Monitoring for Ototoxicity-Induced Tinnitus

Jim Henry
Tara Zaugg
Christine Kaelin
Chronic Tinnitus vs. Transient “Ear Noise”

- “Ear noise” = whistling sound accompanying sudden sensation of hearing loss—quickly resolves
- “Tinnitus” = head noise lasting at least 5 min. that occurs > once/week
- When tinnitus sound becomes extended in duration, on a persistent basis, it is considered chronic, pathological tinnitus
Tinnitus vs. Somatosounds

- Generation of tinnitus can be:
  - Neurophysiologic (sensorineural tinnitus)
  - Somatic (somatosounds)
Somatosounds

- Internally-generated body or head sounds perceived by patient
  - Muscular, vascular, respiratory, TMJ sounds

- Pulsatile vs. non-pulsatile
  - Pulsatile (most common): caused by perception of bloodstream ("venous hum" or "vascular noise")
  - Non-pulsatile: e.g., muscular flutters or spasms, patulous eustachian tube

- Somatosounds require medical evaluation
Subjective vs. Objective Tinnitus

- Somatosounds can be *subjective* (heard only by patient) or *objective* (heard by patient and examiner)

- Objective tinnitus is relatively rare and usually indicates underlying medical condition warranting medical evaluation
  - e.g., eustachian tube dysfunction, palatal myoclonic or muscular contractions of tensor tympani, tensor or levator palati, or vascular disorders such as carotid body tumors
Permanent vs. Temporary Tinnitus

“Permanent” tinnitus = minimum 6-12 mo. duration (Vernon: min. = 2 yr.)

What about sudden-onset tinnitus?

- First, rule out acoustic tumor
- Explain to patient lability of tinnitus during first 3-6 mo—don’t assume permanence unless persistent for about 6-12 mo
  - Counsel to take precautions to minimize tinnitus
  - Critical to allay fears
    - Don’t say “nothing can be done—learn to live with it”

- Full treatment may not be necessary
  - Close monitoring is necessary
Epidemiology and Demographics of Tinnitus

- Many epidemiologic studies conducted to describe factors associated w/tinnitus

- Oregon Tinnitus Clinic, located at OHSU has developed Tinnitus Data Registry—a large database containing data from 1,630 patients
“Definite” Risk Factors (Hoffman & Reed, 2004)

- Acoustic neuroma
- Age
- Cardiovascular & cerebrovascular disease
- Drugs or medications
- Ear infections/inflammation
- Head/neck trauma and injury
- Hyper- & hypothyroidism
- Loud noise exposure
- Meniere’s disease
- Otosclerosis
- Presbycusis
- Sudden deafness
General Categories of Tinnitus Etiology

- Data from Oregon Tinnitus Clinic
- 40% indicated no known events associated with their tinnitus
- When causes were reported, they fell into four categories
  1. Noise-related
  2. Head and neck trauma
  3. Head and neck illness
  4. Other medical conditions
4. Other Medical Conditions

- Other illnesses (2%)
- Drugs, medications (2%)
- Stress (1%)
- Surgery (1%)
- Possible TMJ syndrome (1%)
- Barotrauma (1%)

Total other medical conditions (7% as single cause; 13% as one of multiple causes)

(Data from Oregon Tinnitus Clinic)
Prevalence of Tinnitus

- Prevalence estimates from numerous epidemiologic studies: 10-15% (adults)
- Vernon estimates up to 40 million Americans have tinnitus “to a minor degree,” and that 5-13 million Americans have “severe, quality-of-life-disruptive” tinnitus
Prevalence Estimates (ATA)

- Estimates of tinnitus prevalence by American Tinnitus Association (ATA) often referred to in literature
  - 40-50 million Americans experience tinnitus as a chronic condition
  - 10-12 million seek some form of medical help
  - 2.5 million “debilitated” by tinnitus
Prevalence of Tinnitus in Veterans

- 24.7 million veterans
- 3-4 million vets have tinnitus
  - Based on estimated tinnitus prevalence in general population (10-15% of adults)
- Vets are older than general population
  - 36% of vets vs. 17% of general population are ≥65 years
  - Oldest cohort of vets will increase over 500% in next 15 years
- Actual prevalence thus may be higher
Numbers of Vets Service-Connected for Tinnitus

- Connected for Tinnitus
  - 289,159
  - 242,610
  - 196,541
  - 162,409
  - 115,000
  - 86,490
  - 80,000

Year


Numbers of Veterans

- 300,000
- 250,000
- 200,000
- 150,000
- 100,000
- 50,000
- 0
Yearly Total Compensation for Tinnitus Disability

<table>
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<tr>
<th>Year</th>
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<td>2004</td>
<td>$345M</td>
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Tinnitus Severity

- “Severity” in clinical context = impact of a health condition on quality of life

- Tinnitus severity = impact of tinnitus on quality of life
Effects of Tinnitus on Quality of Life

Highly individualized—based on:
1. Personality characteristics
2. Daily lifestyle
3. Acoustic environment
4. Characteristics of tinnitus
“Problem” vs. “No-Problem” Tinnitus

