

## Correlation of Vertebral Artery Parameters on Color Doppler Ultrasound and Symptom of Vertigo in Cases of Cervical Spondylosis- A Prospective Analysis of 60 Cases

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### Abstract

**Introduction:** Degenerative changes of the cervical spine, symptomatic or asymptomatic condition are associated with malfunction in vertebral artery blood flow affecting brain and vestibulocochlear organ blood flow presenting with various symptoms like Vertigo, neck pain, rigidity. So far the evaluation of vertebral arteries has been done by angiography with a limited data on evaluation with duplex scanning of the vertebral arteries and the role of duplex ultrasound in identifying the external compression of the vertebral artery has not been extensively studied. Hence the present study was undertaken to study the Doppler parameters like systolic velocity and flow volume of the vertebral artery with association of the color Doppler characteristics to the symptom of vertigo related to vertebrobasal insufficiency.

**Aim:** To study association between symptom of vertigo with Color Doppler findings of Vertebral artery diameter, Vertebral artery blood flow volume and Vertebral artery velocity.

**Materials and Methods:** It is a Prospective analytical Study, conducted in Radiology Department of a Tertiary care Teaching institute in Central India, with a total 60 cases aged over 35 years with the clinical diagnosis of Cervical Spondylosis. Characteristics of the vertebral artery were recorded in terms of Peak systolic Velocity, Time averaged maximum velocity, The Diameter of the Segment in gray scale in millimetres and Flow volume of the vertebral artery and were later correlated to Vertigo using chi square test, student t test and z test with p values < 0.05 being considered statistically significant.

**Results:** A total 60 patients with clinical diagnosis of cervical spondylosis were included. Majority of patients were in the age group 41 - 50 years [30 (50%)]. Among cases 39 (65%) were males and 21 (35%) females. Vertigo was noted in 35 (58.3%) cases. Vertebral artery diameter less than or equal to 3 mm on the right side was associated with vertigo in 55.5% cases. There is no statistically significant correlation between Vertigo and Vertebral artery diameter on the Right side ( $p = 0.77$ ). A similar observation is made for the correlation between Vertigo and Vertebral artery diameter on the Left side too ( $p$  value = 0.48). Reduced blood flow volume of the vertebral artery (less than or equal to 100 ml/min) on the right side was associated with Vertigo in 53.3% of cases of Cervical Spondylosis. The association was statistically insignificant on both right and left side. Decreased Vertebral artery blood flow velocity (of less than or equal to 30 cm/s), 11 (78.5%) had vertigo was associated with vertigo on Right side in 52.2% cases. There was no significant correlation between right Vertebral artery blood flow velocity and vertigo ( $p = 0.07$ ). However, on the left side the association was significant ( $p = 0.01$ ).

**Conclusion:** Whereas reduced vertebral artery diameter or decreased vertebral artery blood flow volume alone does not contribute to vertigo, (the decreased) blood flow velocity of at least one vertebral artery may contribute to development of vertigo.

**Keywords:** Vertebral Artery; Doppler Ultrasound; Vertigo; Cervical Spondylosis

## **Introduction**

Degenerative changes of the cervical spine may present as a symptomatic or asymptomatic condition in adults [1], which lead to malfunction in vertebral artery blood flow affecting brain and vestibulocochlear organ blood flow [2]. These cases present with various symptoms like neck pain, rigidity and vertigo. Though neck pain is a very specific symptom to the spondylosis, vertigo can be a vague symptom and is seen with other disorders also. Vascular trauma and resultant atherosclerosis of the vertebral artery has been defined as “Cervical vertigo” [3].

So far the evaluation of vertebral arteries has been done by angiography with a limited data on evaluation with duplex scanning of the vertebral arteries [4] and the role of duplex ultrasound in identifying the external compression of the vertebral artery has not been extensively studied [5].

Hence the present study was undertaken to study the Doppler parameters like systolic velocity and flow volume of the vertebral artery with association of the color Doppler characteristics to the symptom of vertigo related to vertebobasal insufficiency.

## **Aim of the Study**

To study association between symptom of vertigo with Color Doppler findings of

1. Vertebral artery diameter
2. Vertebral artery blood flow volume
3. Vertebral artery velocity.

## **Materials and Methods**

It is a Prospective analytical Study, conducted in Radiology Department of a Tertiary care Teaching institute in Central India, with a total 60 cases aged over 35 years with the clinical diagnosis of Cervical Spondylosis. Patients with cardiac problems or with otogenic vertigo were excluded. Evaluation was performed on “Logic 500 MD MR 3 Wipro GE Sonography machine” with a Linear array transducer of 6 - 9 megahertz frequency. Imagesoft programme was used for the recording of images.

