

# A Study of the Relationship between Syncope Attacks and Diminished Carotid and Vertebral Artery Flow Using Doppler Ultrasonography of Cervical Vessels

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## ABSTRACT

**Background:** Syncope or drop attack is a common and potentially serious condition and prompt evaluation of the affected patients should be evaluated prompting for cardiac disease, seizure, structural lesions of the brain or peripheral nerves, as well as drug induced and metabolic disturbances. This study was conducted to evaluate carotid and vertebral arteries blood flow in patients with syncope in which other etiologies had been ruled out.

**Methods:** This one-year retrospective case-control study involved 33 patients (case group) and 33 normal individuals (control group). Carotid and vertebral arteries blood flow was measured in all subjects (ml/min) and SPSS was used for data analysis.

**Results:** Mean blood flow in vertebral arteries in the case group was significantly lower than in the control group ( $P < 0.001$ ), however mean carotid artery flow was not significantly different between them ( $P = 0.58$ ).

**Conclusion:** Based on our results and findings of some other studies, we recommend duplex ultrasonography of vertebral and cervical arteries in patients suffering from drop attacks, after ruling out the prominent etiologies, such as seizure, heart disease, etc.

**Keywords:** syncope, ultrasound, carotid artery, vertebral artery

Cardiologists and neurologists frequently encounter middle-aged and elderly patients who present with history of drop attack (syncope). These patients undergo various diagnostic and therapeutic procedures.

Syncope is defined as a sudden loss of consciousness and postural tone arising from decreased cerebral perfusion<sup>1</sup>. Interruption of blood supply to the brain for 7-13 seconds is enough to alter consciousness level. Drop attacks are occasionally preceded by dizziness, light-headedness, and blurred vision, also known as presyncope symptoms<sup>2</sup>. Syncope is categorized into four main groups:

1- Neurological-vasodepressor syncope, including syncope of vasovagal and neurocardiogenic etiology, syncope caused by carotid sinus hypersensitivity, etc. This type of syncope is highly prevalent and is diagnosed based on history and clinical evidence. Tilt-table test is a useful diagnostic procedure. Positioning the patient in a tilted position on bed (at an approximately 60° angle) will lead to a drop in diastolic and systolic blood pressures, hence engendering a spell of syncope.

2- Syncope caused by disorders of the sym-

thetic nervous system, including autonomic neuropathies (e.g. diabetes, Guillain Barre Syndrome, etc.), and autonomic disorders originating from the central nervous system (CNS) (spinal trauma, CNS-active and antihypertensive medications).

3- Syncope of cardiac origin caused by reduced cardiac output or decrease in intravascular fluid volume. This is an important type of syncope which requires urgent medical attention. Arrhythmia (tachycardia, bradycardia), diseases of the myocardium (myocardial infarction, cardiac failure), left ventricular outlet narrowing/occlusion (aortic stenosis, etc.), pulmonary artery narrowing/occlusion (Fallot's tetralogy, pulmonary emboli, etc.), and reduced circulating fluid volume (acute hemorrhage, dehydration) can lead to this type of syncope.

4- Syncope of other etiologies (e.g. hypoxia, severe anemia, hyperventilation syndrome, hypoglycemia, panic attacks, transient ischemic attacks within the perfusion domain of the vertebrobasilar artery<sup>1,2</sup>).

Atonic or akinetic seizures may also cause drop attacks. Electroencephalography (EEG) is required to rule out latter etiologies<sup>2,3</sup>.

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Drop attacks which are not associated with altered consciousness level or premonitory symptoms should instigate patient evaluation for organic disorders such as hydrocephaly<sup>1</sup>.

Several studies have recommended evaluation of carotid and vertebral arteries blood flow in diagnostic work up of syncope<sup>3,4,5,9,13</sup>.

The present study was conducted to determine the value of bilateral carotid and vertebral arteries blood flow assessment in patients with history of drop attacks, after ruling out the other causes of syncope.

## Subjects and Methods

This retrospective case-control study was conducted between November 2002 and November 2003 in Isfahan, central Iran. Sample size was calculated as 33, according to statistical formula.

Patient selection was conducted with the assistance of a number of cardiologists in the city of Isfahan, who were asked to refer patients with history of syncope and no positive cardiac findings in echocardiography, ECG, and cardiac monitoring to the Neuro-diagnostic center of Alzahra Hospital. Tilt table test was conducted for all of the patients to rule out the vasodepressor syncope.

Seizures were excluded, using clinical data and EEG. Brain CT scan or MRI was used when brain lesions were suspected.

