Balance disorders and vestibular function testing

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Myths and misconceptions

“There is nothing you can do for dizzy patients...”.
“Live with it...”.

“Ménière’s disease is a common cause of dizziness”.

“All patients with dizziness are mad”.
Objectives

• Understanding the balance system
• Management of common vestibular pathology
Balance overview
Posterior semicircular canal
Utricle
Saccule
Ampulla
Facial nerve
Horizontal semicircular canal
Cochlear nerve
Vestibular ganglion
Vestibular nerve
Anterior semicircular canal
Cochlea
Orientation of hair cells in the utricle
Orientation of hair cells in the saccule
Management of balance disordered patients

History

Appropriate investigations

Intervention

Three blind men and the elephant...
History

- History, may be very difficult.
- First episode
- Frequency and severity
- Last episode
- “Vertigo”, “light headed”, “dizzy”, “swimmy”
- Hearing loss, tinnitus, positional, headache, photophobia, phonophobia
Examination

- Ear examination
- Cranial nerves
- Nystagmus
- Saccades
- Smooth pursuit
- Head thrust test
- Head shake test
- Cerebellar signs
- Romberg’s test
- Tandem Romberg’s
- Unterberger’s test
- Dix-Hallpike test
- Gait
Romberg’s test and Unterberger’s tests

D+R Balance app
Measures postural sway
Innovation award
Chartered Society of Physiotherapists
Examination

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- Cerebellar signs
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- Gait
Dix-Hallpike test
Special investigations
Investigations

• Pure tone audiometry
• Tympanometry

It is not possible to directly assess the peripheral vestibular system. However, it is possible to assess eye movements and posture.
• Smooth pursuit, saccadic movement, optokinetic nystagmus
• Caloric testing
Videonystagmography
Videonystagmography
Caloric testing

- Head raised 30° to the horizontal
- Water at 30°C and 44°C
  - Irrigation 30 for seconds
- (Air at 24°C and 50°C +/- 0.4°C
  - Irrigation 60 seconds)
Radiology

- Computed tomography
- MRI
Common conditions
Common conditions

- Benign paroxysmal positional vertigo (BPPV)
- Labyrinthitis / vestibular neuritis
- Vertiginous migraine
- Multilevel vestibulopathy
- Hyperventilation syndrome
- Ménière's disease
- Multiple sclerosis
- Vertebro-basilar insufficiency
- Superior semicircular canal dehiscence
- Acoustic neuroma
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Benign paroxysmal positional vertigo (BPPV)
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• Commonest cause of vertigo in all age groups
  Affects 1 in 40 people

• Suggested by history and clinical investigation

• Caused by otolith debris shed from the macula of the utricle, usually falling into the posterior semicircular canal.
History

- Patients complain of rotatory vertigo on getting out of bed/rolling/looking up quickly
- Vertigo lasts seconds BUT patients feel very unsteady for much longer
- Nausea and vomiting
- No associated hearing loss/tinnitus
Predisposing factors

• Age – Increasing incidence with increasing age – possibly due to weakening of otoconial filaments, causing “Idiopathic” onset BPPV
• Head trauma – displacement of otoconial debris
• Post peripheral vestibular deficit – 13 to 50% of patients with BPPV demonstrate a co-existent uPVD (including vestibular neuritis, labyrinthitis).
• Other associations include – Middle ear surgery, otosclerosis, chronic otitis media, diabetes.
Dix-Hallpike test
Geotropic torsional nystagmus
Epley manœuvre
Brandt-Daroff
Acute peripheral vestibular deficit
Acute peripheral vestibular deficit

- *Vestibular neuritis/neuronitis*
- *Labyrinthitis*

- Common condition, often occurs just after an upper respiratory tract infection
- ?Vascular aetiology
- Patients usually wake with continuous rotatory vertigo (lasts several days)
Recovery mechanisms in PVD

• Static phase

• Dynamic phase

• Cellular recovery
  – Spontaneous re-establishment of tonic firing rate centrally

• Vestibular Compensation
  – Vestibular adaptation
  – Substitution of other strategies
  – Habituation
Acute peripheral vestibular deficit

• Prochlorperazine required, for a maximum of one week
• Patients may compensate fully without further intervention
• Those who do NOT compensate require physiotherapy exercises (NB visual vertigo)
Virtual reality
Remote supervision of physiotherapy patients

D+R Therapy
Remote monitoring of patients undergoing musculoskeletal physiotherapy
Focus of multiple audit and research projects
Vestibular migraine
Vertiginous migraine

