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Association Between Cervical Rib and Symptoms Suggestive of Thoracic Outlet Syndrome: An Observational Study

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Research Article

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Abstract

Background: Cervical ribs are congenital anatomical variations that may contribute to thoracic outlet syndrome (TOS). However, their clinical significance and association with symptoms suggestive of TOS remain uncertain. Objective: To determine the prevalence of cervical ribs among patients presenting with symptoms suggestive of TOS and evaluate their association with provocative examination findings. Materials and Methods: This observational study included 940 patients aged 18–40 years presenting with persistent neck or shoulder-region pain, with or without radiation to the upper limb, numbness, or mild weakness. Patients underwent clinical examination, a provocative manoeuvre involving arm abduction and external rotation, and cervical spine radiography in anteroposterior and lateral views. Associations between cervical rib detection, sex, and provocative examination findings were assessed statistically. Results: Cervical ribs were identified in 112 of 940 patients (11.91%; 95% confidence interval [CI], 10.00–14.14%). Their prevalence was 12.80% (63/492) in females and 10.94% (49/448) in males, with no statistically significant difference between sexes (χ^2 = 0.779; p = 0.377). Bilateral cervical ribs were observed in 93 patients (83.04%), while 19 (16.96%) had unilateral ribs. Provocative examination findings were positive in 29 of 112 patients (25.89%) with cervical ribs and 150 of 828 patients (18.12%) without cervical ribs. This association did not reach statistical significance (two-sided Fisher's exact test; p = 0.055; odds ratio = 1.58). Conclusion: Cervical ribs were detected in 11.91% of this selected cohort of patients with symptoms suggestive of TOS. Their prevalence did not differ significantly by sex, and their presence was not significantly associated with positive provocative examination findings. Controlled studies using clearly defined diagnostic criteria are required to clarify the clinical significance of cervical ribs in TOS.

Keywords: Cervical Rib; Thoracic Outlet Syndrome

Introduction

Thoracic outlet syndrome [TOS] represents a spectrum of disorders related to compression of brachial plexus, subclavian artery or subclavian vein [1]. TOS is one of the most controversial, most underrated and difficult to manage peripheral nerve compression in upper extremity [2]. Neurogenic TOS is the most common manifestation presenting with pain, numbness, tingling, weakness and vasomotor changes in the upper extremity [3]. Because of the non-specific nature of signs and symptoms, the lack of a consensus for the objective diagnosis and wide range of etiologies, the actual figure is still a matter of debate among experts [4]. The diagnosis of TOS is often made in the presence of symptoms with physical examination findings, but it is not a diagnosis of exclusion, and there should be evidence for a physical anomaly that can be corrected [5]. Neurovascular compression at the thoracic outlet results from one or several local anatomical abnormalities, all involving the first rib to some extent [6]. Despite the significant pathology associated with TOS, there remains some general disagreement among experts on the specific anatomy, etiology, and pathophysiology presumably because of the wide variation in symptoms that manifest in presenting patients and because of lack of a definitive gold standard for diagnosis [7].

Cervical rib is congenital anomality which arises from transverse process of C-7 vertebra and mostly attached to first rib except in case of incomplete cervical rib where the terminal portion may be fibrous. The incidence of cervical rib is between 1-2 % according to different available literature [8]. The incidence of cervical rib has been found to vary from 0.58% in Malaysian population to 6.2% in Turkish population [9]. Cervical rib is grossly under-recognized and under-diagnosed by clinicians due to various reasons [10]. The aim of this study was to find the prevalence of cervical rib among the suspected patients of TOS and to know the association between TOS & cervical rib.

Materials and Methods

Total 940 patients including 492 females and 448 males were selected for this study. Persons of the age between 18 years to 40 years, having vague, deep seated, and poorly localized pain in the root of the neck or shoulder, with or without radiation to arm, forearm or hand, with or without numbness or mild weakness of more than 30 days duration in concerned upper limb, were included in this study. Patients with grade-2 and grade-3 pain only were included in this study; patients having grade-1 pain, which can be ignored easily, and grade-4 pain which is excruciating and incapacitating, were not included in this study. Patients with painful &/or restricted movements of neck or shoulder were excluded from this study assuming that the symptoms are probably from cervical spine or shoulder joint etiology. Patients with history of recent trauma were also not included. Patients with either normal power or mild weakness were included and those having power less than grade-IV were excluded.

Written, informed consents were taken. The selected patients were clinically examined for peripheral pulse, peripheral nerve dysfunction, and thenar wasting. A provocative test to reproduce the symptoms was done over all the patients. The arm of the affected side was abducted and externally rotated with the hand in overhead position, as if he or she is trying to throw something, for two minutes or the re-appearance of the symptoms, whichever came earlier. The oxygen saturation of the finger was measured by pulse oximeter in this pain provocative position and dip in oxygen saturation below 90% was considered as important sign of partial vascular compression. The patients were advised X-Ray of cervical spine from C-1 to D-2, AP and Lateral views.

