Cervical rib resection for symptomatic cervical rib

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ABSTRACT

Background: A cervical rib extends laterally and forward usually from the transverse process of C7, into the posterior triangle of the neck, where it may terminate as a free end or may join the first thoracic rib, via a fibrous band. It varies in shape, size, direction, and mobility. If it reaches far enough forward, part of the brachial plexus and the subclavian artery and vein cross over it and are apt to sustain compression, thus leading to the clinical symptomatology. **Aim of the work:** This study aimed to show the effect of cervical rib resection for symptomatic cervical rib. **Patients and Methods:** Prospective cohort study carried out at Surgical Unit Al Azhar University (Damietta), El-Mataria teaching hospital and others centers which conducted on 25 cases. This study performed between January 2019 and December 2020. **Results**: modified supraclavicular interscalene approach for symptomatic cervical ribs resection effective in management of pain. **Conclusion**: modified supraclavicular interscalene approach for symptomatic cervical ribs resection has been shown to be effective in the neuralgic pain treatment.

Keywords: thoracic outlet syndrome; cervical rib

INTRODUCTION

Cervical rib (CR) is described as an anomalous, supernumerary, extra, or additional rib that arises from the seventh cervical vertebra due to elongation of its anterior (costal) element of its transverse process, also known as “Eve's rib. CR is observed in 0.2 to 1% of the general population. A cervical rib can, through compression on structures in the shoulder and upper thoracic regions by the rib itself or a fibrous band attached to the rib and another nearby structure, lead to thoracic outlet syndrome [1]. Only 10 % of CR are responsible of thoracic outlet syndrome (TOS) [2].

The presence of a cervical rib was already mentioned in the works of Galen in the second century AD, and in sixteenth century by Vesalius. Subsequently, it was classified into four major types based on length and union with the first rib in nineteenth century [3].

TOS is secondary to the compression of the neurovascular bundle. CR is associated with an increased rate of arterial compression in TOS. Arterial injuries are frequently associated to stage 3 or 4 of Grüber’s classification [4].

The supraclavicular approach could relieve TOS by decompression of the brachial plexus and excision of the first rib releases structures that compress soft tissue in the region of the interscalene portion of the brachial plexus. The lower nerve trunk and C8 and T1 nerve roots can be completely identified and protected as the most posterior aspect of the first thoracic rib is resected under direct vision [5].

The transaxillary route was used for removal of the first thoracic rib with decompression of the seventh and eighth cervical and first thoracic nerve roots and the lower trunks of the brachial plexus. Through this approach, first thoracic rib resection can be performed without major muscle division or retraction of the brachial plexus, and the removal of the posterior segment of the first thoracic rib is easier [6]. The transaxillary approach to thoracic outlet decompression in the presence of cervical ribs offers the advantage of less manipulation of the brachial plexus and associated nerves. It reduced incidence of perioperative complications, such as nerve injuries [7].

The present study was designed to evaluate the efficacy and safety of modified supraclavicular interscalene approach for symptomatic cervical ribs resection.

PATIENTS AND METHODS

Prospective cohort study carried out at Surgical Unit Al Azhar University (Damietta), El-Mataria teaching hospital and others centers which conducted on 25 cases. This study performed between January 2019 and December 2020

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Sample Size:

Sample size calculated to be 25 recorded cases.

Methods:

Inclusion Criteria

The study included patients with moderate to severe shoulder and/ or radicular pain in the upper limb with preoperative cervical radiography showing unilateral or bilateral cervical rib(s). Pain had been resistant to medical treatment and physiotherapy for at least 6 months. Patients with other cervical spine or vascular disease were excluded from the study. All patients underwent thorough neurologic examination.

Pain (shoulder pain and radicular pain) was assessed by a pain therapist using a visual analog scale (VAS) and classified as mild, moderate, or severe if the scores were 0-3, 4-6, and >6, respectively. All patients underwent routine preoperative laboratory workup.

