Causes of Dizziness in Patients with Suspected Stroke

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BACKGROUND Acute dizziness may be the only symptom of stroke. Prevalence of this disease among patients with isolated dizziness differs significantly and depends on study design, inclusion criteria and diagnostic methods. In available investigations, we did not find any prospective studies where magnetic resonance imaging, positional maneuvers, and Halmagyi-Curthoys test had been used to clarify a pattern of diseases with isolated acute dizziness and suspected stroke.

AIM OF STUDY To clarify the pattern of the causes of dizziness in patients with suspected acute stroke.

MATERIAL AND METHODS We examined 160 patients admitted to N.V. Sklifosovsky Research Institute for Emergency Medicine with suspected stroke and single or underlying complaint of dizziness. All patients were examined with assessment of neurological status, Dix-Hollpike and Pagnini-McClure maneuvers, Halmagyi-Curthoys test, triplex scans of brachiocephalic arteries, transthoracic echocardiography, computed tomography (CT) and magnetic resonance imaging (MRI) of the brain with magnetic field strength 1.5 T. MRI of the brain was performed in patients without evidence of stroke by CT and in patients with stroke of undetermined etiology according to the TOAST classification.

RESULTS In 16 patients (10%), the cause of dizziness was a disease of the brain: ischemic stroke (n=14 (88%)), hemorrhage (n=1 (6%)), transient ischemic attack (TIA) of posterior circulation (n=1 (6%)). In 70.6% patients (n=113), the dizziness was associated with peripheral vestibulopathy: benign paroxysmal positional vertigo (n=85 (75%)), vestibular neuritis (n=19 (17%)), Meniere's disease (n=7 (6%)), labyrinthitis (n=2 (1,3%)). In 6.9% patients (n=11), the cause of dizziness was hypertensive encephalopathy, 1.9% of patients (n=3) had heart rhythm disturbance, 9.4% of patients (n=15) had psychogenic dizziness, 0.6% of patients (n=1) had demyelinating disease, and 0.6% of patients (n=1) had hemic hypoxia associated with iron deficiency anemia.

CONCLUSION In 70.6% patients with acute dizziness, admitted to hospital with a suspected stroke, peripheral vestibulopathy was revealed. Only 10% of patients had a stroke as a cause of dizziness.

Keywords: dizziness, vestibulopathy, stroke, benign paroxysmal positional vertigo, vestibular neuritis, Meniere's disease, psychogenic dizziness

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ACVE — acute cerebrovascular event
AF — atrial fibrillation
AH — arterial hypertension
CT — computed tomography
GCS — Glazgo Coma Scale
MRI — magnetic resonance tomography
NIHSS — National Institute of Health Stroke Scale
TIA — transient ischemic attack
TOAST — Trial of Org 10172 in Acute Stroke Treatment

BACKGROUND

The improvement of methods of diagnosis, treatment and prevention of stroke is an urgent task for healthcare worldwide [1–4].

Acute cerebrovascular events (ACVE) are characterized by the sudden (within minutes, less hours) appearance of focal and/or cerebral neurological symptoms, which persist for more than 24 hours, or lead to death in a shorter period of time [5]. One of the manifestations of a stroke can be acute dizziness, which is most common for lesions of the vertebrobasilar system and may be the only symptom of stroke [6–12]. The frequency of stroke in patients with a leading or single complaint of dizziness ranges from 0.7 to 2.2% [6, 9, 10].

According to B. Norrving, A.S. Saber Tehrani, J.C. Kattah, the stroke was diagnosed with in 25–74% of patients with dizziness [7, 13, 14].

However, dizziness also appears in conditions that differ in the etiology and pathogenesis. This symptom is observed in diseases of both the central and peripheral nervous system, as well as in somatic disorders (anemia, chronic heart failure, etc.) [10, 15].

