



Importance of vertigo classification in the emergency department and its effects on economic burden

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Abstract

Aim: Patients with vertigo present to the emergency department with their clinical status and social comfort significantly impaired. More importantly, diseases that can pose a life-threatening risk may also underlying vertigo. In our study, we aimed to detect life-threatening conditions in vertigo patients early, and to alleviate the economic burden by preventing unnecessary radiological imaging in emergency services.

Materials and Methods: Three hundred eighteen patients were included in the study. The patients were divided into two groups as peripheral and central vertigo. Patients' age, sex, temperature, pulse, and arterial blood pressure values were examined. The complaints at admission were grouped as dizziness, dizziness+nausea-vomiting, and dizziness+neurological complaint. Furthermore, patients' examination findings, history of diseases, and laboratory data were recorded. Radiological imaging methods used in the emergency department, the requested consultations, peripheral-central vertigo, and hospitalization-discharge status were examined.

Results: Of all patients, 287 (90.3%) and 31 (9.7%) had peripheral and central vertigo, respectively. The mean age of patients with peripheral vertigo was 52.34 ± 17.38 years, while the mean age of patients with central vertigo was 68.06 ± 19.56 years. There was a statistically significant difference between peripheral-central vertigo and age. A statistically significant difference was revealed between peripheral-central vertigo and systolic and diastolic blood pressure. In laboratory data, we found a significant difference between peripheral-central vertigo and glucose and CRP. Hypertension was the most common disease in the history.

Conclusion: The etiology of vertigo should be clarified quickly and reliably in emergency departments. To this end, the patient's complaints and the findings obtained as a result of the examination along with auxiliary radiological imaging methods are vital. Thus, the diagnosis and treatment of patients with severe vertigo will be performed earlier, and unnecessary radiological imaging will be prevented. As a result, the economic burden will also decrease with the decrease in the examinations performed.



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Introduction

Vertigo is a perception of movement, which is described in different ways, either in the patient himself/herself or in the surrounding objects. This condition is mostly described as a sensation of spinning and sometimes as swaying and tilting of the body or the environment [1]. The lifetime prevalence of vertigo has been reported to be 25%. This value increases up to 36% with the elderly [2]. The cause of vertigo can be defined as central vertigo caused by pathologies of the central nervous system and

peripheral vertigo caused by diseases affecting the inner ear or vestibulocochlear nerve [3]. The most common peripheral vestibular disorders in patients with vertigo are Meniere's disease, benign paroxysmal positional vertigo, vestibular neuritis, labyrinthitis, perilymphatic fistula, and acoustic neuroma [3]. Central vertigo is caused by disorders affecting the central structures such as the brain stem and cerebellum (vertebrobasilar insufficiency, lateral Wallenberg syndrome, anterior inferior cerebellar artery syndrome, neoplastic: cerebellopontine angle tumors, cerebellar disorders: bleeding, degeneration, basal ganglia disorders, multiple sclerosis) [4].

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Vertigo is one of the most common reasons for admission to the emergency department. In the USA, vertigo constitutes 2-3% of all admissions to the emergency department [5]. It is necessary to distinguish whether vertigo is caused by the central nervous system or peripheral vestibular disorders, especially in patients presenting to emergency departments with acute vertigo. By thoroughly investigating the etiological cause of vertigo, the causes of life-threatening, especially central vertigo, should be diagnosed in emergency departments, which is sometimes difficult for emergency physicians [5].

During the differential diagnosis of peripheral and central vertigo, the patient's complaints should be evaluated multi-systematically. All patients should also be evaluated in terms of anemia, psychiatric disorders, drug effects, and cardiovascular diseases [6]. Furthermore, if a central vertigo such as cerebellar stroke is missed due to an incorrect or incomplete diagnosis, the patient's treatment will be delayed, and his/her life risk will increase [7]. In all patients, a detailed anamnesis should be taken at the stage of diagnosis. Then, together with a detailed neurological examination, auxiliary laboratory tests, electrocardiography (ECG) and, in necessary cases, neuroimaging methods such as brain computed tomography (BCT) and brain magnetic resonance imaging (MRI) should be used [8]. In this study, we examined patients with vertigo who presented to the emergency department. We investigated the importance of these patients' complaints and examination findings in the differential diagnosis of peripheral-central vertigo with the necessary auxiliary radiological imaging methods. In addition, we aimed to reduce the economic burden by preventing unnecessary tests for these patients.

