Vestibular disorders
Recognition and Medical Management

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Lecture plan
1. Review of anatomy/physiology
2. Medical treatments of vertigo
3. Vestibular disorders one by one.

The ear is an inertial navigation device
- Semicircular Canals are rate sensors.
- Otoliths (utricle and saccule) are linear accelerometers
- Bilateral symmetry means redundant design.

Vestibular Reflexes
- VOR: Vestibulocular reflex
- VSR: Vestibulospinal reflex

Important Ear Structures

Vestibular symptom patterns
- Nystagmus (imbalance between ears)
- Oscillopsia (low gain to one or both sides)
- Motion sickness (overly sensitive to conflict between ear/eye/somatosensation)
Vestibular Nystagmus – result of imbalance in VOR

1. One whole side – lateral/rotatory
2. One horizontal canal → lateral nyst.
3. One vertical canal – mixed vertical/rotatory
4. Pure vertical or torsional – usually central

How to examine for Spontaneous Nystagmus

- Frenzel Goggles (best)
- Ophthalmoscope (good – but backwards)
- Gaze-evoked nystagmus (use Alexander’s law)
- Sheet of white paper (Ganzfeld – German for complete field)

Vestibular nystagmus from one vertical canal
Vertical/Torsion – posterior canal

Downbeating Nystagmus (Central)

Vestibular Nystagmus – from one horizontal canal

Upbeating Nystagmus (Central)
Torsional Nystagmus
(Central)

Part 2
Drugs used to treat dizziness

Oscillopsia

Processes we might try to treat with medications
- Vertigo and nystagmus
- Motion sickness, emesis
- Compensation for vestibular loss
- Migraine

Patients with complete Bilateral loss have no VOR.

Processes we might NOT try to treat with medications
- Low VOR gain such as ototoxicity
- BPPV (best managed with physical treatments)
- Malingerers (legitimate treatment facilitates their fraud)
Main drug categories for vertigo/nystagmus

- Anticholinergic
- GABA agonists
- Everything else

Anticholinergic side effects (Locoweed poisoning)

- Confusion (similar to drug induced Alzheimer’s)
- Dry mouth, loss of sweating
- Urinary hesitancy/stoppage, Constipation
- Blurry vision
- Cardiac conduction block
- Addiction with dizziness on withdrawal

Anticholinergics

- Block central and peripheral ACH
- Reduce vertigo and nausea from peripheral vertigo
- Reduce central nystagmus (in very high doses)
- Numerous interesting side-effects

Anticholinergic side effects

- Confusion (similar to drug induced Alzheimer’s)
- Dry mouth, loss of sweating
- Urinary hesitancy/stoppage
- Blurry vision
- Cardiac conduction block
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H1-antihistamines with strong anticholinergic properties

- meclizine (Antivert, Bonine)
- dimenhydrinate (Dramamine)
- diphenhydramine (Benadryl)

Antihistamines must cross BB barrier -- i.e. OTC fexofenidine, loratidine, cetirizine do not work for dizziness

Scopolamine

Muscarinic antagonist

- Scopolamine (Transderm-Scop patch)
- Transderm does not require ingestion (but many other oral GI drugs do same thing – Levsin and Robinul for example).
- Apply every 3 days to skin surface
- Withdrawal syndrome and CNS side effects limit use

Antihistamine side effects

- Sleepiness
- Weight gain

Anticholinergic side effects

- Dry mouth and eyes
- Constipation
- Confusion
meclizine (Antivot, Bonine)
- 12.5 TID or 25 TID. Lasts about 8 hours. Available OTC.
- Limitation is sedation and anticholinergic side effects
- Pregnancy: category B. May be best drug

Dosing: beer scale
1 glass of beer =
- 2 mg of diazepam (Valium)
- 0.5 mg of lorazepam (Ativan)
- 0.5 mg of clonazepam (Klonapin)

GABA agonists (benzodiazepines)
- Modulate inhibitory transmitter GABA
- Reduce vertigo and nausea from peripheral vertigo
- Reduce nystagmus
- Sedation, addiction limit usefulness
- ? May impede compensation (strangely, no evidence in humans for this)

Benzodiazepines
- Should discourage benzodiazepines whenever practical (this does not always work).
- Benzodiazepines to discourage especially
  - Large doses of any benzodiazepine
  - Alprazolam (xanax) (high addiction)
  - Valium in 5mg+ doses (high addiction)

Benzodiazepines
- Valium (diazepam, “Mothers little helper”)
- Ativan (lorazepam)
- Klonapin (clonazepam)

Benzodiazepines
Bottom line
Extremely useful drugs for symptoms
Treat dizziness and anxiety
Dependency is the big problem
Diuretics

- Dyazide and Maxide (Hctz+triamterine)
  - Menieres
- Diamox (acetazolamide)
  - Menieres
  - Migraine
  - Periodic ataxia
- Lasix
  - Not a good idea – causes hearing loss and hypokalemia

Drugs of unclear utility

- Beta-histine (Serc) ➔
- Baclofen (occasionally useful)
- Alternative medications
  - Vertigo-HEEL (homeopathic)
  - Ginkgo-Biloba (very weak evidence)

Emesis

Vomiting is complex

Drugs used for treatment of emesis

MOST IMPORTANT
- 5-HT3 antagonists
- Dopamine blockers
- Anticholinergics (OTC)
- H1 antihistamines
- Benzodiazepines

Betahistine (Serc)

- FDA position is that it is a placebo
- Readily available from compounding pharmacies, including Walgreens
- Weak H1 agonist and H3 blocker (which results in some Histamine agonism)
- Author’s experience – Useful for motion intolerance and Meniere’s.


