Role of Paediatric Tympanoplasty in Modern Otology

Dr. Gautam Bir Singh
Professor of Otorhinolaryngology
Lady Hardinge Medical College & Associated Hospitals
New Delhi
Discharging ear [Chronic Suppurative Otitis Media: CSOM] is a massive health problem

- Prevalence [India]: 6% (>4%: Health Problem) \(^1\)
- Paediatrics [Northern India]: 4.79% \(^2\)
- CSOM: 164 million deaf/year [90% in developing world] \(^1\)
- CSOM: 28000 deaths \(^1\) /year

**NO INTERNATIONAL GUIDELINES**


**CSOM: Classification**

**CSOM-Attico Antral**
- **Discharge**: scant, purulent & foul smelling
- **Cholesteatoma**: present
- **Complications**: common
- **Perforation**:
- **Treatment**: Mastoid Surgery

**CSOM-Tubo Tympanic**
- **CSOM-Mucosal Disease**
- **Discharge**: profuse, mucoid
- **Cholesteatoma**: absent
- **Complications**: rare
- **Perforation**:
- **Treatment**: Tympanoplasty
CSOM: Mucosal Disease

Clinical Course: MORBIDITY

**DEAFNESS**
- Adverse speech/language
- Undermines academics
- Poor peer acceptance
- Alters personality

**OTHER REASONS**
- Perforation: severe disease
- Ossicular erosions
- Epithelial migration: Cholesteatoma
- Damage to cochlea: Nerve deafness
## COMPLICATIONS

<table>
<thead>
<tr>
<th>INTRATEMPORAL</th>
<th>EXTRATEMPORAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Mastoiditis</td>
<td>✓ Extradural Abscess</td>
</tr>
<tr>
<td>✓ Petrositis</td>
<td>✓ Subdural Abscess</td>
</tr>
<tr>
<td>✓ Facial Nerve Palsy</td>
<td>✓ Meningitis</td>
</tr>
<tr>
<td>✓ Labyrinthitis</td>
<td>✓ Brain Abscess</td>
</tr>
<tr>
<td></td>
<td>✓ Lateral Sinus thrombosis</td>
</tr>
<tr>
<td></td>
<td>✓ Otitic hydrocephalus</td>
</tr>
</tbody>
</table>
MANAGEMENT: Children

- Antibiotics
- Reassurance
- No surgical treatment required
- Delay Tympanoplasty: 16-18yrs
ENT PERSPECTIVE

- PAEDIATRIC TYMPANOPLASTY: *Controversial*
  - *When to do?*
  - *What are the influencing factors?*
  - *Success rate?*

- 21ST CENTURY:
  - *Mention in Standard Text*
  - *Minimum age reported: 8-10 years*
  - *Success rate:*
    - GRAFT UPTAKE: 32% to 92%
    - HEARING IMPROVEMENT: 68% to 100%
Bias: Paediatric Tympanoplasty

- Repeated bouts of URTI
- Eustachian tube dysfunction
- Perforation:
  - Pressure equalizing vent
- Perforations close with age
- Technically difficult operation:
  - Narrow anatomical canal
- Immunological immaturity
- Parents: Lack of confidence
“Believe nothing, no matter where you read it, or who has said it, not even if I have said it. Unless it agrees with your own reason and common sense.”

-LORD BUDDHA
[6th century BC]
RESEARCH

- **Singh GB**, Arora R, Garg S, Kumar S, Kumar D.¹
  Paediatric Tympanoplasty: a comparative study between age groups of 5-8 years and above 14 years.
  *Journal of Laryngology & Otology*, (2016); July; 130(7): 635-9

- **Singh GB**, Arora R, Garg S, Ranjan S, Kumar S.²
  Role of tympanometric volume in paediatric tympanoplasty.
  *International Journal of Pediatric Otorhinolaryngology*, (2015); 79: 1872-75

- **Singh GB**, Sidhu TS, Sharma A, Singh N.³
  Tympanoplasty Type I in Children: An evaluative study.
  *International Journal of Pediatric Otorhinolaryngology*, (2005); 69:1071-1076

