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Original Research Article

A MORPHOMETRIC STUDY OF THE INTRACRANIAL VERTEBRAL ARTERY IN HUMAN CADAVERS

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ABSTRACT

Background: Vertebral artery radically contributes to the blood supply of brain. Any variation in its form will significantly alter the circulation dynamics in the brain leading to fatal consequences. The aim of the study was to measure the diameter of the intracranial part of vertebral artery on both right and left sides.

Materials and method: The study was conducted in Anatomy Department on 30 brains from the cadavers donated to the Medical College Baroda. The diameter of the artery was measured bilaterally with digital vernier caliper and results were statistically analyzed. The data is presented as mean± SD. Students' t test has been applied and observation with $P<0.05$ is considered significant.

Result: The current study observed the mean diameter (mm) on the left side to be greater than on the right. One of arteries on the left side was also found to be hypoplastic.

Conclusion: The results will have wider implications on medical field as any variation in structure of the vertebral artery will compromise the blood flow to the brain. The study will be useful to neurologists, neurosurgeons, radiologists and anatomists alike.

KEY WORDS: Vertebral artery, Intracranial, Diameter, Hypoplastic.

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INTRODUCTION

The vertebral artery is exclusive amid the head and neck blood vessels due to its smaller ratio of diameter as compared to its length, division into four parts and the combination of bilateral arteries into a single one in form of the basilar artery [1]. Therefore the vertebrobasilar system acts as chief vascular supply for Hind brain structures such as cerebellum, pons and medulla oblongata [2].The vertebral arteries arise from the first part of subclavian arteries in the scaleno vertebral triangle. Its course is described under four parts The pre vertebral, Vertebral, atlantooccipital and intracranial[3].

The first part extends from the origin to reach the foramen transverserium of C6 vertebra. The

second part runs headwords through the foramen transversarium of the C6 to C1 vertebrae. The atlanto-occipital part occupies the suboccipital triangle and comes out of the foramen transversarium of C1, curls around lateral mass of atlas posteriorly, moves medially on posterior arch of C1 and comes into the vertebral canal. The fourth part runs from the posterior atlanto-occipital membrane to the inferior border of pons [4].The branches of the fourth part of artery are posterior spinal, anterior spinal, posterior inferior cerebellar, meningeal and medullary arteries [5].Numerous variations are quite frequent in intracranial course of vertebral arteries and include hypoplasia,duplication, unsual origin and fenestration. Such variations often lead to disturbances in cerebral circulation resulting in increased chances of cerebral stroke and thus fatal consequences Therefore such a study will catch attention of anatomists, neurologists, neurosurgeons, radiologists and physicians who are trying to draw an inference [2].

MATERIALS AND METHODS

The present study was conducted after taking permission from the Institutional Ethical Committee for Human Research (IECHR) of Medical College, Baroda, Gujarat. The study was conducted on intracranial part of vertebral arteries of both right and left sides from 30 embalmed human brains obtained from the donated cadavers to Medical College Baroda. Only the undamaged brains with intact vertebral arteries were included for the study. The dissection of the brain was done according to the method mentioned in Cunningham Manual of Practical Anatomy [6]. Brain was thoroughly washed under the tap water for half an hour before measuring the parameters. After visualizing the intracranial part of vertebral artery on both sides, the diameter of the artery was measured using digital vernier caliper (sensitivity: 0.1mm). The observations were recorded and statistically analyzed using Microsoft Excel. The data is presented as Mean $\pm$ SD and students' t-test is applied with p values < 0.05 significant.

OBSERVATIONS AND RESULT

The present study shows that in 93.33% cases diameter of left vertebral artery is greater than the right (0.06%) (Table1). In 28 specimen, where the diameter of Left artery is greater than right there are four such cases where the difference exceeds more than 1mm. (Table1). The mean diameter on the right side is 3.44 $\pm$ 0.64 mm and 3.89 $\pm$ 0.79 mm on the left side (Table 2) (Figure 1). . The observations were tested statistically by t- test where the t value was 2.8 with $P < 0.05$ which shows significant difference between the diameter of artery on left and right sides (Table 2). Out of the 30 specimen observed, occurrence of left vertebral artery hypoplasia is 3.33% (Table 3) (Figure 2).

Fig. 1: Symmetrical Vertebral Arteries on right and left sides forming a single Basilar Artery.

