STANDING update: A retrospective analysis in the Emergency Department one year after its validation

Alice Ceccofiglio,[1] Rudi Pecci,[2] Giulia Peruzzi,[1] Giulia Rivasi,[1] Martina Rafanelli,[1] Simone Vanni,[3] Andrea Ungar[1]

[1]Syncope Unit, Department of Geriatrics, Azienda Ospedaliero-Universitaria Careggi and University of Florence; [2]Unit of Audiology, Head and Neck Oncological and Robotic Surgery, Oncology and Robotic Surgery Department, Azienda Ospedaliero-Universitaria Careggi and University of Florence; [3]Department of Emergency Medicine, Azienda Ospedaliero-Universitaria Careggi and University of Florence, Florence, Italy

Abstract

A structured four-step bedside algorithm, named SponTAneous Nystagmus, Direction, head Impulse test, standiNG (STANDING), has been proposed to differentiate central from peripheral acute vestibulopathy in the Emergency Department (ED). We aimed to evaluate the effective application of STANDING in the management of vertigo in the ED and to define its role in deciding the patient's pathway after discharge. We retrospectively analysed data from 131 consecutive patients (65% female, mean age 56) undergoing ED visits for a vertigo complaint between April and May 2016. Our study showed that the STANDING algorithm is underused, being performed only in the 18% of patients. The positivity of the STANDING did not influence the choice of the following pathway (*e.g.* outpatient fast track or discharge). Moreover, a small percentage of patients had a non-audiological diagnosis (mainly presyncope), for which no defined pathways were yet foreseen. Our study emphasized the need for continuous updating with appropriate training courses and the importance of a multidisciplinary assessment of vertigo in the ED.

Correspondence: Rudi Pecci, Unit of Audiology, Head and Neck Oncological and Robotic Surgery, Oncology and Robotic Surgery Department, Azienda Ospedaliero-Universitaria Careggi and University of Florence, Largo Piero Palagi 1, 50139 Florence, Italy
Tel: +39.055.7947572 - Fax: +39.055.7946229
E-mail: peccirudi@gmail.com

Key words: dizziness; vertigo; Audiology Unit; Syncope Unit.

Contributions: AC, AU, SV: study concept and design; AC, RP, GP and GR: acquisition of data. AC, RP: analysis and interpretation of data. AC, MR statistical analysis. AC, RP, MR: drafting of the manuscript. AU, MR, SV: critical revision of the manuscript for important intellectual content. AU: study supervision.

Conflict of interest: the authors declare no potential conflict of interests.

Ethics approval and consent to participate: The manuscript does not contain any individual person's data in any form.

Received for publication: 26 January 2020.
Accepted for publication: 18 May 2020

This work is licensed under a Creative Commons Attribution 4.0 License (by-nc 4.0).

©Copyright: the Author(s), 2020
Licensee PAGEPress, Italy
Emergency Care Journal 2020; 16:8848
doi:10.4081/ecj.2020.8848

Introduction

Dizziness (including vertigo and non-vestibular dizziness) ranks among the most common complaints in medicine, affecting ~20 to 30% of the general population,[1-3] of which almost a quarter is represented by vestibular vertigo.[4] Its prevalence rises with age and it's about two to three times higher in women than in men.[4,5] Furthermore, vertigo and dizziness are among the main reasons for patients' referral to the Emergency Department (ED), currently amounting to 2-3% of all consultations.[6,7] In this setting, the identification of central or otherwise serious vertigo is a major concern.[7,8] However, stroke was found to be a rare cause of dizziness in the ED; indeed, only the 0.7% of patients presenting with isolated dizziness and the 3.2% of those presenting with any dizziness had an acute cerebrovascular event.[9] More frequently, symptoms are caused by a benign peripheral vestibular disorder, which has characteristic features enabling a bedside diagnosis. Thus, the most effective way to *rule-out* a central disorder is to *rule-in* a specific peripheral vestibular disorder.[10]

A structured bedside algorithm (STANDING: SponTAneous Nystagmus, Direction, head Impulse test, standiNG) has been proposed to differentiate central from peripheral vestibular syndromes in an unselected population presenting with acute vertigo in ED.[11] The four-step algorithm identified central acute vestibular syndromes with a very high sensitivity (72-100%) and specificity (91-94%) and was associated with a significant reduction of neuroimaging and hospitalization rates compared to the standard clinical examination (~28% vs ~51% and ~32% vs ~71%, respectively). The aim of the present study was to evaluate the effective application of STANDING in the management of vertigo in the ED, one year after its validation. The second aim of our study was to establish its role in deciding the patient's pathway after discharge.

