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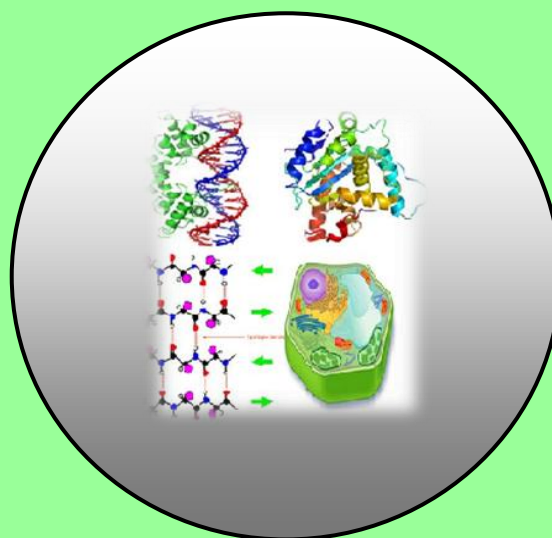
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# Incidence of Ponticulus Posticus in North Indian Population

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Department of Anaesthesia, Sanjay Gandhi Post Graduate Institute of Medical Sciences,  
Lucknow U.P., India**ABSTRACT**

*Atlas is a 1<sup>st</sup> cervical vertebra with a groove for the vertebral artery on posterior arch. Sometimes this groove is bridged by bony spicules which may be complete or incomplete. When complete, it is called ponticulus-posticus. Its incidence as reported in literature ranges from 5.14% to 51%. The vertebral artery is vulnerable to compression in its course between foramen transversarium and the foramen magnum during extreme rotation of head and neck. This situation may be aggravated by the presence of ponticulus-posticus and results in compromised blood flow causing symptoms like headache, migraine or dizziness. The present study comprised of 100 adult atlas vertebrae which were studied for the presence of ponticulus-posticus either complete or incomplete. Out of which 23% showed presence of complete or incomplete vertebral arches. The aim of this study was to determine the incidence of ponticulus-posticus in atlas vertebra in Uttar Pradesh, India. The knowledge of this variation may be important to orthopaedic surgeons, neurosurgeons, radiologists and anthropologists.*

**Keywords:** Ponticulus-posticus, Atlas Bridge, Variation and Posterior arch.

**INTRODUCTION**

Atlas is the first cervical vertebra which is ring shaped, having anterior arch, posterior arch and two lateral masses. Posterior arch forms 3/5<sup>th</sup> of circumference of atlantal ring and having groove behind each lateral mass which is also called vertebral artery sulcus which transmits vertebral artery and 1<sup>st</sup> cervical nerve. The vertebral artery, after leaving the foramen transversarium of the atlas vertebra lies on groove present on the posterior arch and then it pierces posterior atlanto-occipital membrane to enter the vertebral canal. Sometimes this groove is bridged by bony spicules which may be complete or incomplete.

When complete, a foramen is formed called ponticulus-posticus which means "little posterior bridge" in Latin which connect superior articular facet to the posterior arch. It extends horizontally from the posterior surface of lateral mass to the medial edge of posterior arch (Ercegovac and Davidovic 1970, Dhall et al. 1993).

The other name for the same is Kimmerle's variant, superior retroarticular foramen, vertebral artery retrocondylar arch (Ercegovac and Davidovic 1970, Lamberty and Zivanovic 1973, Sun 1990, Li et al. 1995, Wight et al. 1999, Hasan et al. 2001).

Occurrence of atlas bridges results in reduced blood flow to the brain causing vertebro-basilar ischemia. The aim of this study was to determine the incidence of ponticulus-posticus on atlas vertebra which might help in explaining the correlation between the occurrence of bony bridge and vertebral artery entrapment (Buna et al. 1984).

Presence of partial or total ponticulus-posticus mentioned in the literature ranges from 5.14% to 51%.

## MATERIAL AND METHODS

This study was carried out for the period of one year from 2014-2015 in the Department of Anatomy, King George's Medical University, Lucknow, Uttar Pradesh, India. 100 adult atlas vertebrae were obtained from the Osteology Laboratory of unidentified cadavers. The posterior vertebral arches were studied regarding the presence of ponticulus-posticus and were photographed. Classification of vertebrae was done in 4 types:

Type I – Bilateral incomplete ponticulus-posticus forming a semi arch.

Type II – Unilateral incomplete ponticulus-posticus.

Type III – Bilateral complete ponticulus-posticus forming an arch.

Type IV – Unilateral complete ponticulus-posticus.

Type V – Mixed type i.e. one side complete and other side incomplete.

