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Original Research Article

Characteristics of posterior circulation cerebral angiography from dizziness patients: a retrospective single-center cross-sectional study

Fritz Sumantri Usman, Noveline Sagita, M. Gandhi Sastrawan, Andra Vernandi, Merlin P. Kastilong*, Leny Kurnia

Department of Neurovascular Intervention, PELNI Hospital, West Jakarta, DKI Jakarta, Indonesia

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***Correspondence:**
Dr. Merlin P. Kastilong,
E-mail: merlinkastilong07@gmail.com

ABSTRACT

Background: This study aimed to analyze posterior circulation cerebral angiography characteristics in dizziness patients.
Methods: This was an analytical retrospective cross-sectional study on medical records data performed at Pelni Hospital. Subjects with the main complaint of dizziness/vertigo who fulfill the criteria for vascular vertigo and underwent digital subtraction angiography (DSA) in 2023, were recruited. The exclusion criterion was incomplete medical records.
Results: Two hundred and eighty-one subjects aged 14-79 years old were recruited. A total of 88.3% of subjects had abnormal DSA results, comprising posterior circulation abnormalities (hypoplasia/aplasia 11%, tortuous 40.2%, mild stenosis 8.9%, severe stenosis 16.7%, atherosclerosis 2.5%) and 42.8% of them had anterior circulation abnormalities. Older subjects tended to have tortuous vessels and abnormal anterior circulation. Females tended to have tortuous vessels ($p<0.001$) while males tended to have mild ($p=0.001$) and severe stenosis ($p=0.002$). Diabetes mellitus and cardiac disorders had significant associations with severe stenosis ($p=0.035$ and 0.003, respectively) and anterior circulation abnormalities ($p=0.024$ and 0.001, respectively). Subjects with dizziness tended to have hypoplasia or aplasia ($p=0.042$). Posterior circulation severe stenosis was significantly associated with endovascular angioplasty ($p<0.001$) and stenting ($p=0.030$).
Conclusions: Dizziness and vertigo were significantly correlated with hypoplasia/aplasia and tortuous posterior circulation. Age and sex were significantly correlated with posterior circulation disorder. Diabetes and cardiac disorders were significantly associated with severe stenosis, which needed endovascular procedures. The study was conducted in a cross-sectional design which warrants further prospective studies to establish the association.

Keywords: Digital subtraction angiography, Dizziness, Sociodemographic factors, Vertigo

INTRODUCTION

Vertigo is one of the most frequent complaints in neurology clinics. About 7.4% of adults worldwide suffer from vertigo. Vertigo can indicate many diseases, ranging from benign paroxysmal positional vertigo to cerebrovascular disorders.[1] Central and peripheral vertigo should be distinguished with history taking, clinical examination, and imaging examinations.[2]

The committee for the classification of vestibular disorders of the Bárány society has already made a diagnosticcriteria for Vascular Vertigo in 2022. The classification includes vertigo/dizziness due to stroke or transient ischemic attack and vertebral artery compression syndrome. Vascular vertigo/dizziness may be acute and prolonged ($\geq$24 hours) or transient (minutes to <24 hours). We should consider this diagnosis in patients present with acute vestibular symptoms with additional central neurologic symptoms and signs, including central HINTS signs (normal head impulse test, direction-changing gaze-evoked nystagmus, or pronounced skew deviation), especially in patients with vascular risk factors present. Diagnosis of vertebral artery compression needed imaging documentation of vascular compromise.[3]

A previous study in China reported that in vertigo patients, 60% of the cases had posterior circulation lesions, but the study did not state clearly the type of abnormality found except for the location of the abnormality.[4] The consensus from the Bárány Society stated that in patients with transient vestibular syndrome, infarction in diffusion-weighted imaging (DWI) might not be found, but focal stenosis or hypoplasia of the corresponding vertebral artery was present.[3] A study by Choi et al in 2017 showed that vertebral artery stenosis or hypoplasia is a risk factor for stroke in patients with transient vertigo/dizziness.[5] Hypoplasia of the vertebral artery may be a predisposing factor for stroke in the posterior circulation, besides stenosis and occlusion.[6,7] A study in 2022 stated that in subjects with cerebrovascular disease, vertebral artery tortuosity was found in 13% of angiography results, as well as kinking of vertebral arteries and carotid arteries in 10-16% of cases.[8]

