

## ORIGINAL ARTICLE

# ANATOMICAL STUDY OF VARIATION OF VERTEBRAL ARTERY ENTERING THE FORAMEN TRANSVERSARIUM OF CERVICAL VERTEBRAE

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## ABSTRACT

**Introduction:** The vertebral artery is unique among the cervico-cephalic vessels by virtue of its position and relationship to the adjacent structures. The advent of new techniques and materials for surgical treatment of lower cervical spinal condition has come along with possible potential complications. As vertebral artery normally passes through transverse foramen of sixth cervical vertebra, these procedures can safely be done on seventh cervical vertebra.

**Aim:** To study the anatomical variation of vertebral artery entering the transverse foramen of cervical vertebrae.

**Material & Methods:** 50 vertebral arteries were dissected in 25 embalmed cadavers, out of which 19 cadavers were male and 6 were female. Vertebral artery was dissected from its origin to its entry into foramen magnum.

**Results:** 4 (8 %) cases were found where vertebral artery entered into transverse foramen of 7<sup>th</sup> cervical vertebrae out of which 1 was bilateral, and 2 was on left side. In 46 cases (92%) it entered through transverse foramen of 6<sup>th</sup> cervical vertebrae.

**Conclusion:** In 8% cases as vertebral artery enters through C7 transverse foramina, the relation is important while performing transpedicular fixation or other spinal surgeries.

**Key words:** Vertebral artery, cervical vertebra, Spine

## INTRODUCTION

The vertebral arteries can be characterized by their small diameter in relation to great length, asymmetry, segmental branches, and fusion of paired arteries into one artery, the basilar artery, in the direction of forward flow. The vertebral artery arises from the first part of subclavian artery and courses within the bony canals of the cervical vertebrae, anterior to the cervical nerve roots, encircled by veins and nerve elements; then it lies on the upper surface of the posterior arch of the atlas before piercing the dura to enter the cranium. As vertebral artery passes through bony canals of the cervical vertebrae, its relation and variation is important for any cervical spine surgery. Posterior stabilization of the cervical spine is commonly used for treating unstable spine resulting from trauma, neoplasia or degenerating conditions. Such procedure is frequently performed by employing lateral mass screws or interspinous or sublaminar ligations. These techniques not always provide enough stability, sometimes they require subsequent additional anterior stabilization procedures. Recently, the transpedicular fixation technique has been introduced in order to provide an alternative to obtain

a stable fixation through posterior part without requiring a potential anterior approach. Anatomical variations of the artery path at the segment between the second and sixth vertebrae are rare. Upon such anatomy, the use of pedicular screws is safe only when performed at the seventh cervical vertebra, in which the vertebral artery is not usually present at the transverse foramen. Nevertheless, in a small portion of people, the vertebral artery is found inside the seventh cervical vertebra's transverse foramen. In such cases there can be increased risk of vertebral artery damage which can lead to various neurological deficit such as Wallenberg syndrome. This study was undertaken to know the variation of vertebral artery entering the transverse foramen of cervical vertebra.

## MATERIAL AND METHODS

The study consisted of meticulous dissection of vertebral arteries using standard dissection kit. 50 vertebral arteries were dissected in 25 cadavers obtained from Department of Anatomy, GMERS Medical college sola, Ahmedabad and other Institutes.

The cadavers used in this study were obtained after the students had finished the dissection of face, triangles of neck and deep dissection of neck. After removal of larynx, on the anterior surface of the cervical vertebral column, prevertebral fascia is seen. The prevertebral fascia covers the prevertebral muscles (longus colli and longus capitis muscle) and lateral vertebral muscles (anterior, middle and posterior scalene muscles). Each vertebral artery was identified in the root of the neck arising from first part of subclavian artery lying behind common carotid artery and vertebral vein and passing through a scaleno-vertebral triangle between longus colli and scalenus anterior muscle.



**Figure 1: Dissected vertebral artery entering at level of C6 transverse process, O – origin of vertebral artery**

Each vertebral artery was dissected free of its loose connective tissue attachments from its origin up to the transverse foramen of the cervical vertebra. The anterior boundary of the foramen of each of the sixth, fifth, fourth and third cervical vertebra was then removed and each artery was mobilized as far as the axis vertebra, using the scalpel handle. The seventh (C7) and sixth (C6) cervical vertebrae were identified by counting from the first thoracic vertebra (T1), identified by locating the first costal arch. Intending to avoid any failure in detecting C7 and C6 from T1, resulting from the potential existence of a cervical rib, the counting was also performed from the second cervical vertebra.

