Decision Making in the Management of Acoustic Neuromas

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21 March 2014

Disclosure

- Equity interest in Decisive Health Systems, Inc, a decision aid venture firm.

Agenda

- Background
  - Size Metrics (1-, 2-, and 3-Dimensions)
  - Growth Stages
  - Clinical Outcomes: Hearing and Facial Nerve
- Management Choices
- Acoustic Neuroma Decision-Making
  - Provider Centric
  - Patient Centric
    - Health Decision Engine
- Vehicle for Informed Consent

Background

- 10% of Newly Diagnosed Intracranial Tumors
- Incidence 1:100,000
- MRI with Gadolinium is Definitive
- Benign Tumor Arising from a Vestibular Nerve
- Presenting Symptoms
  - Asymmetric Hearing Loss
  - Tinnitus
  - Balance Disturbance
  - Facial Numbness
  - Facial Weakness
- Sporadic (unilateral) versus NF2 (bilateral)
Acoustic Neuroma Descriptors

Intracanalicular (IC) and Extracanalicular (EC)

Complete versus Incomplete Internal Auditory Canal Penetration

Acoustic Neuroma Size

1-, 2-, and 3-D Measurements

A Spheroid Weighted-Axis Converter of Vestibular Schwannoma Size: Maximum Diameter and Cisternal Volume

\[ V_{\text{cist}} = \frac{4}{3}\pi r^3 \]

\[ V_{\text{cisternal}} = \frac{4}{3}\pi \left( \frac{\text{max}(AP)}{2} \right)^3 \]

Acoustic Neuroma Size Comparison

Acoustic Neuroma Growth Stages

Intracanalicular (IC)

Cisternal

Brainstem Compressive

Hydrocephalic

Type A

Type B

Type C

Type D

Acoustic Neuroma Growth Stages

Acoustic Neuroma Size Comparison

Intercanalicular (IC)

≤ 4 mm

10 mm

15 mm

20 mm

25 mm

30 mm

35 mm

40 mm
### Hearing - Grading Scales

<table>
<thead>
<tr>
<th>Class</th>
<th>PTA (dB)</th>
<th>SDS (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0-30</td>
<td>70-100</td>
</tr>
<tr>
<td>2</td>
<td>31-50</td>
<td>69-50</td>
</tr>
<tr>
<td>3</td>
<td>51-90</td>
<td>49-5</td>
</tr>
<tr>
<td>4</td>
<td>91-max loss</td>
<td>4-1</td>
</tr>
<tr>
<td>5</td>
<td>No response</td>
<td>No response</td>
</tr>
</tbody>
</table>

**GARDNER-ROBERTSON (1988)**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Normal symmetrical function in all areas</td>
</tr>
<tr>
<td>II</td>
<td>Slight weakness noticeable only on close inspection&lt;br&gt;Complete eye closure with minimal effort&lt;br&gt;Slight asymmetry of smile with maximal effort&lt;br&gt;Synkinesis barely noticeable, contracture, or spasm absent</td>
</tr>
<tr>
<td>III</td>
<td>Obvious weakness, but not disfiguring&lt;br&gt;May not be able to lift eyebrow&lt;br&gt;Complete eye closure and strong but asymmetrical mouth movement with maximal effort&lt;br&gt;Obvious, but not disfiguring synkinesis, mass movement or spasm</td>
</tr>
<tr>
<td>IV</td>
<td>Obvious disfiguring weakness&lt;br&gt;Inability to lift brow&lt;br&gt;Incomplete eye closure and asymmetry of mouth with maximal effort&lt;br&gt;Severe synkinesis, mass movement, spasm</td>
</tr>
<tr>
<td>V</td>
<td>Motion barely perceptible&lt;br&gt;Incomplete eye closure, slight movement corner mouth&lt;br&gt;Synkinesis, contracture, and spasm usually absent</td>
</tr>
<tr>
<td>VI</td>
<td>No movement, loss of tone, no synkinesis, contracture, or spasm</td>
</tr>
</tbody>
</table>