For neurovascular-related abnormalities, the commonly used imaging techniques included digital subtraction angiography (DSA), computed tomography angiography (CTA), magnetic resonance angiography (MRA), Duplex ultrasound, and color Doppler sonography.[9]

DSA is a sophisticated imaging technique, mainly used for vascular diseases of the brain. Using DSA, real-time assessment of the hemodynamic status can be performed and the entire blood flow as well as its collateral circulation can be visualized.[10] DSA has become the gold standard for establishing the diagnosis of cerebrovascular diseases.[11] While it is deemed invasive and has risks of complications, the evolution of technology and knowledge decreases the incidence of complications. Hence, DSA is extensively used worldwide.[12] In addition to diagnostic modality, DSA might be used to predict the patient's prognosis, especially in acute ischemic stroke patients.[13]

Indonesia is a lower-middle-income country in Southeast Asia. The use of DSA in Indonesia is limited due to the high cost.[14] This study describes the sociodemographic and clinical characteristics of patients with dizziness who underwent DSA in a hospital in Indonesia. The main objective is to analyze the association between these characteristics and the DSA results.

METHODS

This was an analytical cross-sectional study performed at Pelni Hospital from January to December 2023. This study has been approved by the Ethics Committee of the Faculty of Medicine Maranatha Christian University (approval number 076/KEP/VI/2024). The informed consent form was not required because the data was obtained from the medical records. This submission does not include any information that may identify the subject. Subjects with chief complaints of dizziness, vertigo, staggering, loss of balance, and giddiness fulfill the criteria for Vascular Vertigo according to The Consensus from the Bárány society, and underwent DSA in Pelni Hospital from January to December 2023, were recruited to the study with a total sampling method.[11] Subjects with incomplete medical records were excluded from the study. Total sampling was performed.

Data was obtained from the medical records. Sociodemographic (age and sex), clinical (hypertension, diabetes, cardiac diseases, previous stroke), and cerebral DSA results data were documented and divided into normal results, abnormal posterior circulation (hypoplasia/ aplasia, tortuous, mild stenosis, severe stenosis, atherosclerosis, abnormal anterior circulation, and abnormal venous system.

Vertigo was defined as a sensation of spinning. The Bárány society defined vertigo as a sensation of self-motion when no self-motion is occurring.[11] While dizziness describes a more general discomfort without erroneous perception of large-scale movements, this classification also includes complaints of staggering, loss of balance, and giddiness.

We used the qualitative method - the classification from Ryu et al for vertebral artery tortuosity, which has 3 categories. In this study, tortuous vessels included were Type I (C-shaped curved vessel with acute angulation <90°), type II (definite S-shaped curved vessel or acute angulation in 1 location), and type III (coiled vessel/circular configuration of vertebral artery or kinked vessel with acute angulation with stenosis or acute angulation present in >1 location); which was found in the standard projection of the anteroposterior view of DSA.[15] We did not perform quantitative tortuosity measurement for the tortuous vessel. Vertebral artery hypoplasia was defined by a diameter ≤ 2 mm and an asymmetry ratio of $\leq 1:1.7$ of both vertebral arteries.[16] Stenosis was defined as mild (<50%) and severe (50-99%).[17]

Subsequently, the data was analyzed with SPSS version 26.0 (SPSS Inc, Chicago, USA). Categorical data were presented in frequency and percentage. Numerical data was presented in median (minimum-maximum value). Association between categorical variables was assessed with the Chi-square test and Fischer's exact test. The association between categorical data and numerical data was assessed with an Independent T-test if the data distribution was normal or the Mann-Whitney test if the data distribution was abnormal. P value <0.05 was considered significant.