After taking an informed consent, Clinical history of vertigo was noted with special context of ruling out any otogenic vertigo by an ENT consultation.

Vertebral artery Color Doppler was performed in supine position with neck hyperextended and rotated to the side opposite being examined, using a 7.0 MHz frequency, following characteristics of the vertebral artery were recorded:

1. Peak systolic velocity
2. Time averaged maximum velocity
3. The diameter of the segment in gray scale in millimetres.
4. Flow volume of the vertebral artery.

Statistical analysis was done using chi square test, student t test and z test with p values <0.05 being considered statistically significant.

**Results**

**Demographic profile**

A total 60 patients with clinical diagnosis of cervical spondylosis were included. Majority of patients were in the age group 41 - 50 years [30 (50%)]. Among cases 39 (65%) were males and 21 (35%) females.

**Distribution of cases according to symptoms (Table 1)**

Symptoms	Number of cases (Percentages)
Neck Pain	60 (100%)
Neck Pain + Stiffness	43 (71.6%)
Neck Pain + Radiation of pain to arm	39 (65%)
Neck Pain+ Vertigo	35 (58.3%)
Neck Pain + Stiffness+ Radiation of pain to arm	30 (50%)
Neck Pain + Stiffness+Vertigo	25 (41.6%)
Neck Pain + Radiation of pain to arm+ Vertigo	23 (38.3%)
Neck Pain + Radiation of pain to arm+ Vertigo+ Stiffness	19 (31.6%)

*Table 1: Distribution of cases according to symptoms.*

Out of total 60 cases of clinical diagnoses of Cervical Spondylosis vertigo was noted in 35 (58.3%) cases.

Neck pain was most commonly observed symptoms seen in all cases. Many patients had a combination of symptoms including neck stiffness.

**Correlation of vertebral artery diameter with vertigo (Table 2)**

Symptom of Vertigo	Right (P = 0.77)		Left (P = 0.48)	
	Less than or Equal to 3 mm	More than 3 mm	Less than or Equal to 3 mm	More than 3 mm
Vertigo Present	10 (55.5%)	25 (59.5%)	11 (64.7%)	23 (54.7%)
Vertigo Absent	08 (44.4%)	17 (40.4%)	06 (35.3%)	19 (45.2%)

*Table 2: Correlation of vertebral artery diameter with vertigo.*

Most of Cases had vertebral artery diameters in the range of 3.0 - 3.5 mm seen both on right [21 {35%}] as well as on left side [17 {28.3%}].

Out of 18 cases with vertebral artery diameter less than or equal to 3 mm on the right side, 10 cases (55.5%) had vertigo and out of 42 cases with vertebral artery diameter more than 3 mm on the right side, 25 (59.5%) had vertigo. Thus, there is no statistically significant correlation between Vertigo and Vertebral artery diameter on the Right side (p = 0.77).

A similar observation is made for the correlation between Vertigo and Vertebral artery diameter on the Left side too (p value = 0.48).

**Correlation of blood flow volume of vertebral artery with vertigo (Table 3)**

Symptom of Vertigo	Right (P = 0.43)		Left (P = 0.22)	
	Less than or equal to 100 ml/min	More than 100 ml/min	Less than or equal to 100 ml/min	More than 100 ml/min
Vertigo Present	16 (53.3%)	19 (63.3%)	19 (65.5%)	15 (50.0%)
Vertigo Absent	14 (46.6%)	11 (36.6%)	10 (34.8%)	15 (50.0%)

**Table 3:** Correlation of blood flow volume of vertebral artery with vertigo.

Most of the cases had Vertebral artery blood flow in the range of 51 - 100 ml/min both on right side [26 (43.3%)] and Left side [22 (36.7%)]. On comparing Vertebral artery blood flow in the range of <= 100 ml/min and > 100 ml/min, the difference was statistically significant on the left side.

Out of 30 cases with reduced blood flow volume of the vertebral artery (less than or equal to 100 ml/min) on the right side, 16 (53.3%) had vertigo. Amongst those with the blood flow volume of the vertebral artery more than 100 ml/min on the right side, 19 (63.3%) had associated vertigo, which is not statistically significant (p = 0.43).

A similar observation is made on the left side between blood flow volume of the vertebral artery and the vertigo with the p value being 0.22.