Materials and Methods

Study collection

Ethics committee approval was received for this study from Inonu University Scientific Research and Publication Ethics Committee with the decision number 2019/8-21 dated 11.04.2019. Patients were divided into two groups as peripheral and central vertigo as a result of the use of auxiliary diagnostic methods together with their complaints and examination findings. A total of 318 patients, 287 peripheral and 31 central, were included in the study. The physicians retrospectively screened the patients according to the diagnosis of vertigo from the hospital system. Patients with vertigo due to metabolic (hypo-hyperglycemia, hypo-hyponatremia), infectious (meningoencephalitis), traumatic (subdural-epidural hemorrhage, subarachnoid hemorrhage), and cardiac (bradycardia-tachycardia) causes that lead to dizziness were excluded from the study. Patients' age, sex, temperature, pulse, arterial blood pressure values, complaints at admission, examination findings, history of diseases, laboratory data (hemoglobin, platelet, glucose, CRP=C-reactive protein), radiological imaging methods used (BCT, brain diffusion MRI, carotid-vertebral color Doppler ultrasonography), requested consultations, peripheral-central vertigo conditions, hospitalization-discharge status, and wards where they were hospitalized were examined.

Statistical analysis

All data obtained were statistically analyzed using the IBM SPSS (version 20.0; SPSS™, Chicago, IL) program. The means and standard deviations of continuous variables and the numbers and percentages of categorical data were calculated. The patients were divided into two groups as peripheral and central vertigo. The statistical analysis of categorical variables was performed by Pearson's chi-square test. Student's t-test was used to compare the variables between the two groups. The level of statistical significance was considered as $p < 0.05$.

Results

Three hundred eighteen patients were included in the study. Patients were grouped as peripheral and central vertigo. Of all patients, 287 (90.3%) and 31 (9.7%) had peripheral and central vertigo, respectively. Of the patients, 183 (57.5%) and 135 (42.5%) were female and male, respectively. There was no statistically significant difference in terms of peripheral-central vertigo and the sex of patients ($p=0.371$). The mean age of patients with peripheral vertigo was 52.34 ± 17.38 years, whereas the mean age of patients with central vertigo was 68.06 ± 19.56 years. A statistically significant difference was revealed between peripheral-central vertigo and age ($p < 0.01$) (Table 1).

When the patients' vital signs were examined, the mean systolic blood pressure was 135.91 ± 25.52 mmHg, the mean

Table 1. Demographic data, vital signs, and laboratory values of patients with vertigo.

	Peripheral (n=287)	Central (n=31)	p
Sex			
Male	119	16	0.371
Female	168	15	
Age (years±SD)	52.34±17.38	68.06±19.56	<0.01
SBP (mmHg±SD)	135.91±25.52	158.16±29.14	<0.01
DBP (mmHg±SD)	84.95±14.57	92.06±13.50	0.009
Pulse (/min±SD)	81.21±13.18	79.90±16.65	0.675
Hemoglobin (g/dL±SD)	13.54±1.78	13.53±1.55	0.972
Plt (10^3 /uL±SD)	254.96±69.86	264.03±91.54	0.596
Glucose (mg/dL±SD)	118.87±57.10	166.12±99.16	0.014
CRP (mg/dL, min-max)	0.55 (0.10-10)	1.16 (0.10-9.36)	<0.01

SBP: Systolic blood pressure; DBP: Diastolic blood pressure; Plt: Platelet; CRP: C-reactive protein.

Table 2. Patients' history of diseases.

	Peripheral (n, %)	Central (n, %)	Total (n, %)
Hypertension	65 (20.4)	15 (4.7)	80 (25.1)
Coronary artery disease	35 (11)	11 (3.4)	46 (14.4)
Peripheral vertigo	40 (12.5)	0 (0)	40 (12.5)
Diabetes mellitus	17 (5.3)	10 (3.2)	27 (8.5)
Cerebrovascular disease	9 (2.8)	8 (2.5)	17 (5.3)
Hyperlipidemia	6 (1.9)	1 (0.3)	7 (2.2)

Table 3. Patients’ complaints and examination findings.