RESULTS

A total of 281 subjects were recruited for this study. The sociodemographic and clinical characteristics of the subjects are shown in Table 1. The subjects ranged from 14 years old to 79 years old. Most subjects were female (54.8%) and complained of dizziness (50.5%). The comorbidities found in this study were hypertension (46.3%), diabetes mellitus (12.1%), cardiac diseases (28.8%), and previous stroke (38.4%). Some of the subjects complained of vertigo (40.9%), staggering (11.7%), loss of balance (2.8%), and giddiness (0.7%). Of all subjects, 11.7% of them had normal DSA results and 88.3% of them had abnormal DSA results, consisting of posterior circulation abnormalities (hypoplasia/aplasia 11%, tortuous 40.2%, mild stenosis 8.9%, severe stenosis 16.7%, atherosclerosis 2.5%). A total of 42.8% of the patients had anterior circulation abnormalities which can be identified separately or concurrent with posterior circulation abnormalities. A total of 7.1% of the patients showed abnormal venous systems. Five other DSA results consisted of arteriovenous malformation (AVM). We plan to perform a posterior circulation angioplasty (to 7.1% of subjects) and stenting (to 23.5% of subjects). However, only about half of them were performed (posterior circulation angioplasty 3.9%, stenting 13.5%). Other plans and treatments included anterior circulation angioplasty and stenting, as well as AVM embolization.

Table 1: Sociodemographic and clinical characteristics (n=281).

Characteristics	N (%)
Age in years, median (minimum-maximum value)	55 (14-79)
Sex	
Male	127 (45.2)
Female	154 (54.8)
Hypertension	
Yes	130 (46.3)
No	151 (53.7)
Diabetes mellitus	
Yes	34 (12.1)
No	247 (87.9)
Cardiac diseases	
Yes	81 (28.8)
No	200 (71.2)
Previous stroke	
Yes	108 (38.4)
No	173 (61.6)
Dizziness	
Yes	142 (50.5)
No	139 (49.5)
Vertigo	
Yes	115 (40.9)
No	166 (59.1)
Staggering	
Yes	33 (11.7)
No	248 (88.3)
Loss of balance	
Yes	8 (2.8)
No	273 (97.2)
Giddiness	
Yes	2 (0.7)
No	279 (99.3)
DSA results	
Normal	33 (11.7)
Abnormal	248 (88.3)
Abnormal posterior circulation hypoplasia/aplasia	
Yes	31 (11)
No	250 (89)

Continued.

Characteristics	N (%)
Tortuous vessels	
Yes	113 (40.2)
No	168 (59.8)
Mild stenosis (<50)	
Yes	25 (8.9)
No	256 (91.1)
Severe stenosis (≥50)	
Yes	47 (16.7)
No	234 (83.3)
Atherosclerosis	
Yes	7 (2.5)
No	274 (97.5)
Abnormal anterior circulation	
Yes	123 (42.8)
No	158 (56.2)
Abnormal venous system	
Yes	20 (7.1)
No	261 (92.9)
Other DSA results	
Present	5 (1.8)
No	276 (98.2)
Posterior circulation angioplasty plan	
Yes	20 (7.1)
No	261 (92.9)
Posterior circulation stent plan	
Yes	66 (23.5)
No	215 (76.5)
Other plan	
Yes	45 (16)
No	236 (84)
Posterior circulation angioplasty	
Yes	11 (3.9)
No	270 (96.1)
Posterior circulation stent	
Yes	38 (13.5)
No	243 (86.5)
Other treatments	
Yes	24 (8.5)
No	257 (91.5)

Table 2 shows the association between age and DSA results. The subject's age is significantly associated with DSA results ($p<0.001$), tortuous vessels ($p=0.007$), abnormal anterior circulation ($p=0.009$), abnormal venous system ($p=0.006$), and other DSA results ($p=0.007$). Older subjects tended to have abnormal DSA results, tortuous vessels, and abnormal anterior circulation. Subjects with younger age tended to have abnormal venous systems ($p = 0.006$).

