ENDOSCOPIC INSERTION OF TYPANOSTOMY TUBE IN CHILDREN

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Abstract—This study is meant for determining the safety of endoscopy followed by grommet insertion into the middle ear. Traditionally, otoscopy, or the surgery using microscope has been the preferred method of Myringology. But given the limitations of using microscope, surgical interventions such as postauricular access have turned popular for treating the ailments of middle ear.

A sum total of 178 cases of otitis media with effusion who had to undergo myringotomy along with or without tympanostomy tube insertion i.e. grommet were studied. The minimum age of the subject was 2.6 years while the maximum age was 44 years. The patients consisted of both male and female patients. 89 cases corresponded to that of right ear while another 89 cases were indications of left ear.

The result derived from this study is clearly an indicative of the fact that the comparatively novice practice of endoscopy in grommet insertion is quite safe and also provides an edge in the live demonstrations and group teaching methods. However, the study also determines that although, this method is apparently safer and efficient, there is no proof of patients have any gains during post operative care and hearing efficiency when compared to other traditional methods.

Key words —endoscopy, grommet, middle ear, Eustachian tube, myringotomy.

I. INTRODUCTION

Myringotomy is a surgical procedure involving eardrums (Latin myringa meaning eardrum). In this surgery, a tiny slit is cut open in the eardrum. This incision is primarily made to reduce any extra pressure built up or to get rid of any pus formation present in the middle ear. After this procedure, a tympanostomy tube is slipped into the middle in order to maintain the aeration for long time and to check the resettlement of fluid. Myringotomy is often required during Eustachian tube obstruction or in severe otitis media i.e. infection in middle ear. Chronic otitis media with effusion is also one of the causes of myringotomy.

Several techniques are invented for grommet insertion, but previously oto-microscope was the only way to visualize the drum which is still very popular worldwide for tympanostomy insertion. However, endoscopy has also emerged as a better and viable option to substitute microscope in the surgery. Ventilation tubes are generally inserted for refractory middle ear effusions with persistent conducive hearing loss found for at least 3 months and hearing loss greater than 25 dB. They may also be inserted as an additional procedure in acute mastoiditis secondary to acute otitis media.

Eustachian tube was first described by Bartomeus eustachius as pharyngo tympanic tube in 1562 and Antonio Valsalva named it as Eustachian tube. It is 36mm long in adults, inferiorly and medially from anterior wall of middle ear, forming an angle of 45 degree with horizontal. Later it enters naso- pharynx 1.25 cm behind posterior end of inferior turbinate.

| Table 1: Comparison between adult and infant Eustachian tubes |
|-------------------|-------------------|
| Length            | ADULT | INFANT |
| Angle with horizontal | 45 °   | 10 °   |
| Lumen             | Narrower | Wider |
| Angulation at isthmus | Present | Absent |
| Cartilage         | Rigid | Flaccid |
| Elastic recoil     | Effective | Ineffective |
| Ostmann’s fat     | More | Less |

Lateral one-third is bony while medial two- third is fibro cartilaginous.

Eustachian tube is generally closed and opens during swallowing, yawning and sneezing.

Figure 1: Angulation of eustachian tube

Figure 2: Parts of eustachian tube

Adult vs. Child (< 7 yr)
Flammation of the middle ear is known as otitis media. It may also involve inflammation of mastoid, petrous apex and perilabyrinthine air cells. Otitis media with effusion, OME, also known as serous otitis is the presence of fluid in the middle ear without signs and symptoms of acute infection, persisting for 3 months or longer from the date of presentation if we don’t have the date of onset. Otitis media with effusion generally registers its presence in form of fullness, earache, pulling auricles, tinnitus, and conductive hearing loss or diagnosed during screening tests for hearing. Adenoid hypertrophy is one of the commonest causes of Eustachian tube obstruction in children resulting in OME. In addition infective conditions, allergy and irritation from cigarette smoke are proven factors. OME is accumulation of non-purulent fluid of various viscosities with in the middle ear cavity. OME is due to dysfunction of Eustachian tube and reduced or missing aeration of middle air cavity which causes negative pressure to develop in the middle ear cavity leading to formation of serous effusion and metaplasia of the middle ear mucosa to a secretory active epithelium and formation of viscous effusion, mucotympanum. Mucous effusion is common in children while serous effusion is seen in adults.

