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Otoendoscope Assisted Ear Surgery

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Abstract

Endoscopic examination of the middle ear cleft visualizes whole tympanum and the ear canal without having to manipulate the patients head or the microscope. It visualizes structure from multiple angles as compared to the microscope single axis along the canal. It provides extremely sharp image with high resolution. Other than a wider and clearer view of middle ear anatomy, endoscopy allows us to better understand middle ear physiology and ventilation pathways that might cause pathology if impaired using minimal exposure and without the time consuming removal of overlying bone. Endoscope allows the surgeon to visualize the middle ear completely and to simultaneously check the ossicular continuity and mobility.

Material and Methods

The present study was conducted in the department of ENT & Head and Neck Surgery, SMGS Hospital, GMC Jammu for a period of one year commencing from November 2013 to November 2014. The study was done on 70 patients who were admitted for surgical management of tubotympanic CSOM (safe type), atticoantral CSOM (unsafe) and secretory otitis media.

Results in Myringoplasty Group

In endoscopic group it was observed that in 95% (19patients) post operative AB Gap was less than 20db as compared to only 5%(1 patient) pre operatively and in microscopic group it was observed that in 85% (17)patients post operative AB Gap was less than 20db as compared to only 5%(1) patient pre operative AB Gap. There was significant improvement in preoperative and post operative PTA both in endoscopic and microscopic group. (p value 0.0001)

Results in Mastoidectomy Group

In 3 (37.5%) patients out of 8 patients, cholesteatoma left inadvertently after microscopic CWD mastoidectomy (Posterior to Anterior) surgery was identified and removed by otoendoscope from sinus tympani and anterior attic. Similarly in 2 (40%) patients out of 5 patients cholesteatoma left inadvertently after microscopic CWD (Inside out) surgery was removed from sinus tympani, anterior attic and protympanum. No cholesteatoma remnants left inadvertently were observed by otoendoscope in 2 patients of microscopic atticotomy. Overall incidence of cholesteatoma observed and removed from hidden areas by endoscope was 33.3% thus defining the importance of otoendoscopy in cholesteatoma surgery. Overall pre-operative AB-Gap was more than 41db recorded in 13 (86.7%) patients on PTA. Post-operative AB-Gap was reduced by 10 db in 10 (66.7%) patients.

Conclusion

Endoscopic myringoplasty was found to be equally effective and less morbid. Endoscope assisted surgery allows a better understanding of cholesteatoma and improved eradication of residual/recurrent disease from hidden areas such as facial recess, sinus tympani, anterior epitympanic space, protympanum and hypotympanum than with conventional microscopic surgery alone. Grommet insertion can be done effectively using otoendoscope.

Keywords: Endoscopic, Surgery, Surgeon & Patient.

Introduction

Middle ear endoscopy was first introduced by Mer and colleagues in 1967 but till the last decade endoscopes have been mainly used for diagnostic and photographic purposes. **(Harugop et al. 2008).** Today, middle ear surgery is generally performed with the aid of an operating microscope and it was the same operating microscope that revolutionized the surgical management of diseases of ear **(Bhattari 2012).**

One of the main characteristics of otomicroscope is its parallel visual and optical axis, however the middle ear and mastoids are embedded in the bone to form a complex, three dimensional

structure **(Yang Liu et al. 2010)**. The operating microscope provides a magnified image in a straight line and hence the surgeon cannot visualize the deep recesses of the middle ear cleft in a single operating field **(Dennis 2003),** whereas the wide angle view provided by the endoscope enables transcanal access to the tympanic cavity and its otherwise difficult to reach extensions which are the primary site of disease and the areas for surgical failure namely the sinus tympani, anterior epitympanum, attic, facial recess, hypotympanum with minimum invasion of tissue **(Tarabichi 2010)**.

The rigid otoendoscope is simple to use not only for examination but also for the repair of the tympanic membrane perforations. Myringoplasty with temporal fascia or with cartilage grafts can be done with endoscopes. Ventilation tubes insertion, ossiculoplasties and stapedectomies have been performed by some surgeons using endoscopes **(Flavio 2012)**.