Table 3 shows the association between the sociodemographic as well as clinical characteristics of the subjects and DSA results. Several associations were found. Females tended to have tortuous vessels ($p<0.001$) while males tended to have mild ($p=0.001$) and severe stenosis ($p=0.002$). Subjects with hypertension were significantly associated with abnormal anterior circulation ($p<0.001$). Subjects with diabetes mellitus and cardiac disorders had significant associations with severe stenosis of posterior circulation ($p=0.035$ and 0.003, respectively) and anterior circulation abnormalities ($p=0.024$ and 0.001, respectively). Subjects with dizziness tended to have hypoplasia or aplasia ($p=0.042$). Subjects with vertigo tended to have posterior circulation disorder in the form of tortuous vessels ($p=0.030$). Posterior circulation abnormalities such as tortuous vessels and severe stenosis were significantly associated with posterior circulation angioplasty ($p<0.001$) and stenting ($p<0.001$ and 0.030, respectively).

Table 2: Association between age and digital subtraction angiography results.

	Age	Mean difference	P value	95% CI
DSA results[a]				
Normal	45.97 (12.48)	9.594	<0.001*	5.341-13.847
Abnormal	55.56 (11.53)			
Hypoplasia/aplasia[a]				
Yes	53.71 (14.09)	0.796	0.729	-3.727-5.320
No	54.51 (11.78)			
Tortuous vessels[b]				
Yes	57 (36 – 79)	-	0.007*	-
No	53 (14 – 78)			
Mild stenosis[a]				
Yes	54.96 (10.53)	-0.593	0.818	-5.663-4.447
No	54.37 (12.19)			
Severe stenosis[a]				
Yes	56.37 (9.10)	-2.343	0.141	-5.477-0.790
No	54.03 (12.52)			
Atherosclerosis[a]				
Yes	60.71 (7.41)	-6.461	0.161	-13.338-0.415
No	54.25 (12.10)			
Abnormal anterior circulation[a]				
Yes	56.50 (9.95)	-3.670	0.009*	-6.415 – -0.925
No	52.83 (13.21)			
Abnormal venous system[a]				
Yes	44.90 (12.23)	14.886	0.006*	4.321-25.451
No	55.16 (11.72)			
Other DSA results[b]				
Present	43 (24-46)	-	0.007*	-
No	56 (14-79)			

DSA = digital subtraction angiography; [a]Independent T-test; [b]Mann-Whitney Test; *statistically significant

Table 3: Association between sociodemographic as well as clinical characteristics and digital subtraction angiography results.