Long term studies show that the ear tube surgery are not really important, but current guidelines for American otaryngologists indicate tube placement in the following conditions:

- Chronic otitis media with persistent effusion for 6 months (one ear) or 3 months (both ears).
- Recurrent acute otitis media: 3 ear infections in 6 months or 4 infections in a year.
- Persistent eustachian tube dysfunction
- Barotrauma: Especially for prevention of recurrent episodes (e.g., after air travel, hypobaric chamber treatment).

II. MATERIALS AND METHODS

A. Population and collection of data

An ex post facto study of 178 patients was performed. All the patients underwent myringotomy and/ or tympanostomy tube insertion (grommet). The study was performed at Rzgary teaching hospital which is a tertiary care hospital in Erbil. The study dealt with age, symptomology, findings, time of operation using endoscopy and their complications. The patients fell in the age bracket of 2.6 years to 40 years. Out of the 178 patients, 89 patients were operated on left ear and the rest 89 on right ear. Main indication was OME due to adenoid hypertrophy resulting into mild hearing loss.

B. Surgical equipments used

Set of instruments used included- myringostomy knife, zero degree storz Oto endoscope that were 2.7 mm in length, ventilation tube which were mainly Shepard short acting tympanostomy tube, grommet which are less than 2 mm in length, video camera and monitor for recording the endoscopy. An absorbent pad dipped in an antifogging solution and was mounted above the boundary of patient’s ear.

C. Pre surgical procedures and preparations

Before the operation occurred, patients generally underwent pneumatic otoscopy. This was the primary tool to determine that patient was suffering with otitis media with or without effusion. Other diagnostic elements used were physical examination, culture, audiometry etc. As a precaution, the medical history of the patient was carefully examined by anaesthesiologist present as a member in the surgical team. Most patients were admitted on the same day as of operation, and in some cases with severe procuring ailments, the patients were already admitted beforehand. In the cases where the case history files were missing, the patient or their parents were separately counselled to collect the required information.

As a precautionary measure, intake of aspirin was prohibited at least 2 days before the operating time. Anti-inflammatory and non-steroidal medicines such as ibuprofen were also debarred. All types of oral intake including food, chewing gums and water was advised not be taken 6 hours before the surgery lest it should increase anaesthetics complications.

D. Surgical proceeding

All the surgeries were accomplished with general anaesthesia. The patient was given intravenous infusion along with medication to be relaxed. The heart rate and
pulse were observed using a pulse oximeter and heart rate monitor.

The patient’s head was tilted sideways a little to the opposite side of the ear being operated to provide more ease during operation. A zero degree Storz endoscope with diameter 2.7 mm was inserted into the middle ear and then a radial slit is made. The incision was made in the antero inferior- quadrant around the light reflex region with a myringotomy knife. Incisions were not made in the posterosuperior quadrants in order to rule out the damaging of ossicular chain or chorda tympani.

Thereafter, the secretions from the middle ear were sucked and then the grommets were positioned by the forceps on the site of incision. Three types of grommets were used ,shipert ,shah and T tube.

E. Post surgical precautions and medications

The post operative care included a minimum of two day resting period of all the patients. The head was placed atop the level of heart by resting the head on multiple pillows. Excoriation of the outer ear was scrupulously prevented through application of zinc oxide. Acetaminophen was orally given in cases of analgesia. The pain was treated simply using epinephrine. It was advised to all the patients that water entry be avoided by all means from entering into the middle ear as it could damage tympanostomy tube and promote bacterial attack.

Table 2. Patient Information (age)

<table>
<thead>
<tr>
<th>Range of Age</th>
<th>2.6-44 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average age</td>
<td>8.6 years</td>
</tr>
</tbody>
</table>

Table 3. Number of patients of each ear

<table>
<thead>
<tr>
<th>Right ears</th>
<th>89</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left ears</td>
<td>89</td>
</tr>
<tr>
<td>Total number</td>
<td>178</td>
</tr>
</tbody>
</table>

Table 4. Causes for otitis media

<table>
<thead>
<tr>
<th>Cause</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adenoid hypertrophy</td>
<td>140</td>
</tr>
<tr>
<td>Allergy</td>
<td>38</td>
</tr>
<tr>
<td>Not known</td>
<td>1</td>
</tr>
</tbody>
</table>

As visible from the table, the patients who were operated belonged to the age group ranging from as low as 2.6 years to the mid age of 44 years. On an average basis the patient was aged 8.6 years. This is clearly an indicative of the fact that myringotomy was more immediately required in patients of younger age. In fact, it has been established according to various studies conducted worldwide that within 3 years of age, over 90% of children are found inflicted with otitis media with or without effusion.

