Vestibular Rehabilitation and Surgical Management of Vestibular Disorders

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Introduction

- Vestibular neural connections
- Insult, cerebellum, cortical response
- Recalibration, motion essential
- Symptom aggravation
- Inactivity
- Pt education, formal rehab
Rehabilitation and Surgical Management of BPPV

- Most common peripheral disorder

History
- Rotational imbalance lasting seconds
- Head position or movement inciting

Physical exam
- Dix-Hallpike
  - Nystagmus rotational toward downside ear
  - Brief latency in onset 5-15 sec
  - Fatigable
Dix-Hallpike Maneuver
BPPV

- Horizontal canal BPPV
  - Supine head lateral provocative
  - 30 sec to 1 min duration
  - Latency no more than 3 sec
  - No fatigability
BPPV

- Cawthorne 1954
  - 1st exercises for vestibular disorder
- Semont
  - Liberatory maneuver
  - 1st rapid single treatment
  - 83.96% one maneuver 92.68% two
  - 4.22% recurrence
  - Others less success, too violent
Brandt and Daroff exercises

- Seated eyes closed
- Tilted laterally to precipitating position
- Lateral occiput resting
- Vertigo subsides
- Sit up for 30 sec
- Opposite head down position 30 sec
- Vertigo opposite (bilateral) maintain until resolves
- Every 3 hrs while awake, until 2 days free
Brandt and Daroff

- 66 of 67 relief 3-14 days
- Most 7-10 days
- 2 of 66 recurred and responded
- Non-responder had perilymph fistula
Brandt and Daroff
Epley CPR procedure

- Canaliths theory
- Head maneuvers and vibration move particles
- Target canal determined
- Sum of latency and duration
- Estimate of 90 degree time
- Premedicated
Epley Maneuver

- Five position cycle
  - Repeated until no nystagmus observed
  - Induced nystagmus wait until slows
  - No nystagmus time based on last observed
  - Always complete cycle
  - Vibratory source at 700 Hz, and 80 Hz
Epley Maneuver

- Reclined head hanging 45 degree turn
Epley Maneuver

- Rotate 45 degrees contralateral
Epley Maneuver

- Head and body rotated to 135 degrees from supine
Epley Maneuver

- Keep head turn and to sitting
- Turn forward chin down 20 degrees
BPPV

- Epley Maneuver
  - 43 of 44 resolution of positional vertigo
- Overall 90% success of medical cure
- Non-responders offered surgery
BPPV-surgery

- Singular neurectomy
- PSCC occlusion
- Eliminate response from PSCC
- Candidates unrelenting symptoms from same ear, multiple recurrences
Singular Neurectomy

- Gacek described
- Anatomy
  - Nerve exits lateral IAC singular canal
  - Courses inf. and post. to PSCC ampula
  - Intermediate sement inf post to round window niche
  - Approached at this location
Singular Neurectomy

- Lateral to RW membrane 50%
- Medial in 14-27%
- When medial significant risk to vestibule or cochlear basal turn
- Anatomic studies show inaccessible nerves clinical series rarely document difficulty
Singular Neurectomy

- Transcanal approach
- Inferior scutum lowered if needed
- RW overhang taken down
- Immediate resolution of positional nystagmus
- Most spontaneous nystagmus, downbeating, few days
Singular Neurectomy

- Published success 90%
- Persistent symptoms if nerve not definitively found

Complications
- Recurrent vertigo, SNHL
- Severe SNHL 5%
  - Trauma, labyrinthitis
- Mild SNHL 20%

- Only attempted by experience surgeons
PSCC Occlusion

- Prevents flow of endolymph
- Animal studies no effect on remaining vestibular organs

Procedure

- Cortical mastoidectomy
- Identify and blue-line canal
- Open with pick
- Occlude canal
  - Laser partitioning optional
  - Pack canal, bone wax, dust, fascia covering
PSCC Occlusion

- Transient SNHL
  - Detected intraoperatively by ECog
  - Recovers by 6-8 weeks
- Mild SNHL persists 20%
- Post-op dysequilibrium for a few days/weeks
- Average in-patient stay 4.5 days
- Recurrent vertigo rare, f/u limited
- PSCC occlusion vs. singular neurectomy
Meniere’s Disease