Poor access was one of the major reasons for residual disease in cholesteatoma cases, particularly in the sinus tympani, anterior epitympanic recess, and Eustachian tube. Hence, these areas were considered the main sites of recurrence **(Thomassin et al. 1993)**. The sinus tympani has been a focus of clinical interest because of its tendency to be invaded by pathology; its visual obscurity; and the lack of a straight forward surgical approach by which it can be tackled **(Saito et al. 1971)**.

On the other hand, several disadvantages of endoscopes include loss of depth of perception and binocular vision, the inevitable one-handed surgical technique involved, the need of a bloodless field, fogging and smearing of the tip of the endoscope, the mandatory need for reliable physician training, and the cost of equipment involved **(Tarabachi 1997).**

The use of the endoscope in combination with the operating microscope, still could not achieve a 100% eradication of the disease. However, the use of endoscopes does reduces the residual cholesteatoma rate **(Badr-El-Dine 2002).**

The present study was undertaken to evaluate the above mentioned advantages of otoendoscopes along with microscopes in various surgeries of ear like grommet insertion, myringoplasty and mastoidectomies. The objective of this study was to evaluate the effectiveness of otoendoscopy in transcanal endoscopic myringoplasty and in the management of cholesteatoma in order to achieve total control over the disease particularly cholesteatoma extension into the hidden areas and thus highlight the usefulness of otoendoscopy as a tool that could influence surgical decision-making, improve outcome and promote functional ear surgery.

Materials and Methods

The prospective study was conducted in the department of ENT & Head and Neck Surgery, SMGS Hospital, GMC Jammu for a period of one year commencing from November 2013 to November 2014.

The study was done on 70 patients who were admitted for surgical management of following problems.

1. **Safe type of CSOM** (40 patients of either sex in the age group of 16 to 50 years with dry central perforations. 20 patients underwent myringoplasty by otoendoscope assisted transcanal approach and the other 20 patients underwent conventional microscopic myringoplasty)
2. **Unsafe type of CSOM (**15 patients of acquired cholesteatoma underwent conventional microscopic cholesteatoma surgery followed by otoendoscopic examination on completion in order to inspect and remove any remnant of cholesteatoma left inadvertently behind in hidden areas (Endoscope Assisted)**)**.
3. **Secretory Otitis Media (**15 patients underwent otoendoscopic myringotomy with and without grommet insertion).

Inclusion Criteria

Patients in age groups of 16 years and above, both sexes were included for myringoplasty, tympanoplasty and mastoidectomy. However grommet insertion was done at any age group.

Exclusion Criteria

Those excluded from study were children less than 16 years (grommet insertion was done at any age), medically unfit patients, those without residual cochlear function and malignant neoplasms of external and middle ear.

A thorough clinical work up of all the patients was done. Detailed history of the patient was taken and complete Head and Neck examination was performed on all patients. After complete routine investigations, radiological details, audiological assessment and proper informed consent, patients were operated (myringotomy, myringoplasty, mastoidectomy). Preoperative otoscopic examination was done and the findings were confirmed by examining with an endoscope and under microscope accordingly.

Follow Up

All the patients were followed up for a minimum period of 6 months. In patients who had follow up period of more than 6 months, they were further assessed at 9 months, 1 year. However for comparative purposes of the study maximum follow up period of 6 months was taken. Observations were subjected to appropriate statistical analysis. Categorical variables were analyzed by using Fisher exact test. The continuous data was analyzed by using two same independent t-test and paired t-test.

Observations

A. Myringoplasty Group

Majority of patients in endoscopic group i.e. 70% (14/20) presented in 3rd and 4th decade of life. Majority of patients in microscopic group i.e. 65% (13/20) presented in 3rd and 4th decade of life.

Majority of patients were females in the endoscopic group i.e. 60% (12/20). Majority of patients in microscopic group were also females i.e. 65% (13/20). The female to male ratio in endoscopic group was 1.5:1, whereas female to male ratio in microscopic group was 1.8:1.

