

Medical Management of Vestibular Disorders and Vestibular Rehabilitation

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Introduction

- Basic inputs - vision, proprioception, and vestibular system
- Provide ocular stability, gait control, and balance
- Disorders of vestibular system are major disruptors causing spatial disorientation
- Many causes of dizziness, vertigo when caused by a loss of vestibular function
- Management strategies for vestibular disorders has continued to evolve

Pathophysiology

- Vestibular labyrinth - detects linear and angular head movements
- Semicircular canals - angular
 - Hair cells organized under cupula
- Otolithic organs (utricle, sacule) - linear
 - Hair cells attached to a layer of otoconia
- Vestibular nerve - superior, inferior branch
- Afferent nerve fibers are bipolar - cell bodies lie within Scarpa's ganglion

Pathophysiology

- Balance requires –
 - Normal functioning vestibular system
 - Input from visual system (vestibulo-ocular)
 - Input from proprioceptive system (vestibulo-spinal)
 - Central causes compromise central circuits that mediate vestibular influences on posture, gaze control, autonomic fx
 - Disruption of balance between inputs results in vertigo
 - Goal of treatment: restore balance between
- 4 different inputs

Pathophysiology

- Vestibular system influences autonomic system
- Intimate linkage in brainstem pathways between vestibular and visceral inputs
- Alteration of vestibular inputs results in:
 - nausea, vomiting
 - Pallor
 - Respiratory/circulatory changes

Medical Treatment

- Symptomatic
- Specific therapy
- Vestibular rehabilitation

Symptomatic Pharmacotherapy

- Predominant targeted vestibular neurotransmitters:
 - Cholinergic
 - Histaminergic
 - GABA neurotransmitters - negative inhibition
- Vomiting center transmitters:
 - Dopaminergic (D2)
 - Histaminergic (H1)
 - Seratonergeric
- Multiple classes of drugs effective

Symptomatic Pharmacotherapy

- Antihistaminergic - dimenhydrinate
- Anticholinergics - scopolamine, meclizine
- Anti-dopaminergic - droperidol
- (gamma)-aminobutyric acid enhancing (GABA-ergic) agents - lorazepam, valium

Symptomatic Pharmacotherapy

- Some drugs of the antihistamine class are useful for symptomatic control of vertigo
- Have anti-motion sickness properties in large part due to inhibition of vestibular system H1 histaminergic neurotransmitters
- Examples include dimenhydrinate (Dramamine) and promethazine (Phenergan)
- Also suppress the vomiting center

Symptomatic Pharmacotherapy

Table 2. Drugs Commonly Used for Symptomatic Treatment of Acute Vertigo.*

Drug	Usual Starting Dose	Range of Doses and Frequency of Administration†	Antiemetic Action	Common Precautions	Common Side Effects	Common Drug Interactions
Dimenhydrinate (Dramamine)	50 mg IM, IV, or orally	25–100 mg every 4–8 hr	Moderate	Asthma, glaucoma, prostate enlargement	Dryness, drowsiness	Alcohol, hypnotics, antidepressants, sedatives, tranquilizers
Promethazine (Phenergan)	25 mg IM, IV, orally, or by suppository	12.5–50 mg every 4–8 hr	Moderate	Same as for dimenhydrinate	Same as for dimenhydrinate	Same as for dimenhydrinate
Meclizine (Antivert, Bonine)	25 mg orally	12.5–50 mg every 4–8 hr	Mild	Same as for dimenhydrinate	Same as for dimenhydrinate	Same as for dimenhydrinate
Scopolamine (Transderm-Scop)	0.2 mg IM or orally Transdermal patch	0.1–0.4 mg every 4–6 hr 1.5 mg over a 3-day period	Moderate	Same as for dimenhydrinate	Dryness, visual blurring, memory loss, confusion in elderly patients	Alcohol, antidepressants, antihistamines, belladonna alkaloids
Droperidol (Inapsine)	2.5 mg IM or IV	2.5–10 mg every 3–4 hr	Prominent	Liver or kidney disease	Drowsiness, extrapyramidal reactions	Antidepressants, barbiturates, spinal and peridural anesthetics
Prochlorperazine (Compazine)	10 mg IM, IV, orally, or by suppository	5–20 mg every 4–12 hr	Prominent	Same as for droperidol	Same as for droperidol	Alcohol, anesthetics, propranolol, phenytoin anticoagulants, levodopa, thiazide diuretics
Diazepam (Valium)	5 mg IM, IV, or orally‡	2–20 mg every 4–8 hr	Mild	Glaucoma, additive with other CNS depressants	Drowsiness	Alcohol, phenothiazines, barbiturates, antidepressants, scopolamine
Lorazepam (Ativan)	1 mg IM, IV, or orally‡	0.5–2 mg every 4–8 hr	Mild	Same as for diazepam	Same as for diazepam	Same as for diazepam