**AAO-HNS (1995)**

<table>
<thead>
<tr>
<th>Grade</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>0-30&lt;br&gt;70-100</td>
</tr>
<tr>
<td>B</td>
<td>31-50&lt;br&gt;69-50</td>
</tr>
<tr>
<td>C</td>
<td>51-100&lt;br&gt;50-100</td>
</tr>
<tr>
<td>D</td>
<td>0-100&lt;br&gt;49-0</td>
</tr>
</tbody>
</table>

### Facial Nerve - House Brackmann

<table>
<thead>
<tr>
<th>Grade</th>
<th>Definition</th>
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### Management Choices

- Observation – Serial Imaging
  - **EC ≤ 15 mm**
    - 10% Deafness Risk / Year
    - 2mm Growth Risk / Year
Stereotactic Radiosurgery
(£ £≤ 20 mm; 95% Tumor Control Rate)

Open Microsurgery
(All Sizes)
- Middle Fossa (MF)
- Translabyrinthine (TL)
- Retrosigmoid (RS)

Evolution in Decision-Making

UCSF Management Philosophy
1985 – 2004 (Provider Centric)
To intervene with which type of craniotomy,
that is the Question:

2005 – 2013 (Patient Centric)
To intervene or not to intervene,
that is the Question:
Observation versus Intervention

Observation
- **Risks**
  - Loss of Hearing Preservation Opportunity
  - Increase Likelihood of Adverse Outcomes (Larger Tumors → Higher Risk)
- **Benefits**
  - Intervention May Never Become Necessary
  - Defer Risks Associated with Intervention

Intervention
- **Risks**
  - Unfavorable Functional Outcomes (Facial Weakness, Chronic Imbalance)
  - Unfavorable Procedure-Related Outcomes (Facial Numbness, CSF Leak)
- **Benefits**
  - Favorable Outcomes (Facial Sensation Improvement, Brainstem Decompression)
  - Often Definitive (Decrease or Eliminate Monitoring Burden)

### Stereotactic Radiosurgery Hearing Outcomes

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Gamma Knife</th>
<th>Cyber Knife</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tumor Size</td>
<td>Dose to the tumor margin (Gy)</td>
<td>59 (156)</td>
</tr>
<tr>
<td></td>
<td>Pre-A (mean)</td>
<td>35 (41)</td>
</tr>
<tr>
<td></td>
<td>Post-A (mean)</td>
<td>30 (36)</td>
</tr>
<tr>
<td></td>
<td>Pre-A (median)</td>
<td>20 (26.5)</td>
</tr>
<tr>
<td></td>
<td>Post-A (median)</td>
<td>18 (25)</td>
</tr>
</tbody>
</table>

### Simple Intervention Algorithm (Hearing and Size only)

<table>
<thead>
<tr>
<th>Hearing Grade</th>
<th>Tumor Size (cm)</th>
<th>Simple Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>C or D</td>
<td>≤ 4 mm</td>
<td>Intercameral (IC)</td>
</tr>
<tr>
<td></td>
<td>5 mm</td>
<td>GK TL</td>
</tr>
<tr>
<td></td>
<td>10 mm</td>
<td>RM</td>
</tr>
<tr>
<td>C</td>
<td>≥ 10 mm</td>
<td>TL</td>
</tr>
<tr>
<td>B</td>
<td>≤ 10 mm</td>
<td>TL</td>
</tr>
<tr>
<td>A</td>
<td>≥ 10 mm</td>
<td>TL</td>
</tr>
</tbody>
</table>

### TABLE 1. Facial nerve function and hearing preservation outcomes scalable

<table>
<thead>
<tr>
<th>Tumor Size</th>
<th>X ≤ 6</th>
<th>6 ≤ X ≤ 10</th>
<th>X &gt; 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-treatment hearing class</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>10 (17)</td>
<td>6 (10)</td>
<td>15 (25)</td>
</tr>
<tr>
<td>B</td>
<td>28 (47)</td>
<td>9 (15)</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>6 (9.5)</td>
<td>3 (5)</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>15 (25)</td>
<td>41 (69)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hearing Preservation (~3 years)</th>
<th>Pre A or B in A or B</th>
<th>Pre A or B in A or B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre A or B in A or B</td>
<td>10.2% ± 3.8%</td>
<td>15.2% ± 4.9%</td>
</tr>
</tbody>
</table>