Computed tomography was used to show the extent and consistency of the cervical rib and possible other causes of TOS. Magnetic resonance imaging of the cervical spine was used to screen the cervical spine and the intervertebral discs. Magnetic resonance neurography for imaging of the brachial plexus was used in some cases of unexplained brachial radiculopathy to search for compressing fibrous bands or other thoracic outlet diseases.

Surgical technique:

Preoperatively three-dimensional computed tomography scan of the neck confirm the clinical diagnosis of thoracic outlet syndrome caused by cervical rib. Intravenously administered steroids (8-16 mg dexamethasone) and prophylactic antibiotics. Under general anesthesia with endotracheal intubation, the procedure is carried out in a supine position with a slight head tilt to the opposite side of the surgery and mild elevation of the ipsilateral shoulder using a tiny pillow running vertically under the dorsal spine.

From the posterior boundary of the sternocleidomastoid to the anterior border of the trapezius, a transverse supraclavicular half-collar incision was created 2.54 cm (1 inch) above the clavicle. Dissection of the platysma and subcutaneous tissue. The skin flaps are lifted, and the sternocleidomastoid muscle's lateral edge is mobilised and retracted. The supraclavicular nerves were found and preserved, and the cervical fascia's investing layer was dissected. On the lateral margin of the sternocleidomastoid, the external jugular vein is dissected free for 3 to 5 cm and gently retracted laterally with a vein retractor. Over the lateral margin of the anterior scalene muscle, the scalene fat pad is bluntly dissected. The dissection is frequently too medial if the internal jugular vein may be seen. The phrenic nerve was subsequently discovered running down the surface of the scalenus anterior, and moderate traction of the scalenus anterior and the inferior belly of the omohyoid muscles allowed the interscalene triangle to expand allowing structures in the surgical field to be seen. The lower trunk of the brachial plexus, and then the other trunks, were identified, and gentle upward traction was applied anteriorly and medially. The scalenus anterior and overlying phrenic nerve were preserved. Dissection is carried out distally until the cervical rib or any connected fibrous traction band is reached, and proximally until the transverse process of the seventh cervical vertebrae is reached. By dissection and removal of the cervical rib, and excision of fibrous remnants that could be attached to the first rib complete decompression of the trunks of the brachial plexus (especially the lower trunk) is achieved. Secure hemostasis and wound closure were done in layers with the use of a suction drain, which is normally removed within 48 hours postoperatively.

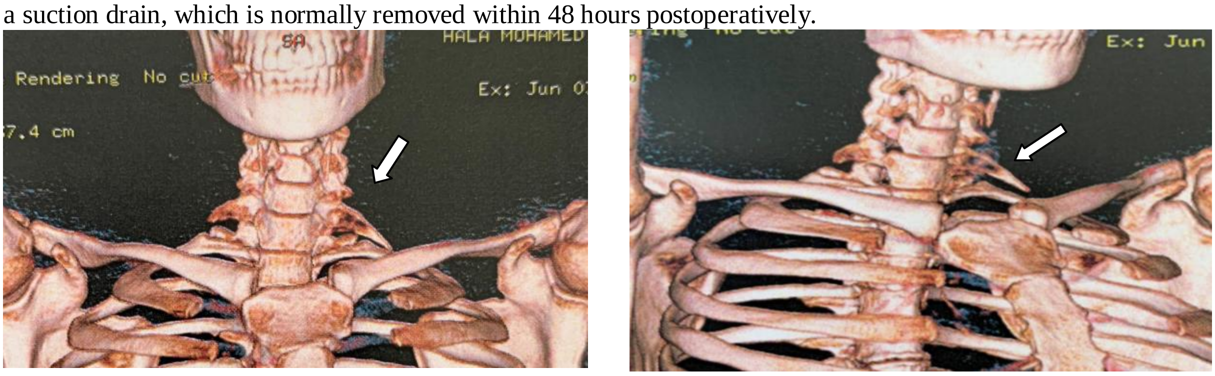

Figure (1): Preoperative three-dimensional computed tomography of a 42-year-old female patient showing left cervical rib; and prominent transverse process of the right side. The left was symptomatic (arrow) and she had severe neck and left upper limb radiculopathy not relieved by analgesics. with marked oedema of the left upper limb.