	Peripheral (n, %)	Central (n, %)	Total (n, %)
Patient complaints			
Dizziness	211 (66.4)	4 (1.2)	215 (67.6)
Dizziness+nausea-vomiting	75 (23.6)	6 (1.8)	81 (25.4)
Dizziness+neurological complaint	1 (0.3)	21 (6.7)	22 (7)
Total	287 (90.3)	31 (9.7)	318 (100)
Examination findings			
No examination findings	217 (68.2)	11 (3.5)	228 (71.7)
Nystagmus	69 (21.8)	1 (0.3)	70 (22.1)
Side finding	0 (0)	12 (3.8)	12 (3.8)
Aphasia-dysarthria	1 (0.3)	3 (0.9)	4 (1.2)
Ataxia-dysmetria-dysdiadochokinesia	0 (0)	3 (0.9)	3 (0.9)
Altered consciousness	0 (0)	1 (0.3)	1 (0.3)
Total	287 (90.3)	31 (9.7)	318 (100)

Table 4. Patients’ BCT and Brain Diffusion MRI findings.

	Peripheral (n, %)	Central (n, %)	Total (n, %)
BCT			
None	64 (20.1)	0 (0)	64 (20.1)
Normal	223 (70.2)	16 (5)	239 (75.2)
Ischemia is present	0 (0)	11 (3.5)	11 (3.5)
Hemorrhage is present	0 (0)	4 (1.2)	4 (1.2)
Total	287 (90.3)	31 (9.7)	318 (100)
Brain Diffusion MRI			
None	192 (60.4)	4 (1.2)	196 (61.6)
Ischemia is present	0 (0)	27 (8.5)	27 (8.5)
Ischemia is absent	95 (29.9)	0 (0)	95 (29.9)
Total	287 (90.3)	31 (9.7)	318 (100)

BCT: Brain computed tomography; MRI: Magnetic resonance imaging.

diastolic blood pressure was 84.95 ± 14.57 mmHg, and the mean pulse rate was 81.21 ± 13.18 /min in patients with peripheral vertigo. These values were 158.16 ± 29.14 mmHg, 92.06 ± 13.50 mmHg, and 79.90 ± 16.65 /min, respectively, in patients with central vertigo. While there was a statistically significant difference between peripheral-central vertigo and systolic and diastolic blood pressure, there was no significant difference between pulse ($p < 0.01$, $p = 0.009$, $p = 0.675$, respectively) (Table 1). Laboratory values of patients with peripheral-central vertigo were evaluated. Whereas there was no statistically significant difference between peripheral-central vertigo and hemoglobin and platelet levels, a significant difference was found between

Table 5. Consultations requested for patients presenting with vertigo and their hospitalization status.

	Peripheral (n, %)	Central (n, %)	Total (n, %)
Consultation			
None	209 (65.7)	0 (0)	209 (65.7)
Neurology	26 (8.2)	31 (9.7)	57 (17.9)
ENT	35 (11)	0 (0)	35 (11)
Neurology + ENT	17 (5.4)	0 (0)	17 (5.4)
Total	287 (90.3)	31 (9.7)	318 (100)
Hospitalization/Discharge			
Discharge	250 (78.6)	4 (1.2)	254 (79.8)
Neurology hospitalization	0 (0)	27 (8.5)	27 (8.5)
ENT hospitalization	37 (11.7)	0 (0)	37 (11.7)
Total	287 (90.3)	31 (9.7)	318 (100)

ENT: Ear, nose and throat.

glucose and CRP ($p = 0.972$, $p = 0.596$, $p = 0.014$, $p < 0.01$, respectively) (Table 1).

One hundred seventy (53.5%) patients had no history of disease. One hundred forty-eight (46.5%) patients had a history of at least one disease. Hypertension (HT) was the most common disease in the history ($n = 80$, 25.1%). Furthermore, coronary artery disease (CAD), peripheral vertigo, diabetes mellitus (DM), cerebrovascular disease (CVD), and hyperlipidemia were other diseases observed in the history (Table 2).