	N (%)	Abnormal DSA Results	N (%)	Hypoplasia/Aplasia	N (%)	Tortuous vessels	N (%)	Mild Stenosis	N (%)	Severe Stenosis	N (%)	Atherosc-lerosis	N (%)	Abnormal Anterior Circulation	N (%)	Abnormal Venous System	N (%)	Other DSA Results
Sex																		
Male	114 (46.0)	0.476[a]	16 (51.6)	0.447[a]	36 (31.9)	<0.001[a]*	19 (76.0)	0.001[a]*	31 (66.0)	0.002[a]*	3 (42.9)	1.000[b]	57 (46.3)	0.733[a]	6 (30.0)	0.157[a]	3 (60.0)	0.661[b]
Female	134 (54.0)		15 (48.4)		77 (68.1)		6 (24.0)		16 (34.0)		4 (57.1)		66 (53.7)		14 (70.0)		2 (40.0)	
Hypertension																		
Yes	121 (48.8)	0.020[a]*	14 (45.2)	0.896[a]	55 (48.7)	0.507[a]	9 (36.0)	0.281[a]	25 (53.2)	0.297[a]	1 (14.3)	0.128[b]	74 (60.2)	<0.001[a]*	6 (30.0)	0.130[a]	1 (20.0)	0.378[b]
No	127 (51.2)		17 (54.8)		58 (51.3)		16 (64.0)		22 (46.8)		6 (85.7)		49 (39.8)		14 (70.0)		4 (80.0)	
Diabetes mellitus																		
Yes	33 (13.3)	0.149 [b]	3 (9.7)	1.000 [b]	10 (8.8)	0.171 [a]	2 (8.0)	0.750 [b]	10 (21.3)	0.035 [a]*	1 (14.3)	0.599 [b]	21 (17.1)	0.024 [a]*	0 (0)	0.146 [b]	0 (0)	1.000[b]
No	215 (86.7)		28 (90.3)		103 (91.2)		23 (92.0)		37 (78.7)		6 (85.7)		102 (82.9)		20 (100)		5 (100)	
Cardiac diseases																		
Yes	75 (30.2)		8 (25.8)		31 (27.4)		6 (24.0)		22 (46.8)		1 (14.3)		49 (39.8)		4 (20.0)		1 (20.0)	1.00[b]
No	173 (69.8)	0.151[a]	23 (74.2)	0.694[a]	82 (72.6)	0.673[a]	19 (76.0)	0.577[a]	25 (53.2)	0.003[a]*	6 (85.7)	0.677[b]	74 (60.2)	0.001[a]*	16 (80.0)	0.366[a]	4 (80.0)	
Previous stroke																		
Yes	93 (37.5)	0.378[a]	12 (38.7)	0.973[a]	40 (35.4)	0.391[a]	9 (36.0)	0.793[a]	22 (46.8)	0.196[a]	2 (28.6)	0.711[b]	55 (44.7)	0.056[a]	4 (20.0)	0.079[a]	1 (20.0)	0.652[b]
No	155 (62.5)		19 (61.3)		73 (64.6)		16 (64.0)		25 (53.2)		5 (71.4)		68 (55.3)		16 (80.0)		4 (80.0)	
Dizziness																		
Yes	128 (51.6)	0.321[a]	21 (67.7)	0.042[a]*	56 (49.6)	0.788[a]	15 (60.0)	0.321[a]	21 (44.7)	0.379[a]	5 (71.4)	0.447[b]	57 (46.3)	0.215[a]	9 (45.0)	0.608[a]	2 (40.0)	0.682[b]
No	120 (48.4)		10 (32.3)		57 (50.4)		10 (40.0)		26 (55.3)		2 (28.6)		66 (53.7)		11 (55.0)		3 (60.0)ß	
Vertigo																		
Yes	99 (39.9)	0.347[a]	10 (32.3)	0.298[a]	55 (48.7)	0.030[a]*	9 (36.0)	0.600[a]	16 (34.0)	0.293[a]	1 (14.3)	0.246[b]	54 (43.9)	0.370[a]	8 (40.0)	0.930[a]	2 (40.0)	1.000[b]
No	149 (60.1)		21 (67.7)		58 (51.3)		16 (64.0)		31 (66.0)		6 (85.7)		69 (56.1)		12 (60.0)		3 (60.0)	
Staggering																		
Yes	32 (12.9)	0.147_b	3 (9.7)	1.000[b]	9 (8.0)	0.107[a]	1 (4.0)	0.330[b]	12 (25.5)	0.001[a]	1 (14.3)	0.587[b]	18 (14.6)	0.184[a]	3 (15.0)	0.715[b]	1 (20.0)	0.467[b]
No	216 (87.1)		28 (90.3)		104 (92.0)		24 (96.0)		35 (74.5)		6 (85.7)		105 (85.4)		17 (85.0)		4 (80.0)	