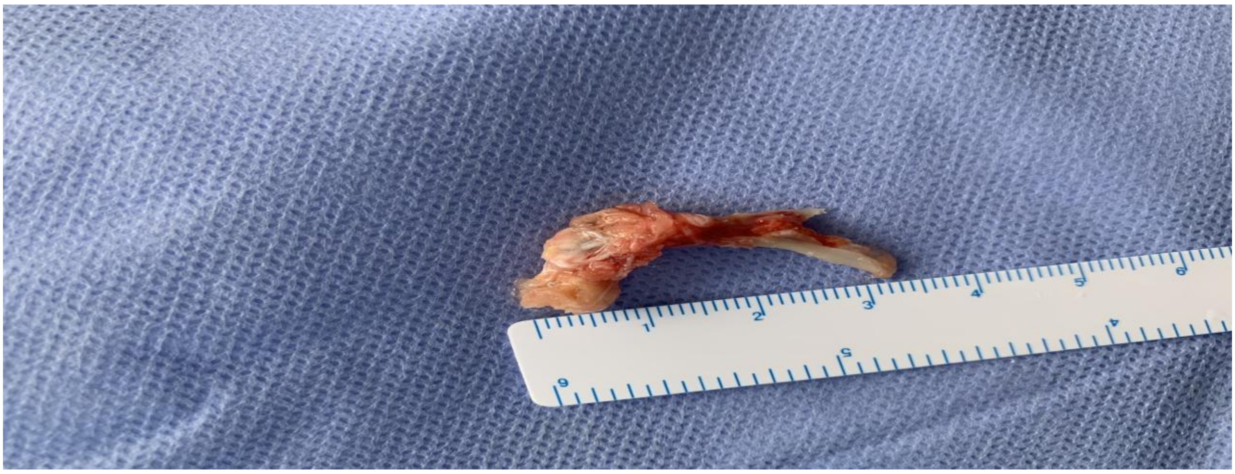

Figure (2): The excised cervical rib

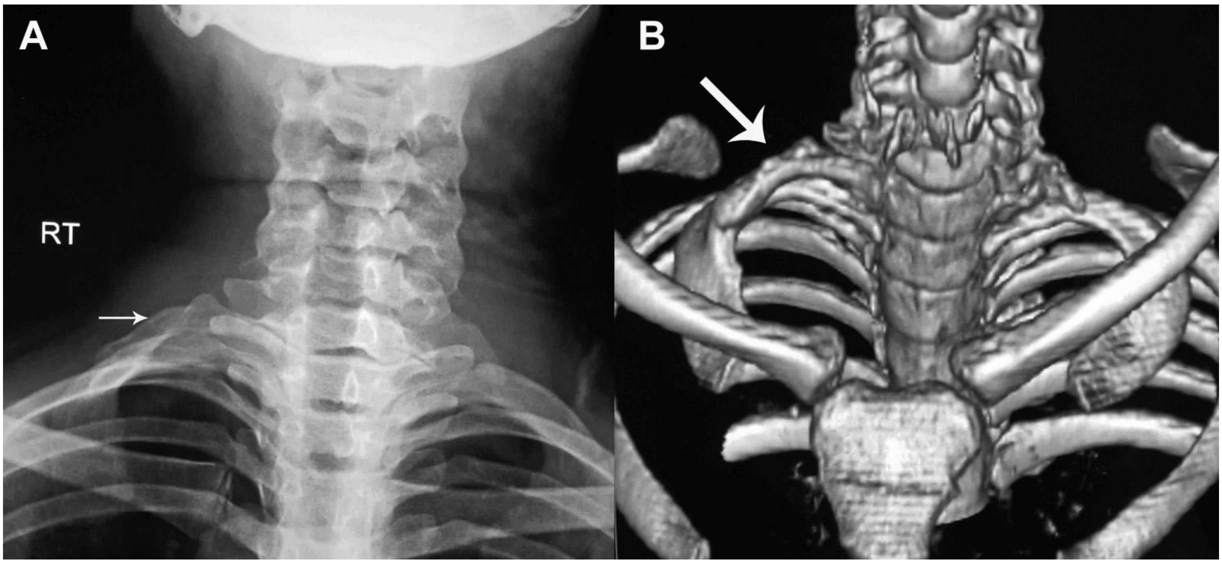

Figure (3): An 22 year-old woman with right brachial radiculopathy. (A) The plain x-ray showing a complete cervical rib (arrow). (B) Three-dimensional computed tomography scan showing a complete cervical rib fused with the first rib (arrow).

Ethical consideration:

Informed consent was obtained from all participants after being informed about the aims and process of the study as well as applicable objectives.

The study procedures were free from any harmful effects on the participants as well as the service provided.

The principal investigators have kept individual data as private information safely. There was no extra fee to be paid by the participants and the investigators covered all the costs in this regard.

Statistical Analysis

Data entry, processing and statistical analysis was carried out using Statistical Package for the Social Sciences (SPSS) version 20**.** Tests of significance (Kruskal-Wallis, Wilcoxon's, Chi square, logistic regression analysis, and Spearman's correlation) were used. Data were presented and suitable analysis was done according to the type of data (parametric and non-parametric) obtained for each variable. P-values less than 0.05 (5%) was considered to be statistically significant.

P- value: level of significance

P > 0.05: Non-significant (NS).

P < 0.05: Significant (S).

P < 0.01: Highly significant (HS).

Descriptive statistics:

- Mean, Standard deviation (± SD) and range for parametric numerical data, while Median and Inter-quartile range (IQR) for non-parametric numerical data.
- Frequency and percentage of non-numerical data.

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Analytical statistics:

