

Anatomy of Vertebral Artery and Its Variations on Color Doppler Scans

Vaishali B Dhawan¹, Bodhraj Dhawan², Atul Tayade³

¹Assistant Professor, Radiology, MGIMS, Sevagram

²Assistant Professor, Ophthalmology, NKPSIMS, Nagpur

³Professor, Radiology, MGIMS, Sevagram

Corresponding Author: Vaishali B Dhawan

ABSTRACT

Introduction- Vertebral artery is sonographically evaluated in terms of its Diameter, blood flow volume and other characteristics in cases of vertebrobasilar insufficiency. Anatomical variants in its origin and course are therefore important for a proper evaluation.

Aim and Methodology- This study aimed to study Sonoanatomy of Vertebral artery and its variations on Color Doppler Ultrasonography in Normal Healthy Individuals aged over 35 Years enrolled as Controls and subjects of the same age group with a Clinical Diagnosis of Cervical Spondylitis who were called Cases. This Observational Comparative study included 120 individuals (60 cases and 60 controls), selected by Convenience sampling at a the Radiology Department of a Medical College in Central India.

Observations- Majority of individuals in both groups were in the age group 41-50 years, with the mean age 43 years. Anatomic origin of the vertebral artery from subclavian artery could sonographically be visualised more commonly on right side (81.6%) than left (60%) among the cases. Similar finding was observed in Controls as well. Visualisation of the Atlas Loop too was similarly common finding on the Right side across both the groups, with minimal difference which was statistically insignificant. In Majority of individuals, the vertebral artery was observed to enter the transverse foramen of C6 vertebral body. In 1 (1.2%) individual the vertebral artery was documented to have the entrance at C4 on the Right side and in another 1 (1.2%), it was documented entering through C4 on the Left side. In another 1 (1.2%) case, the level of entrance on the right was C5.

Conclusions- 1. Sonographic course and variations in the vertebral artery have no significant correlation with the condition of Cervical Spondylosis. 2. The Anatomical Visualisation of origin and Atlas loop is better on the Right side. 3. Anatomical variations in entry of the vertebral artery into the transverse foramen, though uncommon, are not rare. 4. Sonography is an important tool in study of the anatomy and flow dynamics of the vertebral artery.

Keywords: Color Doppler Ultrasonography, Vertebral Artery, Cervical Spondylosis, Subclavian Artery

INTRODUCTION

Vertebral artery is visualised in four segments. [1] Segment 1 includes the osteum and proximal portion of the artery before it enters transverse foramen of C6 vertebra. Segment 2 is the intertransverse portion. Segment 3 is the atlas loop and Segment 4 is the intracranial portion.

Visualisation of its origin and atlas loop is variable from individual to individual and on both right and left side.

In this study we analysed the anatomy of vertebral artery in 120 individuals and compared the anatomy of the vertebral artery between healthy adults aged more than and equal to 35 years and the patients of the same age suffering with Cervical Spondylosis, an Indication for

which maximum referrals were received for the Doppler Study of Vertebral artery.

AIM

To study Sonoanatomy of Vertebral artery and its variations on Color Doppler Ultrasonography & to compare these anatomical features between healthy adults aged more than and equal to 35 years (referred to as Controls) and the patients of the same age suffering with Cervical Spondylosis (The Cases).

METHODOLOGY

Observational Comparative study on 120 consenting individuals aged over 35 years, divided into 2 groups- 1. Case-were the individuals with Clinical Diagnoses of Cervical Spondylosis. 2. Controls- were normal age matched individuals, willing to participate for the evaluation.

Both cases and controls selected by Convenience Sampling. Statistical analysis was done using Chi-square tests where the *p*-value was considered significant at *p* < .05. This was employed mainly to ascertain the anatomical variations amongst the cases and the controls.

Equipment used was a Logic 500 MD MR 3 Wipro GE Sonography machine and vertebral artery color Doppler was performed using a 7.0 MHz frequency.

RESULTS

1. Demographic Profile

A total 60 patients with clinical diagnosis of cervical spondylosis as Cases and another 60 patients as Controls were included. Majority of patients in both groups were in the age group 41-50 years [30 (50%)] amongst cases and [28(46.6%)] amongst controls.

Among cases 39(65%) were males and 21(35%) females. In the control group

30(50%) were males and a similar number were females.

2. Distribution Of The Patients According To The Visualisation Of Origin And Atlas Loop Of Vertebral Artery On Doppler Study (Table 1, Figure 1)

a) The origin of the vertebral artery from subclavian artery

The origin of the vertebral artery from subclavian artery was visualised in 49 (81.6%) of cases on the right side and in 40 (60%) of the cases on the left side.