Source: Nasa vestibular symposium
http://nasa.gov/...
odansetron (Zofran)
5HT3 receptor antagonist

- Dose: 8 mg PO. MLT form is fast acting, regular 8mg SL is cheaper.
- Category B in pregnancy (probably safe)

Dr. Hain's drug of choice to use prior to nauseating PT session.
Generic non-MLT is available ($0.35/pill)

Compensation

Commonly used phenothiazine antiemetics dopamine blockers

- prochlorperazine (Compazine)
  5, 10 and 25 mg forms, including rectal suppositories.
  Pregnancy -- unknown

- promethazine (Phenergan)
  12.5, 25, 50 mg forms, including rectal suppositories
  12.5 BID prn oral dose typical. Pregnancy Cat. C

Compensation -- subtypes

- Static compensation – recovery from tone imbalance (vertigo).
  - Largely automatic and not likely to be modified by drugs.

- Dynamic compensation (oscillopsia) – readjust gain.
  - Takes some time, modifiable by medications.

Compensation -- goal

- Facilitate compensation for static vestibular lesions or central problems. (i.e. vestibular neuritis, bilateral loss)

Commonly used phenothiazine antiemetics dopamine blockers

- Powerful drugs
- Major side effects
- Use if you have a big vomiting problem
Drugs that accelerate dynamic compensation (in animals)

- Amphetamines
- Bromocriptine (Dopamine agonist)
- ACTH (adreno-corticotrophic hormone)
- Caffeine

Modified from Brandt, 1991

Drugs that retard dynamic compensation in animals

- Phenobarbital (sedative, barbituate)
- Dopamine antagonists (e.g. Lisuride, Thorazine)
- ACTH antagonists (e.g. steroids). Steroids seem to help in people!
- Diazepam, (GABA agonist, Valium).

Modified from Brandt, 1991

Epidemiology of Dizziness

Vestibular is about 1/4

29.5% lifetime prevalence of dizziness or vertigo
7% lifetime prevalence of vestibular vertigo, 1-year prevalence is 5.2%

Neuhauser et al. Neurology 65:898-904 2005

Part 3

Causes of Dizziness and their treatment

Positional Vertigo

The most common syndrome

- Benign Paroxysmal Positional Vertigo (BPPV) -- bed spins
  - Orthostatic hypotension (dizzy upright)
  - Central positional nystagmus (dizzy everywhere)
  - Low CSF pressure syndrome (dizzy upright)
Benign Paroxysmal Positional Vertigo (BPPV)

61 Y/O man slipped on wet floor.
LOC for 20 minutes.
In ER, unable to sit up because of dizziness
Hallpike Maneuver: Positive

Positional Vertigo
Dix-Hallpike Maneuver

Benign Paroxysmal Positional Vertigo (BPPV)

- 20% of all vertigo, roughly 2% population/year
- Brief and strong
- Provoked by change of head position
- Definitively diagnosed by Hallpike test

BPPV Mechanism: Utricular debris migrates to posterior canal

BPPV treatment

- Medication (e.g. Antivert/zofran) – minor benefit
  – May avoid vomiting by pretreating
- Excellent response to PT
- Surgery – canal plugging if rehab fails (need more rehab after plug). Rarely done.

Unilateral Vestibular

- Vestibular Neuritis/Labyrinthitis (common)
- Meniere’s disease (unusual, 1/2000 prevalence)
- Acoustic Neuroma (rare)
- Vestibular paroxysmia (not sure how common)
Vestibular Neuritis: Case

56 y/o woman began to become dizzy after lunch. Dizziness increased over hours, and consisted of a spinning "merri-go-round" sensation, combined with unsteadiness. Vomiting ensued 2 hours later, and she was brought by family members to the ER.

HIT test should be positive

Vestibular Spontaneous Nystagmus
seen with video Frenzel Goggles

Vestibular Neuritis -- rx
- Disturbance of unknown cause (Viral ? Vascular) involving vestibular nerve or ganglion
- Off work -- usually 2 weeks. Sometimes 2 mo.
- Symptomatic Rx (meclizine, phenergan, benzodiazepine)
- Rehab if still symptomatic after 2 months.
- These patients can and do still get BPPV!