	N (%)	Abnormal DSA Results	N (%)	Hypoplasia/Aplasia	N (%)	Tortuous vessels	N (%)	Mild Stenosis	N (%)	Severe Stenosis	N (%)	Atherosc-lerosis	N (%)	Abnormal Anterior Circulation	N (%)	Abnormal Venous System	N (%)	Other DSA Results
Loss of balance																		
Yes	7 (2.8)	1.000[b]	0 (0)	0.604[b]	2 (1.8)	0.482[b]	1 (4.0)	0.530[b]	3 (6.4)	0.133[b]	0 (0)	1.000[b]	5 (4.1)	0.304[b]	0 (0)	1.000[b]	0 (0)	1.000[b]
No	241 (97.2)		31 (100)		111 (98.2)		24 (96.0)		44 (93.6)		7 (100)		118 (95.9)		20 (100)		5 (100)	
Giddiness																		
Yes	1 (0.4)	0.221[b]	0 (0)	1.000[b]	0 (0)	0.517[b]	0 (0)	1.000[b]	0 (0)	1.000[b]	0 (0)	1.000[b]	1 (0.8)	1.000[b]	0 (0)	1.000[b]	0 (0)	1.000[b]
No	247 (99.6)		31 (100)		113 (100)		25 (100)		47 (100)		7 (100)		122 (99.2)		20 (100)		5 (100)	
Posterior circulation angioplasty plan																		
Yes	20 (8.1)	0.144[b]	2 (6.5)	1.000[b]	2 (1.8)	0.004[a]*	3 (12.0)	0.402[b]	14 (29.8)	<0.001[b]*	0 (0)	1.000[b]	11 (8.9)	0.294[a]	1 (5.0)	1.000[b]	0 (0)	1.000[b]
No	228 (91.9)		29 (93.5)		111 (98.2)		22 (88.0)		33 (70.2)		7 (100)		112 (91.1)		19 (95.0)		5 (100)	
Posterior circulation stent plan																		
Yes	66 (26.6)	0.001[a]*	3 (9.7)	0.054[a]	49 (43.4)	<0.001[a]*	4 (16.0)	0.355[a]	19 (40.4)	0.003[a]*	2 (28.6)	0.669[b]	26 (21.1)	0.412[a]	4 (20.0)	1.000[b]		0.594[b]
No	182 (73.4)		28 (90.3)		64 (56.6)		21 (84.0)		28 (59.6)		5 (71.4)		97 (78.9)		16 (80.0)			
Other plans																		
Yes	45 (18.1)	0.008[a]*	4 (12.9)	0.797[a]	8 (7.1)	0.001[a]*	6 (24.0)	0.256[b]	10 (21.3)	0.281[a]	2 (28.6)	0.312[b]	44 (35.8)	<0.001[a]*	0 (0)	0.052[b]	1 (20.0)	0.585[b]
No	203 (81.9)		27 (87.1)		105 (92.9)		19 (76.0)		37 (78.7)		5 (71.4)		79 (64.2)		20 (100)		4 (80.0)	
Posterior circulation angioplasty																		
Yes	11 (4.4)	0.373[b]	0 (0)	0.617[b]	2 (1.8)	0.209[b]	1 (4.0)	1.000[b]	7 (14.9)	<0.001[b]*	0 (0)	1.000[b]	6 (4.9)	0.542[b]	0 (0)	1.000[b]	0 (0)	1.000[b]
No	237 (95.6)		31 (100)		111 (98.2)		24 (96.0)		40 (85.1)		7 (100)		117 (95.1)		20 (100)		5 (100)	
Posterior circulation stent																		
Yes	38 (15.3)	0.012[b]*	37 (14.8)	0.094[b]	28 (24.8)	<0.001[a]*	1 (4.0)	0.220[b]	11 (23.4)	0.030[a]*	1 (14.3)	1.000[b]	13 (10.6)	0.201[a]	2 (10.0)	1.000[b]	0 (0)	1.000[b]
No	210 (84.7)		213 (85.2)		85 (75.2)		24 (96.0)		36 (76.6)		6 (85.7)		110 (89.4)		18 (90.0)		5 (100)	
Other treatments																		
Yes	24 (9.7)	0,090[b]	3 (9.7)	0.736[b]	4 (3.5)	0.014[a]*	1 (4.0)	0.707[b]	5 (10.6)	0.569[b]	1 (14.3)	0.468[b]	23 (18.7)	<0.001[a]*	0 (0)	0.235[b]	1 (20.0)	0.362[b]
No	224 (90.3)		28 (90.3)		109 (96.5)		24 (96.0)		42 (89.4)		6 (85.7)		100 (81.3)		20 (100)		4 (80.0)	