In the control group, the origin was visualised in 52(86.9%) on the right side and 39(65%) on the left side. The Visualisation was seen in higher number of Individuals (Both Cases and Controls) on the Right side as compared to the Left.

b) Visualisation of the Atlas Loop

The Atlas loop was visualised in 43(71.6%) of cases on the right side and in 36 (60%) of the cases on the left side.

In the control group, the atlas loop was visualised in 51(85.0%) on the right side and 45(75%) on the left side.

The Visualisation was seen in higher number of Individuals (Both Cases and Controls) on the Right side as compared to the Left.

c) Level of entrance of the vertebral artery into the transverse foramina

In 2 cases, the level of entrance of the vertebral artery into the Transverse foramina was seen at C4 level (which was on Right side in one case and on the left side in the other).

Yet in another case the right vertebral artery was found to enter transverse foramina at C5 level while the left vertebral artery entered at C6 level.

Table 1. DISTRIBUTION OF THE PATIENTS ACCORDING TO THE VISUALISATION OF ORIGIN AND ATLAS LOOP OF VERTEBRAL ARTERY ON DOPPLER STUDY

DOPPLER FINDINGS	CASES (total 60)		CONTROLS (Total 60)	
	Right	Left	Right	Left
Origin of Vertebral artery from Subclavian artery The chi-square statistic is 0.1483. The <i>p</i> -value is .700121. <i>Not</i> significant at <i>p</i> < .05.	49(81.6%)	40(66.6%)	52(86.6%)	39(65%)
Atlas loop visualisation The chi-square statistic is 0.0587. The <i>p</i> -value is .80855. <i>Not</i> significant at <i>p</i> < .05.	43(71.6%)	36(60%)	51(85%)	45(75%)

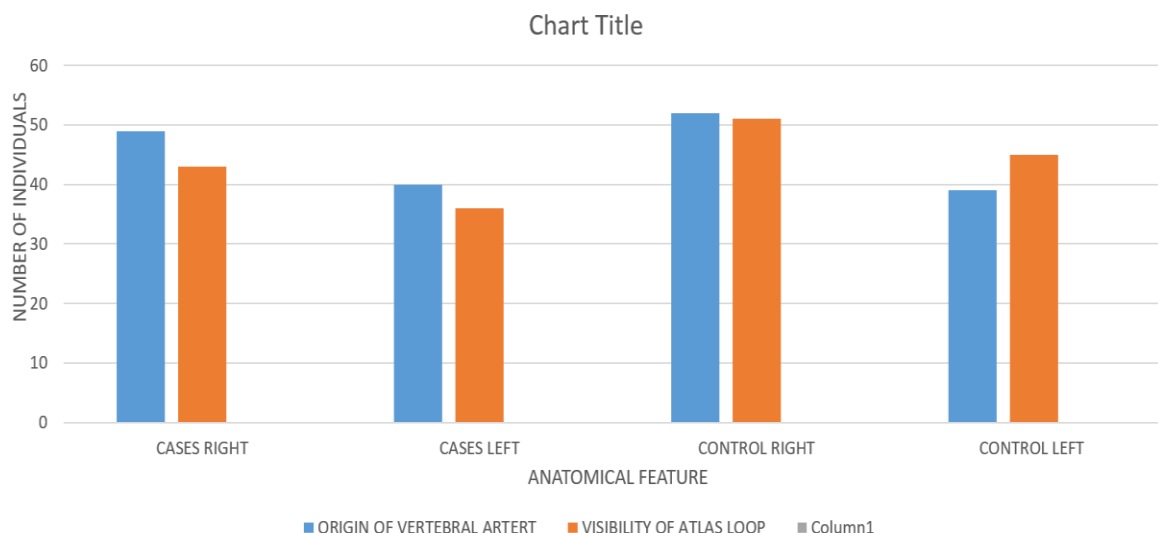


Figure 1

DISCUSSION

A. In this study, the origin of right vertebral artery from the right subclavian artery was visualised ultrasonographically in 101 (84.2%) individuals which includes both cases and controls.

On the left side it was visualised in 79(65.8%) individuals. Thus, the Visualisation was seen in higher number of Individuals (Both Cases and Controls) on the Right side as compared to the Left.