In our study in endoscopic group perforation size were medium in 70% (14/20) patients out of

which three quadrant medium sized perforations were maximum observed perforations seen in 50% (10/20) patients. In microscopic group, perforation size were medium in 75% (15/20) patients out of which two quadrant medium sized perforations were maximum observed perforations seen in 45% (9/20) patients

Table1. Ostoperative Graft Take Up Rates [Endoscopic and Microscopic Group] (n=20)

Take Up	Endoscopic Group		Microscopic Group		p value
	No.	%	No.	%	
Intact TM	15	75	16	80	0.5
Residual Perforation	4	20	3	15	0.5
Reperforation	1	5	1	5	0.75
Total	**20**	**100**	**20**	**100**	

[TM – Tympanic Membrane]

As shown in table 1, postoperatively in endoscopic group intact TM (graft take up) was observed in 75% (15/20) patients whereas graft failure was noted in remaining 25% (5/20) patients which included residual perforation in 20% (4/20) patients and reperforation in 5% (1/20) patient. In microscopic group intact TM (graft take up) was observed in 80% (16/20) patients whereas graft failure was noted in remaining 20% (4/20) patients which included residual perforation in 15% (3/20) patients and reperforation in 5% (1/20) patient. The observation with respect to post op graft take up rates in the two groups under comparative study was quite similar and comparable (p value 0.5). Similarly there was no significant difference found between residual perforation (p value 0.5) and re perforation (p value 0.75) in the two groups under study.

Table 2. Comparison of Pre and post op Conductive Hearing Loss on PTA [Endoscopic and Microscopic Group] (n=40)

Airbone Gap (db)	Preop. Endoscopic n=20	Postop. Endoscopic n=20	Preop., Microscopic n=20	Postop. Microscopic n=20
0-10db	0	11	0	9
11-20db	1	8	1	8
21-30db	12	1	10	2
31-40db	7	0	4	1
41-50db	0	0	5	0
P Value	<0.0001		<0.0001	

As shown in table 2, in our study of endoscopic group, preoperative AB Gap in 7 (35%) patients were in the range of 31-40 db, in 12 (60%) patients in the range of 21-30db, while as in remaining 1 (5%) patient in the range of 11-20 db. In endoscopic group, post operative AB Gap in 11 (55%) patients were in the range of 0-10 db, in 8 (40%) patients in the range of 11-20 db, while as in remaining 1 (5%) patient in the range of 21-30 db. Thus in this study in endoscopic group it was observed that in 95% (19patients) post operative AB Gap was less than 20db as compared to only 5%(1 patient) pre operative AB Gap.

In microscopic group pre operative AB Gap, in 5 (25%) patients were in the range of 41-50 db, in 4 (20%) patients in the range of 31-40 db, in 10 (50%) patients in the range of 21-30 db ,while as in remaining 1 (5%) patient in the range of 11-20 db. In microscopic group post operative AB Gap, in 9 (45%) patients were in the range of 0-10 db, in 8 (40%) patients in the range of 11-20 db, in 2 (10%) patient in the range of 21-30 db, while as in remaining 1 (5%) patient in the range of 31-40 db. Thus in this study in microscopic group it was observed that in 85% (17)patients post operative AB Gap was less than 20db as compared to only 5%(1) patient pre operative AB Gap.

There was significant improvement in preoperative and post operative PTA both in endoscopic and microscopic group. (p value 0.0001)

In this study out of 20 patients each in endoscopic and microscopic group, residual perforations was seen in 4 (20%) patients in endoscopic group and 3 (15%) patients in microscopic group, reperforation was noticed around 3 months post op in 1 patient each in endoscopic and microscopic group.

Follow Up

This study comprised of 20 patients each in endoscopic group and microscopic group. All the patients in two groups had maximum follow up period of 6 months. 13 (65%) patients in each group followed up for 9 months, 7 (35%) patients in each group followed up for 12 months. However anatomical and functional results, GBI scores and complications were recorded for purpose of study at maximum follow up period for all patients as 6 months On analysis of the Glasgow Benefit Inventory (GBI) Scores of all the patients in the endoscopic group, the mean$\pm$SD score in the four categories i.e Total score, General subscale score, Social Support score and physical health score were 26.43$\pm$7.75, 28.91$\pm$7.6, 23.2$\pm$8.03, 28.0$\pm$ 7.4, respectively. On analysis of the Glasgow Benefit Inventory (GBI) Scores of all the patients in the microscopic group, the mean $\pm$ SD score in the four categories i.e. Total score, General subscale score, Social Support score and physical health score were 18.8$\pm$ 12.5, 20.6$\pm$3.8, 15.6$\pm$10.2, 19.9$\pm$ 13.8 respectively. Above results show that the health status of patients undergoing surgery improved overall and according to each of the subcale used.

