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## Radiological and Clinical Aspects of the Eve's Rib in Shahjahanpur District Population

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### ABSTRACT

**Background:** In vertebrate anatomy, ribs are the long curved bones which form the rib cage, part of the axial skeleton. A typical human rib cage or thoracic cage consists of twelve pairs of ribs, the sternum and 12 thoracic vertebrae. Eve's rib or cervical rib is relatively uncommon congenital abnormality, which arises from the seventh or sixth or very rarely fifth or fourth cervical vertebrae. They vary widely in size and shape, usually asymptomatic but it may give rise to neurovascular symptoms if it exerts pressure on the subclavian vessels or the brachial plexus called as thoracic outlet syndrome. Accordingly the aim of this study was to find the prevalence of Eve's (cervical rib) rib in Shahjahanpur district population.

**Materials and Methods:** This study was carried out on 220 adult patients at Varun Arjun medical college and Rohilkhand hospital -Banthra, UP. All patients referred to the radiology department for chest X-ray or other cervical films, for any reasons were evaluated for cervical rib and anyone who had this abnormally was entered in our study.

**Results:** Out of 220 (110 males and 110 females) adult patients 3 adult female patients (1.36%) were found with bilateral cervical ribs.

**Conclusion:** A comprehensive knowledge of the anatomical

characteristics and congenital abnormalities of Eve's rib is very important for surgeons, radiologists and forensic experts as it may increase the success of diagnostic evaluation and surgical approaches to the region.


**Keywords:** Eve's Rib, Ischaemic Stroke, Klumpke's Paralysis, Paraesthesia, Scalenus Anticus Syndrome, Thoracic Outlet Syndrome.

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### INTRODUCTION

Ribs are flat, thin, curved bones that help to protect the vital organs like heart and lungs. A typical human rib cage or thoracic cage consists of twelve pairs of ribs the sternum and the 12 thoracic vertebrae. An Eve's rib or cervical rib or neck rib is an extra rib that forms above the first rib. It is described as an abnormality or extra rib that's present from birth, which arises from one of the cervical vertebrae usually the seventh rarely the sixth, and very rarely the fifth or fourth. However Eve's rib varies widely in size and shape, it may be unilateral or bilateral or may be a fully-formed bony rib or just a thin strand of tissue fibres. The presence of Eve's ribs was first observed by Galen in the second century, during dissections of human cadavers.<sup>1</sup>

However, the first observations of the clinical manifestations of neurovascular compression caused by Eve's ribs were made by Cooper.<sup>2</sup> On physical examination, Eve's ribs may appear as fixed hard lumps, which even mistaken for a metastatic tumours. Even Eve's ribs present since birth they usually diagnosed in middle age group persons because by middle age the shoulders start drooping which causes the cervical rib to get depressed and hence compressing the nerve root of the concerned region. Such congenital abnormalities of cervical ribs compress the lower trunk of brachial plexus and may leads to Klumpke's paralysis. The paralysis affects the intrinsic muscles of hands flexors of digits producing claw hand and anaesthesia along the ulnar side

of forearm, hand and little finger. Hence, knowledge of congenital abnormality of Eve's rib as well as the location of compression is useful in determining the pathology and appropriate treatment for compressive neuropathies. Accordingly this study was undertaken as there is no documented report on its prevalence in Shahjahanpur district population (Uttar Pradesh, India). This study aims to find the prevalence of cervical ribs and percentage of symptomatic patients with cervical ribs among Shahjahanpur district population.

#### MATERIALS AND METHODS

This study was carried out on 220 (110 males and 110 females) adult patients at Varun Arjun medical college and Rohilkhand hospital, Banthra, UP.

After obtaining informed consent from patients referred to the radiology department for chest X-ray or other cervical films, for any reasons were evaluated for cervical rib and anyone who had this abnormally was entered in our study. The age, sex and presence of unilateral or bilateral cervical ribs were noted.

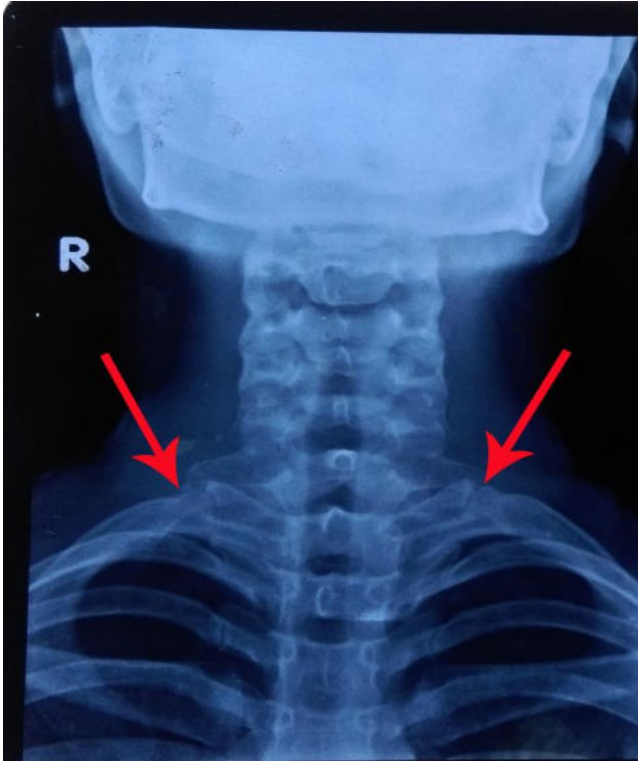


Figure 1: Chest radiograph demonstrating bilateral cervical ribs (arrowed).