- Most common for surgery
- Patient selection difficult
- Preoperative objectives
  - Definition of disease
  - Localizing side
  - Quantification of vertigo
  - Assess hearing
- Surgery contemplated pt must have full understanding including dysequilibrium
Peripheral Vestibulopathies

- Meniere’s, trauma, iatrogenic, delayed endolymphatic hydrops, chronic vestibular neuronitis, labyrinthitis (cholesteatoma, chronic otitis media, viral, otosyphilis) vascular, BPPV, autoimmune, SCDS

- If constant imbalance consider diagnosis other than peripheral lesion
Peripheral Vestibulopathy

- Tinnitus, aural pressure, nystagmus support peripheral cause implicate offending ear
- Audiometry, ENG calorics confirm
- Quantify vestibular disability
- Assess hearing for surgical options
  - ? Contralateral disease
  - 15-30 % Meniere’s
  - 10 yrs PTA 50-60 dB, speech descrim 53%
  - Best preoperative audio
  - 70 dB, 20% descrim
### TABLE 160-3. Functional scale for Meniere’s disease

<table>
<thead>
<tr>
<th>Level</th>
<th>Patient’s assessment of current status of overall function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No effect on activities at all.</td>
</tr>
<tr>
<td>2</td>
<td>I have to stop what I am doing during an attack but may resume activities when it has passed. I continue to work, drive, and engage in most activities I choose without restriction. I have made no changes in my activities in order to accommodate the dizziness.</td>
</tr>
<tr>
<td>3</td>
<td>I have to stop what I am doing during an attack but may resume activities when it has passed. I continue to work, drive, and engage in most activities I choose, but I have had to make changes in my activities in order to allow for the dizziness.</td>
</tr>
<tr>
<td>4</td>
<td>I am able to work, drive, travel, take care of my family, or engage in most essential activities, but I must exert a great deal of effort to do so. I must constantly make adjustments in my activities and budget my energy. I am barely making it.</td>
</tr>
<tr>
<td>5</td>
<td>I am unable to work, drive, or take care of my family. I am unable to do most of the active things I used to do. Even essential activities must be limited. I am disabled.</td>
</tr>
<tr>
<td>6</td>
<td>I have been disabled for 1 year or longer, and/or I receive compensation because of dizziness or balance problems.</td>
</tr>
</tbody>
</table>

### TABLE 160-2. Staging of hearing in Meniere’s disease

<table>
<thead>
<tr>
<th>Stage</th>
<th>Four-tone pure-tone average&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt;26</td>
</tr>
<tr>
<td>2</td>
<td>26–40</td>
</tr>
<tr>
<td>3</td>
<td>41–70</td>
</tr>
<tr>
<td>4</td>
<td>&gt;70</td>
</tr>
</tbody>
</table>

<sup>a</sup>Calculated as the mean of thresholds at 0.5, 1, 2, and 3 kHz from the patient’s worst audiogram in the 6 months preceding treatment. These guidelines were designed only for certain and definite cases of Meniere’s disease.
Meniere’s Categories

- Certain
  - Definite plus histology
- Definite
  - Two episodes 20 min
  - SNHL, documented
  - Tinnitus or aural fullness is affected ear
  - Other causes excluded
Meniere’s Categories

- **Probable**
  - One definitive episode plus definite

- **Possible**
  - Cochlear or vestibular variants of Meniere’s
  - Other causes excluded

- MRI CPA lesions

- FTA-Abs

- Surgery- functional 4 sometimes 3, failed medical management
Chemical Labyrinthectomy

- Schuknecht 1956
- Absorbed round window
- Cochlear and vestibular toxic
- Gent and streptomycin vestibulotoxic
- Many regimens
  - Trend to less frequent
  - Toth and Parnes
  - Rauch and Oas
  - Goal complete ablation
Chemical Labyrinthectomy

- Harner et. al.
  - Prospective one treatment
  - F/u one month
  - Additional injection if needed
  - 43 at FL 3-5
  - 36 at 1-2, 40 at 1-3
  - Only 15 61% greater weakness
  - ?dark cell toxicity
  - No audiometric change
  - ?partial labyrinthectomy effective
Chemical Labyrinthectomy