B. Mastoidectomy Group

In our study 15 (100.0%) patients underwent conventional microscopic cholesteatoma surgery followed by otoendoscopic examination on completion in order to inspect and remove any remnant of cholesteatoma left inadvertently behind in hidden areas (Endoscope Assisted).

Maximum patients were recorded in the age group of 16-40 years i.e. 13 (86.7%) patients and

minimum patients i.e. 5 (33.3%) were recorded in the age group of 20-30 years. Mean age of patient was 28.6 years.

In our study 8 (53.3%) patients were male and 7 (46.7%) patients were female with male female ratio recorded as 1.1:1.

On pre-operative HRCT in group-A, 2 (13.3%) patients had an isolated soft tissue shadow localized to the epitympanum with erosion of ossicles (Malleus & Incus head) suggestive of cholesteatoma. In group-B, 4 (26.7%) patients had an opacification of attic, mastoid and posterior mesotympanum with erosion of ossicles suggestive of cholesteatoma. In group-C, 9 (60%) patients had total opacification of attic, mesotympanum/hypotympanum and mastoid with erosion of ossicles suggestive of cholesteatoma. Multi focal disease was seen in 13 (86.7%) patients which included patients of group B & C.

Surgical procedures done were Canal Wall down Mastoidectomy (Posterior to Anterior) in 8 (53.4%) patients followed by Canal Wall down Mastoidectomy (Inside out) in 5 (33.3%) patients and atticotomy in 2 (13.3%) patients.

Table 3. Sites of Cholesteatoma Removal (n=15)

Surgical Techniques	By Microscope	By Endoscope (Left Inadvertently)
Canal Wall Down Mastoidectomy (Posterior to Anterior) (n=8)	Mastoid Antrum (8), Aditus (8), Attic (8), Mesotympanum (6), Sinus Tympani (5)	Cholesteatoma Remnants Removed From: Sinus Tympani And Anterior Attic (3)
Canal Wall Down Mastoidectomy (Inside Out) (n=5)	Attic, Aditus & Antrum (5), Mesotympanum (3)	Cholesteatoma Remnants Removed From : Sinus Tympani, Anterior Attic And Protympanum (2)
Atticotomy (n=2)	Attic Cholesteatoma + Granulations in Middle Ear	No Cholesteatoma Remnant Seen.

As shown in table 3, in 3 (37.5%) patients out of 8 patients, cholesteatoma left inadvertently after microscopic CWD mastoidectomy (Posterior to Anterior) surgery was identified and removed by otoendoscope from sinus tympani and anterior attic. Similarly in 2 (40%) patients out of 5 patients cholesteatoma left inadvertently after microscopic CWD (Inside out) surgery was removed from sinus tympani, anterior attic and protympanum. No cholesteatoma remnants left inadvertently were observed by otoendoscope in 2 patients of microscopic atticotomy.

Table 4. Cholesteatoma Detected by Otoendoscope from Hidden Areas (n=15)

Site of Cholesteatoma in Hidden Areas	No.	% age
Sinus Tympani and Anterior Attic	3	20.0
Sinus Tympani, Anterior Attic and Protympanum	2	13.3
Total	**5**	**33.3**

In our study, in 3 (20.0%) patients cholesteatoma was detected and removed by otoendoscope from sinus tympani and anterior attic, whereas in another 2 (13.3%) patients cholesteatoma was detected and removed by otoendoscope from sinus tympani, anterior attic and protympanum. It is shown in table 4. Overall incidence of cholesteatoma observed and removed from hidden areas by endoscope was 33.3% thus defining the importance of otoendoscopy in cholesteatoma surgery.

Table 5. Comparison of pre-op and post-op AB-Gap on PTA (n=15)

AB Gap (db)	Pre-op	Post-op
11-20db	0	0
21-30db	0	0
31-40db	2	3
41-50db	2	10
51-60db	11	2

As shown in table 5, overall pre-operative AB-Gap was more than 41db recorded in 13 (86.7%) on PTA. Post-operative AB-Gap was reduced by 10 db in 10 (66.7%) patients.