Results

Out of total 940 patients, 112 (11.91%) patients had cervical rib visible in their X-ray, including 63 out of 492 females (12.80%] and 49 out of 448 males (10.93%). Out of those 112 patients having cervical rib, 93 (83.03 %) had bilateral and 19(16.97 %] had unilateral cervical rib. Out of total 940 patients, 179 (19.04%] patients had provocative re-appearance of symptom or sign like of pain or drop in the oxygen saturation and 761 patients (80.96%) did not have provocative symptoms or signs on clinical examination. In this cohort of 179 patients with provocating re-appearance of symptoms or signs, 29 (16.20%) had cervical rib and in 150 (83.80%), cervical rib was not found. Among 112 patients having cervical rib, 29 (25.89%) had provocating re-appearance of symptoms or signs during clinical examination and 83 (74.11%] were without provocating symptoms or signs.

In contrast to first rib or normal rib, Cervical rib was more radiolucent than normal rib. They look broader in AP view (Figure 1) and may have two distinctly separate parts. Cervical rib may be complete (Figure 2) or incomplete (Figure 3). Cervical rib be unilateral in AP view but were mostly bilateral. It was difficult to visualize cervical rib on lateral view, even when it is easily visible on AP view, probably due to overlapping by vertebral bodies and great vessels (Figure 4). Sometimes, the only evidence of cervical rib on lateral view was an area of increased radio-density or sclerosis in the C-7 vertebral bodies. When present on lateral view, the cervical rib was more oblique than normal or first rib (Figure 5) and usually makes an angle of more than 45 degree with the clavicle or horizontal plain in contrast to

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the first rib which usually makes an angle of 30 degree or less with the horizontal plain. Cortex of the cervical rib was thinner than the normal rib (Figure 6).

Outcome	Estimate	Statistical Result
Cervical rib prevalence	112/940 (11.91%)	95% CI 10.00%–14.14%
Cervical rib by sex	Female 12.80%; male 10.94%	$\chi^2(1) = 0.779$; p=0.377
Positive provocative test with cervical rib	29/112 (25.89%)	
Positive provocative test without cervical rib	150/828 (18.12%)	Fisher exact p=0.055; OR 1.58 (approx. 95% CI 1.00–2.50)

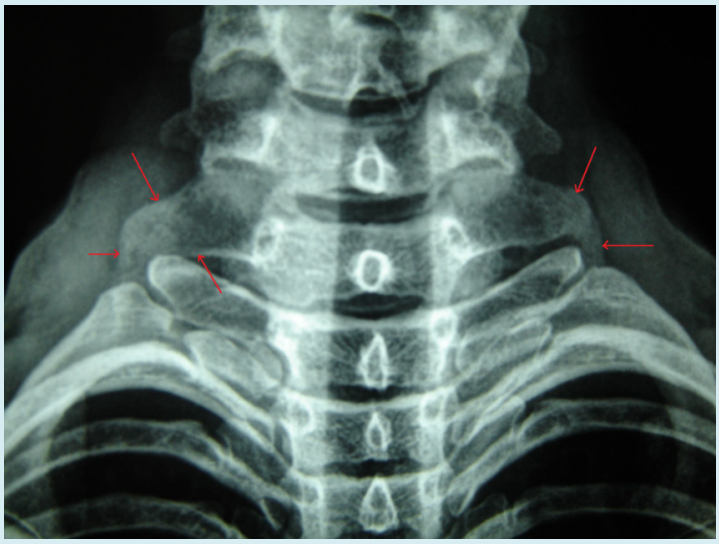


Figure 1: B/L cervical ribs, broader than normal rib in AP view.



Figure 2: Complete B/L cervical ribs in AP view.

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Figure 3: Incomplete cervical ribs in AP view.

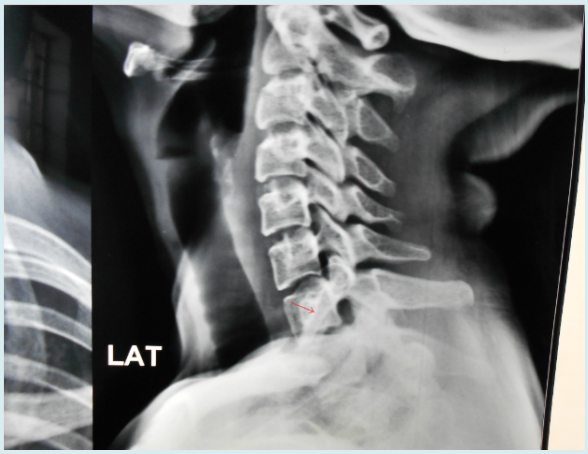


Figure 4: Cervical rib overlapping vertebral body in lateral view.