Materials and Methods

All adult patients complaining of vertigo at the triage of the ED, (main attendance 130.000 people/year) between April and May 2016 were included. Clinical data were retrospectively col-

Non-commercial use only

lected from the *FirstAid* program in order to obtain the baseline characteristics (age, sex, main comorbidities and home therapy), the episode's characteristics (clinical features, predisposing factors, precipitating events, after event's symptoms, associated injuries), the patient's assessment in the ED, focusing on blood tests, electrocardiogram, echocardiography, carotid Doppler study, Computed Tomography (CT) brain scan, brain Magnetic Resonance Imaging, orthostatic challenge, supine carotid sinus massage, STANDING test, audiological evaluation and neurological evaluation, and the final diagnosis.

The STANDING test (Figure 1) is a structured diagnostic algorithm based on clinical signs and bedside manoeuvres assembled into a four-step sequence:[12,13]
i) assessment of the presence and type of nystagmus (SponTAneous, positional, absent); ii) assessment of nystagmus direction (Nystagmus Direction); iii) Head Impulse Test (HIT); iv) evaluation of the standing position and gait (standiNG).

The presence of nystagmus is assessed using Frenzel lenses in the supine position after at least 5 min of rest. When no spontaneous nystagmus is detected in the primary position and in the five main gaze positions, the presence of positional nystagmus is investigated using the Pagnini–McClure test (supine roll test) and the Dix–Hallpike test.[14] The presence of a paroxysmal positional nystagmus (lasting 1-2 minutes), beating on the plane of the assessed canal is considered typical of Benign Paroxysmal Positional Vertigo (BPPV). More in details, from the observer's perspective, typical BPPV nystagmus is counterclockwise and upbeating for the right posterior canal, clockwise and upbeating for the left posterior canal and horizontal for lateral canals.

When spontaneous nystagmus is present, its direction is assessed. Multidirectional nystagmus, such as bidirectional gaze-evoked nystagmus (*i.e.*, right beating nystagmus on rightward gaze and left beating nystagmus present on leftward gaze), and vertical (up or down beating) nystagmus are considered to be signs of central vertigo.

If a spontaneous, horizontal and unidirectional nystagmus is detected (*i.e.*, horizontal nystagmus beating on the same side independently of the gaze direction) the HIT is performed.[15] If an acute unilateral labyrinthine lesion exists, inputs from the opposite side are unopposed resulting in the eyes moving with the head, when the latter is rapidly moved toward the affected side. Immediately thereafter, a corrective eye movement (corrective *saccade*) back to the point of reference is seen. When the corrective *saccad* is present, the HIT is considered to be positive and indicates a peripheral disorder, whereas a negative HIT indicates a central vertigo.[16]

Once nystagmus has been assessed the patient is asked to stand and the gait is evaluated, particularly in patients showing neither spontaneous nor positional nystagmus. When a marked imbalance is present (inability to stand and walk without assistance), vertigo is suspected to be of central origin.[17]

The innovative nature of the STANDING mainly lies in i) the sequence of tests (*i.e.*, the algorithm), ii) the setting (*i.e*, the ED), and - most importantly - iii) the health professionals performing the algorithm, *i.e.* emergency physicians, who are not neuro-otology specialists.

All the study information was recorded from patients as part of the routine clinical care and collected into a database anonymously for the purpose of the present analysis.

