



RESEARCH ARTICLE

PONTICULUS POSTICUS- A CASE REPORT

*Dr. Anupama, K., Dr. Shailaja Shetty, Dr. Jyothi, K. C. and Dr. Snigdha Das

Department of Anatomy, M S Ramaiah Medical College, Bangalore, India

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ABSTRACT

Introduction: The atlas vertebra consists of two lateral masses connected by a short anterior and a longer posterior arch. The superior surface of the posterior arch bears a wide groove for the vertebral artery and the first cervical spinal nerve. An anomalous bony bridge between the posterior portion of superior articular process and the superior margin of the posterior arch of atlas is known as "Ponticulus posticus" and the foramen formed by it is known as "Arcuate foramen"

Observation: During routine dissection for the undergraduate students it was found that there was a bony outgrowth over the third part of the vertebral artery converting the vertebral groove into a foramen.

Conclusion: Patients with ponticulus often show symptoms of vertebrobasilar insufficiency such as headache, vertigo and diplopia. It can also be mistaken for broad posterior arch during surgeries which could cause injury to vertebral artery. Hence knowledge of ponticulus posticus is very useful for the neurophysician, neurosurgeons and radiologist who deal with such patients.

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INTRODUCTION

The atlas vertebra consists of two lateral masses connected by a short anterior and a longer posterior arch. It is unique in that it fails to incorporate a centrum which is modified into dens of axis (Grays 2008). The posterior arch bears a groove on its superior surface immediately behind the superior articular process which transmits the vertebral artery and the dorsal ramus of the first cervical spinal nerve (Krishnamurthy A 2007). In 1-15% of the population an anomalous bony bridge between the posterior portion of the superior articular process and the superior margin of the posterior arch of atlas is present. This bony arch is known as Ponticulus posticus which means "little posterior bridge" in Latin. This anomaly is known as Kimmerly's anomaly. Ponticles may thereby convert this groove into a foramen through which these structures pass. This foramen is known as foramen sagittale, foramen arcuale or arcuate foramen (Sharma 2010).

It is usually asymptomatic but it may cause tethering of vertebral artery and lead to its dissection by repetitive trauma which needs early diagnosis and surgical intervention (Cushing 2001). This paper is an attempt to highlight the evolution, morphological implications and clinical significance of ponticulus posticus. Hence it is useful for the anatomist, radiologist, neurophysicians and neurosurgeons who are dealing with this region.

*Corresponding author: Dr. Anupama, K.

Department of Anatomy, M S Ramaiah Medical College, Bangalore, India.

MATERIALS AND METHODS

During routine dissection of head and neck region for the undergraduate students in M S Ramaiah Medical College, Bangalore it was found that there was an anomalous atlas vertebra with ponticulus posticus. The specimen showed a bony outgrowth over the third part of vertebral artery converting the vertebral groove into a foramen. The specimen was examined in detail, photographed and relevant measurements were recorded using vernier caliper.

Observations and results

The morphological analysis showed that the atlas vertebra on the right side showed the presence of a bony exostosis from the posterior margin of the superior articular facet to the posterior arch of atlas (Fig 1). The arcuate foramen was complete and the vertebral artery was passing through the foramen. The suboccipital nerve was seen passing through the foramen between the vertebral artery and the posterior arch. After dissecting the opposite side it was found that the atlas vertebra on the left side was normal (Fig 2). The measurements of the arcuate foramen after removal of soft tissues were found to be as follows: the vertical height was 4.3mm and the length was 5.7mm.

DISCUSSION

Evolution

The posterolateral tunnel on the superior surface of atlas vertebra is of normal occurrence in monkeys and other lower

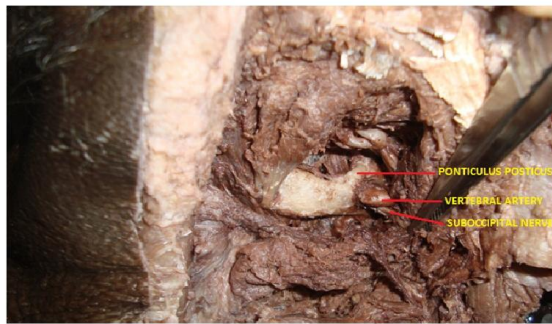


Figure 1. Showing Right sided Atlas with Ponticulus Posticus

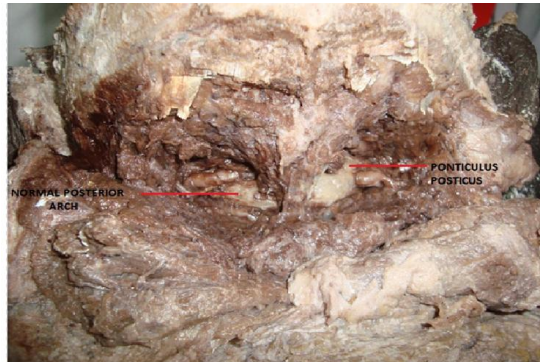


Figure 2. Showing the Ponticulus on the right and normal posterior arch of Atlas on the left side