DSA = digital subtraction angiography; [a]Chi-square test; [b]Fischer's exact test; *statistically significant

DISCUSSION

The subjects in our study ranged from 14 years old to 79 years old with a median age of 55 years old. A previous study showed that dizziness is often identified in the elderly population (>65 years old).[18] Most subjects in this study were female (54.8%). This finding aligns with a previous study, which revealed that 58.2% of the subjects with vertigo were female.[19]

The comorbidities included in this study were hypertension (46.3%), diabetes mellitus (12.1%), cardiac diseases (28.8%), and previous stroke (38.4%). Patients with dizziness had a two times higher risk of cardiac diseases and stroke than a non-dizziness group after adjusting for confounding risk factors, according to studies from Kim et al in 2012.[3] Several studies have shown that stroke is closely related to vertigo or dizziness symptoms. Isolated vertigo is a common finding of posterior circulation ischemia.[3] Vertigo can be a presenting symptom of stroke with or without signs of brainstem disorders.[20] A previous study in vertigo subjects reported similar results that 49.1% of the subjects had hypertension and 14.5% of the subjects had diabetes mellitus. They also found an association between hypertension and cardiovascular diseases with vertigo.[19]

Some of the subjects complained of dizziness (50.5%), vertigo (40.9%), staggering (11.7%), loss of balance (2.8%), and giddiness (0.7%). According to the Bárány Society, this symptom is often used interchangeably since patients often confuse one with another, so the examiner must ask the complaints in detail.[3] These symptoms when occurring together can indicate central vertigo. Several symptoms associated with vertigo in stroke syndromes of the posterior inferior cerebral artery, anterior inferior cerebellar artery, and superior cerebellar artery; included drowsiness, limb ataxia, impaired position, and hemiparesis.[20] These symptoms can be perceived as staggering, loss of balance, and giddiness.[21] Another report also showed that dizziness, staggering, loss of balance, and giddiness are symptoms of posterior circulation ischemia.[22]

The majority of the DSA results in our study were abnormal (88.3%). A previous study also stated that abnormalities were found in vertigo patients who underwent cerebral DSA procedures.[23] This signifies that most patients who complained of dizziness might had vascular etiology. Twenty percent of ischemic events involved vertebrobasilar circulation which resulted in dizziness symptoms. Neuroimaging examination is very important for the evaluation of suspected stroke cases, including patients with dizziness. Magnetic resonance imaging (MRI) is widely used for vascular cases. Perfusion imaging can also be considered but it has a limitation, which is the inability to identify the decrease of small perfusion in the brainstem.[3] DSA is a gold standard examination for vascular disorders. DSA can show vessel occlusion, the collateral status, and the magnitude of stenosis.[24]

The abnormalities we found were separated as abnormal posterior circulation (hypoplasia/aplasia (11%), tortuous vessels (40.2%), mild stenosis (8.9%), severe stenosis (16.7%), atherosclerosis (2.5%)); abnormal anterior circulation (42.8%); and abnormal venous system (7.1%). Five other DSA results consisted of arteriovenous malformation (AVM). Subjects with dizziness tended to have hypoplasia or aplasia (p=0.042), while subjects with vertigo tended to have posterior circulation disorder in the form of tortuous vessels (p=0.030).

A previous study in China reported that, of 56 vertigo patients, 71% of the cases had vessel abnormality, comprising posterior circulation lesions (60%), compound anterior circulation lesions (16%), and simple anterior circulation lesions (11%).[4] A study in patients with posterior circulation infarcts reported similar findings where the MRA findings consisted of stenosis or occlusion (66.7%) and tortuous vessels (33.3%). Tortuous vessels are more common in elderly patients and have a strong association with posterior circulation infarct. The cause of this abnormality is vascular degeneration and reduction of elasticity.[25] Hypoplasia/aplasia was significantly associated with dizziness. Vertebral artery hypoplasia is a common finding in patients with dizziness.[26] Hypoplasia prevalence ranges from 10.8 to 43.5%.[27] A previous study stated that hypoplasia is associated with posterior circulation stroke due to restricted hypoperfusion in the vertebrobasilar area. Hypoplasia increases the risk of thrombosis and low clearance of thrombus.[26]

