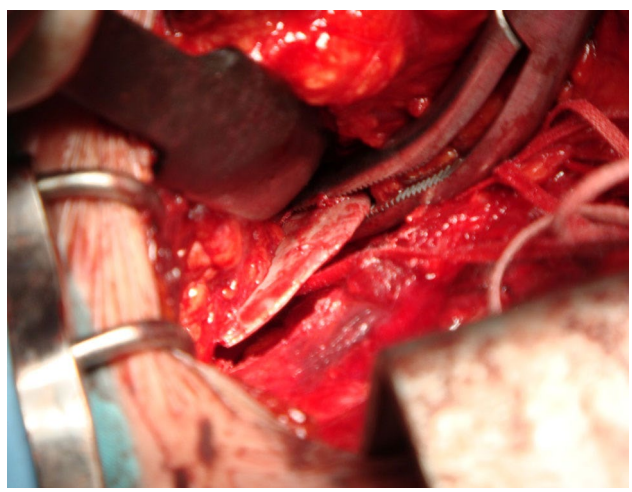

Figure 3. The first rib is disarticulated and removed.

Figure 4. Removed first rib.

that their complaints had improved and did not affect their daily activities, negative provocation tests on physical examination, and improvement in EMG and Doppler findings. The patients' statements regarding improvement were categorized as those with complaints that affected their daily activities and no change. The operation was recommended for three patients with no change in complaints and whose daily activities were affected. One of these patients who accepted surgery was operated on again using the transaxillary route (Figures 3, 4). The fibrous tissue causing subclavian artery compression was removed, and the compression was resolved. Complete recovery was achieved after the operation. Two patients did not accept the operation. All patients were referred to the rehabilitation clinic postoperatively.

Statistical analysis

The NCSS (Number Cruncher Statistical System) 2007 and PASS 2008 (NCSS, Kaysville, UT, USA) were used for data analysis. In addition to descriptive statistical methods (mean, standard deviation, and frequency), the Mann-Whitney U test was used for comparisons of quantitative data between two groups for parameters that did not show normal distribution. The chi-square test and Fisher exact chi-square test were used for the comparison of qualitative data. A p-value <0.05 was considered statistically significant.

RESULTS

Thirty-two TOS procedures were performed on 28 patients. Twenty-four (85.7%) patients were operated unilaterally. Fourteen (43.7%) operations were performed on the left side, and 18 (56.3%) were performed on the right side. One male and three female patients were operated bilaterally.

Four (12.5%) of the cases were 20 years or younger, 13 (40.6%) were between 20 and 29 years of age, six (18.8%) were between 30 and 39 years of age, six (18.8%) were between 40 and 49 years of age, and three (9.4%) were 50 years or older.

Considering the occupational distribution of female cases, 58.3% of them were housewives (Table 1). Pain in the arm was found to be the most common discomfort among the symptoms. Other symptoms and findings are given in Table 2.

The preoperative UNCV value ranged between 44.8 and 64.3 m/sec, and the postoperative UNCV value ranged between 55.3 and 70 m/sec. The mean preoperative UNCV value was 58.07±4.58 m/sec, and the postoperative UNCV value was 66.5±3.50 m/sec. Accordingly, a 16.81% increase in the UNCV value (difference in means: 9.6 m/sec) was detected.

According to clinical, radiological, and laboratory findings, neurological TOS was detected in 28 (87.5%) of the cases, while venous TOS was detected in three (9.4%), and arterial TOS was detected in one (3.1%).

The operative time ranged between 60 and 180 min, with a mean of 135.0±5.3 min. Complications were observed in six (18.7%) of 32 operations. The most common complication was pneumothorax

Table 1
Distribution of occupation (n=32)

	n	%
Housewife	14	43.8
Public servant	5	15.6
Clerk	2	6.3
Student	2	6.3
Computer operator	2	6.3
Teacher	2	6.3
Secretary	1	3.1
Accountant	1	3.1
Garment worker	1	3.1
Construction worker	1	3.1
Freelancer	1	3.1

Table 2
Distribution of symptoms and findings (n=32)

	n	%
Pain in arm	26	81.3
Numbness	20	62.5
Weakness in the arm	9	28.1
Tingle	7	21.9
Shoulder pain	5	15.6
Getting tired easily	4	12.5
Head & neck pain	3	9.4
Bruising on the arm	3	9.4
Chest pain	3	9.4
Edema in the arm	3	9.4
Feeling cold	2	6.3
Atrophy	1	3.1
Discoloration	1	3.1
Swelling in the cervical area	1	3.1

(six cases). Long thoracic nerve damage was observed in one of the six cases that developed pneumothorax. Since the pleura was open during the operation, tube thoracostomy with a hemovac drain or tube thoracostomy only was performed on the same side due to pneumothorax. Hemovac drain, tube thoracostomy, or both did not make a statistically significant difference in terms of the duration of hospitalization (Tables 3, 4).

In the postoperative follow-up, complaints persisted in three (9.4%) of 32 procedures. After the remaining 29 operations, patients stated they did not have any complaints affecting their daily activities. Physical examination and Doppler or EMG findings were found to support patient statements. According to the results obtained, the success rate was determined as 90.6%.