1,2. Thesis study: LHMC, New Delhi
3. Funded by CSIR, Govt of India, New Delhi
STUDY I: SYNOPSIS

- PGIMER & Dr. RML Hospital, NEW DELHI

- STUDY DESIGN: Cohort study with control [prospective]

- AIMS AND OBJECTIVES:
  * Evaluate the success rate of tympanoplasty Type 1 in paediatric population
  * Analyse: factors responsible for the success rate of tympanoplasty type 1 in children

- Sample:
  * CSOM-mucosal disease [6 months]
  * Two groups (20 each): A (8-14 years) / B (> 14 years)
STUDY I: SYNOPSIS

- **INTERVENTION:**
  * TYMPANOPLASTY TYPE 1 UNDER GA, (ADULTS-LA)
  * Post auricular-inlay (temporalis fascia)

- **CRITERIA FOR SUCCESS:**
  * INTACT GRAFT: 6th MONTH END
  * HEARING IMPROVEMENT: MINIMUM 10dB IN TWO CONSECUTIVE FREQUENCIES

- **STATISTICAL INTERPRETATION:**
  * CHI SQUARE TEST WITH YATES’ CORRECTION
STUDY I: RESULTS

- OVERALL SUCCESS RATE:

<table>
<thead>
<tr>
<th>GROUP</th>
<th>TOTAL CASES</th>
<th>GRAFT UPTAKE</th>
<th>HEARING IMPROVEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUP-A</td>
<td>20</td>
<td>16[80%]</td>
<td>11[69%]</td>
</tr>
<tr>
<td>[8-14years]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GROUP-B</td>
<td>20</td>
<td>17[85%]</td>
<td>13[76%]</td>
</tr>
<tr>
<td>[Adults]</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- COMPLICATIONS:
  Two patients: granulations
  One patient: glue ear
**STUDY I: RESULTS**

- **NO SIGNIFICANCE OF CONTRALATERAL EAR PATHOLOGY**
  [Measure of *Eustachian Tube* function]

<table>
<thead>
<tr>
<th></th>
<th>Total Cases</th>
<th>Graft Rejection</th>
<th>Residual Perforation</th>
<th>% Fail Rate</th>
<th>Statistical Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUP-A</td>
<td>08</td>
<td>01</td>
<td>01</td>
<td>25</td>
<td>$\chi^2 = 0.013$</td>
</tr>
<tr>
<td>GROUP-B</td>
<td>12</td>
<td>01</td>
<td>01</td>
<td>16.6</td>
<td>$p &gt; 0.05$</td>
</tr>
</tbody>
</table>

*GROUP-A: CONTRALATERAL EAR DRUM INTACT*
*GROUP-B: CONTRALATERAL EAR PATHOLOGY PRESENT*
## STUDY I: RESULTS

- **NO SIGNIFICANCE OF SITE & SIZE OF PERFORATION**

<table>
<thead>
<tr>
<th>PAEDIATRIC PATIENTS</th>
<th>ADULT PATIENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of cases</td>
<td>Graft uptake</td>
</tr>
<tr>
<td><strong>SITE OF PERFORATION</strong></td>
<td></td>
</tr>
<tr>
<td>Anterior</td>
<td>04</td>
</tr>
<tr>
<td>Inferior</td>
<td>09</td>
</tr>
<tr>
<td>Posterior</td>
<td>07</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
</tr>
<tr>
<td><strong>SIZE OF PERFORATION</strong></td>
<td></td>
</tr>
<tr>
<td>Small [&lt;25%]</td>
<td>04</td>
</tr>
<tr>
<td>Medium[&lt;50%]</td>
<td>08</td>
</tr>
<tr>
<td>Large [&gt;50%]</td>
<td>08</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
</tr>
</tbody>
</table>
STUDY II: SYNOPSIS

- Lady Hardinge Medical College & Associated Hospitals, NEW DELHI

- STUDY DESIGN: Cohort study with control [Prospective]

