Vertebrobasilar Insufficiency

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Vertebrobasilar Insufficiency

- Millikan and Siekert from Mayo Clinic firstly introduced the term of vertebrobasilar insufficiency in 1955.

Studies in cerebrovascular disease, I: the syndrome of intermittent insufficiency of the basilar arterial system. Proc Staff Meet Mayo Clin. 1955;30:61-68.

- A condition characterized by poor blood flow to the posterior portion of the brain

Vertebrobasilar Insufficiency

- Vertebrobasilar insufficiency is a significant cause of vertigo in individuals over age 65.
- Vertigo due to vertebrobasilar insufficiency
  - Sudden onset
  - Duration: several minutes
  - Associated with nausea and vomiting.

Etiology

- Atherosclerosis of the subclavian, vertebral, or basilar arteries is often the underlying cause of vertebrobasilar insufciency.
  - Hypertension increases the risk of lipohyalinotic thickening of these vessels, which increases the risk of infarction.
- Other causes of compression include muscles, ligamentous insertions, deep fascia, osteophytes, cervical spondylosis, membrane hypertrophy, and vertebral subluxation.

Rotational vertebral artery occlusion: a mechanism of vertebrobasilar insufficiency. Neurosurgery 1997;41:427–432; discussion 432–423.

Race and Gender

- The distribution of atherosclerosis differs according to race and gender
- European men tend to have atherosclerosis at the origin of the vertebral arteries near the subclavian
- Inter-cranial large-artery atherosclerosis is more common among African Americans, Asians, and women.

Vertebrobasilar System

- Vertebrobasilar system
  - Inner ear, brainstem, and cerebellum
- Vertigo is a common manifestation of cerebrovascular disease
  - By occlusion of any of the three major circumferential branches of the vertebral or basilar arteries
    - Posterior inferior cerebellar artery (PICA)
    - Anterior inferior cerebellar artery (AICA)
    - Superior cerebellar artery (SCA)

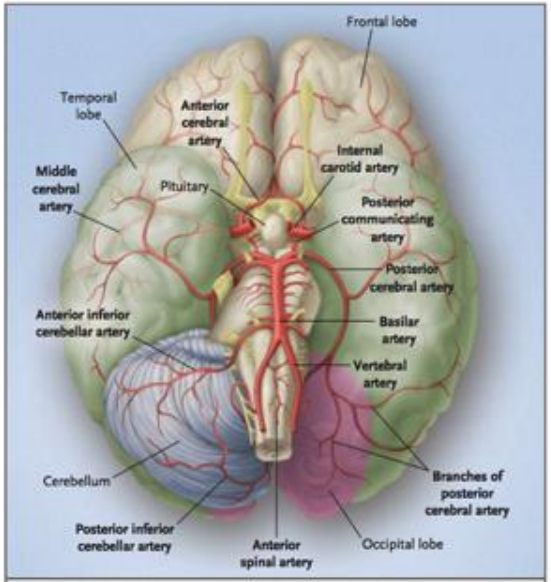

Figure 1. Arterial Supply of the Brain Stem, Cerebellum, Occipital Lobes, Posterior Temporal Lobes, and Thalamus.

The vertebrobasilar arterial supply feeds the brain stem (medulla, pons, and midbrain), cerebellum, occipital lobes, posterior temporal lobes, and thalamus (not visible in this view). The arterial supply consists of the extracranial and intracranial vertebral arteries, which unite to form the basilar artery, which runs midline along the ventral surface of the brain stem, feeding it with small, deep perforators until it merges with the circle of Willis to give off the posterior cerebral arteries.

Classic Presentation

- Vertigo (spinning sensation)
- Imbalance
- Dysarthria
- Hemiparesis
- Diplopia,
- Dysphagia,
- Ataxia
- drop attacks
- Sudden sensorineural hearing loss
  - Branch of the anterior inferior cerebellar artery of the basilar artery

Vertigo disequilibrium and imbalance with aging. Mosby Year Book, p. 527-534.

Is there an overlap between sudden neurosensorial hearing loss and cardiovascular risk factors? Audiol Neurotol, 14, 139-145.

Diagnosis

- History and physical examination
  - Age and risk factors (cholesterol level, lipid profile)
  - to exclude benign conditions (such as labyrinthitis, vestubular neuronitis and BPPV)
- Studies of the vertebral and basilar arteries
  - Magnetic resonance angiography
  - Standard angiography

However.....

- Vertigo caused by vertebrobasilar insufficiency (VBI) is usually accompanied by other neurological disturbances.
- Audiovestibular symptoms can be the first and only clinical signs of VBI
- It can be easily misdiagnosed as peripheral labyrinthine disorder

However.....