Table 3
Length of hospital stay

	n	Mean±SD	Min-Max
All patients	32	4.06±1.27	2-8
Patients receiving hemovac drain only	26	3.92±1.32	2-8
Patients who underwent tube thoracostomy only	3	4.33±0.57	4-5
All patients with hemovac drains	29	4.03±1.32	2-8
All patients who underwent tube thoracostomy	6	4.67±0.81	4-6

SD: Standard deviation.

Table 4
Evaluation of hospital stay in patients who underwent hemovac drain placement and tube thoracostomy

	n	Mean±SD	Median	p^*
Patients with hemovac drains only				
Yes	26	3.92±1.32	3.5	0.292
No	3	4.33±0.57	4	
Patients undergoing tube thoracostomy only				
Yes	3	4.33±0.57	4	0.292
No	26	3.92±1.32	3.5	
All patients with hemovac drains				
Yes	29	4.03±1.32	4	0.418
No	3	4.33±0.58	4	
All patients undergoing tube thoracostomy				
Yes	6	4.67±0.81	5	0.070
No	26	3.92±1.32	4	

SD: Standard deviation.

DISCUSSION

Studies have shown that TOS is common in females. The male/female ratio (MFR) has been reported to be between 1/3 and 1/9 in case series.[1,4] In our study, this ratio was 1/3. The MFR is also preserved in bilaterally operated cases. In this study, the MFR was found to be compatible with the literature.

The most common period with TOS is the third decade of life, which coincides with the period when patients' physical activities are most intense.[1,9] The mean age of the patients operated on in our clinic was 36.2±11.7 years. When distribution was made according to age groups, the ratio of cases between the ages of 20 and 39 to all patients was 87.5%. The mean age of the patients in our study and the fact that the majority of the cases were between the ages of 20 and 39 are compatible with the literature.

It is accepted that TOS may develop due to excessive tension in the upper extremities and neck area, load on the neck area, shoulder muscle and scalene muscle hypertrophy due to the constant use of the upper extremities in the same position, and chronic trauma during work done with the upper extremities, depending on working conditions. Thoracic outlet syndrome findings are more common in occupational groups such as construction workers, secretaries, and computer operators, who work with repetitive movements of the upper extremity with support from the arms, compared to other occupational groups.[10] In a study conducted in Türkiye, female patients (housewives) who did not work in any job constituted 51.4% of the etiology of TOS.[11] In this study, it was determined that 43.8% of the cases were housewives.

In EMG studies, it has been shown that the UNCV value is higher in postoperative measurements compared to preoperative measurements and is above the 60 m/sec limit.[5,10] In our study, postoperative UNCV values were higher than preoperative measurements, indicating that surgical decompression eliminates nerve irritation and contributes to nerve healing in cases where the brachial plexus is affected.

In the transaxillary approach, the surgery is performed in a deep and narrow area. The reported complication rate in the transaxillary region is approximately 13 to 26%, and the incidence of pneumothorax is approximately 14%. Complications encountered after decompressive procedures for TOS include long thoracic nerve injury, pneumothorax, intercostobrachial neuropathy, and arterial and venous hemorrhages.[5,6,9] In our study, the complication rate was 18.7%, and the most common complication was pneumothorax. In cases where the pleura was opened, tube thoracostomy was performed, and in fewer patients, tube thoracostomy and hemovac drains were used. Following the end of the operation, it is recommended to apply a hemovac drain to the operation area.[6,9,12] In many studies, tube thoracostomy on the same side is recommended in case of pleural tear. There are also studies that recommend opening the pleura to prevent the development of fibrous tissue and hematoma formation in the operation area. Tube thoracostomy and opening the pleura to prevent hematoma at the operation site have also been recommended as drainage options.[7,12] According to our results, hemovac drain or tube thoracostomy did not affect hospital discharge. From this point of view, tube thoracostomy as a drainage method becomes a drainage method that can be preferred alone.

Conditions that negatively affect the quality of life of patients and complaints that are at a level that requires reoperation are considered as recurrence. Neurological findings are more evident in clinical practice. In published series, it has been reported that with appropriate patient selection and operation technique, 80 to 90% success rates are achieved with surgical treatment, and pain complaints are significantly reduced.[5-8] This rate is 97% in the case series of Urschel et al.[11] In our follow-up results, we saw that there was recurrence in three cases. While neurological findings were observed in two of these cases, vascular findings were prominent in one case. Two of our patients were directed to receive physical therapy, and one patient was operated on due to vascular findings and the symptoms affecting the quality of life. In our study, the success rate of our surgical interventions was 90.6%.

The retrospective nature and the relatively small number of patients included are among the limitations of our study. Nonetheless, although the small sample size may limit our ability to analyze and compare our data to other previously published studies, statistical power in the present study still correlates with the overall conclusions.

In conclusion, it was determined that the complaints of TOS patients coincided with the

period when physical activity was most intense, and housewifery has an important place in the etiology of TOS in Türkiye. Significant improvements were observed between the tests evaluated for TOS preoperatively and those performed postoperatively. High surgical success rate was observed in our patients who failed in conservative treatment, and transaxillary approach appears to be an effective method of treatment.

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Ethics Committee Approval: This thesis study was performed at Dr Siyami Ersek Education and Research Hospital, Thoracic Surgery Clinic, with the permission of the thesis jury. Approved on 23.12.2010. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Patient Consent for Publication: A written informed consent was obtained from each patient.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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