Considering the patients’ complaints, it was observed that while 215 (67.6%) patients presented only with dizziness, 81 (25.4%) presented with nausea and vomiting along with dizziness, and 22 (7%) presented with dizziness and a neurological complaint (numbness, loss of strength, ataxia, dysarthria-aphasia, altered consciousness) (Table 3).

Considering the examination findings of patients, 228 (71.7%) patients had no examination findings, 70 (22.1%) had nystagmus, 12 (3.8%) had side findings, 4 (1.2%) had aphasia-dysarthria, 3 (0.9%) had ataxia-dysmetria-dysdiadochokinesia, and 1 (0.3%) patient had altered consciousness (Table 3).

Considering the radiological imaging methods of patients, 64 (20.1%) patients did not undergo BCT. Two hundred fifty-four (79.9%) patients underwent BCT. BCT was normal in 239 (75.2%) patients who underwent BCT. Eleven (3.5%) patients had acute infarction in their BCT, and 4 (1.2%) had hemorrhage in their BCT (Table 4). Brain diffusion MRI was not performed in 196 (61.6%) patients. Brain diffusion MRI was performed in 122 (38.4%) patients. While 95 (29.9%) of the patients who underwent brain diffusion MRI had no acute infarction, 27 (8.5%) had acute infarction (Table 4).

The consultations requested for the patients presenting to the emergency department with vertigo were analyzed. A consultation was not requested for 209 (65.7%) patients. All of these patients had peripheral vertigo. While only neurology consultation was requested for 57 (17.9%) pa-

tients, only ENT (ear, nose and throat) consultation was requested for 35 (11%) patients, and both neurology and ENT consultations were requested for 17 (5.4%) patients (Table 5). Considering the hospitalization/discharge status of patients, it was observed that 254 patients were discharged, 27 were hospitalized in the neurology department, and 37 were hospitalized in the ENT department (Table 5).

Discussion

Dizziness constitutes a significant part of admissions to neurology and emergency department clinics after headache in society [9, 10]. It was divided into subgroups such as vertigo, disequilibrium, presyncope or syncope, lightheadedness, and nonspecific dizziness according to the symptoms [11]. Vertigo is the most common among these subgroups, and vertigo is defined as an illusion of movement that arises due to sudden tonic neural activity imbalance of the vestibular-visual system, in which the person states that his/her environment or himself/herself is spinning [12]. In a prospective study conducted by Kroenke et al. with 100 patients, vertigo was reported to be the most common type by 54% among other causes of dizziness [13]. Another prospective study conducted with 108 patients found vertigo as the most common type among other types of dizziness by 50% [14].

The diseases that cause vertigo are divided into two groups as peripheral and central vertigo [11]. While peripheral causes constitute a significant part of vertigo, central causes constitute a small part of it. A study conducted with patients with vertigo in the emergency department showed that vertigo was caused by central causes in less than 5% of these patients [15]. In our study, central vertigo constituted 9.7% of all patients with vertigo. In one of the studies, it was observed that 66% of the patients diagnosed with vertigo were female [16]. Another study reported that 62% of the patients with vertigo were female [17]. As is seen, studies in the literature have demonstrated that vertigo is more common in females [16, 17]. In our study, the majority of the patients were female (57.5%), which was consistent with the literature.

Each year, 7.5 million people are investigated for complaints of dizziness. It has been observed that the prevalence of vertigo between the ages of 18-79 is 7.4%, and its incidence increases especially with age [18]. Dizziness has been reported to be more common in patients over 65 years of age. In a study, 47.3% of the patients with vertigo were found to be over 65 years of age [16]. Another study found the mean age of patients with vertigo to be 52.6 [19]. With advanced age, many chronic diseases such as stroke, CAD, and HT are important and unmodifiable risk factors for vertigo [20]. Upon examining the ages of patients with peripheral-central vertigo in our study, we revealed that patients with central vertigo were older. High mean systolic and diastolic blood pressures in patients with central vertigo show that both advanced age and accompanying comorbid diseases are more common in these patients. We think that the more frequent occurrence of central vertigo at older ages is due to the increase in comorbid diseases with age.

