

Variations In Atlas Vertebrae In Telengana Region

Dr A. Bharathi¹, Dr Navakalyani², Dr V.Janaki³, Dr. Gouri T.L.S⁴

¹Associate Professor Of Anatomy; House Number: 3-6-125; Flat No : 502; B.Samrajya Lakshmi Towers; St. No .18; Beside Madina Public School;Hyderabad-500029; Telengana State, India.

²Associate Professor Of Anatomy, O.M.C, Hyderabad, Telengana State, India

³Assistant Professor Of Anatomy, O.M.C, Hyderabad, Telengana State, India.

⁴Assistant Professor Of Anatomy, Govt.Medical College, Nizamabad, Telengana State, India.

Abstract: Arcuate foramen is less known trait of the human atlas vertebra formed by a delicate bony spiculum, which arches backward from the posterior end of the superior articular process. The importance of the arcuate foramen lies in the external pressure it may cause on the vertebral artery as it passes from the foramen transversarium of the first cervical vertebra to the foramen magnum of the skull. Atlas is the first cervical vertebra with a groove for the vertebral artery on the posterior arch. We found abnormal foramina on the posterior arch The posterior arch of the atlas had one accessory foramen just behind each lateral mass. The knowledge of this variation may be of importance to orthopedic surgeons, neurosurgeons, radiologists and anthropologists. the vertebral artery is vulnerable to compression in its course between foramina transversarium and the foramen magnum during extreme rotation of head and neck. This situation may be aggravated by the presence of posterior and lateral bridge of atlas and result in comprised blood flow. The presence of this bony bridge should be taken into account during surgeries on cervical spine.

Keywords: Vertebral artery, Atlas vertebra, Foramen Transversarium, Retroarticular foramen, Cerebrovascular insufficiency.

I. Introduction

Atlas is the first cervical vertebra. It is ring shaped and does not have a body like other cervical vertebrae. It has two arches named anterior and posterior arches. It has two transverse processes, each one of which bears a foramen transversarium. we noticed abnormal foramina on the posterior arch of the 2 atlas vertebrae. The foramina were situated at the lateral part of the posterior arch, one behind each lateral masses (Figures 1 and 2). The foramen on 1vertebra was larger than the foramen on the other atlas vertebrae and was almost as large as the foramen transversarium. The foramen on the another atlas was almost half the size of that of the 1st one. There were foramina transversaria on both transverse processes and their sizes were normal. In the human atlas vertebra, immediately behind each superior articular process is a groove (sulcus arteriae vertebralis), transmitting the vertebral artery and the suboccipital (first spinal) nerve. This is sometimes converted into a foramen (arcuate foramen) in about 14% of the individuals by a delicate bony spiculum, which arches backward from the posterior end of the superior articular process [1]. Kimmerle anomaly/variant/deformity, ponticulus posterior (ponticulus posticus) of the atlas, pons posticus, foramen atlantoideum posterius/vertebrale, canalis arteriae vertebralis, foramen sagitale, retroarticular VA ring, **foramen retro-articular superior, retrocondylar bony foramen, posterior atlantoid foramen, atlas bridging, posterior glenoid process and spiculum** are the alternate names used for this foramen [2]. The importance of the arcuate foramen lies in the external pressure it may cause on the vertebral artery as it passes from the foramen transversarium of the 1st cervical vertebra to the foramen magnum of the skull.

In the present study, we have tried to know the **incidence, types, phylogenetic and clinical significance** of the arcuate foramen in the Indian population. Studies have been conducted by many authors on the variations in size, shape, incomplete or double foramen transversarium, but very few authors have studied about the variant of retroarticular foramen which we have studied. In an atlas vertebra, the retroarticular foramen variant seen is formed by the bony outgrowth from the superior articular facet over the groove present on the posterior arch of atlas vertebrae. It is formed by ossification of the oblique ligament of atlas present at the inferior border of posterior atlantooccipital membrane. Existence of such foramen may cause compression on the artery during the extreme rotatory movements of the neck or manipulation of the cervical spine during surgeries, physiotherapy or exercises and cause vertebrobasilar ischemia which may lead to symptoms like migraine, vertigo, diplopia, shoulder pain, neck pain and severe incidents of cerebrovascular incidents.