Kruskal-Wallis test was used to assess the statistical significance of the difference of a non-parametric variable between more than two study groups. one-way ANOVA for continuous normally distributed variables. Post hoc analysis after ANOVA was performed using the Tukey test. with post hoc analysis by means of the Mann–Whitney U test

RESULTS

In the present study, mean patients age was 37.15 years with mean BMI of 36.05 ± 8.77 kg/m2, 70% of the patients were females. As regard preoperative pain assessment, There were 16 (64.0%) with severe radicular pain and 9 (36.0%) with moderate radicular pain **(Table I).**

In the present study as regarding sensory examination, there were 2 (8.0%) cases with tenderness, 9 (36.0%) with paresthesias, 3 (12.0%) with paresthesias plus tenderness, 1 (4.0%) with hypothesia and 4 (16.0%) with hypothesia plus tenderness. As regard motor examination, there were 2 (8.0%) with partial claw hand and 5(20.0%) with grade IV hand grip **(Table II).**

Our study showed that postoperative one month pain assessment were all cases had Mild radicular pain **(Table III).**

Table (I): Demographic data of the studied cases.

Age (mean ± SD)		33.2 ± 5.01
Sex (NO)	Male	11 (44.0%)
	Female	14 (56.0%)
Classification	Complete	16 (64.0%)
	Incomplete	9 (36.0%)
preoperative pain assessment	severe radicular pain	16 (64.0%)
	moderate radicular pain	9 (36.0%)
	Mild radicular pain	0 (0.0%)
VAS Preoperatively (mean ± SD)		8.12 ± 1.64

Table (II): Sensory and Motor examination of the studied cases.

Parameter		No (%)
Sensory Examination	Normal	6 (24.0%)
	Tenderness	2 (8.0%)
	Paresthesias	9 (36.0%)
	Paresthesias plus tenderness	3 (12.0%)
	Hypothesia	1 (4.0%)
	Hypothesia plus tenderness	4 (16.0%)
Motor Examination	Normal	18 (72.0%)
	Partial claw hand	2 (8.0%)
	Grade IV hand grip	5 (20.0%)
Electromyography/ Nerve Conduction Velocity Finding	Yes	13 (52.0%)
	No	12 (48.0%)

Table (III): Extent of Excision, postoperative pain and VAS of the studied cases.

