Osteology

UNILATERAL ABSENCE OF FORAMEN TRANSVERSARIUM OF ATLAS VERTEBRA - A RARE CASE REPORT

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ABSTRACT

The cervical vertebra is characterized by a foramen in each transverse process, known as Foramen Transversarium. During the routine osteology demonstration classes, we noticed absence of foramen transversarium on the left side in atlas vertebra. The foramen transversarium and transverse process was normal on right side. Many important neurovascular structures lie in the vicinity of transverse process and foreman transversarium. In the absence of foramen transversarium, it is difficult and creates confusion to reach these structures, because any injury to these structures will lead to devastating complications. Hence to prevent complications while approaching vital structures, neurosurgeons, radiologists and orthopaedic surgeons should have good knowledge of such variations.

KEY WORDS

Foramen Transversarium, Atlas, Transverse process, Vertebral artery.

INTRODUCTION

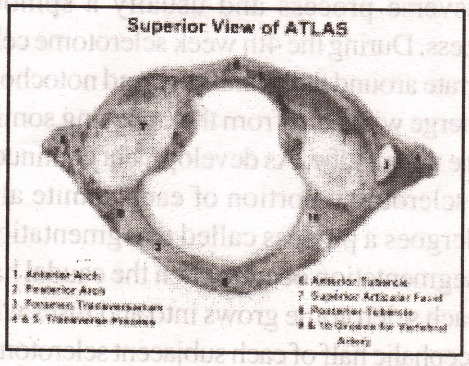
The atlas, the first cervical vertebra, holds the globe of the head. Atlas is devoid of body (centrum) and spine. It has two lateral masses connected by an anterior arch and a posterior arch. The lateral masses are ovoid, each bears a kidney shaped superior articular facet for occipital condyle and the inferior articular facets are almost circular and slightly concave. It consists of anterior and posterior bars meeting laterally which enclose the foramen transversarium which lodges the second part of the vertebral artery with sympathetic and venous plexus. Atlas has no costotransverse bar.

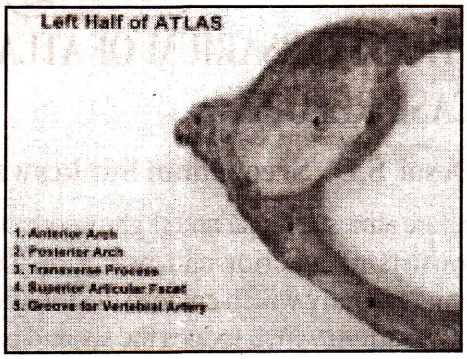
Absence of foramen transversarium in the human atlas vertebra has been reported. Bilateral absence of foramen transversarium in atlas vertebra has also been reported[5]. Variations of atlas vertebra are reported showing the frequency of the anomalies in atlas[6].

MATERIALS AND METHODS

During the routine course of osteology discussion with the undergraduate students, it is observed that there is absence of foramen transversarium on one side, it is left side of an atlas vertebra. The atlas bone is then observed for any other variations and photographed in different angles.

OBSERVATION AND RESULTS





The atlas vertebra was observed for the length of the transverse process and the diameter of the foramen transversarium is measured with the help of measuring tape. On right side, the length of transverse process is 0.6 cms. On left side, the length of transverse process is 1.1 cms. On left side the foramen transversarium is absent. On right side the foramen transversarium is present, appears normal and has diameter of 0.5 cms. On both sides, the groove for the vertebral artery is present, on the posterior arch. There were no other variations found in the atlas vertebra.

Development:

Vertebrae form from the sclerotome portions of the somites which are derived from the paraxial mesoderm. A typical vertebra consists of a vertebral arch and foramen (through which the spinal cord passes), a body, transverse process and usually a spinous process. During the 4th week sclerotome cells migrate around the spinal cord and notochord to merge with cells from the opposing somite of the neural tube. As development continues, the sclerotome portion of each somite also undergoes a process called resegmentation. Resegmentation occurs when the caudal half of each sclerotome grows into and fuses with the cephalic half of each subjacent sclerotome. Thus, each vertebra is formed from the combination of the caudal half of one somite and the cranial half of its neighbour. Patterning of the shape of different vertebrae is regulated by HOX genes.