II. Methods

40 dry atlas vertebrae of unknown sex of a South Indian population were obtained from the department of Anatomy and students of first year MBBS, 40 atlas vertebrae were carefully looked for 1. Presence or absence of transverse foramina 2. complete and incomplete transverse foramina 3. Presence or absence of retroarticular foramen 4. incomplete and complete retroarticular foramen . 5. These vertebrae were examined for evidence of exostosis from the posterior margin of superior articular facet. The specimens exhibiting such bony outgrowths were classified as having either a partial or a complete left and/or right arcuate foramen.

III. Results & Discussion

We found that all the vertebrae had foramina transversaria. Anterior margin of the foramen transversarium on both sides was deficit in one vertebra (fig-1). Incomplete foramina transversarium is present on right side in one vertebra (fig-2). In 2 vertebra along with normal foramen transversarium, retroarticular foramen was observed. On the left side in one vertebra large retroarticular foramen was observed (fig-3) and small retroarticular foramen observed on the left side of the another vertebra (fig-4). (5%) vertebrae had a complete arcuate foramen. Three vertebrae showed incomplete retroarticular foramen in the form of exostosis from the posterior margin of superior articular facet towards posterior arch on both sides (fig-5) vertebrae showed the presence of a bony exostosis from the posterior margin of the superior articular facet in (15%). (5%) vertebrae had a complete arcuate foramen.

In our present study the occurrence of complete arcuate foramen was unilateral side (both are on left side) . The ossification of ligamentous structures in various parts of the body may result in clinical problems such as compression to neighbouring structures and complications in regional surgery. The posterior atlantooccipital membrane when ossified partly or wholly forms a bony bridge over the vertebral groove, called arcuate foramen [3]. In a recent study conducted by Wysocki et al., [4], atlas showed the highest variability among the cervical vertebrae. The variations recorded in their study include the split superior articular process (47.8%), split posterior (3%) or anterior (1%) arches, and the presence of some accessory bony arches embracing the vertebral artery. Absence of foramen transversarium in atlas is a very rare variation. Absence of foramen transversarium unilaterally, on the left side has been reported [5]. Bilateral absence of foramen transversarium has been reported by Satheesha Nayak [6]. Bergman et al., [7] have reported many variations of atlas vertebra. According to their study, atlas may show incomplete ossification of anterior and posterior arches, anterior arch may be absent, posterior arch may have facets and groove for vertebral artery may get converted into a foramen. Existence of a foramen called “retroarticular foramen” has been reported. In a study on South Africans, retroarticular canal was found in 9.8% of cases [8]. in our present study (5%) vertebrae had a complete arcuate foramen. Presence of such a foramen might hinder the flow of blood in the vertebral artery and also make instrumentation in the area difficult. Presence of a “retrotransverse groove/canal” has also been reported [9]. The foramen that we have reported here might fall in one of the categories (retroarticular or retrotransverse) reported earlier. Since it was noted in a dry bone, we are not very sure about the structures passing through it. The knowledge of this foramen may be needed for the orthopedic surgeons and neurosurgeons. Taitz C [10] mentioned about the presence of partial posterior bridging of atlas in 25.9% and complete bridging in 7.9% of the population. They also proposed a hypothesis that external mechanical factors, such as carrying heavy objects on the head, could play a role in the development of these bridges. Paraskevas G [11] mentioned about the higher incidence of complete canal for vertebral artery in laborers to the non-laborers. He also mentioned about the higher occurrence of incomplete canal for vertebral artery in the 5–44 years age range. Stubbs DM [12] mentions that complete foramen is significantly more common in males and partial foramen in white females. Authors like Hasan M *et al.* [13] have classified the arcuate foramen into six groups. In class I: Impression for the vertebral artery was noticeable, class II: Impression was seen as a distinct groove or sulcus, class III: Partial posterior ponticulus was noted as a bony spicule, class IV: Complete posterior ponticulus could be detected, class V: Lateral bridge extended from the lateral mass to the transverse process, class VI: Posterolateral tunnel made its appearance as a combination of complete posterior (class IV) and lateral (class V) bridges. The arcuate foramen is an underestimated structure and clinicians should be alerted to a possible arcuate foramen with patients complaining of vertigo, headache, shoulder-arm, and neck pain. Cushing EK *et al.* [14] found an association between the presence of arcuate foramen and tethering of the vertebral artery in the arcuate foramen and dissection from repetitive trauma with movement of the neck.

