

Value of Head CT Scan in the Emergency Department in Patients with Vertigo without Focal Neurological Abnormalities

Tomislav Pavlović^{1,2*}, Marina Milošević³, Sanja Trtica¹, Hrvoje Budinčević^{2,3}

¹Department of Radiology, Sveti Duh University Hospital, Zagreb, Croatia; ²J. J. Strossmayer University of Osijek, Faculty of Medicine, Osijek, Croatia; ³Stroke and Intensive Care Unit, Department of Neurology, University Hospital "Sveti Duh", Zagreb, Croatia

Abstract

Citation: Pavlović T, Milošević M, Trtica S, Budinčević H. Value of Head Ct Scan in the Emergency Department in Patients with Vertigo without Focal Neurological Abnormalities. Open Access Maced J Med Sci. 2018 Sep 25; 6(9):1664-1667. <https://doi.org/10.3889/oamjms.2018.340>

Keywords: Vertigo; Emergency department; Computed tomography (CT)

***Correspondence:** Tomislav Pavlović. Department of Radiology, Sveti Duh University Hospital, Zagreb, Croatia. E-mail: tpavlovic2@gmail.com

Received: 20-May-2018; **Revised:** 14-Aug-2018; **Accepted:** 29-Aug-2018; **Online first:** 24-Sep-2018

Copyright: © 2018 Tomislav Pavlović, Marina Milošević, Sanja Trtica, Hrvoje Budinčević. This is an open-access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (CC BY-NC 4.0)

Funding: This research did not receive any financial support

Competing Interests: The authors have declared that no competing interests exist

BACKGROUND: Vertigo is a common symptom and reason for admission to the emergency department (ED).

AIM: This research aimed to determine the incidence of clinically significant findings on computed tomography (CT) in patients with vertigo without focal neurological abnormalities in the ED.

MATERIAL AND METHODS: The results of the native CT scans in the ED were retrospectively analysed. Exclusion criteria included: focal neurological abnormalities, underlying malignancy, brain metastasis, previous brain operation, headache, fever, nausea, vomiting, head trauma, coagulopathy. As a clinically significant finding, we took into account tumour, haemorrhage and acute ischemic lesion. 72 patients fulfilled the set criteria, present vertigo, without focal neurological abnormalities. Out of 72 patients with a median age of 62 (23-87) years old, 54% of the patients were female, and 46% were male.

RESULTS: Normal CT findings were found in 44 patients (61.1%), 28 patients (38.9%) had pathological findings, out of that number 23 (31.9%) findings were clinically irrelevant and 5 (6.9%) were clinically significant. Out of the 5 clinically significant findings, tumour process was found in 3 (4.2%) patients, haemorrhage was found in 1 (1.4%) patient, and the ischemic lesion was found in 1 (1.4%) patient. Additional evaluation of five clinically significant findings showed a change of initial diagnosis in one case, but the significance of the finding remained the same.

CONCLUSION: Our study demonstrates a low diagnostic yield of head CT examination with 6.9% of clinically significant findings in patients with vertigo without focal neurological abnormalities.

Introduction

Vertigo is a common symptom and reason for admission to the emergency department (ED). Patients with vertigo constitute about 4% of all emergency visits [1] [2] [3] [4]. Vertigo is a false sensation of body movement or the environment around it. The patient usually senses rotation-rounding or spin. Vertigo represents one of the ten most common reasons for the ambulatory examination [5]. Treatment of patients with vertigo requires examinations from various specialists, including neurologists, ear nose throat (ENT) specialists and internists. Laboratory tests, imaging

with brain computed tomography (CT) and brain magnetic resonance (MR) is often needed [2] [6]. Many patients with vertigo are released from the ED without a diagnosis [2] [7] [8]. CT scanning of the head is often performed in the evaluation of the patient with vertigo as a routine practice. This leads to the increased use of CT in ED [8] [9] especially in patients with vertigo [2]. CT has a limited value in the evaluation of the patient with vertigo [10] [11] [12], MR has a much greater sensitivity, but it is rarely available in the ED [11]. So far, published studies have revealed a small number of positive findings on head CT of the patients with vertigo, Lahwn-Heath et al., reported 2.2% positive findings on head CT scan in ED, Wasay et al., reported that head CT has a low