No Ethics Committee formal approval was needed for this study, as recent Italian Legislation [General Authorization to Process Personal Data for Scientific Research Purposes-1 March 2012 (web document no. 1884019)] conceded that Ethics

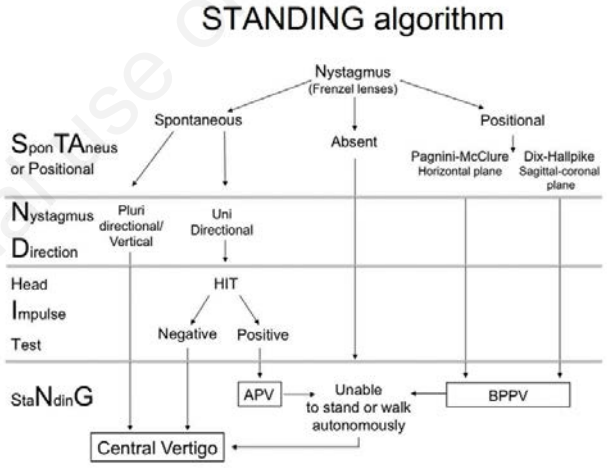

Figure 1. Diagram of STANDING approach. The figure shows the four-step bedside algorithm. APV: acute peripheral vestibulopathy; BPPV: Benign Paroxysmal Positional Vertigo.

Table 1. Diagnostic tests performed in the emergency room for assessment of vertigo.

	Evaluated (n=131)	Diagnosed (n=evaluated)
Blood tests (n,%)*	65 (49.6)	2 (3.1)
Electrocardiogram (n,%)	56 (42.7)	0 (0.0)
Echocardiography (n,%)	6 (4.6)	0 (0.0)
Carotid Doppler Ultrasound (n,%)	16 (12.2)	1 (6.3)
Brain CT (n,%)	52 (39.7)	3 (5.8)
Brain MRI (n,%)	5 (3.8)	1 (20.0)
Orthostatic challenge (n,%)	7 (5.3)	1 (14.3)
Supine carotid sinus massage (n,%)	4 (3.1)	0 (0.0)
STANDING test* (n,%)	24 (18.3)	9 (37.5)
Audiological evaluation* (n,%)	29 (22.1)	21 (72.4)
Neurological evaluation* (n,%)	8 (6.1)	7 (87.5)

CT: Computed Tomography; MRI: Magnetic Resonance Imaging. *Diagnosis. Blood tests: abnormal electrolyte balance (n=1), pulmonary embolism (> d-dimer, n=1); carotid Doppler ultrasound: significant carotid stenosis (n=1); brain TC: white matter inflammatory lesion (n=1), cerebellar infarction (n=1), posterior fossa stroke (n=1); brain MRI: posterior fossa stroke (confirmation of the TC scans finding); STANDING tests: peripheral vertigo (n=10); audiological evaluations: peripheral vertigo (n=18), central disorders (n=3); neurological evaluations: central diseases (n=7).

Non-commercial use only

Committee should only be informed in case of retrospective studies, where no intervention was made, provided that patients had given informed consent to the use of their clinical data.

Statistical analysis

Statistical analysis was performed by using SPSS version 24. Student's *t* test for unpaired data was used to compare continuous data between groups. The X^2 test was used to compare dichotomous variables. A P value < 0.05 was considered significant. Data were reported as mean ± standard deviation or as percentages.

Results

One-hundred thirty-one patients (65% female) presented to the ED complaining of vertigo, the mean age was 56±18 years. Thirty-six patients had a previous diagnosis of hypertension (27.5%), while audiological and psychiatric diseases were present in 13 patients (9.9%). Orthostatic hypotension was detected in 1 patient only (0.8%). Almost the 50% of patients was taking drug therapies, with a mean number of 3.6±2.5 drugs (range 1-12), mainly including antihypertensives (30.5%), antiplatelets (17.6%) and antidepressant (9.1%).

Table 1 illustrates the diagnostic tests carried out in the ED for the assessment of vertigo.

At the end of the diagnostic workup, peripheral vertigo was diagnosed in 85 patients (64.9%) and BPPV was the most common cause. In 17 patients (13%) a central vertigo was diagnosed, while 9 (6.9%) had a presyncope. Other diagnoses were psychogenic dizziness (4.6%), metabolic disorders (1.5%) and miscellaneous (9.2%).

Table 2 shows the final diagnoses according to the patients' assigned pathway, including hospitalization, fast-track to Audiology or Syncope Unit. and direct discharge.

Was the STANDING applied in Emergency Department?

The STANDING was under-used for the evaluation of patients complaining of vertigo in ED.

Indeed, of 131 patients complaining of vertigo: 107 patients (81.7%) underwent a standard clinical examination, not including the STANDING; 24 patients (18.3%) were evaluated using the STANDING.

Did the application of STANDING influence the patient's pathway after Emergency Department evaluation?