III. RESULTS

A comprehensive study was performed upon 178 patients under the premises of Rzgary teaching hospital. All the patients were suffering from otitis media with effusion. The study was statutorily based upon the success of endoscopy of middle ear in a myringotomy operation along with ventilation tube insertion.

The following table represents the primary data of the patients under observation:

The following table aims to determine more closely the case of the operated patients:

The following table highlights roughly, the cause for otitis media with effusion and hence myringotomy:

Upon a vigorous examination of the case history of the patients, it turned obvious that adenoid hypertrophy was one of the leading causes of the ailment, leading to trailing symptoms and the surgery. As already established by the studies conducted across different parts of the world, most of the cases were triggered by adenoid hypertrophy and the rest being the cases of allergy and other causes. Among 178
patients undergoing the surgery, almost three-fourths of them were suffering from adenoid hypertrophy, their number being 140. The second major cause was allergy, probably pulmonary allergies accounting to 38 patients, to be precise. In 1 patient, the cause could not be clearly established.

After the case history and external examination, the symptoms of the patients were studied. The following tables depicts the symptoms that the patients were suffering from:

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hearing loss</td>
<td>97</td>
</tr>
<tr>
<td>Tightness</td>
<td>24</td>
</tr>
<tr>
<td>Pulling ear</td>
<td>11</td>
</tr>
<tr>
<td>Ear ache</td>
<td>4</td>
</tr>
<tr>
<td>Nasal obstruction</td>
<td>47</td>
</tr>
<tr>
<td>Snoring</td>
<td>66</td>
</tr>
<tr>
<td>Open mouth</td>
<td>52</td>
</tr>
<tr>
<td>Fever</td>
<td>5</td>
</tr>
<tr>
<td>Nasal speech</td>
<td>1</td>
</tr>
</tbody>
</table>

**Table 5. Symptoms in patients**

As indicated in the table above, there were varied number of symptoms that the patients had to go through. The highest number of patients reported hearing loss, while the minimum number of patients grieved of ear ache, fever and nasal speech. The patients suffering from hearing loss were 97 in number, those experiencing tightness were 24 in number and the patients who complained about nasal obstruction were forty seven in number. A considerable amount of patients were also found inflicted with snoring, ranging to sixty six in number. Only one patient was found suffering with nasal speech.

As obvious from the table, disturbed cone of light in otoscopy was most common among the patients. It was retraction in 48 patients and bubbles in 14 ears. Other signs such as transverse position of handle of malleus, fluid level increment, meniscus and atelectasis were also seen.

After the final affirmation of the persistence of otitis media with effusion, the patients were operated. Here is a table depicting the time taken during surgery:

<table>
<thead>
<tr>
<th>Side</th>
<th>Average time of operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right side</td>
<td>2.5 minutes</td>
</tr>
<tr>
<td>Left side</td>
<td>2.2 minutes</td>
</tr>
<tr>
<td>Average</td>
<td>2.4 minutes</td>
</tr>
</tbody>
</table>

**Table 7. Operating time**

The most common type of operation used was adenoidectomy with grommet insertion, 82 ears, while the least common were T tubes which were placed only in 2 ears. Tonsillectomy, and adenoidectomy with grommet insertion, 8 ears, while grommets alone were inserted into 5 ears.

After the surgery, a clear follow up was maintained for all the patients except 18 whose follow up could not be feasible. The study of post surgical complications revealed that there were quite less number of complications involved. The table for the same is below:

<table>
<thead>
<tr>
<th>Complications</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infection</td>
<td>8</td>
</tr>
<tr>
<td>Early extrusion (1 month)</td>
<td>6</td>
</tr>
<tr>
<td>Tympanosclerosis</td>
<td>2</td>
</tr>
<tr>
<td>Recurrent effusion</td>
<td>2</td>
</tr>
<tr>
<td>Retraction</td>
<td>2</td>
</tr>
<tr>
<td>Late extrusion (more than one year)</td>
<td>3</td>
</tr>
</tbody>
</table>

**Table 9. Complications after surgery**
The analysis of the data reveals that infection was amongst the most common complication arising after the surgery. 8 patients were found suffering from infections post surgery. 6 patients witnessed early extrusion of ventilation tube 2 patients each complained of recurrent effusion, retraction and tympanosclerosis. It took more than one year in the extrusion of ventilation tube in 3 patients.