diagnostic yield for isolated vertigo [11]. Radiological investigations should be considered as elective diagnostic procedures, and they include CT, MR, MR angiography and digital subtraction angiography [13]. Evaluation of the vertigo is a significant financial load for the health system and also leads to the increased exposure to ionising radiation of the population [14]. Aetiology of vertigo may be related to the cardiovascular system or the central or peripheral nervous system. As a cause of vertigo, we can differentiate a central cause associated with the brain or peripheral cause associated with the diseases of the inner ear. The main reason for a head CT scan is the detection of potentially life-threatening disorders such as a stroke or a brain tumour [15]. Additional reasons for the CT scan examination are the legal aspects, patient's demand or pressure on the emergency physician.

This study aims to determine the incidence of positive CT scan findings in the emergency department in patients with vertigo, without focal neurological abnormalities.

Material and Methods

The results of the native CT scans of the brain performed in the emergency department (ED) of the University Hospital "Sveti Duh" in Zagreb from January 2017 till January 2018 were retrospectively analysed. Patients were older than 18 and younger than 87, and they presented to the ED because of vertigo. We took into the consideration only reports made by the selfsame radiologist with eight years of experience. We restricted our study to patients examined by residents of neurology or neurology specialists. All scans were obtained with 64-section multidetector CT scanner (Siemens). Exclusion criteria were: focal neurological abnormality, head trauma, underlying malignancy, brain metastases, previous brain surgery, headache, fever, nausea, vomiting, coagulopathy. Focal neurological abnormalities include impairments of the nerve, spinal cord or brain that affects a specific region of the body. CT scan reports were divided into three categories: V0-completely normal finding, V1-positive finding but clinically insignificant, V2-positive finding but clinically significant. As a clinically significant finding, tumour, haemorrhage and ischemic lesion were taken into consideration. All of the V2 reports were further evaluated by MR scan and/or CT angiography. Physicians requiring a CT scan were divided into two groups: N0-resident of neurology, N1-neurology specialist. For statistical analysis, MedCalc (16.2.0, MedCalc Software bvba, Ostend, Belgium) was used. Results were shown with descriptive statistics. Normality of the distribution of numeric variables was tested with the Kolgomorov-Smirnov test. Fisher's

exact test was used for comparison of category variables differences. The results were considered statistically significant at $p < 0.05$. Ethical approval for this study was obtained.

Results

After data analysis, 72 patients fulfilled the set criteria, present vertigo, without focal neurological abnormalities. Out of 72 patients with median age of 62 (23-87) years old, 39 (54%) were women with median age of 63 (23-87) years old, and 33 (46%) of them were men with median age of 62 (27-86). Of the 72 patients who presented with vertigo, we found 6.9% clinically significant abnormal CT finding.

Table 1: CT scan reports according to the results

CT examination results	Male N = 33	Female N = 39	All patients N = 72	p
V0	20; 27.8%	24; 33.3%	44; 61.1%	>0.99
V1	10; 13.9%	13; 18.1%	23; 31.9%	0.81
V2	3; 4.2%	2; 2.8%	5; 6.9%	0.66

Classification of the CT scan reports according to its results is shown in Table 1 and according to the physician requiring a CT scan in Table 2.

Table 2: CT scan reports according to the physician requiring a CT scan

	N0	N1	p
V0	22; 30.6%	22; 30.6%	0.15
V1	16; 22.2%	7; 9.7%	0.20
V2	3; 4.2%	2; 2.8%	> 0.99
All patients	41; 56.9%	31; 43.1%	

N0-resident of neurology; N1-neurology specialist.

Positive findings but clinically insignificant are shown in Table 3.

Table 3: Positive findings but clinically insignificant (V1)

Diagnosis N (%)
Microvascular changes and lacunas 11 (47.8%)
Parenchymal calcification 4 (17.4%)
Sinus changes 4 (17.4%)
Asymmetry of the ventricular system 3 (13.0%)
Cyst 1 (4.3%)

Positive findings but clinically significant depending on physician requiring a CT scan are shown in Table 4.