The use of the STANDING did not significantly influence the patient's pathway after ED evaluation.

Indeed, among those who underwent a standard clinical examination, one patient (0.9%) was hospitalized for further investigations following audiological consultation; 44 patients (41.1%) were discharged with a fast-track program to audiology or syncope unit, 8 of them after audiological consultation; 62 patients (57.9%) were discharged without further diagnostic assessment, 16 of them after audiological consultation.

Among those who were evaluated using the STANDING, one patient (4.1%) was hospitalized for further investigations following audiological consultation; 14 patients (58.3%) were discharged with a fast-track program, one of them after audiological consultation; 9 patients (37.5%) were discharged without further assessment, 2 of them following audiological consultation.

So, comparing patients who were evaluated using the STANDING (STANDING group) and those who were not (no STANDING group), we found that the patient's pathway after ED evaluation was similar in the two groups (hospitalization: 0.9% for no STANDING group vs 4.1% for STANDING group, P = 0.256; fast-track: 41.1% for no STANDING group vs 58.3% for STANDING group, P = 0.128; discharge: 57.9% for no STANDING group vs 37.5% for STANDING group, P = 0.072).

Did the STANDING outcome influence the patient's pathway?

Of 24 patients evaluated using the STANDING: i) the only hospitalized patient had a non-diagnostic STANDING; ii) 14 patients were discharged with a fast-track program, of whom 8 had a non-diagnostic STANDING and 6 had a STANDING indicating a peripheral disorder (42.9%); iii) 9 patients were discharged without a fast-track program, of whom 6 had a non-diagnostic STANDING and 3 had a STANDING indicating a peripheral disorder (33.3%).

Overall, the STANDING was diagnostic in 9/24 patients (37.5%). The result of the STANDING did not affect the patient's pathway: among patients with peripheral disorder according to STANDING, 42.9% were referred to a fast-track program and 33.3% were discharged without a fast-track (P = 0.650).

In Figure 2 the screening log of vertiginous patients evaluated in the ED can be found.

Non-commercial use only

Table 2. Final diagnosis according to patients' pathway after discharge from the ED.

	Discharged		Hospitalized (n=2)
	Fast-tracks (n=58)	No fast-tracks (n=71)	
Peripheral vertigo (n,%)	52 (89.7)	33 (46.5)	0 (0.0)
Central vertigo (n,%)	1 (1.7)	16 (22.5)	0 (0.0)
Presyncope (n,%)	1 (1.7)*	8 (11.3)	0 (0.0
Psychogenic dizziness (n,%)	0 (0.00)	6 (8.5)	0 (0.0)
Metabolic disorders (n,%)	0 (0.00)	2 (2.8)	0 (0.0)
Miscellaneous (n,%)	4 (6.9)**	6 (8.5)	2 (100.0)

ED: Emergency Department. *The patient was referred to a Syncope Unit. **External otitis (n=3), solved vertigo (n=1). Miscellaneous: external otitis (n=3), solved vertigo (n=1), hypertension (n=3), acute renal failure (n=1), pulmonary embolism (n=1), arrhythmia (n=1), abdominal colic (n=1), gait disorder (n=1).

Discussion

The STANDING algorithm demonstrated a high sensitivity and specificity and a good reliability in the identification of central vestibulopathies in the ED, allowing a significant reduction in hospitalizations and neuroimaging.[11] Three years after its publication, a prospective study was carried out, to verify the reliability and diagnostic accuracy of the algorithm in the differential diagnosis of acute vertigo in the ED. The follow-up study highlighted a high negative predictive value of STANDING (99%), *i.e*. it showed that a benign STANDING allows to exclude the presence of a central vertigo with a high level of certainty.[13]

Despite the high reliability of the STANDING, our study showed an under-utilization of this algorithm (~18%). The underuse of the STANDING algorithm was attributed to a renewal of the emergency medical staff, not yet adequately trained during the study period. Therefore, the high turnover of physicians in the ED emphasized the need for continuous updating with appropriate training courses.

Our results are consistent with other recent studies showing a widespread underuse of the diagnostic tests and algorithm for vertigo/dizziness in the ED.