The selected patients were those with history of syncope from all age groups and both sexes, who met study criteria. Exclusion criteria were as follows: syncope of cardiac etiology (arrhythmia, structural cardiac defects, etc), seizures (atonic seizures, etc),

vasodepressor syncope (as determined by tilt table test), structural brain lesions (colloid cyst of the third ventricle, hydrocephaly, paraventricular tumors, etc), metabolic disturbances (hypoglycemia, etc.), and psychiatric etiologies (HV syndrome, etc). A total of 16 patients were excluded and 33 (19 men and 14 women) remained in the study.

Thirty-three individuals with no history of syncope who matched the case group in age, sex, and risk factors (hypertension, smoking, hyperlipidemia, etc) were selected from the patients' companions as the control group. Sampling was conducted with simple-randomized method.

Both groups underwent Doppler ultrasonography of carotid and vertebral vessels with ATL color Echo Doppler machine with linear 7 MHz probe at the Neuro-Diagnostic center of Alzahra Hospital. Blood flow was automatically calculated.

Carotid and vertebral arteries blood flow was calculated bilaterally (milliliters per minute) for all subjects.

All subjects were assured of the risk-free nature of the study and their written consent were obtained. The study was double blind and the statistical analyst was not aware of the samples. SPSS software was used for data analysis with t-test.

## Results

The case and control groups were not significantly different in respect of the number of male and female subjects ( $P=0.28$ ). Mean age in control and case groups were  $43.02 \pm 14.2$  and  $44.9 \pm 16.7$  years, respectively, with no significant difference between the two groups.

**Table 1:** Frequency of flow groups and Mean flow of carotid arteries in the cases and controls.

Carotid flow	Groups			
	Case		Control	
	No	Percent	No	Percent
<400	5	15%	2	6%
401-500	5	15%	4	12%
501-600	9	15%	13	39%
601-700	7	21%	8	24%
701-900	7	21%	6	18%
<b>Total</b>	33		33	
<b>Mean</b>	567.2		585.5	
<b>Standard deviation</b>	157.5		105.1	

**Table 2.** Frequency of flow groups and Mean flow of vertebral vessels in the cases and controls.

Vertebral flow	Groups			
	Case		Control	
	No	Percent	No	Percent
<100	13	39%	0	0%
101-200	16	48%	10	30%
201-270	4	12%	23	69%
<b>Total</b>	33		33	
<b>Mean</b>	135.42		206.18	
<b>Standard deviation</b>	56.9		24.02	

Carotid artery blood flow was below 400 (ml/min) in 5 patients and 2 control subjects, 401-500 (ml/min) in 5 patients and 4 control subjects, 501-600 (ml/min) in 9 patients and 13 control subjects, 601-700 (ml/min) in 7 patients and 8 control subjects, and 701-900 (ml/min) in 7 patients and 6 control subjects (Table 1).

Mean carotid artery blood flow were  $567.2 \pm 157.5$  (ml/min) and  $585.5 \pm 105.1$  (ml/min) in case and control subjects, respectively, showing no significant difference between the two groups ( $P=0.58$ ,  $t=0.55$ ).

Vertebral artery blood flow was below 100 (ml/min) in 13 patients and none of the control subjects, 101-200 (ml/min) in 16 patients and 10 control subjects, and 201-270 (ml/min) in 4 patients and 23 control subjects.

Mean vertebral artery blood flow in the case and control groups were  $135 \pm 56.9$  (ml/min) and  $206.18 \pm 24.02$  (ml/min), respectively, showing a significant difference between the two groups ( $P<0.001$ ,  $t=6.57$ ) (Table 2).

## Discussion

The necessity of performing color duplex ultrasonography of carotid and vertebral arteries in patients with history of drop attacks is considered controversially by various authors. Some have

recommended the assessment of both vertebral and carotid arteries blood flow for screening of syncope patients<sup>3,5,8,9,13</sup>, while others have considered that vertebral artery blood flow assessment is adequate, with no need to measuring carotid artery blood flow<sup>1,2,7</sup>.

A study, conducted by Kappor WN, showed a significant reduction of blood flow in vertebral arteries of syncope patients compared with the control group; however, carotid artery blood flow was not significantly different between the two groups<sup>6</sup>. This is consistent with the results of our study.

Another study, conducted by Chamber BR and Norris JW, showed a higher risk of syncope, transient ischemic attacks (TIA), and stroke in patients with carotid stenosis and asymptomatic cervical bruit, compared with the control group<sup>9</sup>. Similar results were obtained in studies performed by Roederer Go, et al, and Johnson BF, et al<sup>11,12</sup>. Based on results of these studies and our findings, we recommend duplex color ultrasonography of carotid and vertebral arteries (especially vertebral artery) as a part of routine assessment of all patients with history of syncope (drop attacks), in order to reduce the risk of serious neurological conditions such as stroke, which may arise from vascular disorders, and recurrent spells of syncope.

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