## RESULTS

Among 100 dried atlas vertebrae, 23 atlas vertebrae showed complete or incomplete arch i.e. 23%. Type I (Bilateral incomplete) was observed in 6 vertebrae (6%) while Type II (Unilateral incomplete) was seen in 9 (9%) specimens of which the distribution was 2 on right side and 7 on left side. Type IV variety (Unilateral complete) was noted in 5 (5%) atlas vertebrae of which 3 on right and 2 on left side. Type V variety was noted in 3 (3%) atlas vertebrae of which 2 were having complete arch on right side and incomplete arch on left side while 1 was having complete arch on left side and incomplete arch on right side. We didn't found any atlas vertebra of Type III variety (Table 1, Figs. 1-4).

## DISCUSSION

Atlas vertebra shows the highest variability among the cervical vertebra (Wysocki et al. 2003).

Ponticulus-posticus has been described in classical literature as an anatomical variation in human beings having a strong relation to the passage of vertebral artery and also associated with numerous clinical conditions like cervical pain, headache and dizziness (Wight et al. 1999, Cakmak et al. 2005).

Its clinical implication may also include cervicogenic migraine, vertigo, nausea and neck pain (Sun 1990, Li et al. 1995, Wight et al. 1999).

Ponticulus-posticus with Barre Lieou Syndrome represents with symptoms of headache, retro-orbital pain, vasomotor disturbance of face and recurrent disturbance of vision, swallowing and phonation due to alteration of blood flow within the vertebral arteries and associated disturbance of periarterial nerve plexus. Radiographic study done by Roy 1987 revealed the presence of bilateral complete ponticulus-posticus in 34.5%, bilateral incomplete in 11.6%, one complete and one incomplete 9.5%, unilateral complete in 24.8%, unilateral incomplete in 19.6%. He also noted the complaints exhibited in ponticulus-posticus i.e. back pain in 36%, headache, vertigo, diplopia in 2.9%, neck and brachial symptoms in 23.7%, hip-leg pain 8.2%, tension insomnia, high B.P. in 4.3%, respiratory illness in 1.7%(Roy 1987).

**Table 1. Incidence of various types of ponticulus-posticus.**

Type	Unilateral Right (%)	Unilateral Left (%)	Bilateral (%)	Total (%)
I (Bilateral incomplete)	-	-	6	6
II (Unilateral incomplete)	2	7	-	9
III (Bilateral complete)	-	-	0	0
IV (Unilateral complete)	3	2	-	5
V (Mixed)	-	-	-	3
<b>Total</b>				<b>23 %</b>



**Figure 1. Type I: Arrow showing bilateral incomplete ponticulus-posticus.**

**Figure 2. Type II: Arrow showing unilateral incomplete ponticulus-posticus on left side.**

**Figure 3. Type IV: Arrow showing unilateral complete ponticulus-posticus on left side.**

**Figure 4. Type V: Arrow (red) showing complete ponticulus-posticus on left side and arrow (blue) showing incomplete ponticulus-posticus on right side.**

Several cases of headache, vertigo and nausea got relief with surgical decompression of vertebral artery (Ercegovac and Davidovic, 1970).

The presence of ponticulus-posticus can be considered as relative contraindication for high cervical spine manipulation (Buna et al. 1984).

Its occurrence is said to be normal in case of quadrupeds probably because it serves the purpose of additional lateral extension for the attachment of posterior atlanto-occipital membrane, where the load of head is supported by the extensor muscles of neck ligament and this membrane. In man, the disappearance of roof of the tunnel is probably because of adoption of erect posture (Hasan et al.2001).

Ponticulus-posticus occur as a result of ossification of free margin of oblique part of posterior atlanto-occipital membrane which may cause external pressure on vertebral artery especially during extreme rotatory movement of head (Lamberty and Zivanovic 1973, Taitz and Nathan 1986, Mitchell 1998).

Some studies suggested that it may be the products of congenital development, a genetic trait, ossification due to age or result of external mechanical factors (Selby et al.1955, Pyo and Lowman 1959, Taitz and Nathan 1986).

Some studies suggested that it may be related to aging (Taitz and Nathan 1986, Paraskevas et al. 2005) but contrary to it some observed that there was the presence of ponticulus-posticus cartilage in foet uses and children also which totally rules out the possibility of ossification with age (Lamberty and Zivanovic 1973).

## CONCLUSION

The present study was conducted on 100 atlas vertebrae of which 23% were having complete or incomplete vertebral arch. Our study suggested that ponticulus-posticus is a common anomaly that can be easily mistaken for broad posterior arch and the surgeon may insert the screw into ponticulus-posticus. This can result in an injury to vertebral artery and lead to stroke or even death by thrombosis, embolism or arterial dissection. This study gives an idea that ponticulus-posticus should also suspect as differential diagnosis of vertebro-basilar insufficiency, cervicogenic headache and cervical pain. Physicians and neurologists should be aware of this variation as a cause of vertebro-basilar insufficiency. This variation is of considerable importance to radiologists as it can point towards the underlying disease process. The knowledge of ponticulus-posticus is also important for orthopaedic surgeons, neurosurgeons and anthropologist.

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