- Tinnitus is not a significant problem for about 80% of those who have it
- What makes tinnitus a problem for some and not for others?
  1. Personality characteristics
  2. Daily lifestyle
  3. Acoustic environment
  4. Characteristics of tinnitus
Personality Characteristics Affect Tinnitus Severity

LESS SEVERE  MORE SEVERE

Calm  →  Anxious
Content  →  Depressed
Peaceful  →  Angry
“Coper”  →  “Non-coper”

- The same tinnitus will affect different people differently, depending on their personality characteristics
Daily Lifestyle Affects Tinnitus Severity

LESS SEVERE ← Active ← Working ← Interested ← Social ← People who are actively involved in meaningful activities tend to be less bothered by their tinnitus

MORE SEVERE → Sedentary → Retired → Bored → Isolated


Acoustic Environment Affects Tinnitus Severity

LESS SEVERE ← More environmental sound tends to reduce awareness/intrusiveness of tinnitus → MORE SEVERE

Enjoy sound ← Enjoy quiet
Noisy workplace ← Quiet workplace
Children at home ← No children
Social ← Isolated

More environmental sound tends to reduce awareness/intrusiveness of tinnitus
Characteristics of Tinnitus

Affect Tinnitus Severity

LESS SEVERE ← Softer ← Low pitched ← Single sound ← Nonfluctuating

MORSE SEVERE → Louder → High pitched → Multiple sounds → Fluctuating

■ These are educated guesses—there are no supporting data
Is “Louder” Tinnitus More Bothersome?

- Two ways to “measure” tinnitus loudness
  1. Patient **reports subjective loudness** on 1-10 scale (ratings correlate with severity)
  2. Patient **matches loudness** of tinnitus to loudness of external tones (matches **do not** correlate with severity)

- We thus don’t know to what extent acoustic correlates of tinnitus are a factor affecting tinnitus severity
Assessing Tinnitus Severity

- Proper methodology for assessing tinnitus severity has been debated for years.
- At least 12 published outcome instruments are used to obtain tinnitus severity ratings.
  - No consensus regarding their use across tinnitus treatment centers.
Tinnitus Questionnaires

- Subjective Tinnitus Severity Scale
- Tinnitus Cognitions Questionnaire
- Tinnitus Coping Style Questionnaire
- Tinnitus Handicap Inventory
- Tinnitus Handicap Questionnaire
- Tinnitus Handicap/Support Scale
- Tinnitus Questionnaire
- Tinnitus Reaction Questionnaire
- Tinnitus Severity Scale
- Tinnitus Severity Index
Don’t Rely on Index Scores for Tinnitus Severity

- e.g., Tinnitus Severity Index (possible range 0-48): 123 research subjects who qualified for long-term treatment had index scores ranging from 9 to 48
- Similar results with Tinnitus Handicap Inventory and Tinnitus Handicap Questionnaire
Limitations of Written Questionnaires

- Provide only a general estimate of tinnitus severity
- Usually fairly accurate, but sometimes not
- Not documented for sensitivity to change over time
- However, they are still useful, and essential
Guidelines for Selecting Tinnitus Questionnaires

- Use questionnaires that:
  - Are efficient for clinical use
  - Have been validated
  - Are well accepted
  - Allow comparison to clinical data
Suggested Questionnaires

- Tinnitus Handicap Inventory
- Tinnitus Handicap Questionnaire
- Tinnitus Severity Index
Tinnitus Interviews

- Much more informative to clinician
- Dialogue also useful to patient
- Can be brief or extensive
- Absolutely necessary for making a clinical judgment of severity
Suggested Interviews

- TRT Initial and Follow-up Interviews (extensive)
- Tinnitus-Impact Screening Interview (brief)
Tinnitus Ototoxicity Monitoring Interview (TOMI)

- 13 questions
- Question 1 asked only at initial visit
- Questions 3-13 asked only if pt reports presence of tinnitus
- Questions 10-13 asked only if tinnitus:
  1. Existed prior to treatment, or
  2. Reported at prior visit
“You are being treated with a medication that has the potential to affect the auditory system. One possible effect is tinnitus, which is ringing, humming, buzzing, or other noises in your ears or head. Almost everyone hears noises in the ears or head that are brief and fade away—these sounds are normal. I am going to ask you about persistent tinnitus that lasts at least 5 minutes, and occurs at least twice a week.”
Question 1

- [Clinician: ask only at first visit]
- Did you have persistent tinnitus before the start of treatment?
  - No
  - Yes
- 1a. IF YES: How long have you had tinnitus?
  - < 1 year
  - 1-2 years
  - 3-5 years
  - 6-10 years
  - 11-20 years
  - > 20 years
  - Not sure
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<td>More than 2, less than/equal to 5</td>
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<td>19.3</td>
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<td>More than 5, less than/equal to 10</td>
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<td>14.0</td>
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<tr>
<td>More than 10, less than/equal to 20</td>
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<td>16.5</td>
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<tr>
<td>More than 20</td>
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<td>0.5</td>
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<tr>
<td>Total</td>
<td>1613</td>
<td>100.0</td>
</tr>
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</table>