- AIMS AND OBJECTIVES:
  * Evaluate The Success Rate Of Tympanoplasty Type 1 In Paediatric Age Group Of 5-8 Years
  * Analyse: Factors Responsible For The Success Rate Of Tympanoplasty Type 1 In Children [5-8 Yrs]

- SAMPLE:
  * CSOM-mucosal disease [6 months]
  * Two groups (30 each): A (5-8 years) / B (> 14 years)
STUDY II: SYNOPSIS

 INTERVENTION:
  * TYMPANOPLASTY TYPE 1 UNDER GA, (ADULTS-LA)
  * Post auricular-inlay (temporalis fascia)

 CRITERIA FOR SUCCESS:
  * INTACT GRAFT: 6th month
  * HEARING IMPROVEMENT:
    Minimum 10 dB In Two Consecutive Frequencies

 STATISTICAL INTERPRETATION:
  * CHI SQUARE TEST WITH YATES’ CORRECTION
  * FISCHER EXACT “P” VALUE TEST
  * EPI-INFO VERSION 7
STUDY II: RESULTS

- **Graft Uptake & Hearing Improvement**

<table>
<thead>
<tr>
<th>Group</th>
<th>Total Cases</th>
<th>Graft Uptake</th>
<th>Statistical Significance</th>
<th>Hearing Improvement</th>
<th>Statistical Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUP-A</td>
<td>30</td>
<td>26 (87%)</td>
<td>$\chi^2 = 0.159$ p&gt;0.05</td>
<td>18 (69%)</td>
<td>$\chi^2 = 0.488$ p&gt;0.05 [Not Significant]</td>
</tr>
<tr>
<td>[5-8 years]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GROUP-B</td>
<td>30</td>
<td>27 (90%)</td>
<td></td>
<td>21 (78%)</td>
<td></td>
</tr>
<tr>
<td>[Adults]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- In children, **Graft uptake/ Audiological results** are comparable to adults for Tympanoplasty Type I
- **FAILURE**: Faulty Surgical Technique
- **COMPLICATIONS**: Nil
**STUDY II: RESULTS**

**SIGNIFICANCE OF CONTRALATERAL EAR PATHOLOGY:**

- *Measure of “Eustachian Tube Function”*
- *No Significance Observed: ET has no impact on Paed Tymp*

<table>
<thead>
<tr>
<th>GROUP</th>
<th>Total Cases</th>
<th>Success</th>
<th>Failure</th>
<th>Statistical Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUP-A</td>
<td>17</td>
<td>16 (94%)</td>
<td>01 (6%)</td>
<td>$\chi^2 = 1.822$ p&gt;0.05 [Not Significant]</td>
</tr>
<tr>
<td>GROUP-B</td>
<td>13</td>
<td>10 (77%)</td>
<td>03 (23%)</td>
<td></td>
</tr>
</tbody>
</table>

**KEY:**
- GROUP-A: Contralateral ear drum intact
- GROUP-B: Contralateral ear pathology present
## Study II: Results

- **Significance of Size & Site of Perforation**

### Surgical Success:

*Anterior Perforations Poor Graft Uptake:*
- Poor perfusion of anterior half of tympanic membrane
- Faulty technique

*Independent of the size of Perforation*

### Statistical Analysis

#### Site of Perforation

<table>
<thead>
<tr>
<th>Site</th>
<th>No of cases</th>
<th>Graft uptake</th>
<th>Statistical Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior</td>
<td>01</td>
<td>nil</td>
<td>$\chi^2 = 7.1538$</td>
</tr>
<tr>
<td>Inferior</td>
<td>25</td>
<td>22</td>
<td>p &lt; 0.05 [Significant]</td>
</tr>
<tr>
<td>Posterior</td>
<td>04</td>
<td>04</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>26</td>
<td></td>
</tr>
</tbody>
</table>

#### Size of Perforation

<table>
<thead>
<tr>
<th>Size</th>
<th>No of cases</th>
<th>Graft uptake</th>
<th>Statistical Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small [&lt;25%]</td>
<td>nil</td>
<td>nil</td>
<td>$\chi^2 = 0.0647$</td>
</tr>
<tr>
<td>Medium [&lt;50%]</td>
<td>13</td>
<td>13</td>
<td>p &gt; 0.05 [Not Significant]</td>
</tr>
<tr>
<td>Large (&gt;50%)</td>
<td>17</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>26</td>
<td></td>
</tr>
</tbody>
</table>
STUDY II: RESULTS

- IMPACT OF MASTOID PNEUMATIZATION ON PAEDIATRIC TYMPANOPLASTY:

[Does adjuvant mastoid surgery improve graft uptake??]