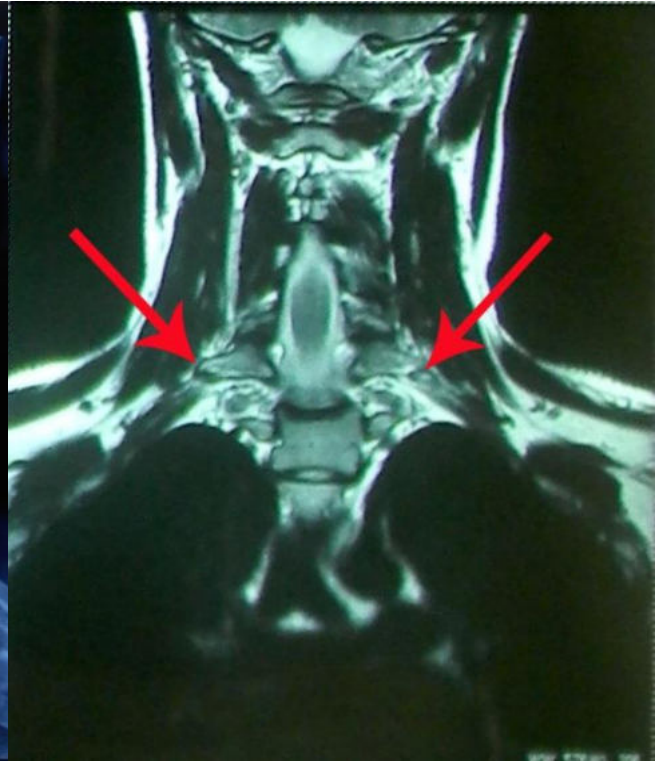


Figure 2: Magnetic resonance imaging (MRI) scan demonstrating bilateral cervical ribs (arrowed).

#### RESULTS

Out of 220 adult patients 3 adult female patients (1.36%) were found with bilateral complete cervical ribs (Figure-1 and Figure-2).

#### DISCUSSION

Developmentally, human skeletal muscles and axial skeleton derive from paraxial mesoderm. Paraxial mesoderm becomes segmented to form a number of mesodermal somites that lie on either side of the developing neural tube. Each somite differentiates into a ventro-medial part, the sclerotome, a dorso-lateral part the dermatome, and the intermediate part the myotome. At the end of the fourth week of embryogenesis, the cells of the sclerotome migrate medially form the mesenchymal basis of vertebral column and ribs. The ribs develop from the mesenchymal costal processes of the thoracic vertebrae. The presence of a foramen transversarium in each of the transverse process is a characteristic feature of cervical vertebrae. Each transverse process presents anterior and posterior roots, the anterior and posterior tubercles, and the costotransverse bar connecting both tubercles on the lateral side of the transverse foramen. Developmentally, in cervical vertebrae the costal and transverse elements are connected to each other around the

foramen transversarium. The anterior root, anterior tubercle, costotransverse bar and posterior tubercle represent the costal elements and the posterior root represents the true transverse element. Cervical ribs, usually rudimentary, result from the development of the costal processes of cervical lumbar vertebrae. Hox genes are responsible for patterning of the axial skeleton, and mutations within them probably are implicated in the development of cervical ribs.<sup>3</sup>

Erken et al. reported higher prevalence of cervical rib in Turkish population was 6.2%.<sup>4</sup> Rakan F Bokhari et al reported prevalence of cervical rib as 3.4% with female male ratio 2.01:1 in a population in Jeddah; Saudi Arabia.<sup>5</sup> Gulekon et al reported the prevalence of the cervical rib as 3% in Anatolian population with a higher rate in females than males.<sup>6</sup> Brewin J reported the prevalence of cervical rib in a population of London was 0.74% with a higher rate in females than males (1.09%:0.42%).<sup>7</sup> Lalchan S et al reported prevalence of cervical ribs as 1.1 % in Nepalese population with higher rate in females.<sup>8</sup> Antima Gupta reported cervical rib prevalence in Indian population around Lucknow UP was 0.6% with bilateral predominance.<sup>9</sup> DK Sharma reported cervical rib prevalence in Central Indian population was 1.22% (0.44% bilateral and 0.78% unilateral) with a little unilateral