Table 4: Positive findings but clinically significant depending on the physician requiring a CT scan

V2	N0 N=3	N1 N=2	All patients V2 N=5 (6.9%)
Tumor	2	1	3 (4.2%)
Haemorrhage	0	1	1 (1.4%)
Ischaemia	1	0	1 (1.4%)

In three patients diagnosed with a tumour, MR showed expansive tumour of the cerebrum in two

cases and arteriovenous malformation of the cerebellum in one case. In a patient diagnosed with subarachnoidal haemorrhage, CT angiography and MR confirmed subarachnoidal haemorrhage. In case of the patient with the ischemic lesion, the finding was confirmed with MR scan. Additional evaluation of five clinically significant findings showed a change of initial diagnosis in one case, but the significance of the finding remained the same. Of the 72 patients who presented with vertigo 20 (27.8%) of them were admitted to the hospital. Of the 5 patients (6.9%) with V2 clinically significant CT finding, all 5 admitted to the Hospital. There was a statistically significant higher admission rate for patients with vertigo who also had a clinical significant CT finding than those who had normal head CT finding ($p = 0.001$). Classification of the CT scan reports according to the admission to the hospital is shown in Table 5.

Table 5: Classification of the CT scan reports according to the admission to the hospital

CT examination results	No admitted no.(%)	Admitted no.(%)	p
VO	36; 50.0%	8; 11.1%	0.03
V1	16; 22.2%	7; 9.7%	0.81
V2	0; 0%	5; 6.9%	0.001
All patients	52; 72.2%	20; 27.8%	

Discussion

Vertigo is a common symptom in medical practice and a common reason for presentation in ED [3] [4] [16]. Diagnostic evaluation of vertigo with CT scan remains controversial; there are some studies that have confused the importance of CT scan in vertigo without focal neurological abnormalities and recent head trauma [10] [17]. Previous studies in the diagnostic of clinically significant findings in CT scans of the head in patients with vertigo but without recent head trauma have various results. Mitsunaga et al., [18] showed 7.1% of clinically significant findings; the study included patients with focal neurological deficit and patients with head trauma. Lawhn-Heath et al., [19] reported 2.2% positive findings for head CT scan in ED; they included patients with the focal neurological deficit, headache and trauma. Ahsan et al., [1] found 6.17% positive findings and 0.74% clinically significant findings for patients who were examined with CT or MR; they included patients with vertigo and dizziness, excluded patients with a history of stroke, brain tumour, brain surgery and other neurological disorder. Fakhran et al., [20] reported 3% positive findings on CT and MR examination performed with contrast; they excluded patients with the focal neurological deficit. Our research revealed 6.9% of clinically significant emergency examinations in patients with vertigo, without focal neurological abnormalities. Analysing the incidence of clinically significant findings in this study, screening methods should be taken into account, considering that all of

the patients were examined by residents of neurology or neurology specialist unlike in other studies where CT scan was required by emergency physicians, general practitioner, internal medicine specialists and other. Navi et al., [21] reported 7% of relevant abnormal head CT scans in the ER what is consistent with our results. Grossman et al., [22] reported 5% of abnormal head CT findings after excluding patients with trauma, altered mental status, seizure and hypoglycaemia what is also similar to our results. Similar to our results, Chase et al., [23] reported 8.3% abnormal finding on MR scan in ED and non-ED patients with vertigo.

According to the results of the requested CT examinations, we found that there is no statistically significant difference between residents of neurology and neurology specialists, according to that, we can conclude that the competences of residents of neurology after education meet the compliance with the clinical guidelines for the implementation of the screening of patients with vertigo. In our study incidence of ischemia is 1.4%. The result is consistent with prior studies, Kerber et al. reported that about 3% of the patients with dizziness had a stroke aetiology, and less of 1% of patients with isolated dizziness had a stroke as the aetiology [7] [8]. Kim et al., [24] estimate that the overall stroke risk for patients with dizziness presenting to the ED is 2.4%. Further evaluation of the clinically significant findings with MR scan or CT angiography showed a change in diagnosis in one case, but the finding remained clinically significant, and there was no change in the outcome category. Mitsunaga et al., [16] reported 18.6% admission to the hospital for the patients with vertigo. We also report an admission rate of 27.8% for patients with vertigo, which is similar to the 22% of patients admitted to the hospital from the ED in the study Navi et al., [21]. In our study patients with vertigo with positive clinically significant CT findings had higher admission rate which is consistent with study Mitsunaga et al., [18].