animals. The possible reason for the bony roof of the tunnel is to serve the purpose of additional lateral extension for the attachment of the posterior atlanto-occipital membrane in quadrupeds, where the load of the head is supported by the extensor muscles of the neck, ligaments and posterior atlanto-occipital membrane. In man the roof of the tunnel has disappeared because the weight of the head is borne by the superior articular process of the atlas (Hasan 2001). Ponticulus posticus should not be considered as a calcification or an ossification of lateral segment of posterior atlanto-occipital ligament as it is actually of functional significance developed in other primates. In primates it protects the passage of the vertebral artery which has a sinuous course and is susceptible of being damaged or compressed as a result of craniocervical dynamics. Hence its incidence in human is a condition independent of age (Schilling 2010, Munjal 2013).

Morphology

The arcuate foramen is classified into six groups:

- 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 lateral mass to the transverse process.
- Class VI: Posterolateral tunnel made its appearance as a combination of complete posterior (Class IV) and lateral bridges (Class V) (Hasan 2001).

According to Miki *et al.* (1979) the ponticulus posticus is classified radiologically into three types: Full type: It forms a complete ring. Incomplete type: Some portions of the bony ring are defective. Calcified type: There is linear or amorphous calcification (Schilling 2010, Munjal 2013). Various theories have been put forward by different workers for the origin of the bridges leading to the foramen formation. It could be congenital characteristic, ossification of the posterior atlanto-occipital membrane, ossification of oblique ligament of atlas which could be induced by pulsation of the vertebral artery, activation of osteogenic potency in the craniovertebral junction or as a result of aging (Piplani 2013). The external mechanical factors, such as carrying heavy objects on the head could play a role in the development of these bridges indicated by the higher incidence of complete canal of vertebral artery in laborers than in non laborers (Krishnamurthy 2007). Some studies have also shown that the occurrence of incomplete canal for vertebral artery is higher in 5-44 years age group. The incidences of complete foramen in male and partial foramen in females are significantly higher (Krishnamurthy 2007).

Table 1. Showing the incidence of arcuate foramen in various studies

Authors	Unilateral	Bilateral	Complete	Incomplete
Krishnamurthy A 2007	7.18%	1.14%	8.33%	5.5%
Malukar O 2011	3.75%	5%	5%	8.75%
Schilling J 2010	----	----	9.2%	10.1%
Munjal S 2013	16.6%	5.5%	21%	35%
Cakmak O 2005	----	----	11.7%	3.3%
Patel Z 2012	2%	1%	3%	10%

Clinical Significance

These days management of atlantoaxial instability with the use of lateral mass screws has gained popularity. A broad posterior arch of atlas is the best indication for this modified screw trajectory. However in patients with ponticulus posticus, there is possibility of it being misinterpreted as the broad posterior arch and the surgeons may insert the screw into the Arcuate foramen. This will result in injury to the vertebral artery leading to stroke or even death by thrombosis, embolism or arterial dissection (Cushing 2001, Malukar 2011 and Desai 2012). The ponticulus is one of the causes of posterior circulation ischemia, cervicogenic headache and clinical complaints such as vertigo, neck pain of discopathy. Arcuate foramen is also associated with Barre-lieou syndrome which manifests with symptoms of headache, retroorbital pain, vasomotor disturbance of the face and recurrent disturbances of vision, swallowing and phonation due to alteration of blood flow within the vertebra (Malukar 2011, Desai 2012, Cakmak 2005). In patients with this syndrome the foramen was fractured and a periarterial sympathectomy was performed with good results (Desai 2012). A preoperative lateral radiograph of neck should be done in patients before lateral mass screw fixation. This will help in proper identification of this anomaly and prevent the injury to the vertebral artery (Malukar 2011). The vertebral artery can be pinched during neck rotations, which may lead to thrombus formation and embolism which causes cerebellar infarction which is known as Bow- hunter's stroke. The groove for vertebral artery on the posterolateral surface of the atlas varies in size and depth; hence the area of

arcuate foramen can vary significantly and can be a compressing factor for the vertebral artery. There was no relation between the ossification of the atlanto occipital membrane with the age and gender. Therefore it was suggested that the formation of arcuate foramen was not a hypertrophic process or a kind of osteophyte formation (Cakmak 2005).

Conclusion

Hence the knowledge of ponticulus and the arcuate foramen of the atlas vertebra are important for anatomist, neurophysicians, neurosurgeons and radiologists who deal with the patients with vertebrobasilar insufficiency and atlantoaxial instability.

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