Vertigo is one of the subgroups of dizziness whose differential diagnosis is quite wide. A detailed anamnesis and then a detailed physical examination are the most important things to do for the diagnosis of these patients in emergency departments. The algorithms developed by O'Brien and Gross contribute significantly to the systematic evaluation of patients [21]. Patients presenting to the emergency department with acute vestibular syndrome are quickly evaluated by the HINTS (head impulse, spontaneous nystagmus, test of skew deviation) examination and STANDING (spontaneous and positional nystagmus, the evaluation of the nystagmus direction, the head impulse test, the evaluation of equilibrium) algorithm [22, 23]. In this study, we showed that when especially neurological deficits (numbness, loss of strength, ataxia, dysarthria-aphasia, altered consciousness) are detected in vertigo patients, these patients should be evaluated for central vertigo, and pathological neurological examination findings should be stimulating.

Although dizziness and vertigo can be treated by primary care health services and more comprehensive centers [24], they continue to be an important health problem in emergency departments. In the USA, 2.6-3.9 million patients present to the emergency department with these complaints in a year. Furthermore, it has been reported that this situation causes 3.9 billion dollars of health expenditures in the country's economy [25, 26]. In Turkey, the number of patients presenting with vertigo and dizziness increases every day, and there is no study examining its effect on the economic burden. Nowadays, elucidating the etiology of these patients in emergency departments is usually difficult, expensive, and requires a long time [27, 28]. One of the studies aimed to detect some critical findings in patients with vertigo presenting to the emergency department, identify non-benign conditions in these patients, and prevent delays in diagnosis and treatment [29]. In our study, patients with vertigo presenting to a tertiary emergency department were examined, and attention was drawn to the importance of examination findings, especially with the complaints of patients, to differentiate between peripheral and central vertigo in these patients.

A retrospective study by Yıldırım et al. showed that BCT examination was requested at a rate of 30.3% in the one-year analysis of patients presenting to otorhinolaryngology, neurology, and emergency medicine departments due to vertigo [30]. BCT was requested for 254 (79.9%) of 318 (100%) patients in our study. We detected pathological findings in 15 (5.9%) of these 254 (100%) patients. We think that the higher rate of BCT in our study was due to including only emergency department admissions in the study and the fact that patients presented with a more severe and acute onset clinical picture. Furthermore, brain diffusion MRI was performed in 38.3% (n=122) of the patients in our study. We found pathological findings in only 22% (n=27) of them. As is seen, high radiological examination, especially in emergency departments, continues to cause a significant economic burden. In this regard, Kerber et al. reported that BCT and MRI requests increased by 169% in patients with dizziness presenting to the emergency department between 1995 and 2004. However, it was observed that the rate of central nervous system di-

agnoses (such as stroke and intracranial space-occupying lesion) did not change, despite the increase in the number of examinations [31].

Patients with vertigo are mostly investigated without requiring hospitalization [32, 33]. However, the physiological and psychological disorders of these patients continue to be an important health problem in society. A meta-analysis by Kovasc et al. investigated the effects on public health and health expenditures due to dizziness between 2008 and 2018 [34]. This study is also important in terms of providing preliminary information about the effects on health expenditures by examining the epidemiological analysis, clinical features, and radiological examinations of patients with vertigo in Turkey.

Conclusion

Vertigo is a frequent reason for presenting to the emergency department, which significantly impacts the quality of life. A detailed anamnesis and detailed physical examination and more frequent use of algorithms in our daily practice are required for a rapid and reliable evaluation of the cause of vertigo. We demonstrated that patients with advanced age, uncontrolled HT, and pathological neurological examination findings should be examined more carefully in terms of central vertigo. The diagnosis and treatment will be performed faster with the complaints and examination findings of patients by avoiding unnecessary radiological imaging in patients presenting with vertigo, and health expenditures will be reduced, which will contribute to the country's economy. In addition, more comprehensive studies to be carried out in the future will contribute more to the literature.

Limitations

Our study has several limitations. The first of these is the small number of patients. Our second limitation is that the study was conducted retrospectively.

Conflict of interests

The authors declare that they have no competing interest.

Financial disclosure

All authors declare no financial support.

Ethics approval

The study was approved by Inonu University Scientific Research and Publication Ethics Committee with the decision number 2019/8-21 dated 11.04.2019.

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