Bedside neuro-otological examination
and
interpretation of commonly used tests
Introduction

- The objective of this presentation is to demonstrate that patient's neuro-otological examination at bedside (together with the history) is extremely reliable to differentiate a peripheral vestibular disorder from a central lesion and often to approach the underlying etiology.

- Based on a set of basic bedside tests, clinician should be able to decide:
  - whether the patient is possibly suffering from a stroke
  - whether the patient is affected by a non-threatnuing 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 neuro-otological examination is required to determine if imaging studies and/or laboratory tests are needed.
The set of **basic bedside tests** should at least include:

1. The simple analysis of eyes movements in different position of gaze as well as ocular pursuit

2. The analysis of nystagmus under videonystagmoscopy (portable device).

3. The Head Impulse Test (Halmagyi test)

4. The positional manoeuvres

5. The analysis of postural stability by Romberg and/or Fukuda testing.
1. The simple analysis of eyes movements in different position of gaze as well as ocular pursuit

The patient is simply ask to fixate a target in the different position of gaze and then to follow a moving target (pursuit)

The occurrence of abnormalities such as a gaze evoked nystagmus, a down beat nystagmus, an internuclear ophtalmoplegia … immediately affirms a central neurological disorder and sometimes the exact localization of the lesion.

Smooth pursuit is often affected by central neurological disorder (cerebellum lesion ++++, brainstem +).
Central Nystagmus
= ‘gaze evoked nystagmus’

- Gaze evoked nystagmus develops because of an inability to maintain fixation in eccentric gaze. The eyes drift back to the midline, and a corrective saccade is generated to reposition the eyes on the eccentric target
  - the fast phase is always in the direction of the gaze.

- This nystagmus should be distinguished from a physiologic nystagmus in the eccentric gaze (which occurs on looking far laterally and is poorly sustained after a few beats)

- This nystagmus is usually associated with a saccadic pursuit

- It is the most frequent central nystagmus
Central gaze evoked nystagmus

Patient with a long lasting history of dysequilibrium

Atypical malformation in the cerebellum
Central Nystagmus
= Down beating nystagmus

- This nystagmus is present at fixation and is downbeating. It increases in lateral gaze (and sometimes is only present in lateral gaze).

- It is associated with vertical oscillopsia (rather than vertigo) and dysequilibrium
Central down beating nystagmus

This nystagmus localizes the lesion to the inferior part of the posterior fossa (medulla or inferior part of the cerebellum) whatever the etiology (craniocervical malformations, cerebellar degeneration, vascular pathology, inflammatory disease, intoxication with lithium or antiepileptic drugs...)

Wagner JN, Glaser M, Brandt T, Strupp M.
Downbeat nystagmus ; aetiology and comorbidity in 117 patients.

Bertholon P et al.
Post-traumatic syringomyelobulbia and inferior vertical nystagmus.
Central down beating Nystagmus

Chiari Malformation
2. The analysis of nystagmus under videonystagmoscopy (static or portable device).

- As a peripheral nystagmus is increased or became apparent when fixation is eliminated, it is necessary to use either Frenzel lenses, ophtalmoscopy or videonystagmoscopy (+++)

- A peripheral vestibular nystagmus due to a lesion of the inner ear and/or vestibular nerve is usually horizontal-torsional (Jerk nystagmus with a slow and a fast phase; the direction of the nystagmus is described with reference to the fast phase).

- This nystagmus does not change direction with change in gaze position
The nystagmus is increased when the eyes are deviated in the direction of the fast phase (Alexander’s law)

This nystagmus is associated with a body deviation, when eyes closed, to the opposite side of the fast phase of the nystagmus (typical peripheral vestibular deficit)
G...Armand. 42 years old.

- History = 0

- Disabling vertigo and vomiting at midday
  No hearing or neurological disorder

- Examination at 5 pm: Left horizontal-torsional nystagmus enhanced with Videonystagmoscopy

- Pure tone audiogram: N
- cVEMPs: N

Right vestibular neuritis (superior nerve)
3. The Head Impulse Test (Halmagyi test)

- It needs to observe the effect of head rotation on the eye movements = the patient is instructed to fixate the examiner’s nose and is applied high acceleration head thrusts.

- Any corrective saccade shortly after the end of the head thrust is a sign of an inappropriate compensatory eye movement (overt saccade).

- By using head thrusts in the various canal planes each individual canal can be tested, but when performed clinically the test is essentially reliable in the horizontal canal.

Halmagyi GM et al.  
The Video Head Impulse Test.  
Front Neurol 2017 Jun;9;8:258
During abrupt head thrust from left (A) to right (B), the vestibulo-ocular reflex will compensate for head turn and gaze will stay fixed on fixation target (nose of the examiner).

In case of a right peripheral vestibular deficit, the eyes will move with the head (C-D) so that the patient has to make a corrective saccade at the end of the head impulse (D-E) in order to return his gaze to the earth-fixed target (nose of the examiner). This ‘overt’ corrective saccade to the left is the clinical sign of a right vestibular deficit.
G…Armand. 42 years old.