- Isolated vertigo or dizziness (unaccompanied by focal neurologic deficits) has been reported as an initial symptom:
  - Cerebellar strokes in 19% of cases
  - VBI in 62% of cases.

Very small (border zone) cerebellar infarcts. Distribution, causes, mechanisms and clinical features. Brain 1993;116(pt 1):161–186.
Vertigo of vascular origin. Clinical and electronystagmographic features in 84 cases. Arch Neurol 1989;46:281–284.

The Laryngoscope

Vertebrobasilar Insufficiency Presenting as Isolated Positional Vertigo or Dizziness: A Double-Blind Retrospective Cohort Study

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Objective

- The presence of isolated positional vertigo or dizziness in patients
  - Evaluation of VA morphology
  - Thrombotic stroke risk factors
  - Evolution of symptoms with time.

Methods

- Double-blind retrospective cohort study
- MRA reports describing the VAs of patients from January 2007 to December 2007 were reviewed (258 reports)
  - Department of Otolaryngology–Head and Neck Surgery, Montreal University Hospital Center, Canada
- All patients were contacted to complete a standardized questionnaire verifying isolated positional vertigo or dizziness and identifying thrombotic stroke risk factors.

Methods

- Thrombotic stroke risk factors were obtained from the American Heart Association scientific statement on stroke risk factors.
- The definitions of physical inactivity and emotional stress as risk factors for atherosclerosis were acquired from the INTERHEART study.

TABLE I.
Thrombotic Stroke Risk Factors Obtained from the American Heart Association Scientific Statement on Stroke Risk Factors.

Risk Factor	Method of Assessment
Age over 55	Hospital chart
Male sex	Hospital chart
Prior stroke or transient ischemic attack	Hospital chart
Ischemic heart disease	Hospital chart
Hypertension (treated or not)	Hospital chart
Diabetes (controlled or not)	Hospital chart
Lipid abnormalities (treated or not)	Hospital chart
Any cigarette smoking in past year	Questionnaire
Emotional stress*	Questionnaire
Less than 4 hours of physical activity weekly	Questionnaire

*Defined as constant stress at home or work, severe financial problems, or in the past twelve months any of the following: separation, divorce, death of spouse, death or serious illness of a family member, major intrafamilial conflict, loss of employment, retirement.

Methods

- Hospital charts of all patients who answered the questionnaire (133 patients) were reviewed.
  - 75 patients were examined for neurotologic evaluation
  - 36 underwent electronystagmographic (ENG) testing.
- Patients were separated into two groups based on the MRA morphology of their vertebral arteries.

Results

- Group A
  - Normal vertebral arteries
  - 72 patients (54.1%).
- Group B
  - At least one hypoplastic or stenotic vertebral artery
  - 61 patients (45.9%)

TABLE II.
Patients' Description.

Vertebral Artery	Group A	Group B	Total
No. of patients	72	61	133
Mean age (yr)	58.2	59.7	58.9
Mean number of stroke risk factors	2.8	3.3	3.1

Group A: Normal vertebral artery; Group B: hypoplastic or stenotic vertebral artery.

- Most frequent indications for MRA
  - Acute stroke or stroke follow-up
  - Evaluation of the carotid arteries
  - Investigation or follow-up of a cerebral aneurysm
- Aneurysm investigation or follow-up was a more frequent MRA indication in group A ($P < .05$)
- Evaluation of the carotids was a more frequent MRA indication in group B ($P < .05$).