Meniere’s Disease
- Prosper Meniere
  - Fluctuating hearing
  - Episodic Vertigo
  - Fluctuating (roaring) Tinnitus
  - Aural Fullness
- About 1/2000 people in population
- Chronic condition – lasts lifetime
Etiology of Meniere’s (Dogma)
- Dilation and episodic rupture of inner ear membranes (Endolymphatic Hydrops)
- As endolymph volume and pressure increases, the utricular/saccular and Reissner’s membranes rupture, releasing potassium-rich endolymph into the perilymph causing cochlear/vestibular paralysis

Meniere’s disease – symptoms
- Progressive hearing loss -- usually go deaf
- Episodic vertigo – out of commission for several days
- Ataxia – gradually increases over years
- Visual sensitivity →

Treatments of Menieres
- Medical management
  - Low sodium, betahistine
- Bad rehab candidate while fluctuating
- Surgery
  - Low dose gentamicin treatment works 85%
  - High dose gentamicin treatment (overkill)
- Rehab useful post destructive treatment

Acoustic Neuroma

Visual Sensitivity is common
- Sensory integration disorder – upweight vision, downweight everything else
- Grocery store, Omnimax, Target, etc
- Typical of disorders with intermittent vestibular problems

Otolithic Crises of Tumarkin
- Drop attacks
- Go from upright to on floor in fraction of second
- No LOC
- Very dangerous
- Destructive treatment is best

Acoustic Neuroma
- Rare cause of unilateral vestibular loss
- Generally also deaf on one side
- Slowly progressive – little or no vertigo

Clinical Diagnosis of MVC
- Quick spins
- May have nystagmus on hyperventilation
- Response to anticonvulsant
- No rehab potential

Treatment of Acoustic Neuroma
- Watchful waiting (about 25%)
- Operative removal (about 50%) – losing ground
- Gamma Knife (about 25%) – gaining ground because effective and noninvasive.
- Good rehab candidate after surgery.

Bilateral Vestibular Loss
A stewardess developed a toe-nail infection. She underwent course of gentamicin and vancomycin. 12 days after starting therapy she developed imbalance. 21 days after starting, she was “staggering like a drunk person”. Meclizine was prescribed. Gentamicin was stopped on day 29. One year later, the patient had persistent imbalance, visual symptoms, and had not returned to work. Hearing is normal. She unsuccessfully sued her doctor for malpractice.

Symptoms of Bilateral Vestibular Loss
- Oscillopsia

Vestibular Paroxysmia (AKA microvascular compression)
- Irritation of vestibular nerve
- Quick spins, tilts, dips
- Motion sensitivity
- May follow 8th nerve surgery, Gamma knife treatment, acoustic neuroma
SYMPTOMS OF BILATERAL VESTIBULAR LOSS

- ATAXIA

Bilateral Vestibular Loss Causes:
- Ototoxicity
- Bilateral forms of unilateral disorders (e.g. bilateral vestib neuritis)
- Congenital (e.g. Mondini malformation)
- Idiopathic

Dynamic Illegible ‘E’ test (DIE test)
- Distance vision with head still
- Distance vision with head moving
- Normal: 0-2 lines change.
- Abnormal: 4-7 lines change

DIAGNOSIS IS EASY

- History of recent IV antibiotic medication
- Eyes closed tandem Romberg is positive
- Dynamic illegible ‘E’ test (DIE) failed

LABORATORY DIAGNOSIS
Everything should be “dead”

- ENG
- Rotatory chair
- VEMP (may remain in bilateral v. neuritis)
DIAGNOSIS Continued

- Rotatory chair confirms diagnosis but requires cooperation

Perilymph Fistula and SCD (superior canal dehiscence)

- Fluctuating conditions
- No rehab until after surgery

Case: WS

Retired plastic surgeon, with impaired hearing related to war injuries, found that when he went to church, when organ was playing, certain notes made him stagger. His otolaryngologist noted that during audiometry (with hearing aid in), certain tones reliably induced dizziness and a mixed vertical/torsional nystagmus. This “Tullio’s phenomenon” could be easily reproduced experimentally. MRI scan was normal.

DIAGNOSIS Continued

- ENG shows little or no response

Tullio in SCD

Treatment Bilateral

- No medical management (other than avoiding more damage)
- Outstanding rehab candidate
- Be prepared for a deposition
Valsalva in SCD

Diagnosis of SCD

- History of sound and pressure sensitivity
- Valsalva test is easiest bedside test
- Temporal bone CT scan (0.6 mm, axial reformatted into oblique planes)
- VEMP: Vestibular evoked myogenic potentials (screen with amplitude, then do threshold)

Superior Canal Dehiscence

- Etiology:
  - Congenital bone defect (2% ?)
  - Trauma may exacerbate
- Treatment:
  - Do nothing
  - Surgical
    - Plug
    - Resurface

Case: KF

- After SCUBA diving, a young woman developed vertigo, aural fullness and tinnitus for 1 year.
- Symptoms were worsened by tragal pressure and straining.
- Surgery was performed.

A large round window fistula was found and symptoms completely resolved after a second surgery.
Recap of diagnoses

- Otologic (30-50%) – BPPV, Menieres, VN.
- CNS (5-30%) – CVA, Migraine
- Medical (5%-30%) Orthostatic, drug
- Psychiatric (15-50%)
- Undiagnosed (15%)

More details

Hain, T.C. Approach to the patient with Dizziness and Vertigo. Practical Neurology (Ed. Biller), Lippincott-Raven

More movies

www.dizziness-and-hearing.com