There is an evidence of a high risk of stroke among patients with new-onset vertigo and diagnosed benign paroxysmal positional vertigo, vestibular neuronitis, or other peripheral vertigo. In a study of C.L. Atzema et al. (2016) the relative risk of stroke in patients with dizziness during the first week after admission to the hospital was 50 times higher than in the comparison group. Patients with renal colic were selected for the comparison group, where the risk of ischemic and hemorrhagic stroke should be as low as in patients with peripheral vestibulopathy [16].

The aim of our study is to determine the structure of the causes of dizziness in patients with suspected stroke.

MATERIAL AND METHODS

Were examined 160 patients hospitalized in the N.V. Sklifosovsky Research Institute for Emergency Medicine with the single or leading complaint of dizziness in the period from October, 2014 to June, 2016. The average age of the patients was 53.3±14 years, the minimum was 22, and the maximum was 83 years. The male/female ratio was 65/95, the NIHSS score when admitted to hospital was 0 (0; 0) points.

Patients were admitted on suspicion of stroke and were hospitalized in the intensive care unit and intensive care unit of the emergency neurology department.

The neurological status was assessed in all patients. Dix and Hallpike, Pagnini-McClure, Halmagyi-Curthoys tests were performed, as well as triplex scanning of brachiocephalic arteries, transthoracic echocardiography, computed tomography (CT) and magnetic resonance imaging (MRI) of the brain with magnetic field induction 1.5 T. MRI of the brain was performed in patients where ACVE was not confirmed by CT and in patients with ischemic stroke of unspecified pathogenetic variant according to TOAST (Trial of Org 10172 in Acute Stroke Treatment).

Statistical processing. To analyze the differences between quantitative data in groups with a normal distribution, we used the Student's t-test for independent samples, and the Mann–Whitney U-test for groups with a distribution other than normal. The Kolmogorov–Smirnov criterion was used to verify the compliance of the sample with the normal distribution law. To analyze the differences in qualitative traits, the chi-square test or Fisher's exact test was used. Microsoft office excel 2010 and IBM SPSS Statistics 21 were used to calculate statistics.

RESULTS

In 16 patients (10%), vascular diseases of the brain were the cause of dizziness: ischemic stroke (n=14; 88%), hemorrhagic stroke (n=1; 6%) and transient ischemic attack (TIA) in the vertebrobasilar system (n=1; 6%). In 70.6% of patients (n=113) peripheral vestibulopathy was the cause of dizziness: benign paroxysmal positional vertigo (n=85; 75%), vestibular neuronitis (n=19; 17%), Meniere's disease (n=7; 6%), labyrinthitis (n=2; 1,3%). In 6.9% of patients (n=11), hypertensive encephalopathy was the cause of dizziness, in 1.9% (n=3) it was heart rhythm disorder, in 9.4 % (n=15) — psychogenic dizziness, in 0.6 % (n=1) — demyelinating disease, and in another 0.6% (n=1) — hemic hypoxia against the background of iron deficiency anemia (Table 1).

Table 1
General characteristics of the examined patients

Disease	Indicators				
	n (%)	Age, years	Gender (m/f), *n*	*NIHSS*, score	GCS min/max, score
Ischemic stroke	14 (8.8)	59±16	9/5	0 [0; 2]	14/15
Hemorrhagic stroke	1 (0.6)	61	1/0	2	15/15
Transient ischemic attack	1 (0.6)	75	1/0	0	15/15
Hypertensive encephalopathies	11 (6.9)	59±9	1/10	0 [0; 0]	15/15
Vestibular neuronitis	19 (11.9)	53±13	11/8	0 [0; 1]	15/15
Ménière 's disease	7 (4.4)	48±14	3/4	1 [0; 2]	15/15
Benign positional paroxysmal dizziness	85 (53.1)	54±13	31/54	0 [0; 0]	15/15
Arrhythmia	3 (1.9)	61±20	2/1	1 [0; 1]	15/15
Anemia	1 (0.6)	78	0/1	0	15/15
Demyelinating disease	1 (0.6)	34	0/1	2	15/15
Psychogenic dizziness	15 (9.4)	38±11	4/11	0 [0; 0]	15/15
Labyrinthite	2 (1.3)	51±9	2/0	0	15/15
Total	160 (100%)	53±14	65/95	0 [0; 0]	14/15