In this study, the subject's age is significantly associated with DSA results, tortuous vessels, abnormal anterior circulation, abnormal venous system, and other DSA results. Subjects of older age tended to have abnormal DSA results, tortuous vessels, and abnormal anterior circulation. Similar findings were stated in a previous study that older individuals are more prone to have tortuous vessels due to vascular aging and degeneration.[25] Age is also linked to anterior circulation abnormalities, particularly atherosclerosis due to vascular aging.[28] Other studies found that subjects with younger age tended to have abnormal venous systems. Venous abnormalities, particularly venous thrombosis, are linked to stroke in younger adults; and this statement supported our findings.[29]

Our study showed that subjects with hypertension were significantly associated with abnormal anterior circulation (p<0.001); and besides hypertension, abnormal anterior circulation was significantly associated with diabetes mellitus and cardiac diseases. Hypertension is associated with the degeneration and aging of the vascular system. Hypertension is also a sign of hemodynamic changes which play an important role in the development of atherosclerosis, inducing the formation of tortuous vessels, as well as vascular degeneration and aging.[25] Therefore, hypertension increases the risk of cardiac diseases and simultaneously induces abnormal anterior circulation.[25] Diabetes mellitus is also a known risk factor for atherosclerosis which can manifest as abnormal anterior circulation.[28]

Subjects in our study who had diabetes mellitus and cardiac disorders as comorbid had significant associations with severe stenosis of posterior circulation (p=0.035 and 0.003, respectively) and anterior circulation abnormalities (p=0.024 and 0.001, respectively). A previous study in Switzerland reported that most vertebral artery stenosis patients were female and smoking history. In the study, a total of 35.6% of vertebral artery stenosis patients had a history of diabetes mellitus and 45.2% had a history of coronary artery diseases. Direct stenting had to be performed in 68.5% of the cases and balloon angioplasty was performed in 16.4% of the patients.[30]

Our study showed that posterior circulation abnormalities such as tortuous vessels and severe stenosis were significantly associated with posterior circulation angioplasty (p<0.001) and stenting (p<0.001 and 0.030, respectively). Previous reports showed that tortuous vertebrobasilar vessels might manifest as vascular vertigo, in combination with other stroke risk factors.[31] Tortuous vessels are associated with a higher risk of posterior circulation ischemia, which needs prompt treatment.[32]

We planned to perform posterior circulation angioplasty for 7.1% of subjects and stenting for 23.5% of subjects, but only about half of them continued with endovascular therapy (3.9% angioplasty and 13.5% stenting). Stent angioplasty is a modality used for treating stenosis.[33] This treatment has a higher rate of success in treating posterior atherosclerotic stenosis with a low number of recurrences. Stent angioplasty is preferred, especially in patients intractable to conservative therapy.[34] Things to be monitored during and after the procedure are transient ischemic attack (1%) or stroke (0%) before discharge. Other possible complications included access site complications (2%), myocardial infarction (0%), bleeding (0%), dissection (0%), and allergy to dye (0%).[22]

This study is not without limitations. The study was conducted in a cross-sectional design which warrants further prospective studies to establish the association. Since this is a cross-sectional study, there was no follow-up on the outcome of the patients and treatments. Further study is warranted with prospective design and more subjects in a multicenter manner to generalize the results.

CONCLUSION

This study showed the characteristics of posterior circulation angiography in patients with dizziness. The findings highlight the importance of assessing sociodemographic factors and clinical symptoms which are significantly associated with DSA results. Dizziness and vertigo were significantly correlated with abnormal posterior circulation DSA results, in the form of hypoplasia/aplasia and tortuous vessels. Age and sex were significantly correlated with posterior circulation disorder. Diabetes mellitus and cardiac disorders were significantly correlated with severe stenosis which needed endovascular procedures.

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