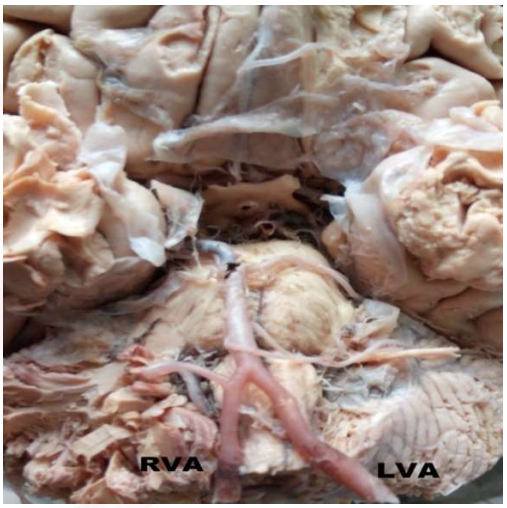

Fig. 2: Hypoplasia of LVA.

Table 1: Percentage Distribution Of The Specimen In Study.

Parameter	No. of Specimen	Percentage
LVA>RVA	28	93.33
RVA>LVA	2	0.06
RVA=LVA	0	0
Total	30	100

Table 2: Mean Diameter (In mm) Of Intracranial Part Of Vertebral Artery.

Side	Right	Left
Diameter (Mean+ SD)	3.44 ± 0.64	3.89 ± 0.79
Statistical Parameter	t-test 2.8, P<0.05	

Table 3: Occurrence Of Hypoplastic Artery.

	Sample size	Mean diameter (mm) of vertebral artery on right side	Mean diameter (mm) of vertebral artery on left side	LVA hypoplasia%	RVA hypoplasia %
Present study	30	3.50 ± 0.62	4.02 ± 0.74	3.7	0
Geetharani BG et al [2]	20	3.12 ± 0.08	3.64 ± 0.04	5	0
Julius Ogeng'o et al [10]	173	2.84±0.43	2.35 ±0.16	28.9	

Table 4: Comparison Of Present Study With Other Studies.

Parameter	No. Of Specimen	Percentage (%)
Normal	29	96.66
LVA Hypoplastic	1	3.33
RVA Hypoplastic	0	0
Total	30	100

DISCUSSION

The morphological and structural characteristics of intracranial part of vertebral artery are becoming vital with the ever-increasing cases of cerebrovascular accidents. The anomalies of vertebral artery can be significantly upsetting especially if there is an obstruction to other arteries supplying brain as it will not allow any compensation in the blood flow. Vertebral artery hypoplasia may cause reduction in blood supply of the region and give rise to neurological as well as vascular issues like migraine, vestibular neuronitis, Medial and lateral medullary syndromes [7,8].

We compared our results and observations to that of other authors' studies. (Table 4).Results of Geetharani BG et al were similar to our observations where the mean diameter on left side (3.64±0.04mm) was greater than on right(3.12 ±0.08 mm)[2]. They also reported 5% of left hypoplastic vertebral artery [2] However, Akar ZC et al observed the intracranial part of right vertebral artery to be larger in diameter than the left which contradicts our observation [9]. A similar observation was done by Julius Ogeng'o et al who studied 173 brains to find out that mean diameter was greater on right side than on left [10].

Chuang YM et al stated that the vertebral artery can be labelled as hypoplastic when the diameters are < 2 to < 3 mm, or an asymmetry ratio is either equal to or greater than 1:1.7 [6].

Aristeidis H Katsanos et al underline the occurrence of hypoplasia to be from 1. 9% to 11.6%, but also observes that there is no common agreement on a uniform value for the diameter (range 2.0 mm-3.0 mm) for the same. They also stress that vertebral hypoplasia not only related to hypoperfusion, but also with the formation of atherosclerotic changes, which eventually lead to cerebral insults [11].

Jong-Ho Park deduced that the hypoplastic vertebral artery is associated with higher chance of posterior circulation stroke (PCS) with probability of atherosclerosis and lesions on the same side in the region supplied by vertebral artery [12].

CONCLUSION

A number of anomalies are found in vertebral arteries which tend to be commonly benign [13].The variations in the intracranial part of the vertebral artery have clinical and diagnostic relevance as the artery and its branches supply important regions brainstem & cerebellum [14]. Lack of awareness regarding the anatomical variations in morphology can have disastrous consequences in surgeries such as vertebral endarterectomy or aneurysm repairs as well as lead to inaccurate radiological reporting [2]. Moreover, such anomalies often incline towards formation of intracranial aneurysm and ischemic strokes [15].

ABBREVIATIONS

LVA - Left Vertebral Artery

RVA - Right Vertebral Artery

mm - millimeters

PCS - Posterior Circulation Stroke

PICA - Posterior Inferior Cerebellar Artery

Conflicts of Interests: None

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