**Correlation vertebral artery blood flow velocity with vertigo (Table 4)**

Symptom of Vertigo	Right (P = 0.07)		Left (P = 0.01)	
	Less than or equal to 30 cm/s	More than 30 cm/s	Less than or equal to 30 cm/s	More than 30 cm/s
Vertigo Present	11 (78.5%)	24 (52.2%)	14 (82.3%)	20 (47.6%)
Vertigo Absent	03 (21.4%)	22 (47.8%)	03 (17.7%)	22 (52.3%)

**Table 4:** Correlation vertebral artery blood flow velocity with vertigo.

Among the cases the maximum number of cases showed the vertebral artery blood flow in the range of 31 - 40 cm/s both on right side [24 (40%)] and on the left side [19 (31.7%)].

Out of 14 cases with right Vertebral artery blood flow velocity of less than or equal to 30 cm/s, 11 (78.5%) had vertigo. Out of 45 cases with right Vertebral artery blood flow velocity more than 30 cm/s, 24 (52.2%) had vertigo. There was no significant correlation between right Vertebral artery blood flow velocity and vertigo (p = 0.07).

However, on the left side the association was significant (p = 0.01).

**Discussion**

This Study includes 60 patients aged over 35 years with the clinical diagnosis of Cervical Spondylosis evaluated for symptoms of vertigo (non-otogenic) and Characteristics of Vertebral artery.

Most commonly encountered age group 41 - 50 years and male Preponderance with 65% being males is consistent with the literature report for similar cases [6,7].

Out of all 60 cases, a total 35 cases had Vertigo as a sole symptom or in association with other symptoms.

Most common symptom was Neck Pain in 60 (100% cases). It was followed by Neck stiffness in 43 (71.6% cases), Radiating Neck pain 39 (65%), Neck pain with vertigo in 35 (58.3%) and Neck pain with Stiffness with Radiation 30 (50%). This is different from published reports where radiating pain and headache were commonest presenting complains [7].

Most of Cases had vertebral artery diameters in the range of 3.0 - 3.5 mm seen both on right [21 {35%}] as well as on left side [17 {28.3%}]. Hence the present study observes a symmetry between vertebral artery diameters on both sides as reported in the literature [9,10]. The vertebral artery diameter less than or equal to 3 mm and more than 3 mm, both on right side and left side were correlated with Vertigo and no significant association was observed (Table 2). This finding differs from the findings of Jeng and Yip, who documented that in symptomatic cases, the vertebral artery diameter is less than 2.2 mm atleast on one side [11]. However, no reference is available to correlate the vertebral artery diameter less than 3 mm to be the sole cause of vertigo.

Most of the cases had Vertebral artery blood flow in the range of 51 - 100 ml/min both on right side [26 (43.3%)] and Left side [22 (36.7%)]. On correlating vertebral artery flow volume with the symptom of vertigo, no statistical significance was found on both sides. This is similar to report by Sidel., *et al.* a blood flow less than 100 ml/min as low vertebral blood flow (with normal range being 171 +- 42 ml/min) [12]. Jeng., *et al.* reported that a unilateral vertebral blood flow less than 30 ml/min along with ipsilateral vertebral artery diameter less than 2.2 mm was associated with symptoms of dizziness in 7.8% cases on right side and 3.8% cases on the left [11].

Among the cases the maximum number of cases showed the vertebral artery blood flow in the range of 31 - 40 cm/s. Out of 14 cases with right Vertebral artery blood flow velocity of less than or equal to 30 cm/s, 11 (78.5%) had vertigo. Out of 45 cases with right Vertebral artery blood flow velocity more than 30 cm/s, 24 (52.2%) had vertigo. There was no significant correlation between right Vertebral artery blood flow velocity and vertigo ( $p = 0.07$ ). However, on the left side the association was significant ( $p = 0.01$ ). Similar results have been reported by Bakr., *et al* [13].

## Summary and Conclusion

On Correlating vertebral artery diameter and vertebral artery blood flow volume with symptom of vertigo, no significant difference was observed on both right and the left side. Hence reduced vertebral artery diameter or decreased vertebral artery blood flow volume alone does not contribute to vertigo.

On correlating the vertebral artery blood flow velocity less than or equal to 30 cm/s with the symptom of vertigo, no statistical significance was found on right side, while on the left side a statistical significance was found with p value of 0.01.

The Decreased blood flow velocity of at least one vertebral artery may contribute to development of vertigo.

Ultrasound is a non-invasive quick modality to evaluate vertebral arteries in cases of vertigo secondary to cervical spondylosis.

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