* IM denotes intramuscularly, IV intravenously, and CNS central nervous system.

† It is recommended that the following doses not be exceeded in adults during a 24-hour period: 200 mg of dimenhydrinate, 75 mg of promethazine, 150 mg of meclizine, 1.2 mg of scopolamine (orally), 30 mg of droperidol, 60 mg of prochlorperazine, 60 mg of diazepam, and 6 mg of lorazepam. Smaller doses are used in children and elderly persons.

‡ With intravenous use, equipment to maintain patent airway should be available.

Symptomatic Pharmacotherapy

- Two recent ER clinical trials
 - Marill et al. 2000
 - 50mg IV dimenhydrinate vs. 2mg IV Ativan
 - Benadryl more effective for symptoms
 - Irving et al. 2002
 - 50mg IM dimenhydrinate vs. 2.5mg IM droperidol
 - Equally effective
- Response is dose-dependent
- All medications are sedating
- Newer non-sedating antihistamines do not cross blood-brain barrier - little therapeutic value

Specific Pharmacotherapy

- Vestibular Neuritis *
- Meniere's Disease *
- Benign Paroxysmal Positional Vertigo *
- Ootosyphilis
- Vertebrobasilar Insufficiency
- Migraine (with vertigo)

* more common

Vestibular Neuritis

- Sudden onset of peripheral vertigo
 - Usually without hearing loss
 - Period of several hours - severe
 - Lasts a few days, resolves over weeks
 - Inflammation of vestibular nerve - presumably of viral origin
 - Spontaneous, complete symptomatic recovery with supportive treatment
- 13 Treatment aimed at stopping inflammation

Vestibular Neuritis

- Ariyasu et al.
 - 20 patients: double-blinded, crossover
 - Methylprednisolone vs. placebo
 - 90% decrease in vertigo within 24 hours vs. 30% of placebo group
 - Placebo switched to steroid after 24 hours with decrease in vertigo over next 24 hours
 - 16 patients receiving steroid with resolution had normal ENG within one month

Meniere's Disease

- Hallpike and Cairns - 1938 found endolymphatic hydrops by histology
- Implicated a disturbance of salt and water as pathology
- Classic triad
 - Recurrent vertigo
 - Fluctuating SNHL
 - Tinnitus
 - (aural fullness very common)

Meniere's Disease

- Widely accepted medical treatment
 - Dietary salt restriction
 - Diuretics
- Thiazide diuretics
 - Decrease Na absorption in distal tubule
 - Side effects - hypokalemia, hypotension, hyperuricemia, hyperlipoproteinemia
- Combination potassium sparing agents
 - Maxzide, Dyazide
 - Avoids hypokalemia

Meniere's Disease

- At least 3 months of diuretic therapy recommended before discontinuing
- Sulfa allergies - can try loop diuretics or alternate therapies