Figure 5: Cervical rib making an angle of more than 45^0 in lateral view.

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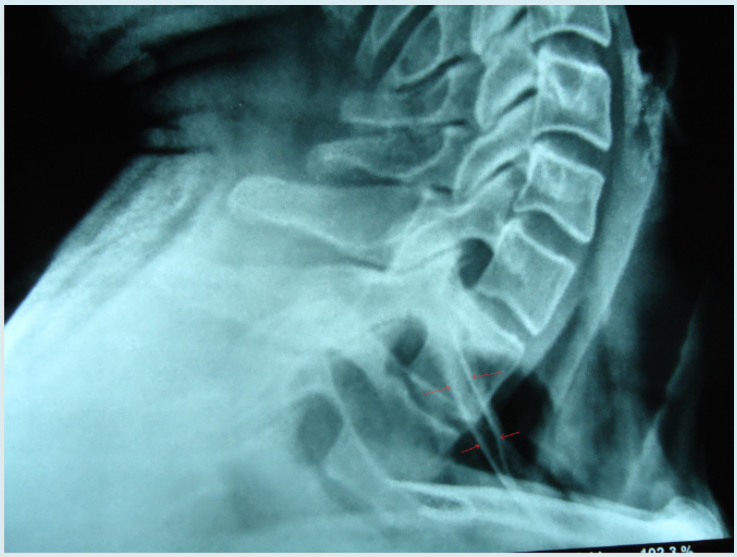


Figure 6: Thin cortices of cervical rib in lateral view.

Discussion

Among 940 patients referred with symptoms suggestive of thoracic outlet syndrome (TOS], cervical ribs were identified in 112 (11.91%; 95% confidence interval [CI], 10.00%–14.14%). This is the prevalence within this selected symptomatic cohort and should not be interpreted as prevalence in the general population. Cervical ribs were identified in 63/492 females (12.80%] and 49/448 males (10.94%]. The difference by sex was not statistically significant (Pearson chi-square = 0.779, 1 degree of freedom; p = 0.377). Of the 112 patients with a cervical rib, 93 (83.04%) had bilateral ribs and 19 (16.96%) had unilateral ribs.

The provocative examination reproduced symptoms or signs in 179/940 patients (19.04%). Among patients with a cervical rib, 29/112 (25.89%) had a positive provocative examination, compared with 150/828 (18.12%) of those without a cervical rib. The association was borderline and did not reach statistical significance using a two-sided Fisher exact test (p = 0.055; odds ratio [OR) = 1.58; approximate 95% CI, 1.00–2.50). These data do not establish an association between cervical rib and the provocative-test outcome. A positive provocative test or oxygen-saturation change is not, by itself, a definitive diagnosis of TOS.

The manuscript also describes radiographic appearances of cervical ribs, including complete or incomplete morphology and frequent bilateral presentation. These descriptive observations were not subjected to inferential statistical testing.

Thoracic outlet syndrome is diagnostically challenging, and cervical ribs may be asymptomatic. This study describes cervical-rib frequency in a selected group of patients with symptoms suggestive of TOS; it does not establish that a cervical rib caused the symptoms or that all participants had confirmed TOS. The provocative examination outcome was somewhat more frequent among patients with a cervical rib, but the difference was not statistically significant using the two-sided Fisher exact test (p = 0.055). These findings should be interpreted cautiously because the provocative test is not a definitive diagnostic reference standard and the cohort had no asymptomatic control group. Future studies should use clearly defined diagnostic criteria, include an appropriate comparison group, and collect individual-level data to permit adjustment for potential confounding factors.

Conclusion

In this cohort of 940 patients referred with symptoms suggestive of thoracic outlet syndrome, 112 (11.91%; 95% CI, 10.00%–14.14%) had a cervical rib on radiographs. Cervical-rib detection did not differ significantly by sex (p = 0.377). A positive provocative examination occurred in 25.89% of patients with a cervical rib and 18.12% of those without one; this difference did not reach statistical significance using Fisher's exact test (p = 0.055). Because there was no asymptomatic control group and TOS was not established using a stated diagnostic reference standard, this study cannot conclude that cervical ribs are six times more common than in the general population, estimate the risk of TOS among people with cervical ribs, or calculate an attributable risk. The findings describe cervical-rib prevalence in this selected symptomatic cohort and warrant confirmation in controlled studies.

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