

# Evaluation of Neurovascular Complication of Cervical Ribs

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## ABSTRACT

**Introduction:** Cervical rib is relatively uncommon congenital abnormality that originates from the seventh cervical vertebrae and rarely from the sixth vertebrae. The purpose of this paper is to consider that this abnormal condition is an important cause of neurovascular compression at the thoracic outlet.

**Methods:** In this study all patients who were referred to radiology department of Isfahan hospitals (Iran) for chest X-ray or other cervical films, for any reasons, were evaluated for cervical rib and anyone who had this abnormality was entered in this study. Here, we performed Nerve Conduction Velocity Test (NCV) and Doppler sonography, depending on the vascular or neurological symptoms.

**Results:** The results of this study show that the incidence of the neurological compression was higher than vascular compression. In addition, the prevalence of neurological complication in female was high (85.7%) and a significant percentage of them were above 30 years.

**Conclusion:** Cervical rib occurs more commonly in women and have different prevalence rates in different ethnic populations. Moreover, a high percentage of them have neurological complication which is a symptom of thoracic outlet syndrome.

## 1. Introduction

**A** cervical rib, sometimes known as neck ribs, is a supernumerary rib which is developed from costal process or the transverse process of seventh cervical vertebra and was first noticed by Galen in the second century and later by Vesalius (Figure 1) [1]. In most cases, cervical rib has a head, neck and tubercle with or without a shaft that is extending antero-

laterally in the posterior triangle of neck where it may end freely in the soft tissues or articulate with the first rib costal cartilage or even the sternum [2]. This abnormal condition is presented in 0.2-8 percent of individuals based on series of studies using radiograph [3, 4].

The trunks of brachial plexus, specifically the lower trunk, and the second part of subclavian vessels pass via the narrow angle between rib and anterior scalenus muscle. So, it might lead to compression of these struc-

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tures. According to above mentioned topics, the clinical presentation of cervical rib may be first revealed as neurovascular symptoms. Previous studies have shown that most patients with cervical rib, suffer from neurological disability and a smaller percentage of them suffer from vascular insufficiency [5-7].

In addition, for unknown reasons, this pathological condition is more common in women. The set of symptoms, which is produced by a cervical rib, are a part of thoracic outlet syndrome (TOS). So, cervical rib may be an important cause of this syndrome [8]. TOS refer to symptoms that are produced by obstruction of the neurovascular bundle which passes from the base of the neck to axilla and is classified into three categories including neurogenic (94-97%), venous (4-6%) and arterial (1%) [9]. Hempel et al. reported that nearly 10% of patients with cervical rib had TOS [10]. The neurological lesions which result from compression of brachial plexus are found in 95% of cases [11]. Moreover, in the clinic, it is difficult to identify these cases. The upper limb weakness, which is seen in these patients may be the reason of grasping and holding action disability [12].

In addition to neurological symptoms, a set of symptoms related to vascular disease may also be seen in this

syndrome including: claudication, ischemic ulcers, gangrenous fingertips (indicative of arterial thrombosis and emboli), cold hands, color change and mild swelling [5, 6]. Long-standing compression of the subclavian artery may lead to major arterial lesions with post stenotic dilation, aneurismal and thromboembolic complication which may even jeopardize the upper limb viability.

Arterial obliteration may present with Reynaud's phenomenon. In addition, it may occur in patient with a coincident symptomatic cervical rib. So, it is important to demonstrate a definitive vascular abnormality by angiography before attributing the Reynaud's syndrome to TOS [12, 13]. When the creation of cervical rib is complete, arterial compression may be accentuated, whereas, it seems that incomplete cervical rib is the main cause of nerve compression. Since sympathetic nerve fibers are associated with lower trunk of brachial plexus, increased activity of these nerves can cause symptoms similar to vascular compression. So, when coldness and color changes occur without other arterial symptoms, neurological disorders are discussed [13].

In accordance to all the aforementioned, the purpose of this study was to investigate and evaluate the cervical rib neurovascular complication in Isfahan population.