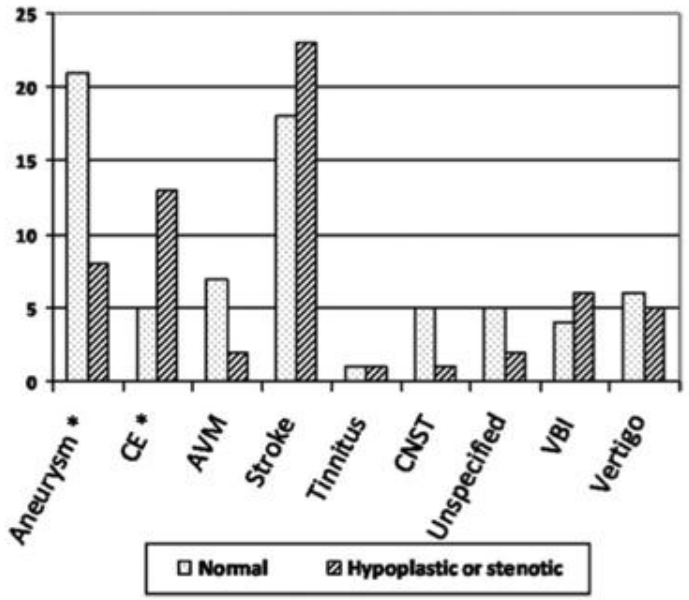

Fig. 1. Magnetic resonance angiography indications depending on vertebral artery morphology. CE = carotid evaluation; AVM = arteriovenous malformation; CNST = central nervous system tumor; VBI = vertebrobasilar insufficiency. *Pairs with significance level of 0.05 on 2-sided test.

TABLE IV.

Isolated Positional Vertigo or Dizziness on Questionnaire With Stratification for Stroke Risk Factors.

Isolated Positional Vertigo or Dizziness	Stroke Risk Factors			
	Group A		Group B	
	<3	≥3	<3	≥3
Absent	25 (49.0%)	26 (51.0%)	17 (42.5%)	23 (57.5%)
Present	10 (47.6%)	11 (52.4%)	3 (14.3%)	18 (85.7%)*
Total	35 (48.6%)	37 (51.4%)	20 (32.8%)	41 (67.2%)

Group A: normal vertebral artery. Group B: hypoplastic or stenotic vertebral artery.

*The Pearson chi-Square test is significant at the 0.05 level; $P = .026$.

TABLE V.

Prediction of Vertebral Artery Abnormality With Stroke Risk Factor Stratification in Patients Complaining of Isolated Positional Vertigo or Dizziness.

	Isolated Positional Vertigo or Dizziness	
	Abnormal VA	Normal VA
At least 3 stroke risk factors	18	11
<3 stroke risk factors	3	10

Sensitivity: 85.7%; specificity: 47.6%; positive predictive value: 62.1%; negative predictive value: 76.9%.

VA = vertebral artery.

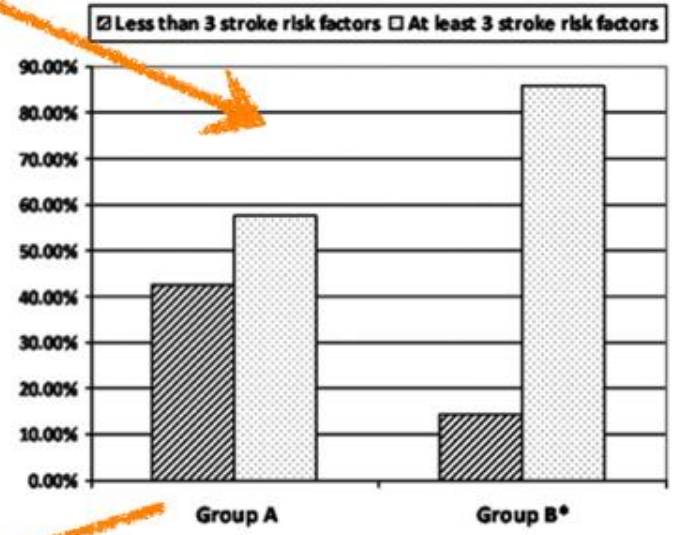

Fig. 2. Patients complaining of isolated positional vertigo or dizziness on questionnaire. Group A: Normal vertebral arteries. Group B: Hypoplastic or stenotic vertebral arteries. *The Pearson chi-Square test is significant at the 0.05 level; $P = 0.026$.

Discussion

- Of all patients complaining of isolated positional vertigo or dizziness on questionnaire (42 patients) and in the hospital chart (15 patients), 28 patients (49.0%) had a hypoplastic or stenotic vertebral artery.
  - This rate is comparable to the study that 52% of patients with isolated vertigo had an anomaly of the posterior circulation.

Discussion

- First aiming for a high sensitivity (85.7%)
- The specificity is too low (47.6%).
- The positive predictive value is not too high (62.1%),
- The negative predictive value reaches 77%.
  - Patients suffering from isolated positional vertigo or dizziness who have less than three stroke risk factors most probably do not have a vertebral artery abnormality.

Discussion

- This probability is 16% at 12 months and 21% at 24 months for patients with symptomatic intracranial arterial stenosis, of which 40% were affected by VBI.
- In regard to the consequences of VBI, we recommend performing an imaging study to adequately assess the morphology of the vertebral arteries in patients suffering from isolated positional vertigo or dizziness of unexplained etiology and having at least three stroke risk factors

Discussion

- The sensitivities of MRA, CTA, and Doppler ultrasound were 93.9%, 100%, and 70.2%, respectively.
- The specificities for MRA, CTA, and Doppler ultrasound are 94.8%, 95.2%, and 97.7%, respectively.