- Migraine affects 10% general population, 30% will suffer spells of vertigo.
- Both adults and children are affected (*benign positional vertigo of childhood*).
- Symptoms are thought to arise due to reactive hyperaemia following transient vasoconstriction and ischaemia within the cerebral cortex. This is supported by intracoarotid and single-photon emission computed tomography (SPECT) studies.
- Hormonally related.
Vertiginous migraine

- Common cause of dizziness/vertigo
- Classically 2-3 day history of dizziness just before period starts
- Aura, vertigo, photophobia, phonophobia
- No associated hearing loss/tinnitus
- May have a personal/family history of classical migraine
- Clinically well, PTA normal
- MRI required to exclude other causes of dizziness
- Treat with dietary changes initially
Ménière's disease
Menière's disease

- Incidence: 4.3-157:100,000
- Prevalence: 100-200:100000 in UK
- M=F (small female preponderance)
- Peak onset: 40-60 (rare in children)
- **Bilateral disease: 11-40%** (rate increases with increased history of the disease)
- 10-20% associated with a familial autosomal dominant form
- Classical history of aural fullness, hearing loss followed by rotatory vertigo and tinnitus
Classification

• **Definite**  Two or more episodes of vertigo* plus audiometrically confirmed sensorineural hearing loss plus tinnitus or aural fullness plus other causes excluded

• **Probable**  One episode of vertigo* plus audiometrically confirmed sensorineural hearing loss plus tinnitus or aural fullness plus other causes excluded

• **Possible**  Episodes of vertigo* with no hearing loss, or sensorineural hearing loss with dysequilibrium; other causes excluded

•  *Defined as spontaneous, rotational vertigo lasting more than 20 minutes.
Classification

- **Certain**  Definite Menière's plus postmortem confirmation
- **Definite**  Two or more episodes of vertigo* plus audiometrically confirmed sensorineural hearing loss plus tinnitus or aural fullness plus other causes excluded
- **Probable**  One episode of vertigo* plus audiometrically confirmed sensorineural hearing loss plus tinnitus or aural fullness plus other causes excluded
- **Possible**  Episodes of vertigo* with no hearing loss, or sensorineural hearing loss with dysequilibrium; other causes excluded
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My current diagnostic criteria

1. History consistent with Ménière’s disease
   Clinical findings that support the diagnosis
2. Pure tone audiograms
3. MRI to exclude central pathology
4. Formal vestibular testing
   – Gaze testing
   – Caloric testing
Medical treatment

- **Salt limited diet**
- **Thiazide diuretics**
  - Bendrofluazide 5mg daily + potassium sparing agents
  - Loop diuretics should not be used as they affect stria vascularis
  - Small RCT found no change in hearing, but reduced frequency if vertigo after 4 months (van Deelen, 1986)
- **Betahistine**
  - Vasodilation of stria vascularis
  - Increase in cochlear blood flow
  - H3-antagonist
  - Caution with gastric ulceration or asthma
  - Cochrane Review (James 2002) Systematic Review (no meta-analysis): Six RCTs found insufficient evidence about the effects of betahistine versus placebo on the frequency and severity of attacks of vertigo, tinnitus, and aural fullness. Four RCTs found no change in hearing as assessed by changes in pure tone audiograms with betahistine versus placebo
Surgical non-ablative treatment

- **Grommet insertion**
  - No scientific evidence

- **Saccus decompression**
  - Portman 1927
  - Thomsen (Danish sham study)
  - Moffat: 80% improvement in vertigo, 20% in hearing
  - EChoG: the greater the SP the more likelihood of failure to control symptoms
  - Dehydration test: gives indication of the possible benefits regarding hearing
Ablative treatment

- **Labyrinthectomy**: transtympanic, transmastoid
- **Intratympanic gentamycin infusion**
  - Control of vertigo: 90%
  - Cochleotoxic effect: 15-25%

- **Bilateral disease – bilateral vestibular hypofunction**
My current intervention

• All patients undergo Shah grommet insertion under general anaesthetic
• All undergo customised vestibular physiotherapy
• All salt restricted diet
Cholesteatoma/CSOM

- Results in intermittent vertigo associated with hearing loss.
- This may be due to direct invasion of the labyrinth or secondary to the toxic effect of recurrent infection.
Superior semicircular canal dehiscence

- Associated with Tullio’s phenomenon, secondary to stapedial reflex.
- Valsalva associated disequilibrium due to pressure change within the inner ear.
Questions?

• End