Extent of Excision (NO)	Complete	19 (76.0%)
	Subtotal	6 (24.0%)
postoperative pain assessment (1 month)	severe radicular pain	0 (0.0%)
	moderate radicular pain	0 (0.0%)
	Mild radicular pain	25 (100.0%)
VAS Postoperatively (mean ± SD) (1 month)		1.4 ± 0.96

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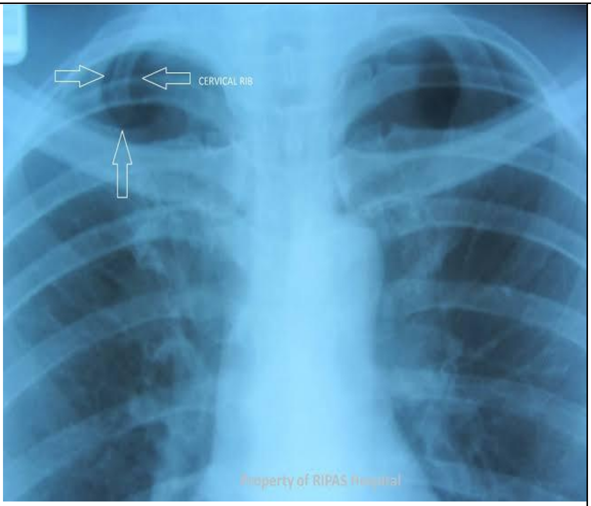

Figure (4):AP chest x-ray with right cervical rib(white arrow)

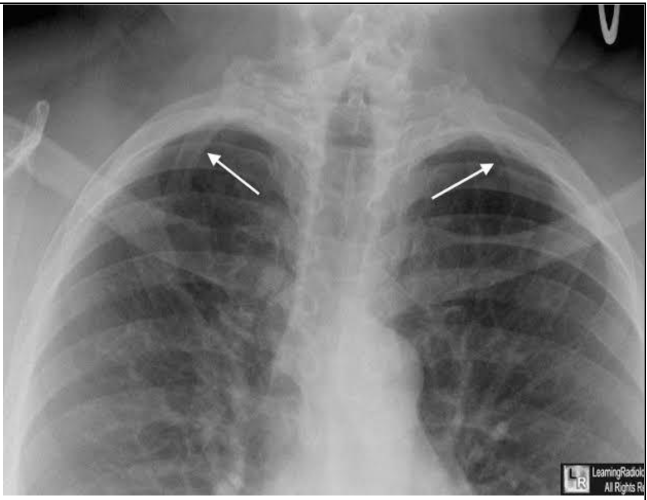

Figure (5): AP chest X-ray with bilateral cervical rib (white arrow)

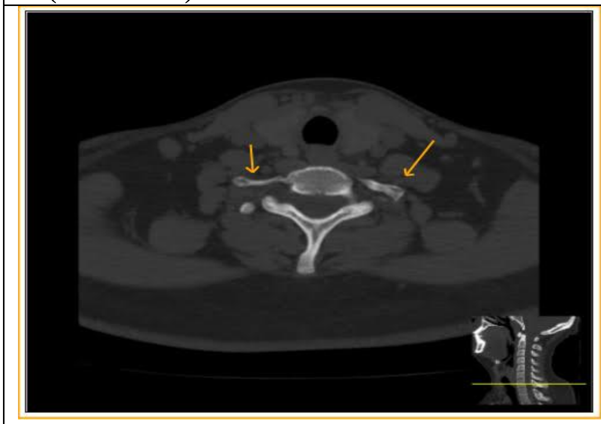

Figure (6): Axial CT cut at level C7 showing bilateral cervical rib(yellow arrow)

