Vertigo in the emergency department

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Introduction

- Vertigo/dizziness is a common complaint that accounts for 3.3 to 3.6% of emergency department visits.

Newman-Toker DE et al.
Spectrum of dizziness visits to US Emergency Departments: cross-sectional analysis from a nationally representative sample
Mayo Clin Proc 2008 July; 83(7):765-775

Cheung CS et al.
Predictors of important neurological causes of dizziness among patients presenting to the emergency department.
Emerg Med 2010 July,27(7):517-521

- Diagnosis of a patient suffering from vertigo is challenging as it may due to various disorders in the fields of Otology, Neurology, Psychiatry and Internal Medicine...

- However, in emergency, it is easier to make an accurate diagnosis as vertigo should be associated with objective signs, in particular oculomotor abnormalities.
It is essential to remind that vertigo due to a peripheral (ENT) disorder has mainly 2 different presentations:

- either a dysfunction of a canal as observed in BPPV: the patient complain of brief (less than 1 minute) positional vertigo and positional manoeuvres should trigger a typical positional nystagmus (according to the canal involved)

- or a dysfunction of the inner ear and/or vestibular nerve, with a spontaneous vertigo during a least 20 minutes as can be observed in a crisis of Meniere’s disease, labyrinthitis, vestibular neuritis… Then, the patient should have a typical peripheral vestibular deficit with a spontaneous horizontal-torsional nystagmus and a contralateral body deviation.
- However, one of the most difficult diagnostic challenge is to differentiate a benign vestibular neuritis from a dangerous stroke in the posterior fossa that can present with isolated vertigo.

**Peripheral vestibular disease**

*(vestibular neuritis +++)*

Labyrinth = Inner ear

Vestibular Nerve

**Central vestibular or cerebellar disease** *(cerebellar stroke +++)*

Vestibular Nuclei

Cerebellum


It should be immediately emphasized that:

- Imaging of the head of all patients with vertigo is neither practical nor useful. Due to the risk of a vertebrobasilar ischaemia, it is tempting to perform a CT brain scan which was positive in only 0.74% of patients (6/810 patients) and/or a brain MRI positive in only 12.2 patients (11/90 patients).
  

- It is even worse for laboratory abnormalities which were able to explain vertigo in 0.6% of patients (26/4538).
  

Imaging (MRI and/or CT scan) and/or laboratory testing should be appropriately guided by clinical evaluation of symptoms and signs.
The diagnosis relies on **history taking** (symptoms).

There is accumulating evidence that trying to clarify the type of vestibular symptoms (dizziness / vertigo / unsteadiness /lightheadedness…) is of limited clinical utility.

On the contrary, it is useful to focalize on:

**TIming** (onset, duration, evolution) and

**TRiggers** (action, movements or situations that provoke the onset of dizziness in patient with intermittent symptoms)

For example:
- Vestibular symptoms only on arising is an argument for orthostatic hypotension, whereas symptoms both on arising and on lying back or when rolling in bed is typically observed in BPPV.
  - Head trauma induces BPPV, labyrinthine concussion and/or fracture.

*(TITrATE is the acronym for TIming, TRiggers And Targeted Exams)*

Newman-Toker DE, Edlow JA.
TITrATE: A Novel Approach to Diagnosing Acute Dizziness and Vertigo

A few simple questions should be systematically asked in order to search for a neurological disorder (clumsiness, paresthesia/tingling, dysarthria…)
Isolated Vertigo

Brief (< 1 mn) and Positional (bed +++)

Spontaneous Vertigo

Unique episode (days)

Usually PERIPHERAL (BPPV)

Vestibular neuritis ?

Cerebellar Infarct (PICA)?

Vertigo with hearing loss
Fullness, tinnitus

Recurrent episodes

Usually PERIPHERAL (vestibular neuritis ?)

Recurrent Vestibulo-Pathy ?

Vestibular schwannoma ?

Vertigo with neurological symptoms:
double vision, paresthesia, clumsiness (hand)

Vertigo with
dysarthria
dyshagia, dysphonia

Unique episode (days)

Usually PERIPHERAL (vestibular neuritis ?)

