RATIONALE FOR AUDIOLOGICAL TESTING IN CANCER PATIENTS

Rationale for Audiometric Testing:

Ototoxically induced hearing loss initially manifests itself as an alteration in the function of the Organ of Corti at the basal end of the cochlea. This disease process is evident as a change in the sensitivity of hearing in the extended high frequencies (EHF), which appear to be more sensitive to ototoxic effects than conventional frequencies.

Early detection of cochlear damage may prevent or reverse hearing loss through acceptable manipulation in the treatment regimen.

Pre-treatment counseling offers the patient important information for post-treatment planing in order to ensure an acceptable quality of life.

Patients with severe-profound hearing loss, in the conventional frequencies 500Hz through 8KHz, and relatively good speech production, may have usable residual hearing in the extended high frequencies (EHF) as they may potentially benefit from frequency transposition hearing aids.

Hearing thresholds above 8 kHz are strongly age dependent and intersubject variability is higher in this range. Test-retest reliability within subjects is greater than that between subjects. For this reason, a pre-treatment baseline audiogram is the best method to determine whether change occurs in conjunction with chemotherapy or other potentially ototoxic medications. Hearing Loss at higher frequencies is determined by comparing a patient's hearing thresholds at baseline to the patient's hearing thresholds after treatment with suspected ototoxic agents.

Target Population:
Patients who are treated with ototoxic drugs will be classified as at risk or high risk on the following criteria:

**At risk:**

Patients are at risk for ototoxicity if any of the following conditions are met:
1. Treatment with 1 ototoxic medication (excluding diuretics) for \( \geq 21 \) days regardless of peak and trough levels.
2. Treatment with 1 ototoxic medication for \( \geq 2 \) days with peak and trough levels exceeding safe ranges on two or more occasions.
3. Simultaneous treatment with two or more ototoxic medications for \( \geq 2 \) days.

**High risk:**

Patients are at high risk for ototoxicity if any of the following conditions are met:
1. Patient is at risk and has renal impairment (serum creatinine \( \geq 1.4 \) mg/100 ml or BUN \( \geq 30 \).
2. Patient is at risk and exhibits symptoms of inner ear disease (tinnitus, hearing loss, dizziness, imbalance and or posture disorder).
3. Patient is at risk and has a family history of hearing impairment.
4. Simultaneous treatment with 2 or more ototoxic medications for \( \geq 7 \) days.
5. Treatment with 1 ototoxic medication with peak and trough levels exceeding safe ranges for 3 successive days.

**Schedule and Monitoring Procedure:**

Ideally, baseline audiogram with extended high frequency audiometric testing should be obtained during the initial visit before initiating treatment. However, audiograms can be accepted as baseline if they are obtained within 48 hours of the beginning of the treatment course. Usually, at risk patients are evaluated weekly; high risk patients biweekly. Specific audiometric testing and monitoring schedules will be designed according to the patient needs. All patients will be tested with behavioral audiometry with extended high frequency evaluation and Otoacoustic emissions (OAE). Patients who can not be tested behaviorally will be evaluated with Otoacoustic emissions (OAE) only.
Chemotherapy patients should be retested before the administration of each new therapy session, or sooner if the patient has hearing problems, tinnitus or dizziness. Re-tests include basic and extended high frequency pure tone thresholds, otoacoustic emissions (OAE), and if appropriate, speech recognition testing and tympanometry.

**OTOTOXIC DRUG LIST**

**ETHACRYNIC ACID: (Edecrin)**
- Reversible hearing loss of short duration
- Sense of fullness in the ears
- Tinnitus and vertigo
- May increase ototoxic potential of other drugs

**FUROSEMIDE: (Lasix)**
- Reversible or permanent hearing loss
- Associated with rapid injection
- Therapy with other ototoxic drugs

**ANTIMALARIAL**

**GENERAL:**
- Ototoxicity
- Cochleotoxic, tinnitus
- Hearing loss usually reversible

**QUININE: (Quinidex)**
- Intrauterine ototoxicity
- Hearing loss associated with high doses

**QUINIDINE:***
- Tinnitus, vertigo, dizziness
- Cardiac arrhythmia
- Some hearing loss possible

**CYTOXICS**

**GENERAL**
Ototoxicity related to dosage
Chemical treatment at tumors
Hearing loss can be asymmetrical and malignancies
Hearing loss is permanent
Effects high frequencies first, later affects all frequencies
Can include otalgia and tinnitus
Word recognition scores often disproportionately poor

**CIS-PLATINUM (Platinol)**
- Tinnitus
- Testicular/ovarian cancer
- High frequency hearing loss, uni/bilateral
- Ototoxicity is cumulative

**NITROGEN MUSTARD: (Mustargen)**
- Tinnitus and diminished hearing

**CARBO-PLATIN (Paraplatin)**
- Possible high frequency hearing loss

**AMINOGLYCOSIDE ANTIBIOTICS**

GENERAL (Brand Name) in USA
- Permanent loss of inner and outer hair cells
- Ototoxicity related to dosage and combination with other drugs.
- Can have delayed onset
- Cochleotoxic and/or vestibulotoxic, including tinnitus, vertigo, and nausea
- Word recognition scores often disproportionately poor
- Intrauterine toxicity possible
- If ingested, toxicity unlikely because aminoglycosides are poorly absorbed from an intact gastrointestinal tract

**AMIKACIN:** (Amikin)
- Cochleotoxic - staph infections

**GENTAMICIN:**
(Garamycin, G-Myticin)
- Vestibulotoxic, dizziness, vertigo, tinnitus
- Meningitis
- Maybe some high frequency hearing loss
- Neonatal sepsis
with excessive doses - bacterial septicemia
-topical use on burns

**KANAMYGIN:** (Kantrex)
-cochleotoxic, bilateral high frequency hearing - tuberculosis
loss may be partially reversible - peritonitis
-tinnitus, loss of balance

**References:**