predominance.<sup>10</sup> Sushant Agarwal et al reported cervical rib prevalence in Assam population was 0.76% with female predominance.<sup>11</sup> Bhat MH et al reported the prevalence of the cervical rib as 2.67% in Kashmiri population with a higher rate in females (3.1%) as compared to males (2.1%).<sup>12</sup> In our present study bilateral prevalence of cervical rib in Banthra population was noted as 1.36% with female predominance. Our finding overall prevalence of cervical rib (1.36%) is more than the result of Brewin J et al, Lalchan S et al, Antima Gupta et al, Schein CJ et al, Sushant Agarwal et al and Kurihara Y et al, but less than the finding by Erken et al, Rakan F Bokhari et al, Gulekon et al and Bhat MH et al.

Subclavian vessels and brachial plexus from the thoracocervical region pass three narrowing channels to reach the axilla to supply sensation and circulation to the entire upper extremity. The first narrow channel is the scalene triangle, which is bounded anteriorly by skin, fasciae and scalene Pad of fat, at the sides by the anterior and middle scalene muscles and the base is formed by first rib. The next is the costoclavicular space, which is bordered by the clavicle anteriorly, the first rib posteromedially, and the superior margin of the scapula posterolaterally. Finally, the neurovascular bundle travels under the coracoid process and beneath the pectoralis minor tendon (sub-pectoralis minor space). Compression or injury or irritation of the neurovascular triad can occur at any of these three narrowing channels may be responsible for the development of Thoracic outlet syndrome. Prolonged transverse process of the C7 vertebra or cervical rib or anomalous first rib may be responsible for the development of Thoracic outlet syndrome. Most patients with cervical ribs suffer due to compression of the brachial plexus than subclavian vessels. Incomplete cervical ribs only affect the brachial plexus; whereas complete cervical ribs also have an impact on the subclavian vessels can cause arterial stenosis or aneurysms in the subclavian artery and is rarely associated with thromboembolic or ischaemic stroke. Subclavian arterial thrombosis, and both cerebellar and cerebral infarctions secondary to retrograde thromboembolisation were reported.<sup>13,14</sup> Todd et al reported that the lowest trunk of brachial plexus was usually in closer opposition to the first thoracic rib or the cervical rib; sympathetic fibers which enter the arm in the lowest trunk of the brachial plexus are distributed to the peripheral vessels. Irritation or pressure of the cervical rib leads to paralysis of the sympathetic fibers induces spasm of the arterial wall, obliteration of the vasa vasorum and eventually such changes in wall of vessels leads to thrombosis and occlusion.<sup>15</sup> Eve's ribs are that are known to cause thoracic outlet syndrome or brachial plexopathy in up to 10% of the affected individuals.<sup>16</sup> The most common clinical presentation of the Thoracic outlet syndrome arises from compression of the lower trunk of brachial plexus and results in pain in the neck, trapezius, anterior chest wall, shoulder, arm, elbow, and forearm; paraesthesia in the fingers, usually all five and often worse in the fourth and fifth fingers; occipital headaches; weakness in the hand and arm; Hence, proper knowledge of such abnormalities essential for clinicians, radiologists and orthopaedic surgeons to distinction from pathologic changes for differential diagnosis.

The scalenus anterior, medius and posterior muscles are three pairs of muscles in the lateral side of neck, belonging to the scalene group. The brachial plexus and subclavian artery emerge

between the scalenus anterior and scalenus medius. The scalenus anterior muscle arises from the anterior tubercles of the transverse processes of the third to sixth cervical vertebrae and it is inserted into the scalene-tubercle on the upper surface of the first rib. Scalenus anterior muscle elevates the first rib and produce flexion of cervical part of vertebral column. A complete cervical rib passes laterally and forward between the scalenus anterior and scalenus medius muscles, and join with the first rib. The lower trunk of brachial plexus arches over the cervical rib, with the subclavian artery in front of the nerve. A complete cervical rib may interfere or disturb the biomechanics of scalenus anterior muscle and leads to compression of lower trunk of brachial plexus or intermittent occlusion of the subclavian artery. During elevation of the shoulder girdle in the absence of congenital abnormalities of cervical ribs, when the same symptoms are present the clinical condition known as the "scalenus anticus syndrome". Hence anatomical and radiological knowledge of congenital abnormalities of cervical ribs is necessary for clinicians to avoid confusion while treating scalenus anticus syndrome, subacromial bursitis, brachial neuritis and Raynaud's disease with the foregoing symptoms of cervical rib.

## CONCLUSION

We believe that the present study has provided some important data which will contribute to the scientific literature, providing the anatomical data on prevalence of Eve's rib in Shahjahanpur district population. Hence, sound knowledge of such anatomical characteristics and congenital abnormalities noted in our study is not only enlightening for the orthopaedic surgeons, also vital for the clinical anatomist, Radiologists, Forensic experts in operative procedures and appropriate treatment for compressive neuropathies.

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