Notes: the data presented as (M±σ) (M is the arithmetic mean, σ is the standard deviation) for normal and Median [25 and 75 persentile] under abnormal distribution, n is the number of patients. The scores according to NIHSS (National Institute of Health Stroke Scale) and GCS (Glasgow Coma Scale) were performed upon admission to hospital the data presented as(M±σ) (M is the arithmetic mean, σ is the standard deviation) for normal and Median [25 and 75 persentile] under abnormal distribution, n is the number of patients. The scores according to NIHSS (National Institute of Health Stroke Scale) and GCS (Glasgow Coma Scale) were performed upon admission to hospital

The average age of patients with ACVE was higher than that of patients with other pathologies: 60.1±15 and 53.6±14 years, respectively (p<0.05). The NIHSS score (National Institute of Health Stroke Scale) when admitted to hospital was also higher in patients with cerebrovascular accident — 0±1 versus 1±2 in patients with other pathologies (p<0.05).

Among patients with ACVE, the proportion of men and women was 69% and 41%, respectively, and among patients with other causes, 38% and 62%, respectively; thus, male gender was associated with ACVE. Also, patients with arterial hypertension and atrial fibrillation were more common in the group with ACVE. The proportion of

patients with arterial hypertension was 87.5% (n=14) in patients with ACVE and 56.3% (n=90) in patients with other pathologies, and the incidence of atrial fibrillation was 25% (n=4) and 4.9% (n=7), respectively. There were no statistically significant differences in the prevalence of diabetes among both groups: 6.3% (n=1) and 8.3% (n=12). Dissection of the vertebral artery was detected in one patient in the group of ACVE (7.1%), whereas erythremia was in one patient with benign paroxysmal positional vertigo (Table 2).

Table 2

Comparative characteristics of patients in the presence or absence of ACVE

Groups of patients	Indicators								
	n (%)	Age,	Gender (m/f)	*NIHSS*, score	AH, *n* (%)	DM, *n* (%)	AF, *n* (%)	Erythremia, *n* (%)	Dissection of the vertebral artery, *n* (%)
ACVE	16 (10)	60±15	11/5	0±1	14 (87.5)	1 (6.3)	4 (25)	0	1 (6.3)
Other reasons	144 (90)	54±14*	54/90*	1±2*	90 (56.3)*	12 (8.3)	7 (4.9)*	1 (0.7)	0

Notes: * — p<0.05, n — the number of patients. ACVE — acute cerebrovascular event; AF — atrial fibrillation; AH — arterial hypertension; DM — diabetes mellitus; NIHSS — National Institute of Health Stroke Scale

DISCUSSION

In our study, the majority of patients who came to the hospital with complaints of acute dizziness, etiological factors were peripheral vestibulopathies, which is consistent with the data of most authors.

So, D.E. Newman-Toker et al. (2008) studied the structure of the causes of dizziness in 9,472 patients who asked for assistance in the emergency room. The most common causes of vertigo were vestibular (32.9%), cardiovascular (21.1%), respiratory (11.5%) and neurological diseases (11.2%). The proportion of ACVE was 2.2% [10].

In a study by K.A. Kerber et al. (2006) ACVE and TIA were confirmed in 0.7% of 1,297 patients with isolated dizziness [6].

In a study by K.A. Kerber et al. (2014) ACVE was diagnosed in 2.2% of 1,273 patients with dizziness [9].

It is important to note that the above studies on large samples had a number of common features: retrospective or ambispectual design of the study; only a small proportion of patients were examined by a neurologist; neuroimaging was not used in all patients, and the proportion of patients examined using MRI did not exceed 18%.

In studies where the protocol included the use of neuroimaging in all patients (CT and MRI of the brain in the absence of signs of stroke), the proportion of ACVE in patients with acute dizziness was significantly higher.