Meniere's Disease

- Carbonic anhydrase inhibitors (acetazolamide)
 - “inner ear glaucoma”
 - Decreased Na-H exchange in tubule
 - Decreased CSF production
 - Diuretic effect not as long-lasting
 - Side effects - nephrocalcinosis, mild metabolic acidosis, GI disturbances

Meniere's Disease

- Vasodilators
 - Based on hypothesis - pathogenesis results from ischemia of stria vascularis
 - Rationale - improve metabolic function
 - IV histamine, ISDN, cinnarizine (CA agonist), betahistine (oral histamine analogue)
 - Anecdotal success
 - No demonstrated beneficial effects in studies

Meniere's Disease

- Newer theories
 - Multifactorial inheritance
 - Immune-mediated phenomena
 - Association of allergies
- Study by Gottschlich et al.
 - 50% meeting criteria have antibodies to 70-kD heat-shock protein
 - 70-kD HSP implicated in AI-SNHL

Meniere's Disease

- Immunosuppressive agents gaining favor
 - Systemic and intra-tympanic glucocorticoids
 - Cyclophosphamide
 - Methotrexate
- Shea study - intractable Meniere's
 - 48 patients IT dexamethasone
 - 66.7% elimination of vertigo
 - 35.4% improvement in hearing (>10dB and/or 15% change in word recognition score)

Meniere's Disease

- Chemical labyrinthectomy
 - Disabling vertigo
 - After trial of adequate medical therapy
- Intratympanic aminoglycoside (ITAG)
- Allows treatment of unilateral disease
- Gentamicin
 - Primarily vestibulotoxic
 - may impair vestibular dark cells (endolymph)
- Inherent hearing loss risk - 30%

ITAG

- Stock solution - 40mg/mL gentamicin
- 10 to 20 mg injected over round window
- Patient supine, ear up for 30 minutes
- Instructed not to swallow
- Bolus injections - weekly or bi-weekly
- End point variable - vestibular hypofunction
- Audiometry monitoring between injections
- Total vestibular ablation not necessary

ITAG

- Minor
 - 91% control of vertigo
 - 3% rate of profound SNHL (usually sudden)
 - 22% recurrence rate
- Continuous delivery
 - Microwick
 - Round Window Microcatheter
- Direct injection (labyrinthotomy)
 - Significant hearing loss
 - Out of favor

BPPV

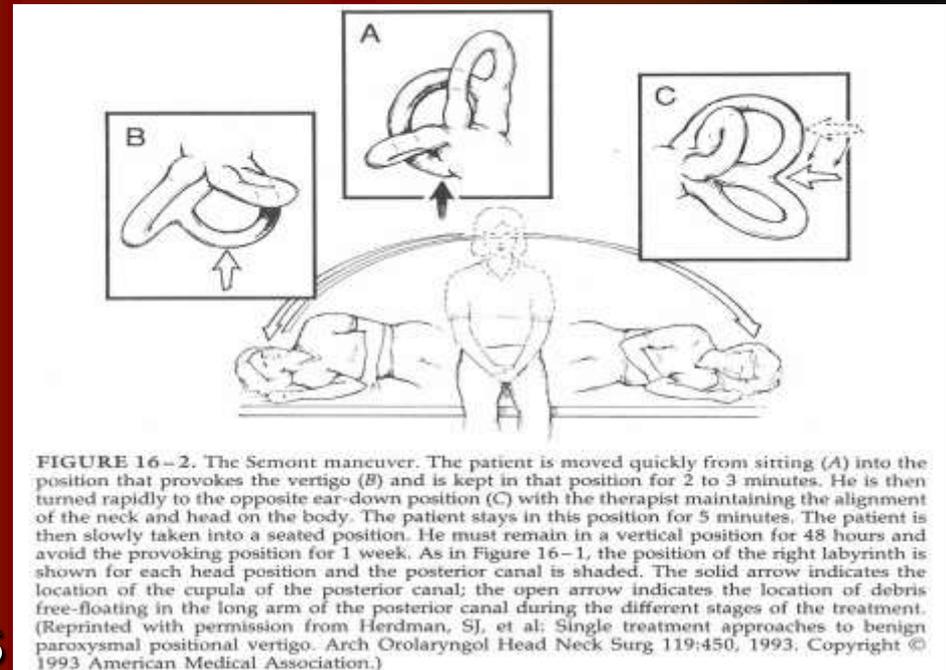
- Most common cause
- Dysfunction of posterior SCC
- Cupulolithiasis vs. Canalithiasis
- Cupulolithiasis
 - Calcium deposits embedded on cupula
 - PSCC becomes dependent on gravity
- Canalithiasis
 - Calcium debris (otoconia) displaced into PSCC
 - Does not adhere to cupula