- Office procedure
- Anesthesia
  - Injectable local
  - Emla
  - Phenol
- Tympanostomy tube, wick
- 25 guage needle, tuberculin syringe
- .5-.75 ml gent 40 mg/mL or less buffered
- Submerge round window
- 30-45 min
- No swallowing
Endolympathic Sac Procedures

- Portmann
- Histology
  - Dilation of endolymphatic spaces
  - Intralabyrinthine membrane rupture, fibrosis, obstruction of endolymphatic, utricular, saccular ducts
- Proposed causes
  - Infection, autoimmune, vascular, altered endolymph production or absorption
Endolymphatic Sac Procedures

- Multiple variations of technique
  - Endolymphatic-subarachnoid shunt
  - Sac decompression
  - Sac excision
  - Endolymphatic-mastoid shunt
- 75% success regardless of technique
Endolymphatic Sac Procedures

- No controlled studies
  - Difficulty in finding control group
  - Unpredictability of natural course
- Bretlau, Thomsen et. al. 1981
  - Prospective, blinded
  - Simple mastoid vs. active mastoid shunt
  - Concluded no difference in vertigo control yearly for up to 9 years
Endolymphatic Sac Procedures

- Welling, Hagaraja 2000
  - Same data
  - Stat Sig difference in groups in vertigo as well as several other sx

- Thomsen
  - Shunt vs tympanostomy tubes
  - No difference
Endolymphatic Sac Procedures

- Silverstein et. al.
  - Retrospective 3 groups
  - Sac surgery, vestibular nerve section, denied surgery
  - Controls
    - Elimination of vertigo 57% at 2 yrs
    - 71% at 8.3 yrs
  - Sac surgery
    - 40% at 2 yrs
    - 70% at 8.7 yrs
  - Vestibular nerve section
    - 93% at 2 years

- ? Benefit sac surgery
Endolymphatic Sac Procedure

- Post-auricular
- Complete mastoidectomy jugular bulb, facial nerve, PSCC
- All bone post. fossa ant to sigmoid
- Dura appears thick as overlaps sac
- Open, excise or stent
Endolymphatic Sac Procedure

- Outpatient surgery
- Usually not vertiginous
- Complications rare
  - SNHL, CHL(bone dust), CN VII injury, CSF leak, bleeding from sinus
Selective Vestibular Nerve Section

- Described early 20\textsuperscript{th} century
- High incidence facial nerve injury
- House 1961 Middle fossa approach
- Brackmann, Hitzelberger, Silverstein 1978, retrolabyrinthine approach
- Retrosigmoid and retrosigmoid-IAC
Selective VNS

- Perioperative antibiotics
- CN VII and VIII monitoring
- ICU, neurologic status, hypertension
- Vestibular symptoms droperidol
- Regular floor POD #1-2
- Observe for CSF, meningitis
- Early ambulation
- D/C ambulate independently, regular diet
Middle Fossa Approach

- 4X4 cm temporal craniotomy centered slightly anterior to the EAC
- Elevate Middle fossa dura
- Retract temporal lobe
- Greater superficial petrosal nerve, malleus head, SSCC landmarks IAC
- Remove bone 180 degrees
- Incise dura posteriorly
- Section SVN, IVN laterally
- Include singular nerve
- Muscle or fat plug
Retrolabyrinthine/retrosigmoid Approach

- Post-auricular incision posteriorly
- Craniotomy post to sigmoid inferior to transverse sinus 4x5 cm
- RL- complete mastoid, post PSCC, 1-2 cm post to sigmoid
- Dural incision, release CSF
- Displace cerebellum
- Sigmoid retracted
- Porus vestibular portion superior
- Cleavage plane in 75%
- Abd fat in retrolab, pressure dressing
VNS

- Approach success varies by author
- Overall 90% elimination of vertigo MFA
- Posterior 80% complete, 95% substantial improvement
- McKenna
  - Retrosigmoid-IAC better than RL, vertigo
- Glasscock
  - No difference, preferred exposure
- Silverstein
  - Retrosigmoid-IAC better exposure, easier than MF
  - 92% done posteriorly in survey
VNS