The extrusion time of the ventilation tubes was studied extensively based on which, the following data was emanated-

<table>
<thead>
<tr>
<th>Average extrusion time /months (Right ears)</th>
<th>Average extrusion time /months (left ears)</th>
<th>Average extrusion time /months</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.1</td>
<td>7.8</td>
<td>7.5</td>
</tr>
</tbody>
</table>

**Table 10. Average extrusion time**

This table indicates that the average extrusion time for the ventilation tube was 7.5 months for both years. Separately, average extrusion time for right ear was 7.1 months and that for left ear was 7.8 months.

IV. DISCUSSIONS

The oto-endoscopic technique has opened up multitudes and possibilities and a change in surgical approaches in middle ear. The use of an otoendoscope for myringotomy and grommet insertion was first reported by Thomassin in 1998 (0 Thomassin JM. Endoscopically Assisted Diagnostics and Surgery in Otology. Volume 1: Technique, Equipment and Indications. Tutlingen: Endo-Press, 1998) but did not become popular because the operating microscope had the major advantage of providing binaural vision.

This procedure was first used in children due to its ease and efficiency, and since this procedure can be easily followed, this procedure is now gaining commendable importance. The feasibility of this surgery is highly magnified and the complications are relatively minor and negligible. In addition to endoscopic ventilation tube insertion rigid endoscopes have been used as an adjunct to standard otologic and neuro-otologic including ventilation tube myringoplasty,(1) , cochlear implant(2) cholesteatoma surgery(3)Endoscopic Stapedotomy (4)

1. European Archives of Oto-Rhino-Laryngology
   - July 2014, Volume 271, Issue 7, pp 1897-1902
   - Date: 03 Sep 2013
   - Endoscopic vs microscopic myringoplasty: a different perspective
     Himani Lade, Santossa Ram Choudhary, Ashish Vashisth

2. European Archives of Oto-Rhino-Laryngology
   - May 2014, Volume 271, Issue 5, pp 959-966
   - Date: 18 Apr 2013
   - Endoscopic cochlear implant procedure
     Daniele Marchioni, Alberto Grammatica, Matteo Alicandri-Ciuflelli, Elisabetta Genovese, Livio Presutti

Presutti Endoscopic CI is a safe and viable technique with a low rate of complications and with good outcomes.

   - Endoscopic exclusive transcanal approach to the tympanic cavity cholesteatoma in pediatric patients: Our experience.
   - Marchioni D1, Soloperto D2, Rubini A1, Villari D1, Genovese E1, Artioli F1, Presutti L1.

4. Eur Arch Otorhinolaryngol. 2014 Dec 27. [Epub ahead of print]
   - Endoscopic stapedotomy: our view point.
   - Naik C1, Nemade S.

In our study The average time of operation for the right side was 2.5 minutes, while that of the left side was 2.2 minutes. On an average, it took almost 2.4 minutes to accomplish a single operation. In a study by FEI-PENG LEE on 37 ears, The operation time for each ear ranged from four to 13 minutes, with an average of seven minutes. (An alternative use of video-telescopic guidance for insertion of myringotomy tube

The Journal of Laryngology & Otology, E10, 1 of 3. # 2005 JLO)

In another study by Nassif, he mean duration of the VT placement unilaterally by endoscope was 18 min and that by microscope was 11 min. For bilateral placement, mean duration was comparable (microscope/endoscope = 26/27 min (Endoscopic ventilation tube placement in the pediatric age Clinical Otolaryngology Volume 39, Issue 1, pages 50–53, February 2014 N. Nassif1,*, L.O. Redaelli De Zinis2, M. Berlucchi and D. Zanetti3

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[8] Adrian F Fernando Memorial medical center philippines 2012
[9] https://www.youtube.com/watch?v=XPU1diFGMzQ