- History = 0

- Disabling vertigo and vomiting at midday
  No hearing or neurological disorder

- Examination at 5 pm: Left horizontal-torsional nystagmus enhanced with Videonystagmoscopy
  Halmagyi test is positive for head thrust to the right
  = Left horizontal corrective saccade

- Pure tone audiogram: N
- cVEMPs: N

→ Right vestibular neuritis (superior nerve)
Previous history = 0

28/09/2013: Vertigo + Vomiting and left instability

Left body deviation and intermittent and slight right nystagmus

Halmagyi test is normal.

Left Wallenberg syndrome (←) with cerebellar ischemia (↑)
4. The positional manoeuvres

- There are essential to diagnose Benign Paroxysmal Positional Vertigo (BPPV) which is the first cause of vertigo and manifests by brief and positional vertigo.

- They should be performed in the plane of the posterior (and anterior) canal (Dix Hallpike Manœuvre) and horizontal canal (Head rotation in the supine position)

- The direction of the nystagmus is essential to diagnose the canal involved

Horizontal canal

Horizontal canal BPV.
McClure JA.
J Otolaryngol 1985;14:30-5.

Head rotation in the supine position

Horizontal nystagmus
(right beating for rotation of the head to the right)

Horizontal Canal
Connection with ocular eyes muscles

Geotropic form
Horizontal canal

Ageotropic form

Head rotation in the supine position

Horizontal nystagmus
(left beating for rotation of the head to the right)

Baloh RW, Yue Q, Jacobson KM, Honrubia V.
Persistent direction-changing positional nystagmus: another variant of benign positional nystagmus?
5. The analysis of postural stability by Romberg and/or Fukuda testing.

- The diagnosis of a patient with posture and gait disorders is a difficult challenge for the clinician as what is wrong can be due to impairments ranging from the top of the head to the tip of the toes (vision deficiency, inner ear disease, polyneuropathy, brainstem and/or cerebellar disorders, hydrocephalus or parkinsonian disorder, spinal cord lesion, musculoskeletal dysfunction…)

- However, a gait disorder is unlikely to be due to vestibular disease (peripheral or central) if it has never been associated with vertigo, dizziness, oscillopsia or hearing disorder.
Examination of posture and gait (vestibulo-spinal reflex) can shed useful light in the diagnosis of the dizzy patients but is less important than eye movements (vestibulo-ocular reflex) or positional manoeuvres.

Examination of posture and gait sometimes can immediately differentiate a peripheral (5a) from a central vestibular disorder (5b).

Examination of posture and gait is more important than eye movements to diagnose a psychological disorder (5c).
Examination of posture/gait disorder

- **Romberg test** = patient stands with feet together, hands by the sides, eyes opened and then eyes closed.

- **The Fukuda (or Unterberger) stepping test** = patient walks on the spot with feet together, eyes opened and then eyes closed.

- **Gait analysis**

50 steps in 30 s.  
(N < 30°)

These tests cannot be taken in isolation but should be performed in conjunction with appropriate additional tests in particular the search for a nystagmus, the Halmagyi test.
5 a. Postural stability in Peripheral vestibular disease

- Patient is able to stand with eyes opened (when reassured) and turns towards one side with eyes closed.

- Horizontal or horizontal-torsional nystagmus towards the other side without fixation (Videonystagmoscopy).

- Additional test = Halmagyi test should be + (corrective saccade)
Disabling vertigo and vomiting at midday
No hearing or neurological disorder

Examination at 5 pm: Left horizontal-torsional nystagmus enhanced with Videonystagmography
Halmagyi test is positive for head thrust to the right
= Left horizontal corrective saccade
The patient is able to stand with eyes opened and deviate to the right with eyes closed

Pure tone audiogram: N
Pure VEMPs: N

Right vestibular neuritis (superior nerve)
5 b. Postural stability in central vestibular disorder

- Usually no correlation between the body deviation and the nystagmus.

- Intensity of the body deviation (inability to stand alone with eyes opened).

- Central or no nystagmus (isolated body lateropulsion).

- Additional test = Halmagyi test (usually N).

- Often associated with central neurological symptom or sign.
B... Michel (55 years old).

➢ Previous history = 0
➢ 28/09/2013: Vertigo + Vomiting and left instability

Left body deviation (unable to stand with eyes opened)
intermittent and slight right nystagmus   Halmagyi test is normal.

Left Wallenberg syndrome (←) with cerebellar ischemia (↑)
5 c. Psychological gait disorder

- Posture and gait is more important than eye movements to depict psychological disorder.

- Diagnosis at glance

  be aware of discrepancy: Sitting/Standing
  Romberg/Fukuda

  can happen in children (around puberty)
Difficult if association of a functional gait favoured by peripheral / central lesion

Right vestibular schwannoma
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 (head shaking, vibratory test, fistula test...search for dysmetria...) and of course audiological testing.

This clinical evaluation will guide for other appropriate audiovestibular electrophysiological, imaging (brain MRI and/or inner CT) and/or laboratory testing.