Mesenchymal cells between cephalic and caudal parts of the original sclerotome segment fill the space between the two precartilaginous vertebral bodies and contribute for the intervertebral disc. Although the notochord regresses entirely in the region of the vertebral bodies, it persists and enlarges in the region of the intervertebral disc and contributes to the nucleus pulposus which is later surrounded by circular fibers of the annulus fibrosus. Combined these two structures form the intervertebral disc.

The embryological development of the first two cervical vertebrae is complicated and different from that of the more typical vertebrae. The caudal part of the 4th occipital somite fuses with the cranial part of the 1st cervical somite to from what is known in zoological terms as proatlas.

In lower vertebrates, it remains as separate bone, in man; it is assimilated into the occipital condyles and the apex of the odontoid process of the axis. The caudal part of the 1st cervical sclerotome segment forms the lateral masses and anterior and posterior arches of the atlas. At birth, atlas is represented by 2 bony masses with articular facets on superior and inferior surfaces and a large nutrient foramen. The groove for the vertebral artery is present behind the superior articular facet and the posterior arches curve towards the midline. The anterior bar is not present at this stage and the superior

articular facet may look somewhat foreshortened at the neurocentral junction as the remainder will form from the anterior centre of ossification.

At this stage, the transverse process is only represented by a thick posterior bar, but this will eventually fuse with a thinner anterior bar, which develops from the ventrolateral aspect of the articular pillar between the 3rd and 4th years. It is clear that the posterior tubercle is formed from the thick posterior bar which fuses with anterior bar to complete foramen transversarium. Thus in atlas, the posterior tubercles represent the end of the true transverse process.

Thus foramen transversarium is formed by the fusion of the anterior and the posterior bars as they pass round the position of vertebral artery. The foramina are usually completed by 3-4 yrs. Occasionally, the foramen transversarium of the atlas may be absent or sufficiently rudimentary to exclude the passage of the vertebral artery[7].

DISCUSSION

The transverse process of the first cervical vertebra is taken as reference guide in the surgeries of upper lateral part of neck and to identify the structures around its vicinity. The foramen transversarium and transverse process identification is very essential because, in between it and the styloid process lie the Vagus, Spinal accessory, Hypoglossal nerve and the Internal Jugular Vein; and the structures of posterior triangle lie posterior to the transverse process of atlas[1,8]. Foramen transversarium and transverse process of atlas are taken as reference points to approach carotid sheath and its contents which lie superiorly.

Reduced foramen area of some cervical vertebra may be attributed to periosteal growth at the foramen margins to fit around their neurovascular and other contents. Since the presence of vertebral vessels are an important factor in the genesis of Foramen transversarium, a variation in its course will influence the presence / absence of the Foramen transversarium.

Split posterior arch (3%) and split anterior arch (5%) were also reported. The superior articular facet of atlas divided into two parts in 47.8% has been reported by few authors. Bifid transverse process observed in 6.68% in a study.

In the present case, the exact cause for the absence of the foramen transversarium is not known. The probable cause could be the excessive overgrowth of the costal element which grows backwards towards the transverse element[2].

There are several abnormalities seen in the developing 1st cervical vertebra. The occipito-Atlanto-Axial region is both a phylogenetically and ontogenetically inconstant region of the axial skeleton. Its embryological development is complex and gives rise to high incidence of congenital and acquired abnormalities[3,4].

CONCLUSION:

In the present case the exact cause for the absence of foramen transversarium is not known, but it could probably due to excessive growth of costal element and transverse element. As it is observed in dry bone, the

course of the structures passing through it is not clear, except for the presence of the groove for the vertebral artery on the posterior arch. Special caution must be bore in mind while operating on this area because any injury may result in serious neurological and vascular symptoms necessitating an emergency surgical intervention. So, in cases of absence of foramen transversarium, there may be difficulty in intervening the areas around the atlas vertebra. Hence this case is noteworthy for Head and Neck Surgeons, Radiologists and Orthopaedic surgeons.

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