So, B. Norrving et al. (1995) examined 24 patients aged 50 to 70 years with acute systemic vertigo lasting more than 48 hours in a prospective study. Patients with subjective hearing impairment were excluded from the study. All patients underwent MRI of the brain with induction of a magnetic field of 0.3 T, which made it possible to establish the diagnosis of stroke in 25% of patients.

In the works of J.C. Kattah (2009), A.S. Saber Tehrani et al. (2014), performed with the use of MRI with induction of a magnetic field of 1.5 T, determined the prevalence of stroke among patients with acute vestibular syndrome [13, 14]. The studies included patients with one or more risk factors for stroke. Patients with previous episodes of vertigo were excluded from the study of J.C. Kattah. In patients in these studies, the proportion of stroke was 74% and 55%, respectively. It is worth paying attention to the fact that the authors included in the study only patients with vestibular syndrome. Its manifestations include systemic vertigo, nystagmus, nausea/vomiting, intolerance of head movement and unsteady gait [17]. This means that patients with other types of dizziness, without nystagmus, without disturbing gait, without nausea were excluded from the study. In addition, patients who had no risk factors for stroke were excluded. Given the prevalence of arterial hypertension, diabetes mellitus, atrial fibrillation and other risk factors in patients with dizziness and ACVE, this method of patient selection could affect the increase in the proportion of patients with ACVE in the sample. The exclusion of patients with repeated episodes of vertigo could also have led to this result, since it is known that more than half of patients with benign vestibular pathology experience repeated episodes of dizziness [6, 18].

Our study was prospective. Such a design, in our opinion, was optimal for the solution of the set goal: it allowed to develop a protocol for examining the patient at the planning stage and then apply it to create a sample. The examination included both a routine assessment of neurological status and tests aimed at verifying the most common peripheral vestibulopathies. For verification of benign paroxysmal positional vertigo, Dix and Hallpike, McClure-Pagnini maneuvers and the Semont maneuver were used. To assess the vestibular and ocular reflex, Halmagyi-Curthoys test was used.

The study included all patients admitted to the Institute due to a suspicion of stroke with a single or leading complaint of dizziness, regardless of age, presence of risk factors, previous episodes of dizziness, type of dizziness and hearing loss. This, in our opinion, allowed us to see the undistorted structure of the causes of dizziness in this group of patients and clarify the ratio of diseases in the sample.

The protocol of our study included MRI with a magnetic field induction of 1.5 T using a pulse sequence of diffusion-weighted images for all patients where the stroke was not verified using CT data. Also, MRI was performed in patients with an unspecified pathogenetic variant of ischemic stroke.

The use of a comprehensive examination protocol made it possible to determine the causes of dizziness in all patients, and the proportion of patients with stroke was 10%.

CONCLUSION

In 70.6% of patients with acutely developed dizziness, entering the hospital with suspected acute cerebrovascular event, peripheral vestibulopathy is detected. Only in 10% of patients the cause of dizziness is ACVE.

