Intratympanic therapy of inner ear disease

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Sudden Sensorineural Hearing Loss

Definition

- Sudden SNHL is defined as a loss greater than 30 dB in three contiguous frequencies, occurring over a period of less than 3 days
Identifying the Sudden Sensorineural Hearing Loss

- Identification of probable cause of sudden SNHL must be undertaken in order to treat appropriately
- This includes a comprehensive history, physical examination, complete audiologic evaluation, laboratory and radiographic studies
Clinical Manifestations

- The loss starts relatively quickly, developing over the course of an hour, a day or several days.
- A loud sound in the affected ear may occur at onset.
- The hearing loss may present with tinnitus and/or vertigo.
- The spoken voice is often described as “sounding like a cartoon character.”
Statistics on Sudden SNHL

- 5 to 20 per 100,000 persons per year
- These numbers may be even higher as some patients may not seek medical attention due to spontaneous recovery
- Incidence appears to increase with age:
  - 4.7 per 100,000 in 20-30 years old
  - 15.8 per 100,000 in 50-60 years old
- Mean age for sudden SNHL: 46-49
Statistics on Sudden SNHL

- 70% of patients experience tinnitus
- 50% of patients experience vertigo
- The loss of hearing is usually unilateral
- 4% of patients have bilateral involvement
Statistics on Sudden SNHL

- There is no gender correlation
- Sudden hearing loss does not appear to be related to seasonal patterns
- 20-60% of patients with sudden SNHL report recent URI symptoms

Note: at any given time almost 40% of the general population gives history of recent URI
40% of patients show a spontaneous recovery to within 20 dB of interaural thresholds (Guyot and Thielen)

Recovery, if present, may take several days

Vertigo tends to subside within one week, even if severe

Vestibular symptoms appear to clear spontaneously within 6 weeks
Differential Diagnosis: Infections/Inflammatory

- Viral infections of cochlea/CN VIII
- Bacterial labyrinthitis
- Syphilis
- Meningitis
- Encephalitis
Differential Diagnosis: Neoplastic

- Cerebellopontine angle tumor
  - Acoustic Neuroma
  - Meningioma
About 15% of patients with an acoustic neuroma will present with sudden sensorineural hearing loss as the initial symptom. The cause of the loss is from compression of the internal auditory artery.
Differential Diagnosis: Vascular

- Sludging/occlusion due to hyperviscosity
- Polycythemia vera
- Macroglobulinemia
- Leukemia
- Accelerated coagulation
Differential Diagnosis: Vascular causes, cont’d

- Arteriosclerosis related to
  - Aging
  - Diabetes
  - Hypertension
  - Hyperlipidemia

- Aneurysm of anterior inferior cerebellar artery
Vascular causes

- Vasospasm, thrombosis, embolism, hemorrhage into the inner ear, hypercoagulation are frequently mentioned as causes of sudden deafness, but the evidence is lacking.
Differential Diagnosis: Trauma

- Temporal bone fracture
- Barotrauma
- Noise
Injuries from firearms and explosions may cause severe and sudden hearing loss. This is likely due to bleeding and possible hair cell damage. There are some who theorize that a metabolic effect permanently damages sensory cells of the organ of Corti.
Perilymph fistula

- Spontaneous or post surgery, barotrauma or acoustic trauma can cause sudden deafness secondary to a perilymphatic fistula
Differential Diagnosis: Drug effects

- Aminoglycosides
- Furosemide
- Antineoplastics
Differential Diagnosis: Autoimmune

- Cogan's syndrome
- Lupus
Differential Diagnosis: Endocrine

- Hypothyroidism
- Diabetes
Differential Diagnosis

Idiopathic Sudden Sensorineural Hearing Loss
Differential Diagnosis: Other Causes of SSNHL

- Meniere’s Disease
- Round or oval window fistula
- Multiple sclerosis
Other causes (cont’d)

- Lumbar puncture – especially in patients with a known history of endolymphatic hydrops
- Post-irradiation deafness
- Cerebellar infarction
Medical examination

- History
- Physical Exam
- Audiological Studies
- Laboratory Studies
- CBC, ESR, serological tests, others
- Radiological Studies
  - CT
  - MRI
Treatment options

- Medical treatment traditionally used:
  - Vasodilators
  - Plasma expanders
  - Anti-coagulants
  - Carbogen inhalation
  - Hyperbaric oxygenation
  - Steroids
Treatment

- For the majority of cases, treatment may be empirical
- For vascular related diagnoses:
  - vasodilators
  - anticoagulation
- Theory: reducing the viscosity of the blood increases blood flow
Symptom Recovery

- Except for steroid therapy in select patients, there is general consensus that there is little evidence to support medical treatment for sudden hearing loss.
Treatment

- For idiopathic diagnoses:
  - Prescription of corticosteroids
- Theory: anti-inflammatory effects of these agents on viral infections and immune related disorders
Treatments most used at this time:

- Steroids
- Anti-virals
- Surgical intervention
Steroid Treatment

- Studies have shown a 78% response to steroids and a 38% response to placebo in a double blind study (61/32 Wilson, et al, 1980)

- Steroids have the greatest benefit in patients younger than age 40 displaying a moderate, unilateral hearing loss
Steroid Treatment (cont’d)

- There appears to be less benefit from steroids for those with severe losses
- Mild losses tends to recover spontaneously
Methods of Steroid Treatment

- Oral
- Intra-tympanic
Intratympanic therapy

Premise

- Round window is a semi-permeable membrane
- Many substances will pass through into the inner ear
Techniques Used to Perfuse Inner Ear Fluids

