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Accessory Transversarium Foramen of Cervical Vertebrae: A Case Study

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ABSTRACT

The anatomical variations of the cervical vertebrae as reported in most classical anatomical textbooks mainly include: cervical ribs, non fusion of the halves of the posterior arch of the atlas, presence of articular facets on the superior margin of the anterior arch of the atlas incase of presence of a third occipital condyle. A male cadaver preserved by means of the routine embalming techniques following the completion of dissection was used for bone maceration. The soft tissues were removed and the cervical vertebrae were studied for variations. The variations recorded in this study include the presence of accessory transverse foramina in the atlas, C5 and C6, The presence of an accessory foramen transversarium in the cervical vertebra is a rare variation. It narrowed the size of the real transverse process and this may result in pressure on the vertebral artery and the sympathetic plexus embedding it. Similarly the narrowing of the transverse foramen may result in formation of atheromatose plaque which may also result to thrombosis emboli or just reflex spasm. The implications of these variations in the anatomy of this region should be noted by neurologist and by those who advocate instrumentation of the cervical vertebrae.

Key words: Cervical vertebra, Atlas, Accessory transverse foramina, Foramen transversarium.

In humans, and almost all other mammals, there are seven cervical vertebrae, which are labeled C1 to C7. Only the cervical vertebrae have three openings or foramina, the vertebral foramina and two transverse foramina. A characteristic feature of the vertebrae C2 to C6 is a projection known as the bifid spinous process only the C7 vertebra has a prominent non bifid spinous process that can be felt at the base of the neck. The transverse processes are each pierced by the foramen transversarium, which in the upper six vertebrae gives passage to the vertebral artery and vein and a plexus of sympathetic nerves.

The anatomical variations of the cervical vertebrae as reported in most classical anatomical textbooks mainly include: cervical ribs, non fusion of the halves of the posterior arch of the atlas, presence of articular facets on the superior margin of the anterior arch of the atlas incase of presence of a third occipital condyle. During an osteology demonstration classes for undergraduate medical students, the bilateral absence of foramen transversarium was noticed in an atlas vertebra with a transverse process of about 2 cm in length resembling that of the thoracic vertebra (Nayak 2007). Though the foramen transversarium was absent, the groove for vertebral artery was present on the posterior arch (Nayak 2007). Other reported variations of atlas include partial or total fusion of atlas vertebra with the occipital bone, absence of foramen transversarium unilaterally, on the left side and the presence of some accessory bony arches embracing the vertebral artery (Nayak et al 2005, Vasudeva and Kumar 1995). It is reported that the average transverse foramen depth, average inter foraminal distance, the distance from the anterior border of the vertebral artery foramen to the anterior border of the transverse process as well as the average distance between the anterior borders of the vertebral artery foramina and the anterior border of the vertebral body gradually increase from C3 to C6 (Ebraheim et al 1987)

Cervical vertebrae's transverse foramina are located at vertebral body's lateral side, in front of the lateral mass and just anterior to nervous root (Ebraheim et al 1987, 1996). The presence of accessory transverse foramina or its absence is not so common. Since the vertebral artery and vein as well as the vertebral sympathetic nerve plexus passes through the

transverse foramina, these abnormal foramina may have some clinical importance.

CASE REPORT

A male cadaver preserved by means of the routine embalming techniques following the completion of dissection was used for bone maceration. The later was slightly modified by means of boiling the dissected parts in autoclaves and adding potash powder into the boiling water. Following cleaning of the soft tissues the cervical vertebra were immersed for weeks in pure benzene and then bleached by hydrogen peroxide until the vertebra became whitish and the bones were then dried and presented for study.

THE ATLAS:

The atlas showed the presence of accessory transverse foramina on both sides which is ellipsoid in shape on the right but broken (during the course of preparation) on the left which are located posterior to the normal transverse foramen. The foramina may possibly transmit tributaries of the vertebral vein which possibly communicate with the internal vertebral venous plexus; as such we may suggest these foramina to be regarded as emissary foramina (Fig. 1).

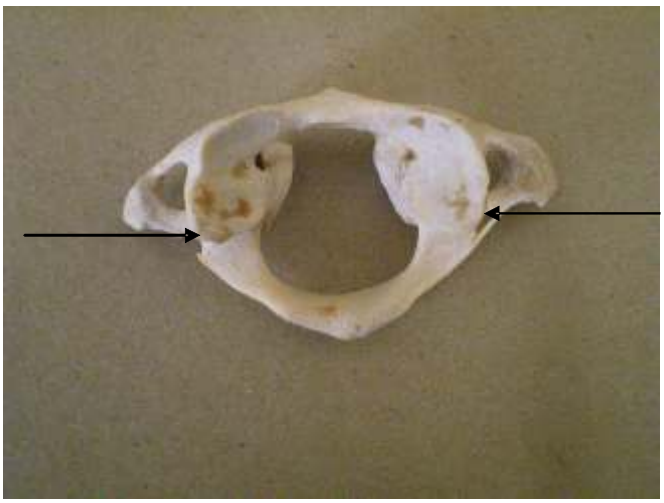

Fig 1: The Atlas showing the presence of an accessory transverse foramina on both sides but broken (during the course of preparation) on the left

CASE TWO

THE FIFTH CERVICAL VERTEBRA:

The fifth cervical vertebral showed an accessory transverse foramina on both sides but broken (during the course of preparation) on the right. Its spinous process is bifid (Fig 2).