### Spheroid Weighted-Axis Converter

<table>
<thead>
<tr>
<th>Maximum Diameter (cm)</th>
<th>Cisternal Volume (cm^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.24</td>
<td>1.25</td>
</tr>
<tr>
<td>0.45</td>
<td>0.49</td>
</tr>
</tbody>
</table>
Simple Intervention Algorithm (Hearing and Size only)
Hearing Grade A or B – Tumor Ear is Useful

Multiple Factors in Decision-Making

Key Considerations
(Tumor Ear is Poorer Hearing)
- Hearing Preservation
- Temporary Facial Weakness
- Permanent Facial Weakness
- Tumor Remnant Enlargement
- Brainstem Compression Relief
- Duration of Recovery
- Number of Treatments

Extent of Microsurgical Tumor Excision

Management Heuristics

Extracanalicular Tumor Size
- Complete IAC Penetration – Hearing Preservation drops by 50%
- 15 mm - Size Limit for Observation and Hearing Preservation
- 20 mm - Size Limit for Radiosurgery
- 25 mm - Facial Weakness Risk Accelerates
- 35 mm – Brainstem Injury Risk Accelerates
“...the current health-policy debate comes down to a very **personal** issue:

how to make ever-more-*complex decisions* when faced with **multiple options**, each with **no clear advantage** and with risks and harms that patients may **value differently**.”

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### Acoustic Neuroma Decision Engine

**What is it?**

A decision aid that organizes treatment outcomes information and quantifies patient preferences to enable shared decision-making.

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### Multiple Attribute Decision-Making

**Conjoint Analysis**

**Acoustic Neuroma Decision Engine**

**Deafness**

**Facial Paralysis**

**Recovery Duration**

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### Weighty Choices, in Patients’ Hands

By LAURA LANDRO

AUGUST 4, 2015, 9:18 A.M. ET

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### Synthetic Clinical Scenario

50 year old ♂ with a 10 mm acoustic neuroma in a serviceable hearing.

**Multiple Outcomes Attributes**

- Deafness
- Facial Paralysis
- Radiation Induced Neoplasm
- Recovery Duration

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### Conjoint Analysis Interview

**Treatment A**

- Hearing Loss (over 4 years) Risk: 65%
- Tumor Enlargement Risk: Medium
- Facial Weakness (permanent) Risk: 2%
- Facial Numbness (permanent) Risk: 1%

**Outcomes**

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**Treatment B**

- Hearing Loss (over 4 years) Risk: 45%
- Tumor Enlargement Risk: Low
- Facial Weakness (permanent) Risk: 15%
- Facial Numbness (permanent) Risk: 4%

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**Strongly Prefer A**  **Somewhat Prefer A**  **No Preference**  **Somewhat Prefer B**  **Strongly Prefer B**
Preference Profile & Treatment Rankings

1. Gamma Knife Radiation (95.7)
2. Retrosigmoid (GTR) (75.6)
3. Observation (30.3)

Health Decision Engine

Summary Features
- Flattens Information Asymmetry
- Operates on Personal Health Information
- Alters Locus of Decisional Control

Questions
Case Presentation

40 year old healthy woman with a unilateral 13 mm acoustic tumor and normal hearing.
- Tumor is virtually all extracanalicular
- CSF fills most of the internal auditory canal

MR Imaging Features

Treatment Outcome Attributes
(Observation, Radiation, Microsurgery)

- Useful Hearing
- Facial Movement
- Facial Numbness
- Treatment Induced Tumors
- Psychological Burden

Patient-Centric Decision-Making

- Identify 3-4 Key Outcome Attributes
- Rank Order Attributes by Querying Patient
- Explore Tradeoffs Among Treatment Options
- Help Patient Make an Informed Decision