McDowell *et al*. present a retrospective chart review of patients presenting to the ED over a one year-period and receiving a final diagnosis of dizziness or vertigo. Their study clearly demonstrates that HIT was under-utilized by both emergency physicians and neurologists, being performed in only 31 of 642 (5%) patients.[18] The Authors hypothesize different explanations for this finding. In particular, physicians may be unfamiliar with the test and they may lack confidence in performing it. In addition, they may consider it to be too subjective in its interpretation, thus considering clinical history a more reliable diagnostic tool. Conversely, it is unlikely that the time necessary to the test has played a role, as the HIT is simple and rapid to administer in the emergency room.

Similarly, another retrospective cohort study analysed data from 500 randomly selected ED patients receiving a diagnostic code related to peripheral vertigo, to assess the use of HINTS (Head Impulse, gaze-evoked Nystagmus, Test of Skew) algorithm and neuroimaging in the evaluation of vertiginous patients.[19] Neuroimaging was performed in a significant proportion (36%) of patients, while the HINTS protocol was relatively under-utilized (7%); moreover, when the HINTS was used, it was often inappropriately applied and ambiguously interpreted. Once again, the underuse of the HINTS algorithm may result from several factors, including limited awareness among emergency physicians and a lack of familiarity with the HINTS technique and its interpretation.

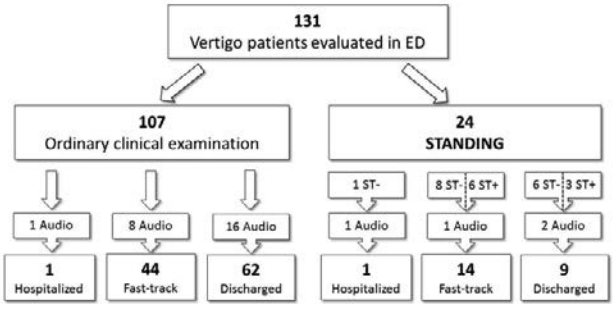

Figure 2. Patient's examination and pathway. The figure shows the screening log of patients evaluated in the Emergency Department for vertigo. ST: STANDING; ST+: STANDING diagnostic; ST -: STANDING no diagnostic; Audio: audiology consultancy.

Contrary to what was expected, we also noticed that the application and the positivity of the STANDING did not influence the patient's management after discharge, particularly it did not favour referral to an outpatient fast-track or direct discharge without further investigation. Indeed, among patients referred to these two pathways, a similar percentage had a STANDING positive for peripheral vestibulopathy.

This finding implies that the decision was subjective, not standardized and probably influenced by the physician's experience; indeed, we supposed that those with a long-term experience were more self-confident and chose direct discharge, whereas younger physicians preferred a fast-track program. Moreover, patients' management was probably influenced by the audiological diagnosis: BPPV was more frequently referred to the fast-track, while patients with acute peripheral vestibulopathy were mainly discharged and referred to the general practitioner.

Finally, it is also worthwhile to underline that a minority of patients had no audiological diagnoses (mainly presyncope), for which no defined pathways were yet foreseen. Indeed, only one patient was referred to the Syncope Unit for further assessment and treatment. Similarly, we know that the 13% of patients referred to the Syncope Unit had dizziness and about the 4% had a peripheral vestibular disorder which had not been recognized during the first evaluation in the ED.[20]

For the above reasons, we suggest a contextualization of the STANDING within a multidisciplinary network involving emergency physicians, syncope experts and audiologists, in order to standardize the physician's approach and the patient's management. In addition, a widespread application of the STANDING may limit possible errors in the differential diagnosis of dizziness, particularly for less experienced physicians.

Even more important is the training of the emergency physicians. Indeed, audiologists as well as neurologists and the otorhinolaryngologists may not be available for consultation in the ED, particularly in peripheral centers. Therefore, emergency physicians should be confident with semeiotic tools that are helpful to identify patients with an indication for referral to specialist centers.

Limitations

Our data should be interpreted in the context of some limitations. First, the retrospective nature of the study limits the accuracy and completeness of the collected data. Second, the study was conducted in a tertiary care referral centre, with daily available expert neuro-otologists consultation, which allows a rapid improvement of the expertise in vertigo assessment; this resource is likely not available in other environments and therefore it is likely that the STANDING will be even less used in other settings. Third, not all patients underwent head CT or MRI; 74 patients (56,5%) in the present study did not have imaging evaluation, but we do not know if these patients have been followed-up for some time to exclude the rare occurrence of stroke presenting with clinical features similar to peripheral vestibulopathy; this occurrence would limit the accuracy of the STANDING.