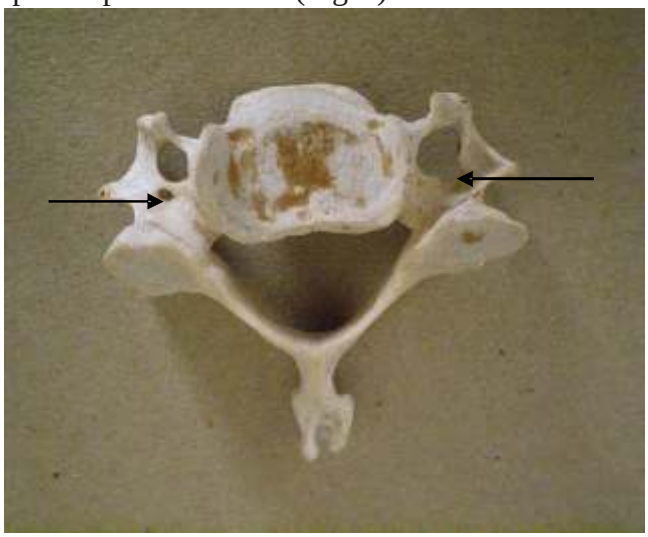

Fig 2: The fifth cervical vertebra showing an accessory transverse foramina on both sides (broken on the right).

CASE THREE

THE SIXTH CERVICAL VERTEBRA:

The sixth cervical vertebra showed again accessory transverse foramina on both sides but again broken (during the course of preparation) on the right (Fig 3).

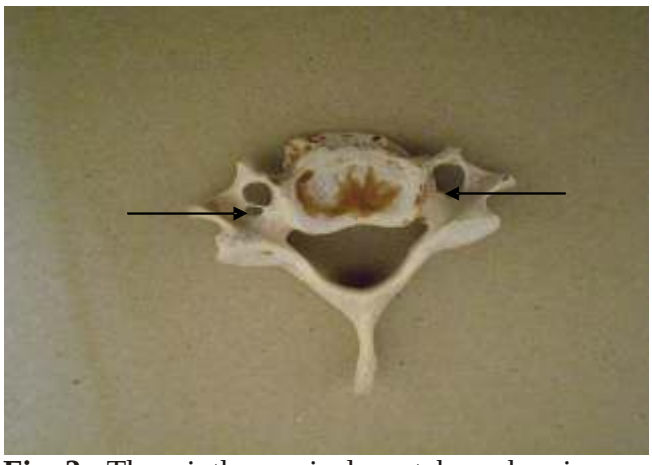

Fig 3: The sixth cervical vertebra showing an accessory transverse foramina on both sides but broken (during the course of preparation) on the right

DISCUSSION

Normally the transverse foramina of the cervical vertebrae transmit the vertebral artery and vein and accompanying the vertebral artery is the vertebral sympathetic plexus (Williams et al 1989). According to classical anatomical descriptions, the vertebral artery originating from the subclavian artery, ascends anteriorly to the transverse process of the seventh cervical vertebra then penetrating the transverse foramen of the sixth cervical vertebra, and following an ascending path always through the transverse foramina up to the first cervical vertebra, it then runs across the posterior arch of the first vertebra, going into the foramen magnum. At times it may enter the transverse process of the fifth and sometimes that of the seventh cervical vertebra (Kajimoto 2007). A case of an unusual course of the vertebral artery with intra-foraminal entrance at C4 detected on preoperative magnetic resonance imaging was presented (Müller et al 2008).

The vertebral vein usually descends the foramina through the transverse process of the first cervical vertebra and emerges from the transverse foramen of the seventh cervical vertebra but it may also show some variations but finally it does communicate with the internal vertebral venous plexus and with the basilar plexus of veins.

The variations recorded in this study include the presence of accessory transverse foramina in the atlas, C5 and C6. The presence of the accessory transverse foramina in the cervical vertebrae was rarely reported in the past. To the best of our knowledge, only one case of accessory foramina and variations in shape and number found in 10 out of 250 cervical vertebrae studied has been reported (Erbil et al 2007).

The ossification of the body and laminae of the cervical vertebrae commences at about the sixth week of intra uterine life at the place the transverse process afterwards projects and the ossification spreads backwards to the spine and forward to the pedicles and laterally to the transverse process. The ends of the transverse processes are capped by cartilages where at the age of sixteen years a secondary center of ossification appears and give the origin of the antitubercle costal part. These secondary centers for the costal part have been found in the fourth to seventh cervical vertebrae (Williams et al 1989). Perhaps the failure of the complete fusion of the secondary centers of ossification from the transverse process with the ossifying granules growing backward forward and laterally could be the basis of the accessory foramen.

The presence of accessory transverse foramina which narrows the size of the real transverse process may result in pressure on the vertebral artery and the sympathetic plexus embedding it. It may also lead to vasoconstriction and cerebellar vascular disturbances because the vertebral sympathetic plexus is considered to be the main intracranial extension of the sympathetic system along the branches of the vertebral and basilar arteries as far as the posterior communicating arteries (Williams et al 1989). Similarly the narrowing of the transverse foramen may result in formation of atheromatose plaque which may also result to thrombosis emboli or just reflex spasm.

The implications of these variations in the anatomy of this region can not be overemphasized by neurologist and those who advocate instrumentation of the upper cervical vertebrae. This, then, may be considered our modest contribution towards creating awareness of this interesting variation.

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