Follow Up

In our study all the 15 (100%) patients had minimum follow up period of 6 months, 10 (66.7%) patients had maximum follow up of 9 months. 5 (33.3%) patients had maximum follow up of 12 months. Post-operative surgical and functional results, GBI scores and complications were recorded for purpose of study at minimum follow up period for all the 15 patients at 6 months. 2 (13.3%) patients had post-operative wet ear and 2 (13.3%) patients had mild retraction of tympanic membrane none of these required further intervention. No cholesteatoma pearl, iatrogenic facial nerve injury, vertigo, sensorineural hearing loss or recurrence/residual was seen in any patients

Above results show that the health status of patients undergoing surgery improved overall and according to each of the subscale used.

Table 6 shows the advantages and limitations of using endoscope during microscopic mastoidectomy.

Table 6. Advantages and Limitations of using Endoscope during conventional Microscopic Mastoidectomy

Parameter	Endoscopic Surgery	Microscopic Surgery
Follow the disease from its origin.	Advantage	Limitation
Identifying & removing disease from hidden & difficult areas: Sinus tympani, Facial recess, Anterior attic, Hypotympanum.	Advantage	Limitation
Removing the disease in Toto rather than piece meal.	Advantage	Limitation
Less need for removal of healthy bone.	Advantage	Limitation
Anatomical variations which hampers view and need canaloplasty.	Advantage	Limitation
Visualization of middle ear structures from multiple angles with angled endoscopes.	Advantage	Limitation
Better preservation of ossicles & reconstruction of hearing mechanism	Advantage	Limitation
Image		
No shadow zone Wide panoramic view (wide angle - short focal length 2-5 mm) High resolution & contrast. More fine details.	Advantage	Limitation

Discussion

Myringoplasty Group/ Safe Type of CSOM

Age Wise Distribution

In the present study, Mean age at diagnosis in endoscopic group was 28.1 years with youngest and eldest patients as 18 years male and 43 years old female. Mean age of patients in microscopic group at diagnosis was 27.2 years with youngest and eldest patients as 17 years female and 48 years old male. There was no significant difference recorded with respect to age distribution of patients in two groups under comparative study. **Black JH and Wormald PJ (1995)** conducted a retrospective study on patients aged 7 to 66 years to record effects of contributing factors in myringoplasty on hearing and graft success. They could not find any statistical relationship between the age and success of graft take up and hearing. However **Albera R et al. (1998)** reported that younger patients had better outcome results.

Sex Distribution

Majority of patients were females in the endoscopic group i.e. (60%). The female to male ratio recorded was 1.5: 1. Majority of patients in microscopic group were females i.e. (65%). The male to female ratio recorded was 1.8:1. There was no significant difference recorded with respect to ratio of sex distribution in the two groups. **Bunzen D et al. (2006)** conducted a study to record middle ear status and success in myringoplasty and included 29 men (29.90%) and 68 women (70.10%). **Sharma DK et al. (2009)** studied various factors including sex which influence surgical out come in myringoplasty. They concluded that sex of patient among other factors had no bearing on graft uptake rate. In our study we too did not observe any significant correlation between sex of the patient and success.

Graft Take Up

In this study in endoscopic group post operatively intact TM (graft take up) was observed in 15(75%) patients ,where as graft failure was reported in remaining 5 (25%) patients which included residual perforation in 4 (20%) patients and reperforation in 1 (5%) patient and in microscopic group post operatively intact TM (graft take up) was observed in 16 (80%) patients, where as graft failure was reported in remaining 4 (20%) patients which included residual perforation in 3 (15%) patients and reperforation in 1 (5%) patient**. Hussain A et al. (2004)** conducted a study to record outcome of graft acceptance and reported success rate of 60%. **Raj A and Mehar R (2001)** studied the role of endoscope in management of DCP and compared the results of endoscopic and microscopic groups. The graft take up rate in endoscopic group was observed as 90% and in microscopic group as 85%. The results of graft take up observed in our study are almost similar with observations on graft take up of above quoted reference and under other subheadings like size, approach, graft material.

Graft Take Up Results

In our study in the endoscopic group in 15 (75%) patients graft take up was successful, which included 11 patients where tragal perichondrium was used as graft material and 4 patients where ATF was used as graft material.. Thus 80% success rate with respect to ATF graft material and 73.3% success rate with respect to tragal perichondrium was recorded. In the microscopic group in 16 (80%) patients graft take up was successful, which included 12 patients where ATF was used as graft material and 4 patients where tragal perichondrium was used as graft material. Thus 80% success rate with respect to both the graft materials was recorded**. Awan Z et al. (2008)** in their study to determine take up rate of graft for perforations of different sizes observed graft take up for tragal perichondrium was 85%, temporalis fascia 75% and fat as 100%. There was no significant difference with respect to post op graft take up rates using different graft materials in the two groups under comparative study.