IV. Conclusion

The increasing incidence of neck injuries and related syndromes necessitates the study of bony variations of the atlas vertebra. Due to the formation of the incomplete and complete foramen transversarium the second part of vertebral artery is prone to be damaged easily during posterior cervical injuries and Surgeries. The bony bridges embracing the vertebral artery may be responsible for vertigo and cerebrovascular accidents hence the knowledge of such variations is important for Physicians, Otorhinolaryngologists, neurologists

,Orthopaedicians and Radiologists. They should have knowledge about the present variation and try to look for it when dealing with the patients complaining of symptoms of vertebrobasilar insufficiency like headache, vertigo, shoulder and arm pain.

References

- [1]. SOAMES R. W., Skeletal system. In: GRAY H., Gray's Anatomy, 38th edition, Churchill Livingstone, Toronto, 1995, 425–736.
- [2]. TUBBS R. S., JOHNSON P. C., SHOJA M. M., LOUKAS M., OAKES W. J., Foramen arcuale: anatomical study and review of the literature, *J Neurosurg Spine*, 2007, 6(1):31–34.
- [3]. LIMOSIN C. A., Foramen arcuale and syndrome of Barre-Lieou. Its surgical treatment, *Int Orthop*, 1980, 4(1):19–23.
- [4]. Wysocki J, Bubrowski M, Reymond J, Kwiatkowski J. Anatomical variants of the cervical vertebrae and the first thoracic vertebra in man. *Folia Morphol. (Warsz)*. 2003; 62: 357–363.
- [5]. Vasudeva N, Kumar R. Absence of foramen transversarium in the human atlas vertebra: a case report. *Acta Anat. (Basel)*. 1995; 152: 230–233.
- [6]. Nayak S. Bilateral absence of foramen transversarium in atlas vertebra: a case report. *Neuroanatomy*. 2007; 6: 28–29.
- [7]. Bergman RA, Afifi AK, Miyauchi R. Skeletal systems: Cranium. In: *Compendium of human anatomical variations*. Baltimore, Urban and Schwarzenberg. 1988; 197–205.
- [8]. Mitchell J. The incidence and dimensions of the retroarticular canal of the atlas vertebra. *Acta Anat. (Basel)*. 1998; 163: 113–120.
- [9]. Bilodi AK, Gupta SC. Presence of retro transverse groove or canal in atlas vertebrae. *J. Anat. Soc. India*. 2005; 54: 16–18.
- [10]. Taitz c., nathan h., some observations on the posterior and lateral bridge of the atlas, *acta anat (basel)*, 1986, 127(3):212–217.
- [11]. paraskevas g., papaziogas b., tsonidis c., kapetanos g., gross morphology of the bridges over the vertebral artery groove on the atlas, *surg radiol anat*, 2005, 27(2):129–136.
- [12]. Stubbs d. M., the arcuate foramen. Variability in distribution related to race and sex, *spine*, 1992, 17(12):1502–1504.
- [13]. hasan m., shukla s., siddiqui m. S., singh d., posterolateral tunnels and ponticuli in human atlas vertebrae, *j anat*, 2001, 199(pt 3):339–343.
- [14]. cushing k. E., ramesh v., gardner-medwin d., todd n. V., gholkar a., baxter p., griffiths p. D., tethering of the vertebral artery in the congenital arcuate foramen of the atlas vertebra: a possible cause of vertebral artery dissection in children, *dev med child neurol*, 2001, 43(7):491–496.



Figure -1: Anterior margin of the foramen transversarium on both sides was deficit.



Figure -2: showing incomplete foramina transeversarium on right side



Figure- 3: showing retroarticular foramina on leftside



Figure -4: showing retro articular foramen on leftside



Figure-5 : showing exostosis from the posteriormargin of superior articular facet towards posterior arch.