Conclusions

The diagnostic assessment of vertigo may be challenging for emergency physicians. The STANDING test is helpful to differen-

Non-commercial use only

tiate central vertigo from other disorders, however it is still widely underused. Our study emphasizes the need for continuous updating with appropriate training courses for emergency physicians and the importance of a multidisciplinary assessment of this condition, including the Audiology Unit and the Syncope Unit.

References

1. Kroenke K, Price RK. Symptoms in the community. Prevalence, classification, and psychiatric comorbidity. Arch Intern Med 1993;153:2474-80.
2. Yardley L, Owen N, Nazareth I, Luxon L. Prevalence and presentation of dizziness in a general practice community sample of working age people. Br J Gen Pract 1998;48:1131-5.
3. Hannaford PC, Simpson JA, Bisset AF, et al. The prevalence of ear, nose and throat problems in the community: results from a national cross-sectional postal survey in Scotland. Fam Pract 2005;22:227-33.
4. Neuhauser HK, von Brevern M, Radtke A, et al. Epidemiology of vestibular vertigo: a neurotologic survey of the general population. Neurol 2005;65:898-904.
5. Neuhauser HK, Radtke A, von Brevern M, et al. Burden of dizziness and vertigo in the community. Arch Intern Med 2008;168:2118-24.
6. Kerber KA, Meurer WJ, West BT, Fendrick AM. Dizziness presentations in U.S. emergency departments, 1995-2004. Acad Emerg Med 2008;15:744-50.
7. Newman-Toker DE, Hsieh YH, Camargo CA Jr, et al. Spectrum of dizziness visits to US emergency departments: cross-sectional analysis from a nationally representative sample. Mayo Clin Proc 2008;83:765-75.
8. Eagles D, Stiell IG, Clement CM, et al. International survey of emergency physicians' priorities for clinical decision rules. Acad Emerg Med 2008;15:177-82.
9. Kerber KA, Brown DL, Lisabeth LD, et al. Stroke among patients with dizziness, vertigo, and imbalance in the emergency department: a population-based study. Stroke 2006;37:2484-7.
10. Kerber KA. Vertigo presentations in the emergency department. Semin Neurol 2009;29:482-90.
11. Vanni S, Pecci R, Casati C, et al. STANDING, a four-step bedside algorithm for differential diagnosis of acute vertigo in the emergency department. Acta Otorhinolaryngol Ital 2014;34:419-26.
12. Vanni S, Nazerian P, Casati C, et al. Can emergency physicians accurately and reliably assess acute vertigo in the emergency department? Emerg Med Australas 2015;27:126-31.
13. Vanni S, Pecci R, Edlow JA, et al. Differential diagnosis of vertigo in the emergency department: a prospective validation study of the STANDING algorithm. Front Neurol 2017;8:1-9.
14. Madlon-Kay DJ. Evaluation and outcome of the dizzy patient. J Fam Pract 1985;21:109-13.
15. Tarnutzer AA, Berkowitz AL, Robinson KA, et al. Does my dizzy patient have a stroke? A systematic review of bedside diagnosis in acute vestibular syndrome. CMAJ 2011;183:571-92.
16. Newman-Toker D, Kattah J, Talkad A, et al. H.I.N.T.S. to diagnose stroke in the acute vestibular syndrome-three-step bedside oculomotor exam more sensitive than early MRI DWI. Stroke 2009;40:3504-10.
17. Edlow JA, Newman-Toker D. Using the physical examination to diagnose patients with acute dizziness and vertigo. J Emerg Med 2016;50:617-28.
18. McDowell T, Moore F. The under-utilization of the head impulse test in the emergency department. Can J Neurol Sci 2016;43:398-401.
19. Quimby AE, Kwok ESH, Lelli D, et al. Usage of the HINTS exam and neuroimaging in the assessment of peripheral vertigo in the emergency department. J Otolaryngol Head Neck Surg 2018;47:1-8.
20. Ceccofiglio A, Peruzzi G, Pecci R, et al. Retrospective analysis of patients with dizziness evaluated in syncope unit: a real-life experience. European Geriatric Medicine 2018;9:1-5.

Non-commercial use only

OPEN ACCESS