BPPV

- Head movements
 - Looking up
 - Lying down
 - Rolling onto affected ear
- Result in displacement of “sludge” / otoconia
- Vertigo lasting a few seconds
- Treatment approaches
 - Liberatory maneuvers
 - Particle repositioning
 - Habituation exercises

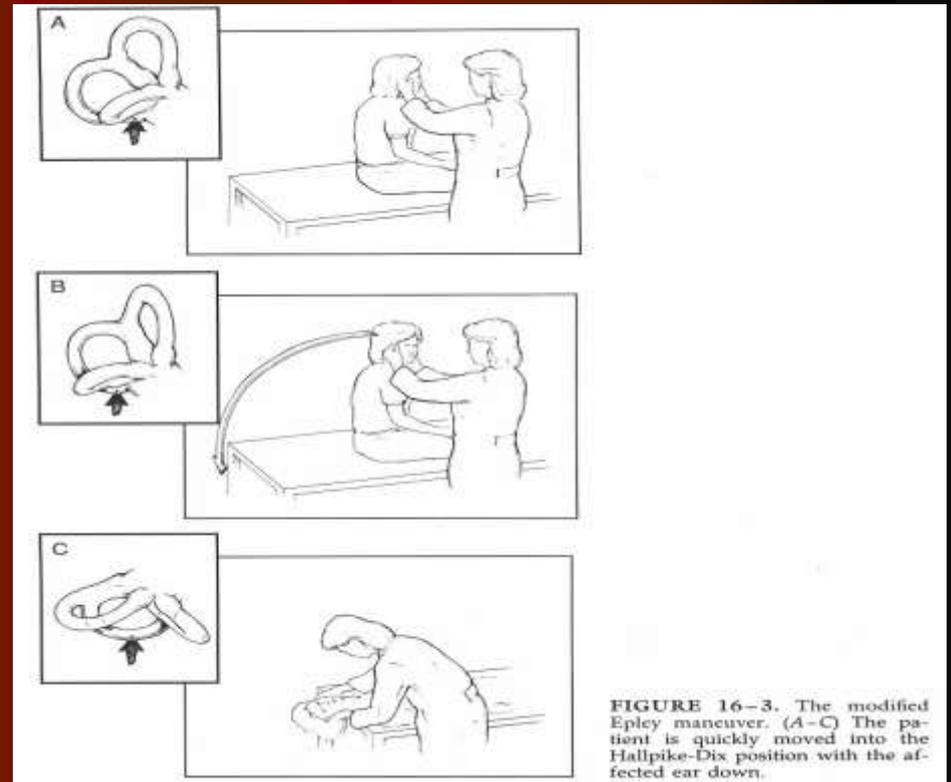
BPPV

- Semont et al
- Cupulolithiasis
- Liberatory maneuver
- Single treatment
- Cure rates
 - 84%-one treatment
 - 93%-two treatments