In conclusion, our study demonstrates a low diagnostic yield of head CT examination for patients with vertigo without focal neurological abnormalities. Routine CT scan cannot be recommended in these patients. Adequate guidelines need to be developed for the diagnostic treatment of patients with vertigo without neurological symptoms and signs.

References

- Ahsan SF, Syamal MN, Yaremchuk K, Peterson E, Seidman M. The costs and utility of imaging in evaluating dizzy patients in the emergency room. *Laryngoscope*. 2013; 123(9):2250-3. <https://doi.org/10.1002/lary.23798> PMID:23821602
- Newman-Toker DE, Hsieh YH, Camargo CA, Pelletier AJ, Butchy GT, Edlow JA. Spectrum of dizziness visits to US

- emergency departments: cross-sectional analysis from a nationally representative sample. *Mayo Clin Proc.* 2008; 83(7):765-75. <https://doi.org/10.4065/83.7.765> PMID:18613993 PMCID:PMC3536475
3. Kroenke K, Lucas CA, Rosenberg ML, Scherokman B, Herbers JE, Wehrle PA, et al. Causes of persistent dizziness. A prospective study of 100 patients in ambulatory care. *Ann Intern Med.* 1992; 117(11):898-904. <https://doi.org/10.7326/0003-4819-117-11-898> PMID:1443950
4. Hanley K, O'Dowd T, Considine N. A systematic review of vertigo in primary care. *Br J Gen Pract.* 2001; 51(469):666-71. PMID:11510399 PMCID:PMC1314080
5. Cappello M, di Blasi U, di Piazza L, Ducato G, Ferrara A, Franco S, et al. Dizziness and vertigo in a department of emergency medicine. *Eur J Emerg Med.* 1995; 2(4):201-11. <https://doi.org/10.1097/00063110-199512000-00006> PMID:9422208
6. Stewart MG, Chen AY, Wyatt JR, Favrot S, Beinart S, Coker NJ, et al. Cost-effectiveness of the diagnostic evaluation of vertigo. *Laryngoscope.* 1999; 109(4):600-5. <https://doi.org/10.1097/00005537-199904000-00015> PMID:10201748
7. Kerber KA, Brown DL, Lisabeth LD, Smith MA, Morgenstern LB. Stroke among patients with dizziness, vertigo, and imbalance in the emergency department: a population-based study. *Stroke.* 2006; 37(10):2484-7. <https://doi.org/10.1161/01.STR.0000240329.48263.0d> PMID:16946161 PMCID:PMC1779945
8. Kerber KA, Meurer WJ, West BT, Fendrick AM. Dizziness presentations in U.S. emergency departments, 1995-2004. *Acad Emerg Med.* 2008; 15(8):744-50. <https://doi.org/10.1111/j.1553-2712.2008.00189.x> PMID:18638027
9. Smith-Bindman R, Miglioretti DL, Larson EB. Rising use of diagnostic medical imaging in a large integrated health system. *Health Aff (Millwood).* 2008; 27(6):1491-502. <https://doi.org/10.1377/hlthaff.27.6.1491> PMID:18997204 PMCID:PMC2765780
10. Wasay M, Dubey N, Bakshi R. Dizziness and yield of emergency head CT scan: Is it cost effective? *Emergency Medicine Journal.* 2005; 22(4):312. <https://doi.org/10.1136/emj.2003.012765> PMID:15788853 PMCID:PMC1726733
11. Chalela JA, Kidwell CS, Nentwich LM, Luby M, Butman JA, Demchuk AM, et al. Magnetic resonance imaging and computed tomography in emergency assessment of patients with suspected acute stroke: a prospective comparison. *Lancet.* 2007; 369(9558):293-8. [https://doi.org/10.1016/S0140-6736\(07\)60151-2](https://doi.org/10.1016/S0140-6736(07)60151-2)