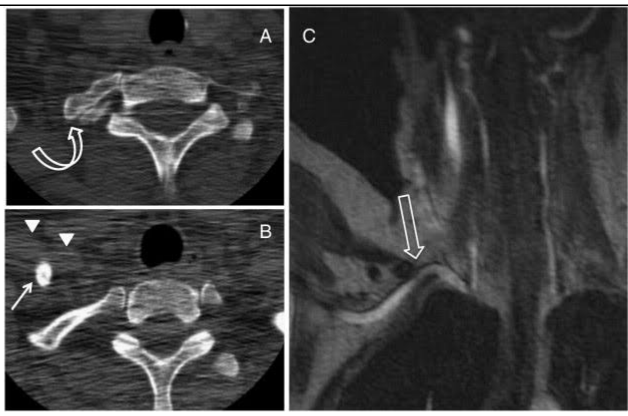

Figure (7): Axial and reconstructed coronal cuts showing right cervical rib (white arrow).

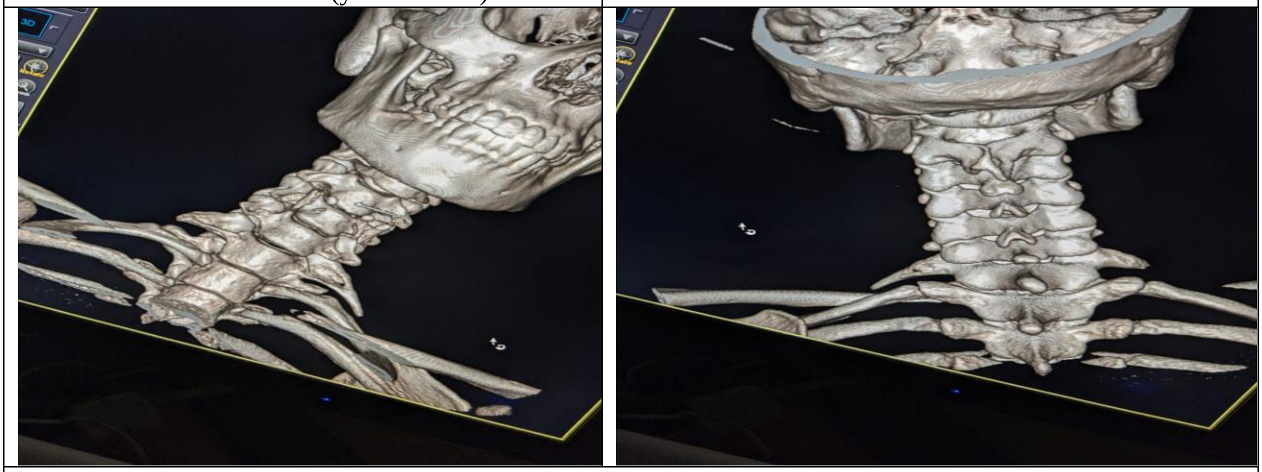

Figure (8):3D CT right distal cervical rib made psoudoarticular joint with left first rib

DISCUSSION

A cervical rib extends laterally and forward usually from the transverse process of C7, into the posterior triangle of the processes of the cervical ribs is the homologue of the thoracic ribs, and elongation of the anterior tubercle of a cervical vertebral transverse process suggests another manifestation of a cervical vertebral costal component and is similar to a cervical rib. Aberrant articulation between the two anterior tubercles, as is fusion of the fifth and sixth cervical vertebrae in this case, has only been reported twice in the literature [3]

Accessory ribs are permanent structures as opposed to ossification sites that disappear postnatally, probably becoming part of the lateral transverse vertebral processes. Ribs are normally present in the fetus in articulation with vertebrae above the eighth, and after birth they are present only as transverse processes of the cervical vertebrae. The extent of growth of a cervical rib is determined by the resistance of the nerve in its path [8].