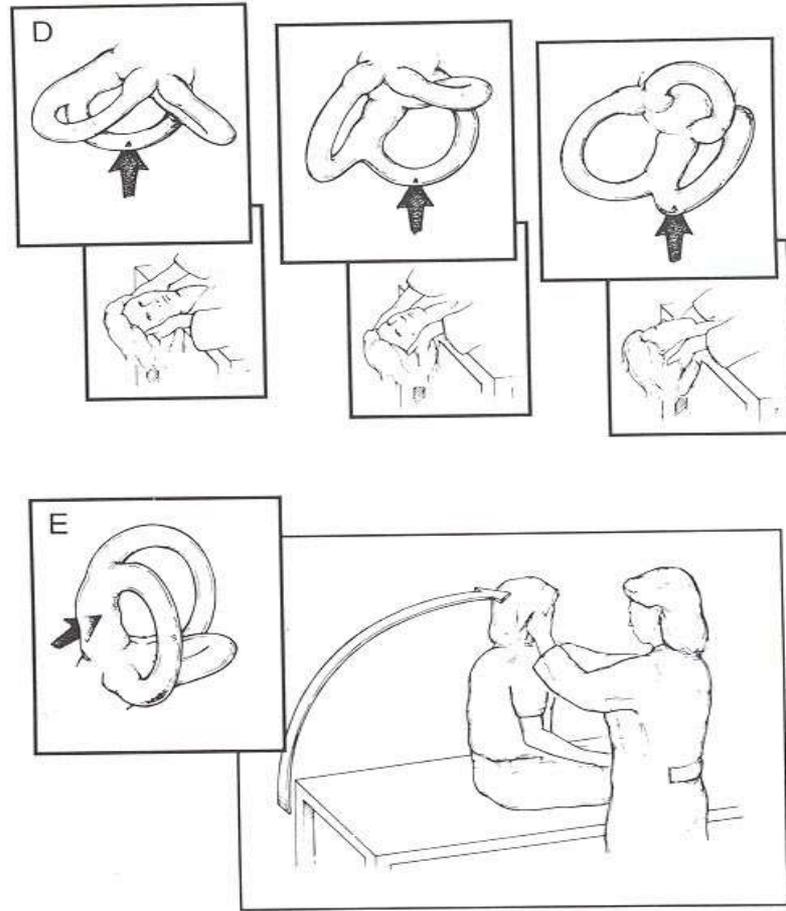
BPPV

- Epley
- Canalithiasis
- Canalith repositioning
- Move into vestibule
- Cure rates
 - 80% - one treatment
 - 100% - multiple