12. Simmons Z, Biller J, Adams HP, Dunn V, Jacoby CG. Cerebellar infarction: comparison of computed tomography and magnetic resonance imaging. *Ann Neurol.* 1986; 19(3):291-3. <https://doi.org/10.1002/ana.410190312> PMID:3963774
13. Bruzzone MG, Grisoli M, De Simone T, Regna-Gladin C. Neuroradiological features of vertigo. *Neurological Sciences.* 2004; 25:S20-S3. <https://doi.org/10.1007/s10072-004-0211-x> PMID:15045615
14. Smith-Bindman R. Is computed tomography safe? *N Engl J Med.* 2010; 363(1):1-4. <https://doi.org/10.1056/NEJMp1002530> PMID:20573919
15. Savitz SI, Caplan LR, Edlow JA. Pitfalls in the diagnosis of cerebellar infarction. *Acad Emerg Med.* 2007; 14(1):63-8. <https://doi.org/10.1197/j.aem.2006.06.060> PMID:17200515
16. Burt CW, Schappert SM. Ambulatory care visits to physician offices, hospital outpatient departments, and emergency departments: United States, 1999-2000. *Vital and health statistics. Series 13, Data from the National Health Survey.* 2004; (157):1-70.
17. Goyal N, Donnino MW, Vachhani R, Bajwa R, Ahmad T, Otero R. The utility of head computed tomography in the emergency department evaluation of syncope. *Internal and Emergency Medicine.* 2006; 1(2):148-50. <https://doi.org/10.1007/BF02936543> PMID:17111790
18. Mitsunaga MM, Yoon HC. JOURNAL CLUB: Head CT Scans in the Emergency Department for Syncope and Dizziness. *American Journal of Roentgenology.* 2015; 204(1):24-8. <https://doi.org/10.2214/AJR.14.12993> PMID:25539233
19. Lawhn-Heath C, Buckle C, Christoforidis G, Straus C. Utility of head CT in the evaluation of vertigo/dizziness in the emergency department. *Emerg Radiol.* 2013; 20(1):45-9. <https://doi.org/10.1007/s10140-012-1071-y> PMID:22940762
20. Fakhra S, Alhilali L, Branstetter BF. Yield of CT angiography and contrast-enhanced MR imaging in patients with dizziness. *AJNR Am J Neuroradiol.* 2013; 34(5):1077-81. <https://doi.org/10.3174/ajnr.A3325> PMID:23099499
21. Navi BB, Kamel H, Shah MP, Grossman AW, Wong C, Poisson SN, et al. The use of neuroimaging studies and neurological consultation to evaluate dizzy patients in the emergency department. *Neurohospitalist.* 2013; 3(1):7-14. <https://doi.org/10.1177/1941874412458677> PMID:23983882 PMCID:PMC3726125
22. Grossman SA, Fischer C, Bar JL, Lipsitz LA, Mottley L, Sands K, et al. The yield of head CT in syncope: a pilot study. *Intern Emerg Med.* 2007; 2(1):46-9. <https://doi.org/10.1007/s11739-007-0010-5> PMID:17551685 PMCID:PMC2780634
23. Chase M, Joyce NR, Carney E, Saliccioli JD, Vinton D, Donnino MW, et al. ED patients with vertigo: can we identify clinical factors associated with acute stroke? *Am J Emerg Med.* 2012; 30(4):587-91. <https://doi.org/10.1016/j.ajem.2011.02.002> PMID:21524878
24. Kim AS, Sidney S, Klingman JG, Johnston SC. Practice variation in neuroimaging to evaluate dizziness in the ED. *Am J Emerg Med.* 2012; 30(5):665-72. <https://doi.org/10.1016/j.ajem.2011.02.038> PMID:21570240 PMCID:PMC4560264