- Blind injection into the middle ear over the RW
- Saturated Gelfoam on the RW
- RW Microcath
- Silverstein Microwick®
Microwick Method

- Laser assisted otoendoscopy over RW niche (myringotomy)
- Removal of membranes over the RWM if needed
- Insert special vent tube 1.4mm diameter
- Insert MicroWick
Mechanism of Action of Steroids on the Inner Ear

- Active transport through membranous labyrinth from perilymph to endolymph with higher endolymph concentration
- Suppress immune-mediated inflammatory response
- Increase cochlear blood flow
- Improves cochlear homeostasis
Sudden Deafness

Si Study

- Prednisone 60 mg daily for 2 weeks
  - 74 patients
  - 50% improvement in hearing
    - MicroWick with Dexamethasone perfusion (4mg/cc or 10mg/cc) for 4 wks
    - 50% get further improvement
  - 50% no improvement in hearing
    - 15% get improvement with subsequent Dexamethasone perfusion
Sudden Deafness Treated with MicroWick, G. Hicks study

- Success rate: 28 of 47 (59.5%)
- Most successful technique: Silverstein MicroWick (31 total, 21 of 28 successes)
- Successful medication: dexamethasone 24 mg/ml
- Early intervention favors success—Of 28 successes, 24 (85%) were treated within an average of 18.8 days
- Presence of vertigo decreases success (4 of 6 failed)
Intratympanic Dexamethasone

- Advantages
  - Direct application of steroids
  - Highest concentration in the inner ear
  - Little systemic side effects
  - Can be used when there is diabetes, hypertension, or ulcers
  - Does not cause hearing loss
  - Best results if used early in disease
Sudden Deafness

- Indication for early Intratympanic Dexamethasone perfusion
  - Hx of diabetes, hypertension, GI ulcers
  - Becoming more aggressive with intratympanic treatment within the first 2 weeks
Intratympanic Dexamethasone

- Complications infrequent
- Persistent perforation 5%
  - Fat graft myringoplasty
- Infection rare
Prognosis

- Medical treatment within 7-10 days after onset of symptoms have better outcomes than patients waiting 30 days or more.
- The more severe the hearing loss, the worse the prospects of a full recovery.
- Losses with upwardly sloping audiograms do better than those with high frequency or downward sloping configurations.
- The hearing status of the uninvolved ear may play a role in prognosis: Patients with normal hearing in the contralateral ear do better than those with hearing loss in that ear.
Prognosis

- The presence of vertigo may mean poorer recovery rates
- Age may play a role: patients younger than 15 or older than 60 have poorer recovery
- Delivery system
- Drug concentration
Osseointegrated Bone Conduction SSD

- The latest development in the rehabilitation of patients with single sided deafness
- Transcranial contralateral cochlear stimulation
Intratympanic Gentamicin
Meniere’s Disease
Surgical Procedures for Vertigo Survey

- Intratympanic Gentamicin
- Endolymphatic Sac Surgery
- Vestibular Neurectomy
- Labyrinthectomy

IT perfusion methods

- Direct injections
- Microwick
MicroWick

- Gentamicin treatment
  - Indications
    - Meniere’s disease
      - To relieve vertigo attacks
      - To reduce tinnitus and pressure (secondary)
Treatment protocol

- Surgeon injects the 1st time
- Patient instills 3 drops of medication into ear canal t.i.d.
Method - Gentamicin

- Diluted 10mg/ml - compounding pharm. dropper bottle.
- Hearing test and air caloric ENG pre-op and weekly
- 3 drops t.i.d.
- Length of treatment determined by HT and ENG
Gentamicin Treatment Results with MicroWick

- 204 Patients - 4 year follow up
  - Vertigo relief 81%
  - Tinnitus improved 52%
  - Pressure improved 67%
  - Repeat gent or surgery  6%
  - 62% No change or improved PTA
  - 60% No change or improved Discrimination
Gentamicin Treatment Complications

- 6% Retreatment
  - 7 gent perfusions - 6 cured
  - 5 labyrinthectomies
  - 3 vestibular neurectomies
- Permanent perforation 1%
- Transient infection 1%
- Anacusis 5%
Direct injection

- Fine needle
- No anesthesia needed
- Topical tetracaine anesthesia if necessary
- Micro puncture anteriorly superiorly to depressurize
- 0.4 cc gentamicin 40 mg/cc
- Allow 30 minutes for round window penetration
Direct injection

- Usually no symptoms after first injection
- HT/ENG 1 week later prior to second injection or third injections if necessary
- Symptoms of dizziness and dysequilibrium predictive of changes on ENG
Vestibular Rehab / Prehab

- Help patient compensate for the loss of vestibular function as it occurs
Intratympanic treatment for Tinnitus

- AM 101 Clinical trial
- Acute onset of tinnitus within 3 months of therapy
- Causes:
  - Trauma
  - Acute otitis media
- Direct injections x 3
- Promising results
MicroWick Conclusions

- Advancement in the treatment of inner ear disease
- Inexpensive yet effective office procedure
MicroWick Conclusions

- MicroWick provides continuous perfusion of the inner ear
- Self-treatment well accepted by patients
- Good Results with few complications!
Possible future indications

- Tinnitus - antioxidants, Dexamethasone ...
- Vestibular Meniere’s - Antivirals
- Prevention of noise induced trauma
- Protection from ototoxicity
- Sensorineural loss - new drugs