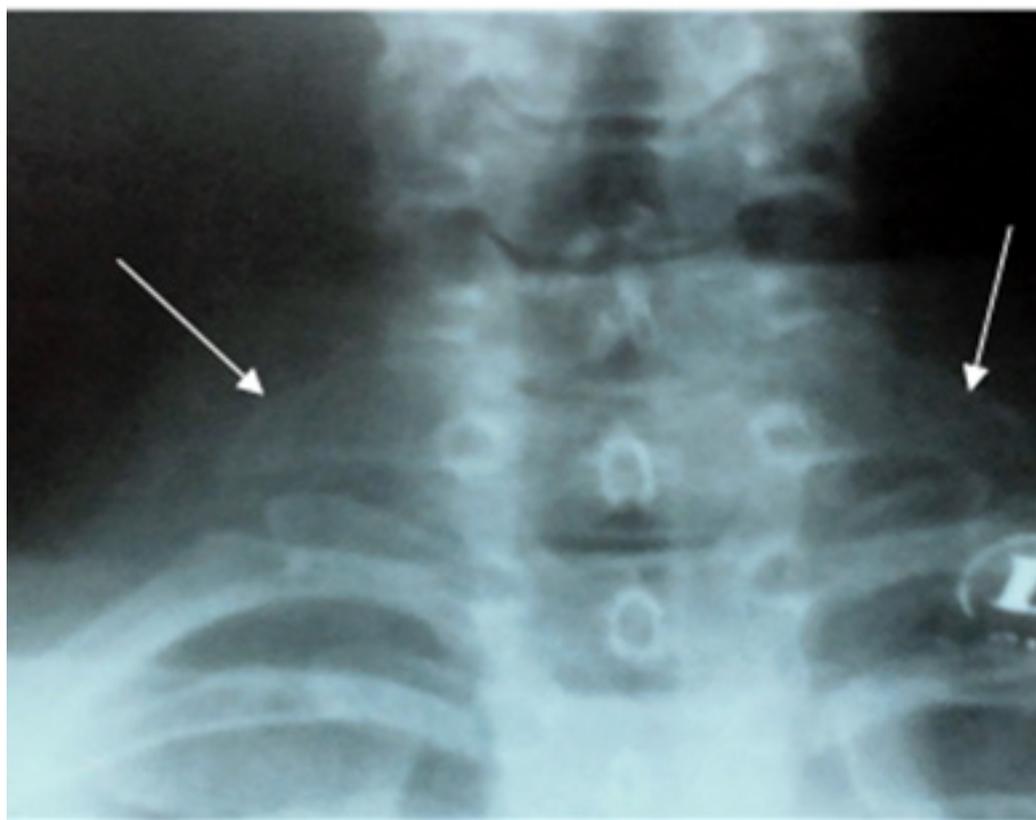


Figure 1. Chest radiograph showing bilateral cervical ribs (arrowed).

## 2. Materials and Methods

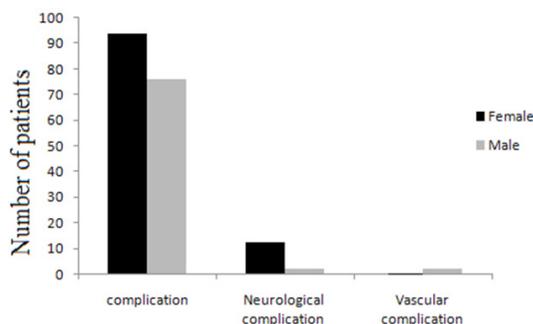
We reviewed 170 chest X rays of adult patients at AL-Zahra and Kashani university hospitals, Iran, Isfahan, taken during the 24 month period between the years 2012 to 2013. The biomedical ethics committee approved this hospital-based study.

After obtaining informed consent from patients referred to the radiology department for chest X-ray or other cervical films, for any reasons, all patients were evaluated for cervical rib and anyone who had this abnormally was entered in our study. In addition, the patients who had received medical treatment for neurovascular complications, or those who had undergone surgery for these complications were excluded from this study. If patients had neurovascular complications, we performed NCV test and Doppler sonography, depending on the vascular or neurological symptoms.

## 3. Results

Among our study population of 170 patients, 94 (55.3%) were females and 76 (44.7%) were males. Evaluation of neurovascular symptoms showed that 14 patients (87.5%) had neurological complications and only 2 patients (12.5%) had vascular complications. In addition, out of total patients with neurological complications, 12 (85.7%) patients were female and all patients with vascular complications were male (Figure 2).

Gender frequency distribution in patients with neurological complications showed that 9 patients (65.5%) were below the age of 30 and 5 patients out of them (35.5%) were above the age of 30. Moreover, all patients with vascular complications were above the age of 30.



**Figure 2.** Frequency distribution in patients with neurovascular complications. The prevalence of neurological complication in female is higher than male.

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## 4. Discussion

Cervical rib has been explained as a supernumerary rib which arises either from the costal process of the vertebral arches or from the transverse process of seventh cervical vertebra. Cervical rib usually is detected in patients with neurovascular disorders, resulting from excess pressure placed on a neurovascular bundle. This abnormal condition affects women more than men [4] and has a different prevalence between ethnic population, from 0.5% to 3.0% [14, 15] and is much higher in fetuses than in adult humans [16, 17].

In addition, age has no effect on the incidence of cervical rib [17]. Although the etiology of cervical rib is yet obscure, the present documents demonstrated that the cause of cervical rib is multifactorial and includes the genetic predisposition combined with environmental influences which can lead to severe physical disability and neurovascular defects. Recently Merks et al. [3] reported that cervical rib is more common in children with chromosomal abnormalities. Also, in several studies it is demonstrated that abnormalities in HOX gene can induce vertebral anomalies such as cervical rib [3, 18]. In human, cervical rib is associated with TOS and brachial plexus palsy and brachial plexopathy [19, 20].

TOS is a complex syndrome that occurs when the neurovascular structures become compressed between first rib or cervical rib and clavicle. This syndrome is more common in women than in men and can occur from the ages of 20 to 80 but is most common around the age of 40. The pathological hallmark of TOS is neurovascular compression, which leads to radiating pain and paraesthesias, numbness and weakening grip and impaired circulation to the extremities [5-7]. In this study we determine the prevalence of cervical rib and the results indicate that the incidence of this abnormal condition in women is greater than men which are similar to previous study [4]. Similar to other experiments, we demonstrated that most patients had neurological symptoms and a lesser percentage of them had vascular symptoms (Figure 1) [5-7]. In addition, the prevalence of neurological complication in women is high (85.7%) and most of them were older than 30 years. One explanation for these effects may be related to this fact that the size of a cervical rib plays a significant role in the severity of symptoms [21]. Indeed, the variety of cervical rib sizes is related with differentially expressed HOX genes. So, the severity of neurological symptoms in women can be related to further development of the cervical rib.

The results of this study along with other recent studies indicate that cervical rib occurs more commonly in women and have different prevalence rates in different ethnic populations. In addition, we demonstrated that the high percentage of them has neurological complication which is a symptom of TOS. Therefore, in patients with TOS symptoms, identifying the cause of these complications is significantly important.

### Conflict of Interest

The authors have no conflicts of interest.

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