In the present study there were 11 case (44.0%) male and 14 (56.0%) female. This results agreed with [2] who noticed that the cervical rib is common in females than males, although not significantly. In case of symptomatic individuals, females more commonly presented with TOS.

In the present study the types of cervical rib were 16 case (64.0%) with complete and 9 (36.0%) with incomplete. [9] classified the cervical ribs depending upon the ossification, they are classified broadly into complete or incomplete types. The complete cervical ribs are known to produce vascular symptoms. The symptoms of a cervical rib may be neurogenic (95%) most commonly followed by venous (4–5%), then arterial (1%) [9].

In the present study as regarding sensory examination, there were 2 (8.0%) cases with tenderness, 9 (36.0%) with paresthesias, 3 (12.0%) with paresthesias plus tenderness, 1 (4.0%) with hypothesia and 4 (16.0%) with hypothesia plus tenderness. As regard motor examination, there were 2 (8.0%) with partial claw hand and 5(20.0%) with grade IV hand grip. Neurogenic TOS is due to brachial plexus compression, associated with chronic inflammation of the scalene muscles, forming tendinous bands, causing compression. Venous TOS, due to venous impingement, presents with arm swelling, cyanosis, and pain due to subclavian vein obstruction, with or without thrombosis. The patients have either hypercoagulable disorders or they may present with effort thrombosis (Paget–Schroetter syndrome) [10]. Arterial TOS is usually due to emboli arising from subclavian artery thrombosis, within the poststenotic dilatation due to compression. Compression may be due to a cervical rib, an anomalous first rib or due to fibro-cartilaginous bands in the thoracic outlet. This may be visible on a regular X-ray of the chest. [11]. Prevention of adverse vascular events requires early detection of lesions like subclavian artery compression with post-stenotic dilatation or an aneurysm, which cause embolism and are responsible for the same.

Symptomatology of TOS may also include pain over the extremity with or without paraesthesia, neck pain, and occipital headache. The possible sites of compression of the neurovascular bundle are the interscalene triangle, costoclavicular space, and retropectoralis minor space. Compression in the interscalene triangle, known as scalene syndrome, has neurological and arterial symptoms; there are no venous symptoms, since the subclavian vein is not contained in this triangle. Costoclavicular compression syndrome can compress any bundle structure [9].

The traditional supraclavicular approach relieves symptoms of TOS by decompression of the trunks of the brachial plexus, through division of the anterior and the middle scalene muscles, and resection of the first thoracic rib with or without excision of the cervical rib [12].

Complications of this traditional supraclavicular procedure are probably frequent because of the more thorough exposure of the brachial plexus trunks and other interscalene structures during the course of scalenectomy [13].

In our modified approach, we avoided also the complications of the transaxillary approach, because the transaxillary approach is used to resect the first thoracic rib through the second intercostal space, without exposure of the supraclavicular structures. [14] used the video-assisted transaxillary technique to help in resection of the offending cervical rib in 2 cases, with unilateral intraoperative ventilation and insertion of an intercostal tube to help drain the resultant pneumothorax. This situation is completely avoided in our approach. [15] reported that the most significant complication is injury to the major blood vessels or nerves in the region of the brachial plexus, and pneumothorax was reported to occur in 9% of cases operated on by the transaxillary approach and about 2.5% of cases operated on by the supraclavicular approach because of the intimate relationship of the pleura and the first rib; compared with the modified interscalene approach we used, these rates and types of complications are absent.

From all the aforementioned data we can conclude that, high index of suspicion is required for considering cervical rib as potential cause for arterial TOS. A surgical intervention is strongly recommended in cases of symptomatic cervical ribs, presenting with arterial TOS that may decrease the morbidity of the patient.

Conclusion: Cervical ribs should be resected only in symptomatic patients in whom the symptoms and examination findings indicate a clinical diagnosis of TOS and the symptom severity is such as to warrant the potential risks of this surgery. This report indicates that cervical ribs may be resected through a modified approach with an acceptable rate of morbidity and no mortality.

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Conflicts of interest: There are no conflicts of interest

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