# Mastoid Pneumatization was determined by Tympmanometric Volume

# TYMPANOMETRIC VOLUME

*Volume of External aud canal, Middle ear cleft & Mastoid cavity
*Measured by Impedance Audiometry

[Tympanometric probe, Pressure:-300daPa to +300 daPa & Expressed in cu cm]
STUDY II: RESULTS

TYMPANOMETRIC VOLUME: NO SIGNIFICANCE

# GROUP-A: Tympanometric volume < 1.60 cm³
# GROUP-B: Tympanometric volume > 1.60 cm³

[1.60 cm³ – mean tympanometric volume]
STUDY II: RESULTS

- **PREMISE:**
  - Small Tympanometric volume
  - Poorly aerated middle ear & mastoid
  - poor graft uptake
  - *[Larger the tympanometric volume: greater the chances of success of tympanoplasty]*

- **STUDY: NO ROLE OF TYMPANOMETRIC VOLUME**
  - # Diamant: mastoid size has Gaussian distribution genetically determined
  - # Role of cortical mastoidectomy in tympanoplasty: Controversial
CONCLUSIONS

- Children have graft uptake & audiological results comparable to adults

- Paediatric age for tympanoplasty: 5 years

- Paediatric tympanoplasty: No significance of Eustachian tube

- No impact of size or site of perforation on paediatric tympanoplasty

- No impact of mastoid pneumatization on paediatric tympanoplasty
MINIMUM AGE FOR PAEDIATRIC TYMPANOPLASTY?

# Medical text: 8-10 Years

[Anatomical maturity of ET: increase in cartilaginous portion and tensor palati mass]

# Study: 5-8 years

[No role of Eustachian tube]

# Medical literature: 2 to 3 years of age
CONCEPT OF SAFE EAR: CHALLENGED?

Complications of CSOM are seen equally in both CSOM-Tubotympanic/Attico antral.

All Perforations: Warrant Immediate Closure
REVIEW OF LITERATURE

- **EUSTACHIAN TUBE: DISPUTED ROLE?**
  - No consistent clinical method for evaluation

- **GAS DIFFUSION THEORY:**
  - [Plausible pathophysiological explanation for middle ear diseases]
REVIEW OF LITERATURE

- CHILDREN - ideal candidates for tympanoplasty:

  - OSSICULAR EROSIONS ARE LESS
  - GOOD COCHLEAR RESERVES
  - QUALITY OF LIFE IMPROVED:
    # Physical activity: water sports
    # Reduced emotional stress
    # Decreased parent concern

- POTENTIAL RISK: CHOLESTEATOMA

- PREVENTION: DEAFNESS [repeated bouts of CSOM]
PREVENTION [WHO Guidelines]:

- ASOM: proper management
- Minimize Risk factors:
  - # Good ear hygiene
  - # Avoid Dirty water
  - # Proper posture during breast feeding
- Immunization: Measles/H. Influenzae/ Pneumococcal
- Preschool/School Screening for CSOM
  
  *Patients can be recruited for tympanoplasty*
TAKE HOME MESSAGE

- Discharging ear in children: *Tympanoplasty* is the treatment of choice

- Discharging ear: [morbidity-DEAFNESS]
- No role of Eustachian tube
- No concept of safe/unsafe ear

Please do paed tympanoplasty
DEAFNESS: Dreadfull
MAGIC OF SOUND
If you can’t explain it simply, you don’t understand it well enough.

– Albert Einstein