



Incidence and Clinical Implications of Posterolateral Vertebral Artery Tunnel by Ossified Posterior Atlanto-Occipital Membrane in Human Atlas Vertebrae in North Karnataka Region: An Osteological Study

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Abstract

Background: Groove for third part of vertebral artery on superior surface of posterior arch of atlas vertebra may be converted into foramen. The vertebral artery is prone to compression resulting in vertebrobasilar insufficiency and nerve compression.

Aims and Objectives: The present study aims at incidence of posterolateral vertebral artery tunnel in human atlas vertebrae in South Indian population and discusses its clinical implications.

Material and Methods: The present study was done on 99 dry adult human atlas vertebrae of unknown age and sex obtained during routine undergraduate teaching in the department of anatomy in our institution. Posterior arch of atlas was observed for presence of posterolateral vertebral tunnel; complete or incomplete and unilateral or bilateral.

Results and Conclusion: Posterolateral vertebral artery tunnel was complete and unilateral (right side) in 2 atlas vertebrae 2%. This variation is important to radiologists, orthopedicians and neurosurgeons operating in this region.

Keywords: Atlas Vertebrae; Posterolateral; Vertebral Artery; Tunnel; Atlanto-Occipital Membrane

Introduction

The first cervical vertebra lies between cranium and axis vertebra. The first cervical vertebra is also known as atlas. It is derived from Greek warrior atlas who carries globe over his head, as atlas bone also carries the cranium over it. It is an atypical vertebra and has peculiarities like no body and no spinous process. It is ring like with short anterior and longer posterior arches with two lateral masses. The superior surface of posterior arch of atlas has groove for third part of vertebral artery, immediately behind which lies venous plexus and suboccipital nerve. The groove is called the groove for vertebral artery or sulcus arteria vertebralis. The anterior and posterior arches provide attachment for a broad, dense fibrous atlanto-occipital membrane and a broad but relatively thin posterior atlanto-occipital membrane [1]. Posterior atlanto-occipital membrane is made up of medial membranous part and a lateral tendinous part [2]. The tendinous part may sometimes gets ossi-

fied, forms a bony spicule converting the groove into foramen [1]. This is called foramen of Arcuale or Arcuate foramen or posterolateral vertebral artery tunnel. It has also been named as Kimmerle's anomaly, foramen sagittale, foramen atlantoideum, foramen retro-articulare superior, canalis vertebralis [3,4]. Other terms used are retroarticular vertebral ring, retroarticular canal, retrocondylar vertebral artery ring [5-7]. The presence of posterolateral vertebral artery tunnel may be complete or incomplete and may be unilateral or bilateral. The atlanto-occipital joints allow movements mainly flexion and extension, the total range of which is about 15 degrees. But the lateral flexion is not measured in living subjects. During movements at the atlanto-occipital joint, in presence of arcuate foramen the vertebral artery becomes unprotective and gets pressed resulting in vertebro-basilar insufficiency resulting in various neurological symptoms [8].

Aims and Objectives

The present study aims at incidence of posterolateral vertebral artery tunnel in human atlas vertebrae in South Indian population and discusses its clinical implications.

Materials and Methods

The present study includes 99 dry adult human atlas vertebrae of unknown age and sex obtained during routine undergraduate teaching in the department of anatomy in our institution. Only intact vertebrae were included for the study. Vertebrae with other variations, broken and damaged ones were excluded. Posterior arch of atlas was observed for presence of posterolateral vertebral tunnel; complete or incomplete and unilateral or bilateral.

Results and Discussion

Out of 99 dry adult human atlas vertebrae, posterolateral vertebral artery tunnel was complete and unilateral (right side) in 2 atlas vertebrae 2%.



Figure 1: 99 atlas vertebrae.

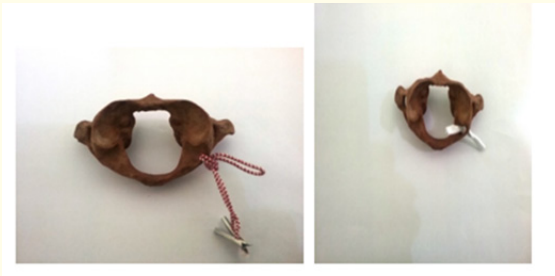


Figure 2: 2 atlas vertebrae with posterolateral vertebral artery tunnel complete and unilateral (right side).

Authors	Population	Incidence		
		Right	Left	Bilateral
Seema., <i>et al.</i> [9]	Indians - Punjab	2%	2%	
Bilodi and Gupta [10]	Nepal		2.9%	
Veleanu., <i>et al.</i> [11]	Romania	1.4%	1.4%	1.4%
Gupta., <i>et al.</i> [12]	Indians	4.88%	2.4%	4.08%
Malukar., <i>et al.</i> [13]	Indians- Gujarat	1.25%	2.5%	1.25%
Krishna., <i>et al.</i> [14]	Indians -Kanpur	2.33%	3.33%	2.33%
Present study	Indians- Karnataka	2%		

Table 1: Comparison of incidence of posterolateral vertebral artery tunnel.

In Romania, Velenae., *et al.* first studied the presence of retroarticular groove or canal [12]. The bony spurs called ponticles arising from the anterior and posterior margins of the groove converts it into a foramen [15,16]. These ponticles may either be due to ossification of posterior atlanto- occipital membranes or may represent the remanants of proatlans [11]. The ponticles in atlas vertebrae predisposes to vertebrobasilar insufficiency, Barre Lieou and cervicogenic syndrome during neck movements. In a study conducted by S. S Baesa state that the theories on formation of the foramen are controversial. Some authors have reported presence of foramen even in fetuses and children where it was present in cartilaginous form indicating congenital origin. Another theory states the foramen could develop as a result of degenerative calcification of atlanto-occipital membrane. The canal can therefore compress any or all of these structures as the neck rotates [17]. In a study

by Stubbs, on variability of posterolateral vertebral artery tunnel found that complete tunnel common in males and incomplete in female [18]. Difference in sex could be due to genetic feature related to ossification in course of aging; as a remnant of proatlas also known as occipital vertebra representing the rudimentary transverse process of the proatlas [19]. Increase in incidence of the lateral and posterior ponticles on left side; asymmetry due to unequal weight bearing due to left tilted head posture [20]. The presence of posterolateral vertebral artery tunnel is associated with symptoms of vertebrobasilar insufficiency like vertigo, headache, migraine, shoulder pain and neck pain. Other conditions associated with the presence of posterolateral vertebral artery tunnel are strokes, subarachnoid haemorrhage, and posterior fossa infarction and nerve entrapments. Investigations done are digital subtraction imaging supplemented with helical or spiral CT angiography.

Conclusion

Knowledge of presence of posterolateral vertebral artery tunnel is important as vertebral artery and associated nerves are vulnerable to compression. The present study is helpful for anatomists for academic purpose, for radiologists as incomplete tunnel and ponticles/spurs can be confused for fractures and anomalies; for accurate interpretation of radiographs and computed tomographic scans and also to orthopedicians and neurosurgeons operating in this region.

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