The difference on both sides was evaluated for significance between cases

and controls. The Chi-square statistic is 0.1483. The *p*-value is .700121. *Not* significant at *p* < .05. Thus the findings were similar irrespective of the patients' medical condition of cervical spondylosis or not.

This finding is consistent with findings of Touboul et al, who documented the Visualisation in 94% cases on the Right side as compared to 60% on the left Left. [2] Various previous such reports have earlier been published (Table 2)

Serial number	Author	Year	Visualisation on right in percentages	Visualisation on left in percentages
1	Touboul et al [2]	1986	94	60
2	Tratting S et al [1]	1990	88.1	66.7
3	Bartels E [3]	1992	88	73
4	Tratting S et al [4]	1993	87	71
5	Kuhl V et al [5]	2000	92	86
6	PRESENT STUDY	2008	84.2	65.8

The variations cross the various studies can be attributable to age of the patient being different in multiple trials, the depth of the structure examined in relation to the skin and the experience of the examiner.

B. In the present study the atlas loop of the Right Vertebral artery was visualised in 94 (78.4%) individuals (including both cases and controls), and on left side in 80(66.7%) individuals (including both cases and controls).

This is in consistence with earlier reports by Bartels E who reported good documentation

of vertebral artery flow in 87% on the right atlas loop and 85% on the left atlas loop with color Doppler. [3]

Our study differs from the report by Tratting et al, who documented visualisation of the atlas loop more on the left side (85.7%), compared to the right (76.2%). [1]

There was no difference in status of visualisation amongst cases and controls (The chi-square statistic is 0.0587. The *p*-value is .80855).

C. Tratting S et al, documented anomalous origin of vertebral artery in 6% cases

with the left vertebral artery originating directly from aorta. [4] However in our series we did not have any case of anomalous origin.

Normally the vertebral artery enters the transverse foramen of C6 vertebral body. In our study, 1 (1.2%) individual was documented to have the entrance of the vertebral artery at C4 on the Right side and in another 1 (1.2%), it was documented entering through C4 on the Left side.

In another 1 (1.2%) case, the level of entrance on the right was C5.

Similar findings anomalous entry at multiple levels (C1,C4,C5,C7) have earlier been reported with C6 the Commonest, Normal level. [6]

CONCLUSIONS

Ultrasonography is a great tool to study Vertebral Artery Anatomy. In vast majority of cases the origin of vertebral artery from the subclavian artery can be visualised irrespective of the laterality in question. Same holds valid for the visualisation of the atlas loop of the vertebral artery. Anatomical variations are rarely seen. Status of anatomical variations is not correlated to the Clinical Syndrome of Cervical Spondylosis.

REFERENCES

1. Trattnig S, Hübsch P, Schuster H, Pölzleitner D. Color-coded Doppler imaging of normal vertebral arteries. *Stroke*. 1990 Aug;21(8):1222-5. doi: 10.1161/01.str.21.8.1222. PubMed PMID: 2202095.
2. Touboul PJ, Bousser MG, LaPlane D, Castaigne P. Duplex scanning of normal vertebral arteries. *Stroke*. 1986 Sep-Oct; 17(5):921-3. doi: 10.1161/01.str.17.5.921. PubMed PMID: 3764964.
3. Bartels E. [Color coded Doppler sonography of the vertebral arteries. Comparison with conventional duplex sonography]. *Ultraschall Med*. 1992 Apr;13(2):59-66. doi: 10.1055/s-2007-1005277. PubMed PMID: 1604294.
4. Trattnig S, Matula C, Karnel F, Daha K, Tschabitscher M, Schwaighofer B. Difficulties in examination of the origin of the vertebral artery by duplex and colour-coded Doppler sonography: anatomical considerations. *Neuroradiology*. 1993;35(4): 296-9. doi: 10.1007/bf00602620. PubMed PMID: 8492900.
5. Kuhl V, Tettenborn B, Eicke BM, Visbeck A, Meckes S. Color-coded duplex ultrasonography of the origin of the vertebral artery: normal values of flow velocities. *J Neuroimaging*. 2000 Jan;10(1): 17-21. doi: 10.1111/jon200010117. PubMed PMID: 10666977.
6. Cavdar S, Arisan E. Variations in the extracranial origin of the human vertebral artery. *Acta Anat (Basel)*. 1989;135(3):236-8. doi: 10.1159/000146760. PubMed PMID: 2675528.

How to cite this article: Dhawan VB, Dhawan B, Tayade A. Anatomy of vertebral artery and its variations on color doppler scans. *Int J Health Sci Res*. 2020; 10(5):111-114.