Imaging of vertebral artery stenosis: a systematic review.
J Neurol Neurosurg Psychiatry 2007;78:1218–1225.

Discussion

- Current treatment consensus for VBI among neurovascular specialists includes acetylsalicylic acid (ASA) at doses between 30 mg/day and 325 mg/day for the prevention of complications
  - Clopidogrel in patients who cannot tolerate ASA.
  - Warfarin was associated with significantly higher rate of adverse events and provided no benefit over ASA.
- Percutaneous transluminal angioplasty in alleviating symptoms and improving blood flow to the posterior cerebral circulation
  - A systematic review of the Cochrane database shows insufficient evidence to assess the effect of PTA for VA stenosis.

TABLE VI.
Studies of Vertigo or Dizziness as a Presenting Factor of Vertebrobasilar Insufficiency (VBI).

Study	Description	Data Level	Results
Our Series	Retrospective cohort study of patients with normal or abnormal vertebral arteries and prevalence of isolated positional vertigo or dizziness	IIb	85.7% of patients complaining of isolated positional vertigo with at least 3 stroke risk factors have a vertebral artery abnormality
Cloutier and Saliba[6] (2008)	Retrospective case series of vertigo of vascular origin	IV	7 of 9 patients had at least 2 vascular risk factors
Welsh et al.[11] (2000)	Retrospective case series of patients with isolated vertigo	IIIb	52% of patients with isolated vertigo had an anomaly of the posterior circulation
Kim and Heo[7] (1996)	Retrospective case series of cerebellar, pons, or medulla infarcts	IV	12 of 30 patients had position-unrelated isolated vertigo as the only presenting symptom
Gomez et al.[12] (1996)	Retrospective case series of VBI (transient ischemic attacks)	IV	6 of 29 patients had position-unrelated isolated vertigo as the only presenting symptom
Magnusson and Norrving[13] (1993)	Prospective case series of patients with isolated vertigo lasting 48 hr	IIIb	25% of patients had a cerebellar infarct; 13% had a concomitant occlusion of a vertebral artery; 8% had occlusion of a vertebral artery without evidence of infarct
Amarenco et al.[14] (1993)	Retrospective case series of AICA infarcts	IV	2 of 9 patients had position-unrelated isolated vertigo as the only presenting symptom
Amarenco et al.[3] (1993)	Retrospective case series of cerebellar infarcts	IV	9 of 47 patients had isolated vertigo, sometimes position related, as the only presenting symptom
Oas and Baloh[15] (1992)	Retrospective case series of AICA infarcts	IV	Isolated vertigo was the only symptom preceding a cerebellar infarct
Grad and Baloh[4] (1989)	Retrospective case series of vertigo of vascular origin	IV	62% of patients with VBI and 29% of patients with infarct had at least one episode of isolated vertigo before the infarct
Baloh et al.[16] (1987)	Retrospective case series of patients with symptoms of BPPV	IV	4.6% of patients had a final diagnosis of VBI
Huang and Yu[17] (1985)	Retrospective case series of cerebellar infarcts	IV	6 of 39 patients had position-unrelated isolated vertigo as the only presenting symptom
Duncan et al.[18] (1975)	Retrospective case series of PICA infarcts	IV	All 3 patients received a preliminary diagnosis of labyrinthitis, but it was subsequently changed to cerebellar infarcts
Millikan and Siekert[19] (1955)	Retrospective case series of "intermittent VBI"	IV	4 of 10 patients had position-unrelated isolated vertigo as the only presenting symptom

AICA = anterior inferior cerebellar artery; BPPV = benign paroxysmal positional vertigo; PICA = posterior inferior cerebellar artery.

- In terms of isolated positional vertigo or dizziness as a presenting symptom of VBI, this is the first level IIb cohort study to examine this pathology, as all previous studies were case series (level IV).

Conclusion

- Vertigo of vascular origin should be suspected if positional vertigo or dizziness is accompanied by neurological signs.
- When isolated positional vertigo or dizziness is not attributable to a specific etiology after standard examination and neurotologic evaluation, VBI might be a potential cause.
- Recommend:
  - A radiological evaluation for patients with at least three stroke risk factors who are complaining of isolated vertigo or dizziness of unexplained etiology.
- The sensitivity in these cases is as high as 85.7%, and the positive predictive value reaches 62.1% for identification of VA abnormalities.

Thank You