- Complications
  - Dysequilibrium, headache, hearing loss, CSF leak
  - Dysequilibrium 30%
    - Rarely debilitating
  - Hearing loss uncommon
  - Wound infection, CN VII injury less than 5%
  - Menningitis, hemmorrhage, stroke more rare

- MFA
  - Increase CN VII injury, memory loss, total hearing loss
  - Labyrinthine artery, adherence of dura in elderly, subdural hematoma
VNS

- Retrolabyrinthine
  - Increased CSF leak, CHL, requires abd fat graft
  - Lower success due to lack of cleavage plane
- Retrosigmoid
  - Headache more common
  - Greater if IAC drilled
Labyrinthectomy

- Final surgical option for control of vertigo
- 1904 described
- Transcanal, transmastoid
- PTA 70, discrim 20%
Labyrinthectomy

- Transcanal
  - Local or general
  - Typanomeatal flap
  - IS joint disarticulated
  - Incus removed
  - Stapes tendon divided, stapes removed
  - Vestibule drained of perilymph, vertigo
  - Oval window enlarged
  - Saccule removed
  - Utricle superior medial to facial nerve
  - Hook used to probe ampulated of SCC
  - Gelfoam soaked ototoxic med inserted
Labyrinthectomy

- Transmastoid
  - Excise all five end-organs
  - Complete mastoidectomy
  - Visualize facial mastoid segment and 2\textsuperscript{nd} genu
  - Exenterate perilabyrinthine cells
  - Enter lateral canal superiorly, protect facial
  - Superior canal entered posteriorly
Labyrinthectomy

- Follow to ampulla located superior to vestibule, and avulse
- Enlarge vestibule and remove utricle and saccule
- Respect lateral wall
- Carry posteriorly medial to second genu to locate PSCC ampula and remove
- Closed in layer and mastoid dressing
Labyrinthectomy
Labyrinthectomy

- **Post-operative course**
  - Horizontal nystagmus
  - Anti-emetics
  - Ambulation

- **Results**
  - 85% relief of vertigo
  - Labyrinthectomy-VNS no benefit

- **Complications**
  - Rare-wound infection, hemorrhage, facial nerve injury, CSF leak, meningitis if VNS
  - Post-op dysequilibrium 30%
Superior Canal Dehiscence Syndrome

- Minor
- Sound/pressure induced vertigo
- Dehiscence over SCC

History
- Vertigo with loud noise (Tullio's phenomenon)
- Sneezing, coughing, Valsalva, lifting, autoinsufflation
- Occas. Constant dysequilibrium

Exam
- Vertical-torsional eye movement
- Fast-phase toward affected ear with positive pressure
Mechanism
- Dehiscent bone over SSCC
- Mobile 3rd window to inner ear
- Endolymph motion as result deflects cupula
- Positive pressure excitatory fast phase toward affected ear
- Increase ICP inhibitory fast phase to opposite ear
- Diagnosis confirmed by high resolution CT
SCDS

- Carey

- 1000 T-bones, 596 adults
- 5 specimens 0.5% complete dehiscence
  - 1 middle fossa floor
  - 4 superior petrosal sinus contact with canal
- 14 (1.4%) 0.1 mm thick
  - 8-sinus, 6-floor
- Thinner than controls, might appear on CT dehiscent
- Abnormalities tended bilateral
- Uniformly thin until 3 yrs of age
- Failure of post-natal bone development
SCDS

- Symptomatic
  - Avoid offending stimuli
  - 10/17 affective (Minor)
  - Debilitation symptoms, surgery
  - Middle fossa approach
  - Care in raising dura
  - Resurface, or occlude, optimal procedure not determined
Conclusion

- Diagnosis
- Medical/rehabilitation
- BPPV Epley, Brandt Daroff, singular neurectomy, PSCC occlusion
- Peripheral-VNS, labyrinthectomy
- Meniere’s-?sac surgery, VNS, labyrinthectomy,
- Chemical labyrinthectomy- Meniere’s, ?non-Meniere’s, ? Non-serviceable hearing
- SCDS