(Data from Oregon Tinnitus Clinic)
Question 2

- Have you noticed any **persistent** tinnitus since you started the treatment?
  - No
  - Yes

- IF NO: *The interview is complete. No further questions are required.*

- IF YES:
Question 3

- What does your tinnitus sound like? (mark all that apply)
  - Ringing
  - Hissing
  - Buzzing
  - Sizzling
  - Crickets
  - Whistle
  - Hum
  - Other: ____________________________
Predominant Tinnitus Sound

(Data from Oregon Tinnitus Clinic)
Predominant Tinnitus Sound

(Data from Oregon Tinnitus Clinic)
Question 4

- Does your tinnitus have a pulsing quality to it?
  - No
  - Yes

(6% of Oregon Tinnitus Clinic pts reported that their tinnitus has a pulsing quality)
Question 5

Where is your tinnitus located?

- Left ear only
- Right ear only
- Both ears
- Inside head
- Other (describe) ____________________
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<td>91</td>
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<td>Outside head—left</td>
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<td>0.6</td>
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<tr>
<td>Not sure—left</td>
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<td>176</td>
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<tr>
<td>Inside head—right</td>
<td>80</td>
<td>4.9</td>
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<tr>
<td>Outside head—right</td>
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<td>0.7</td>
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<tr>
<td>Fills head</td>
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<tr>
<td>Inside top of head</td>
<td>22</td>
<td>1.4</td>
</tr>
<tr>
<td>Outside top of head</td>
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<td>0.2</td>
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<tr>
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<td>Back of head</td>
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<tr>
<td>Other answer</td>
<td>96</td>
<td>5.9</td>
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(Data from Oregon Tinnitus Clinic)
Question 6

Is your tinnitus louder on one side of your head than the other?

- Right louder than left
- Left louder than right
- Equal
<table>
<thead>
<tr>
<th>Localization</th>
<th>N</th>
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<tr>
<td>Right ear or side</td>
<td>525</td>
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<tr>
<td>Both ears or sides</td>
<td>281</td>
<td>17.2</td>
</tr>
<tr>
<td>Head (not lateralized)</td>
<td>123</td>
<td>7.6</td>
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<tr>
<td>Head + one or both ears</td>
<td>16</td>
<td>1.0</td>
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<td>Variable location</td>
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<td>1.4</td>
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<td>0.4</td>
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<tr>
<td>Other answer*</td>
<td>11</td>
<td>0.7</td>
</tr>
<tr>
<td>Total</td>
<td>1629</td>
<td>100.0</td>
</tr>
</tbody>
</table>

(Data from Oregon Tinnitus Clinic)
Question 7

- How loud is your tinnitus on average?
  - Not loud at all
  - Slightly loud
  - Moderately loud
  - Very loud
  - Extremely loud
## LOUDNESS RATING (SUBJECTIVE)

<table>
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<tr>
<th>Scale Value</th>
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<td>2.1 - 4.0</td>
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<td>4.1 - 6.0</td>
<td>328</td>
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</tr>
<tr>
<td>6.1 - 8.0</td>
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<td>34.5</td>
</tr>
<tr>
<td>8.1 - 10.0</td>
<td>209</td>
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<tr>
<td>Variable loudness</td>
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<td>0.8</td>
</tr>
<tr>
<td>Total*</td>
<td>1094</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Question 8

- How much of the time do you think your tinnitus is present?
  - Occasionally
  - Some of the time
  - Most of the time
  - Always
Question 9

On average, how much of a problem is your tinnitus?

- Not a problem
- Slight problem
- Moderate problem
- Big problem
- Very big problem
Questions 10-13

- [Clinician: Ask the following questions only if the patient: (1) had tinnitus before the start of treatment, or (2) reported tinnitus previously with this TOMI. The objective is to determine if the patient’s tinnitus is being affected by the drug treatment. If the patient has previously responded to this interview, each response should reflect the period of time since the last interview. Otherwise, each response reflects the period of time since before the start of treatment.]
Question 10

- Has the sound of your tinnitus changed?
  - No
  - Yes
  - Not sure

- IF YES: How is it different?
  ________________________________________________________________
Question 11

- Has the **location** of your tinnitus changed?
  - No
  - Yes
  - Not sure

- IF YES: How is it different?
  
  _____________________________________________
  
  _____________________________________________
Question 12

Has the **loudness** of your tinnitus changed?
- No
- Yes, louder now
- Yes, quieter now
- Not sure
Question 13

Has the amount of time your tinnitus is present changed?

- No
- Yes, more often
- Yes, less often
- Not sure
Counseling the Patient Who Has Ototoxicity-Induced Tinnitus

- Counsel as for sudden-onset tinnitus
  - Explain to patient lability of tinnitus during first 3-6 mo—don’t assume permanence unless persistent for about 6-12 mo
    - Counsel to take precautions to minimize tinnitus
    - Critical to allay fears
      - Don’t say “nothing can be done—learn to live with it”
  - Full treatment may not be necessary
    - Close monitoring is necessary
If Treatment for Tinnitus Becomes Necessary

- Tinnitus Masking
- Tinnitus Retraining Therapy
- Cognitive-Behavioral Therapy
- Audiologic Tinnitus Management