Hyperbaric Oxygen for Idiopathic Sudden Sensorineural Hearing Loss
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Introduction - ISSHL

- Definition
  Perceptive hearing loss
  Hearing loss occurred within 72 hours
  Severity of the hearing loss averages at least 30 dB HL for three subsequent one octave steps in frequency as shown in the standard pure-tone audiogram
  Hearing loss is nonfluctuating
  Etiology remains unknown after clinical, laboratory and imaging studies
  Blank otological history in an otherwise healthy individual
  Unilateral in >97% of cases

- US Incidence
  5-20 cases/100,000/year
  ~4000 cases annually
  Many cases unreported
- Heavy social and economic burden
- Difficult to obtain, keep jobs
- Stigmatization and isolation
- Special educational needs
- Most common cause of disability globally
- 15th leading cause of burden of disease

Diagnosis

- Symptom complex
- On phone - ask pt to hum - if sound lateralizes to side of hearing loss - suspect conductive (non-urgent)
- If doesn’t lateralize or lateralizes to opposite ear, urgent eval
- History: trauma, pain, drainage, fever, FNS, HA, diplopia, eye pain, prior history of hearing loss
- Otoscopic exam (OM, foreign body, perforation, OE, cholesteatoma
- Neuro exam exclude stroke
- Rinne/Weber
- Audiometric exam
- MRI with contrast (2.7-10.2%) – normal in ISSHL – r/o acoustic neuroma, perilymph fistula, Meniere’s, vascular, MS

Differential Diagnosis

- Acute stroke
- Anterior inferior cerebellar artery
  Ipsilateral Horner syndrome, diplopia, nystagmus, facial weakness, limb sx, ataxia, contralateral pain or temp sensation loss
- MS, meningitis, schwannoma, migrainous infarction
Ear anatomy

Blood supply to Ear

Etiology of ISSHL
- Unclear!
  - Vascular occlusion
  - Viral infections
  - Labyrinthine membrane breaks
  - Immune associated disease
  - Abnormal cochlear stress response
  - Abnormal tissue growth
  - Toxins
  - Cochlear membrane damage

Natural History of ISSHL
- Often quoted recovery rate of 65%
- Lamm et al. - 25 - 68% spontaneous full remissions and 47 - 89% partial remissions
- Difficult to judge efficacy of therapy given high remission rate and low incidence

Costs
- Hearing aids $1,500 - 3,000 per pair
- Replace 3-5 years
- Cost of ten HBO2 treatments $2,000 - 5,000

I said, it's the only hearing aid covered by your insurance.
Corticosteroids and ISSHL

- **Rationale**
  - Decrease inflammation and edema
  - Scant data
    - Cochrane review - two randomized, controlled trials
    - Results conflicting - one no difference, one statistically better outcome with steroids
  - 1980 - 67 pts with SSHL within 10 days (poor study)
    - Glucocorticoid (varying dose) vs. Placebo - overall 61% vs. 32% recovery, RR 1.3, 95% CI 0.91-1.86
    - Pts with mild loss recovered regardless
    - Profound hearing loss no benefit
    - Moderate loss - GC 78% vs. placebo 38%, RR 1.74, CI 1.19-2.55

Corticosteroids, cont.

- 2001 randomized trial, 41 patients
  - 4 treatment groups - glucocorticoids, carbogen inhalation, placebo, combined
  - No difference
  - Multiple retrospective studies equivocal

Antivirals and ISSHL

- Not recommended by AAO-HNS due to lack of evidence of efficacy and risk of side effects

Rationale for HBO\textsubscript{2} use

- High metabolism and scant vascularity to cochlea
  - Cochlea and inner structures require a high O\textsubscript{2} supply
  - Oxygen to supply to inner cochlea is via oxygen diffusion through perilymph
  - Studies of perilymph pO\textsubscript{2} showed trend toward low O\textsubscript{2} in ISSHL
  - Normobaric O\textsubscript{2} (3.4 X) and HBO\textsubscript{2} (9.4 X) raise perilymph O\textsubscript{2} compared to room air
  - HBO\textsubscript{2} also is anti-inflammatory, reduces edema and blunts ischemia-reperfusion injury

Cochrane reviews

  - Only HBO\textsubscript{2} received conservatively favorable review
  - 2007 and 2010 - “For people with acute ISSHL, the application of HBO\textsubscript{2} significantly improved hearing, but the clinical significance remains unclear.”
  - Average hearing gains of 19.3 dB for moderate loss and 37.7 dB for severe

Cochrane Review 2012

- 7 studies, 392 participants form 1985 to 2004
  - 207 received HBOT and 185 control
  - Dosages from 1.5 ATA for 45 minutes daily X 15 days to 2.5 ATA for 90 minutes daily X 25 days
  - Exclusions and comparator regimens were different - some to no treatment, some to pharmacologic treatment, some to sham.
  - F/U periods varied 10 days to 3 months
  - Entry criteria also different (time, dB loss, pharmacologic failure, etc)
  - Overall, blinding and randomization procedures were poor
**Cochrane Review 2012 Results**

- Proportion of participants with > 50% return of hearing
  - 2 trials, 114 patients
  - RR of improvement with HBOT 1.53, p=0.16, 95% CI 0.85 to 2.78.
- Proportion of participants with > 25% return of hearing
  - 2 trials, 114 patients
  - RR of improvement with HBOT 1.39, p=0.02, 95% CI 1.05 to 1.84, NNT 5 for improvement in 1
- Mean improvement in pure tone average as percentage of baseline
  - 1 trial, 50 participants, with HBOT 61%, without 24%, so 37% better with HBOT, statistically significant

**Cochrane 2012 Review Conclusions**

- Limited evidence from poor studies
- HBOT improves hearing in pts with ISSNHL
  - Within 2 weeks
  - Might improve tinnitus
  - No evidence that improvement is functionally significant
- Routine use cannot be justified

**Impairment ranges**

- Slight
  - 26-40 dB - hear and repeat spoken words at 1 meter
- Moderate
  - 41-60 dB - hearing aids
- Severe
  - >61 dB - hearing aids, lip-reading, sign language training

**Additional data**

- 12 retrospective and prospective case-controlled studies
- >1650 patients
- All but 2 studies positive, none negative
- Six of the studies combined HBOT with oral steroids
- Of randomized controlled studies, none negative

**UHMS conclusion**

- Given the large amount of positive data - recommend treatment as an adjunct with corticosteroid treatment
- Patient selection
  - Moderate to profound hearing loss
  - Early in course of disease (< 14 days)
  - Use as adjunct to corticosteroids
  - < 60 years old
- Dosage
  - 100% O₂ at 2 to 2.5 ATA for 90 minutes daily X 10-20 treatments
AAO-HNS Clinical Practice Guideline

- Although hyperbaric oxygen therapy (HBOT) is not widely available in the United States and is not recognized by many US clinicians as an intervention for ISSNHL, the panel felt that the level of evidence for hearing improvement, albeit modest and imprecise, was sufficient to promote greater awareness of HBOT as an intervention for ISSNHL.