Recurrent Vestibulo-Pathy ?

Cerebellar Infarct (PICA)?

Central (stroke...)

Recurrent Episodes (> 20 mn)

Usually PERIPHERAL (labyrinthitis ?)

Cerebellar Infarct (AICA)?

Usually PERIPHERAL (Meniere ?)

Vertigo with

Post traumatic Vertigo

Usually PERIPHERAL (labyrinthine concussion and/or fracture)

Vertigo with

Spontaneous Vertigo

SYMPTOMS

Spontaneous and Positional (bed +++)

Fullness, tinnitus

SYMPTOMS

Dysarthria, dyshagia, dysphonia

SYMPTOMS
The diagnosis relies on **bedside examination** (signs)

At least **2 recent series** show the importance and sensitivity of clinical examination compare to imaging tests in acute vertigo patients:

- **Series from a Neurological Department using a 3-step bedside oculomotor examination**
  
  **No device takes 2 minutes**
  
  Kattah JC et al. HINTS to diagnose stroke in the Acute Vestibular syndrome. Three-step bedside oculomotor examination more sensitive than early MRI diffusion-weighted Imaging.
  
  Stroke 2009;40:3504-3510

- **Series from an ENT Department using a 4-step bedside examination including oculomotor and body examination**
  
  **Frenzel glasses are needed**
  
  Vanni S et al. STANDING, a four-step bedside algorithm for differential diagnosis of acute vertigo in the emergency department
  
  Acta Otorhinolaryngologica italic 2014;34:419-426

Prospective study of 101 consecutive patients with an acute vestibular syndrome and at least 1 stroke risk factor underwent:

A 3-step bedside oculomotor examination including:

- Observation of Nystagmus in different positions of gaze.
- Prism cross-cover test of ocular alignment (search for a skew deviation)
- Horizontal head impulse test (Halmagyi test)

Bedside examination was compared to Neuroimaging (MRI or CT)
Among the 101 consecutive patients:

- 25 patients had a peripheral lesion
- 76 had a central lesion (69 ischemic strokes)

The presence of normal horizontal head impulse test, direction changing nystagmus in eccentric gaze, or skew deviation was 100% sensitive and 96% specific for stroke.

Initial MRI diffusion-weighted imaging was falsely negative in 12% (all < 48 hours after symptoms onset)

A 3-step bedside oculomotor examination appears more sensitive for stroke than early MRI in Acute vestibular syndrome.
Vanni S et al. **STANDING**, a four-step bedside algorithm for differential diagnosis of acute vertigo in the emergency department

*Acta Otorhinolaryngologica italica* 2014;34:419-426

Prospective study of 292 consecutive patients with an acute vestibular syndrome randomized in a STANDING group and a CONTROL group

A 4-step bedside examination including:

- Observation of **Spontaneous nystagmus** (Frenzel glasses)
- Observation of **Positional nystagmus** (supine roll test, Dix Hallpike)
- **horizontal head impulse test** (Halmagyi test)
- Analysis of **body stability** (the inability to stand alone with eyes opened is considered a central sign)

The STANDING algorithm shows good reliability and very high accuracy in excluding dangerous disease in the hands of emergency physicians.
Based on the 2 previous studies we regularly use a simple algorithm using a set of 5 basic bedside tests:

1. Analysis of eyes movements in different position of gaze as well as ocular pursuit

2. Analysis of nystagmus under videonystagmoscopy (portable device).

3. Head Impulse Test / Halmagyi test

4. Positional manoeuvres

5. Analysis of postural stability by Romberg and/or Fukuda testing.

The strategy (order of realisation) of these tests is important.
Spontaneous Nystagmus is present

Nystagmus is obviously Central
(Gaze evoked Nystagmus, Nystagmus is purely vertical or purely torsional or multidirectional)

Spontaneous Nystagmus is absent

CENTRAL SIGNS

Cerebellar infarct in the territory of the medial branch of the posterior inferior cerebellar artery (PICA)

Wallenberg syndrome with hypersignal in the bulb and cerebellum.