**RESULTS**

The study pertaining to variation of vertebral artery entering the transverse foramina of vertebral artery was done.

25 cadavers were dissected out of which 6 cadavers were female and 19 were male. From all 50 dissected vertebral arteries, we found 46 vertebral arteries entering the transverse foramen of the sixth cervical vertebra (92 %) and 4 of them entering transverse process of seventh cervical vertebra (8%). All vertebral arteries entered transverse foramina of cervical vertebrae through C6 and C7 only. Variation was

bilateral in 1 case and unilateral in 2 cases. In unilateral cases variation was present on left side only and on right side it was normal.

**Table 1: variation of vertebral artery entering the transverse foramina of vertebral artery**

	Vertebral artery entering at C6 level		Vertebral artery entering at C7 level		Total
	Rt.	Lt.	Rt.	Lt.	
	Specimens	23	23	1	
Percentage	46	46	2	6	100

**DISCUSSION**

Various studies have been conducted on the variation of vertebral artery passing through transverse foramen of cervical vertebra. The incidence of vertebral artery passing through transverse foramen of C6 vertebra was found to be 6% in the studied population.

Bruneau M et al<sup>1</sup> studied pathway of vertebral artery by means of MRI and CT angiographic images found variations in 7 % cases. In his study it was also found vertebral artery entering at C3, C4 and C5 level which is not found in present study. Bruneau et al also described bilateral abnormality 0.8% and unilateral abnormality 12.4% which was more common on left side .In his study he found vertebral artery entering transverse foramen of C5 more in number than C7 vertebrae, which is not seen in present study. In present study it was found entering at C7 level only.

Yamaki k et al<sup>2</sup> described the correlation exist between vertebral artery entering the foramen at abnormal level and variation of its origin from subclavian artery, which is not done in the present study.

**Table 2: Comparisons of Variation of vertebral artery entering foramen transversarium of cervical vertebrae other than C6**

Authors	Incidence of vertebral artery entering through foramen transversarium of various cervical vertebrae (in %)				
	C3	C4	C5	C7	Total
	Bruneau M et al	0.2	1	5	0.8
Kajimoto BHJ et al	0	0	0	7.5	7.5
Susan S. et al	1	2	5	2	10
Present study	0	0	0	8	8

Kajimoto BHJ et al<sup>3</sup> in his study described variations of vertebral artery entering the transverse foramen of cervical vertebra to be 7.5%, which is nearer to the value of present study<sup>7</sup>.

Author of Gray's Anatomy like Susan Standring et al<sup>4</sup> has also mentioned that 10% of vertebral artery enters transverse foramina of cervical vertebrae other than C6 vertebrae.

The incidence of people with unusual vertebral artery path in its way through low cervical spine is not neglectful, and should be considered when selecting a transpedicular fixation technique at that region. Panjabi et al<sup>5</sup> published the first anatomical 3D study in which the ability of human cervical vertebrae's pedicles to enable transpedicular fixation was proven. So damage to the vertebral artery is possible while fixing transpedicular screw at all cervical vertebral level is possible, also at C7.

The present study is based on 25 cadavers of which 19 male and 6 female cadavers. So comparison of variation in male and female was not possible. Also correlation based on anthropometric parameter like age, weight and sex could not be made with the variation in the path of vertebral artery.

## CONCLUSIONS

Vertebral artery entered the transverse foramen of cervical vertebra at C6 level in 92% cases and at C7 level in 8 % cases. In total 4 cases of vertebral artery entering C7 level it was found that 1case was bilateral

and in 2 other cases it was unilateral and on left side. As in 8% cases the vertebral artery enters through C7 transverse foramina, the relation is important while performing transpedicular fixation or other spinal surgeries. In further research, the correlation between vertebral artery entering the foramen at abnormal level and variation of its origin from subclavian artery can be studied. Also correlation of path of vertebral artery in cadaveric dissection and MRI can be studied.

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