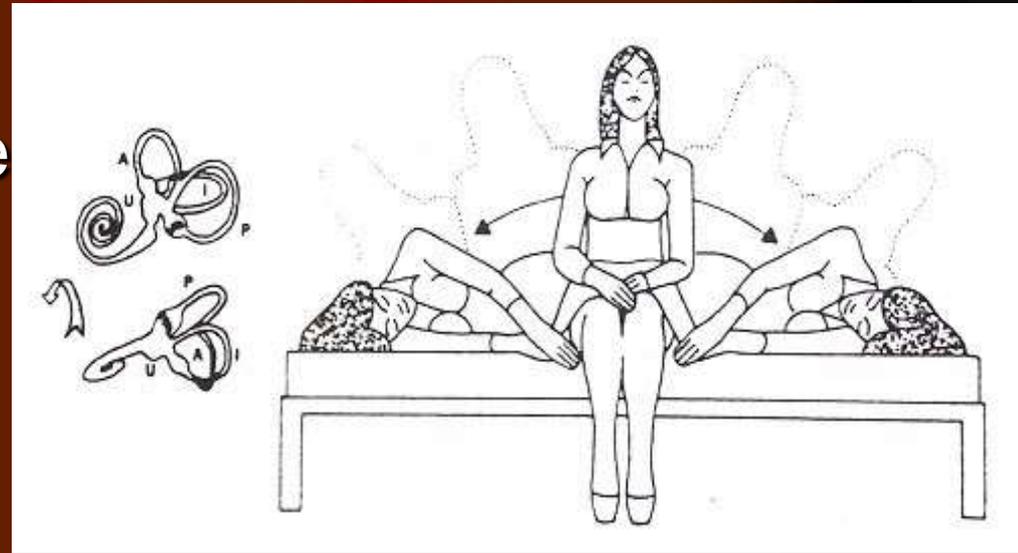
BPPV - Epley

FIGURE 16-3. Continued. (D) He is kept in that position for 3 minutes and then the head is slowly moved through extension until the opposite ear is down (opposite Hallpike-Dix position). (E) The patient stays in that position for 4 minutes and then slowly sits up. The patient must then remain with the head in an upright position for 48 hours and must avoid lying on the affected side for 5 days after that. As in Figure 16-2, the position of the right labyrinth is shown for each head position, and the posterior canal is shaded. The arrows point to the presumed location of debris in the canal with each position change. (Reprinted with permission from Herdman, SJ, et al: Single treatment approaches to benign paroxysmal positional vertigo. Arch Otolaryngol Head Neck Surg 119:450, 1993. Copyright © 1993, American Medical Association.)



BPPV

- Brandt and Daroff
- Habituation technique
- Move to provoking position repeatedly
- 98% success rate after 3 to 14 days of exercises



BPPV

- Blakely
 - Compared repositioning techniques with no treatment
 - 89% of all patients improved after 1 month
 - No statistical significance between groups
 - 50% spontaneous remission after 1 month

Otosyphilis

- Penicillin established treatment
- IM and IV routes acceptable
- IM - 2.4 million units benzathine PCN weekly x 3 consecutive weeks is minimal treatment (some advocate up to 1 year)
- IV - 10 million units PCN G qD in divided doses x 10 days, followed by 2.4 million units benzathine PCN x 2 weeks

Vertebrobasilar insufficiency

- Vertigo, diplopia, dysarthria, gait ataxia and bilateral sensory & motor disturbance
- Transient ischemia - low stroke risk
- Antiplatelet therapy - aspirin 325mg qD
- Ticlid
 - Platelet aggregate inhibitor
 - Risk of life-threatening neutropenia
 - Only in patients unable to tolerate aspirin

Migraine

- Concomitant vertigo and disequilibrium
- Headache control improves vertigo
- Diagnostic criteria
 - Personal/family history
 - Motion intolerance
 - Vestibular symptoms - do not fit other causes
- Theories - vascular origin, abnormal neural activity (brainstem), abnormal voltage-gated calcium channel genes

Migraine

- Treatment
 - Modifying risk factors
 - Exercise and diet
 - Avoid nicotine, caffeine, red wine and chocolate
 - Abortive medical therapy
 - Ergots
 - Sumatriptin
 - Midrin
 - Prophylactic medical therapy
 - B blockers, Ca channel blockers, NSAIDs, amitryptiline, and lithium

Vestibular Rehabilitation

- Promoting vestibular compensation
- Habituation
- Enhancing adaptation of VOR & VSR
- May have initial exacerbation

Vestibular Rehabilitation

- Cawthorne - Cooksey
 - Developed in 1940s
 - Head movements
 - Balance tasks
 - Coordination of eyes with head
 - Total body movements
 - Eyes open & closed
 - Noisy environments

Vestibular Rehabilitation

- Habituation of pathologic responses
- Postural control exercises
- Visual-vestibular interaction
- Conditioning activities
- B.I.D., most improve after 4-6 weeks

VRT - Elderly

- Multifactorial causes of balance difficulty
 - Need 2 of 3 systems functional
 - vestibular, visual, proprioceptive
- Good outcome measures with longer time
- Impact on complications of falls

Conclusions

- Vestibular complaints common to ENT
- Thorough evaluation and understanding
- Dx and treat acute symptoms
- Wean vestibular suppressants
- Specific pharmacotherapy instituted
- Chronic, uncompensated disease benefits from early VRT

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