Symmetric Gaze evoked

Downbeat Spontaneous
Spontaneous Nystagmus is present

CENTRAL

PERIPHERAL

Head impulse test

Saccade +

Nystagmus is possibly Peripheral
= horizontal-torsional

Saccade -

Standing Position +

Standing Position -

Spontaneous Nystagmus is absent

Nystagmus (fixation, VNS)

Standing Position -

Nystagmus (fixation, VNS)
Spontaneous Nystagmus is present

- Dix Hallpike

Spontaneous Nystagmus is absent

Positional Manœuvres

- Supine roll test
- Dix Hallpike

  - Horizontal Nystagmus
  - Rotatory Upbeating Nystagmus

Hor BPPV Post BPPV
Spontaneous Nystagmus is present

Spontaneous Nystagmus is absent or atypical

Positional Manœuvres

Nystagmus (fixation, VNS)

Atypical positional nystagmus in Multiple Sclerosis

Nystagmus is absent or atypical

Standing Position - or other neurological Signs +

Atypical positional vertigo revealing a cerebellar metastasis

CENTRAL
Summary of a simple algorithm

Spontaneous Nystagmus is present

Nystagmus is obviously Central
(Gaze evoked Nystagmus, Nystagmus is purely vertical or purely torsional or multidirectional)

Nystagmus is possibly Peripheral = horizontal-torsional

Positional Manœuvres

Supine roll test
- Horizontal Nystagmus
- Hor BPPV

Dix Hallpike
- Rotatory Upbeating Nystagmus
- Post BPPV

Saccade +
- Standing Position - or other neurological signs +
- CENTRAL

Saccade -
- Standing Position -
- PERIPHERAL

Nystagmus is absent or atypical

Head impulse test
This set of 5 basic bedside tests is usually able to differentiate a peripheral vestibular disorder from a central lesion and often to approach the underlying etiology.

This set of 5 basic bedside tests can be completed by many others clinical tests (cover test, head shaking, vibratory test, fistula test…search for cerebellar dysmetria…).

This clinical evaluation should be completed by audiological testing (which can be performed with a portable device) as audiometry often immediately orientates the diagnosis.
Normal pure tone Audiometry

Normal Audiometry is compatible with BPPV, vestibular neuritis, recurrent vestibulopathy, vestibular migraine, cerebellar stroke (in the territory of the postero-inferior cerebellar artery), Wallenberg syndrome…
Audiometry showing a sensorineural hearing loss on the low-middle frequencies

This audiometry is typical of a Meniere’s disease (right Meniere’s disease at an early stage)
Audiometry showing a sensorineural hearing loss on the middle-high frequencies or total deafness (Right side)

This audiometry is compatible with a vestibular schwannoma (A) (including an intralabyrinthine form), labyrinthitis (B), temporal bone fracture (C),
Audiometry showing a sensorineural hearing loss on the middle-high frequencies or total deafness (Left side)

This audiometry is also compatible with intralabyrinthine hemorrhage (D), cerebellar stroke (rare) in the territory of the antero-inferior cerebellar artery (E) (which also supply the inner ear)
Audiometry showing a mixed hearing loss

This audiometry in the context of vertigo is an argument for a third window mechanism as can be observed in dehiscence of the superior canal (A), enlarged vestibular aqueduct (B)...

Dehiscence of the right superior canal with dehiscence of the tegmen tympani

Enlarged right vestibular aqueduct
CONCLUSION

Based on history taking and a set of basic bedside tests (together with pure tone audiometry), clinician should be able to decide:

- whether the patient is possibly suffering from a stroke → Brain MRI

- whether the patient is affected by a non-threatening disorder for which treatment can be started (Benign paroxysmal positional vertigo, vestibular neuritis, Meniere’s disease, vestibular migraine…)

- whether the diagnosis is still unclear and additional oto-neurological examination is required to guide for other appropriate audiovestibular electrophysiological, imaging (brain MRI and/or inner CT) and/or laboratory testing.