REFERENCES

1. *WHO methods and data sources for country-level causes of death 2000–2015*. Department of Information, Evidence and Research WHO, Geneva. 2017.
2. Zhdanova S.G., Petrikov S.S., Ramazanov G.R., et al. Cerebral Infarction as the First Manifestation of Erythremia. *Russian Sklifosovsky Journal Emergency Medical Care*. 2016; (1): 66–69. (In Russian).
3. Krylov V.V., Volodyukhin M.Yu. Organization of interventional surgery for patients with acute ischemic stroke. *Neyrokhirurgiya*. 2017; (2): 60–65. (In Russian).
4. Bonita R., Mendis S., Truelsen T., et al. The Global Stroke Initiative. *The Lancet Neurology*. 2004; 3 (7): 391–393. PMID: 15207791. DOI: 10.1016/S1474-4422(04)00800-2.
5. Cnyrim C.D., Newman-Toker D.E., Karch C., et al. Bedside differentiation of vestibular neuritis from central ''vestibular pseudoneuritis''. *J Neurol Neurosurg Psychiatry*. 2008; 79 (4): 458–460. DOI: 10.1136/jnnp.2007.123596.
6. Norrving B.,Magnusson M., Holtis S. Isolated acute vertigo in the elderly; vestibular or vascular disease? *Acta Neurol Scand*. 1995; 91(1): 43–48. PMID: 7732773.
7. Lee H., Sohn S.-I., Cho Y.-W., et al. Cerebellar infarction presenting isolated vertigo: frequency and vascular topographical patterns. *Neurology*. 2006; 67(7): 1178–1183. PMID: 17030749. DOI: 10.1212/01.wnl.0000238500.02302.b4.
8. Kerber K.A., Zahuranec D.B. Brown D.L., et al. Stroke Risk after Nonstroke Emergency Department Dizziness Presentations: A Population-Based Cohort Study. *Ann Neurol*. 2014; 75 (6): 899–907. PMID: 24788511. PMCID: PMC4286199. DOI: 10.1002/ana.24172.
9. Kerber K.A., Brown D.L.,Lisabeth L.D., et al. Stroke Among Patients Whith Dizziness, Vertigo, and Imbalance in the Emergency Department: a population based study. *Stroke*. 2006; 37 (10): 2484–2487. DOI: 10.1161/01.STR.0000240329.48263.0d.
10. Newman-Toker D.E., Hsieh Y-.H., Camargo C.A.Jr., et al. Spectrum of dizziness visits to US emergency departments: cross-sectional analysis from a nationally representative sample. *Mayo Clin Proc*. 2008; 83(7): 765–775. PMID: 18613993. PMCID: PMC3536475. DOI: 10.4065/83.7.765.
11. Paul N.L., Simoni M., Rothwell P.M. Transient isolated brainstem symptoms preceding posterior circulation stroke: a populationbased study. *Lancet Neurol*. 2013; 12(1):65–71. PMID: 23206553. PMCID: PMC3530272. DOI: 10.1016/S1474-4422(12)70299-5.
12. Tarnutzer A.A., Berkowitz A.L., Robinson K.A., et al. Does my dizzy patient have a stroke? A systematic review of bedside diagnosis in acute vestibular syndrome. *CMAJ*. 2011; 183(9): 571–592. PMID: 21576300. PMCID: PMC3114934. DOI: 10.1503/cmaj.100174.
13. Saber Tehrani A.S., Kattah J.C., Mantokoudis F.G., et al. Small strokes causing severe vertigo Frequency of false-negative MRIs and nonlacunar mechanisms. *Neurology*. 2014; 83(2): 169–173. PMID: 24920847. PMCID: PMC4117176. DOI: 10.1212/WNL.0000000000000573.
14. Kattah J.C., Talkad A.V., Wang D.Z., et al. H.I.N.T.S. to Diagnose Stroke in the Acute Vestibular Syndrome. *Stroke*. 2009; 40(11): 3504–3510. DOI: 10.1161/STROKEAHA.109.551234.
15. Navi B.B., Kamel H., Shah M.P. Rate and Predictors of Serious Neurologic Causes of Dizziness in the Emergency Department. *Mayo Clin Proc*. 2012; 87(11): 1080–1088. PMID: 23063099. PMCID: PMC3541873. DOI: 10.1016/j.mayocp.2012.05.023.
16. Atzema C.L., Grewal K., Lu H., et al. Outcomes Among Patients Discharged From the Emergency Department With a Diagnosis of Peripheral Vertigo. *Ann Neurol*. 2016; 79(1): 32–34. PMID: 26385410. DOI: 10.1002/ana.24521.
17. Hotson J.R. Baloh R.W. Acute vestibular syndrome. *N Eng J Med*. 1998; 339(10): 680–685. PMID: 9725927. DOI: 10.1056/NEJM199809033391007.
18. Abdulina O.V. *Frequency, causes, differential diagnosis, treatment and prognosis of acute vestibular dizziness in emergency neurology: Cand. med. sci. diss*. Moscow, 2007. 92 p.