A B Gap (Pre and Postoperative)

In this study in endoscopic group the maximum pre op A-B Gap on PTA was recorded as 38 db in 1 patient and the minimum pre op A-B Gap on PTA was recorded as 22 in 2 patient whereas maximum post operative A-B Gap was recorded as 26db recorded in 1 patient and the minimum post op A-B Gap recorded was 3 db recorded in 2 patients. On statistical analysis there is a significant difference between preoperative and postoperative A-B gap on PTA (p value 0.0001).

In microscopic group maximum pre op A-B Gap recorded was 50db recorded in 1 patient where as minimum pre op A-B Gap recorded was 20 db

recorded in 1 patient. In this study in microscopic group maximum post op A-B Gap recorded was 33db recorded in 1 patient where as minimum post op A-B Gap recorded was 5 db recorded in 4 patients. On statistical analysis there is a significant difference between preoperative and postoperative A-B gap on PTA (p value 0.0001)

In this study in endoscopic group preoperative AB Gap, in 7 (35%) patients were in the range of 31-40 db, in 12 (60%) patients in the range of 21-30db, while as in remaining 1 (5%) patients in the range of 11-20 db. In this study in endoscopic group post operative AB Gap, in 11 (55%) patients were in the range of 0-10 db, in 8 (40%) patients in the range of 11-20 db, while as in remaining 1 (5%) patient in the range of 21-30 db.

Raj A and Meher R (2001) studied the role of rigid endoscope in myringoplasty. In endoscopic group preoperative AB gap of 0-10db was recorded in 2 patients (10%), 11-20db in 6 patients (30%), 21-30db in 10 patients (50%) and 31-40db in 2 patients (10%). After the surgery postoperative AB gap of 0-10db was recorded in 12 patients (60%), 11-20db in 6 patients (30%), 21-30db in 1 patient (5%) and 31-40db in 1 patient (5%). In microscopic group preoperative AB gap of 0-10db was recorded in 2 patients (10%), 11-20db in 9 patients (45%), 20-30db in 7 patients (35%) and 31-40db in 2 patients (10%). Postoperative AB gap of 0-10db was recorded in 11 patients (55%), 11-20db in 6 patients (30%), 21-30db in 2 patients (10%) and 31-40db in 1 patient (5%). Post operative Air Bone Gap was less than 10 db in 60% of patients in the endoscopic group and 55% of patients in the microscopic group**.**

Mastoidectomy Group/ Unsafe Type of CSOM

Age Wise Distribution of Patients

In our study maximum patients were recorded in first three decades i.e. 13 (86.7%) patients. Youngest patient recorded was 18 years old male and eldest was 52 years old female. The mean age recorded was 28.1 years. **Ayubi S and Rafiq Gill MZ (2011)** studied value of oto-endoscopy for residual disease after Radical and Modified radical mastoidectomy for cholesteatoma, on patients with age group of 15 to 55 years. Mean age of presentation was 31.75 years. Range of age in our study (16 years and above) and the mean age recorded in our study was quite similar to range of age of patients in above quoted references.

Sex Wise Distribution of Patients

In our study, 8 (53.3%) patients were male and 7 (46.7%) patients were female. Male female ratio overall recorded was 1.1:1. **Toran KC et al. (2004)** in their study included 42 (65.7%) males and 22 (34.3%) females. **Tarabichi M (2004)** studied endoscopic management of limited attic cholesteatoma and their study included 22 (31.8%) were males and 47 (68.1%) females.

Pre-Operative Ab-Gap on Pta

In our study overall pre-operative AB-Gap was more than 41 db in 13 (86.7%) patients. **Tarabichi M (2004)** showed AB-Gap of 20db or more in 51 (69.8%) ears. **Ayubi S and Rafiq Gill MZ (2011)** studied value of otoendoscopy for residual disease after Radical and Modified radical mastoidectomy for cholesteatoma, average pre operative AB-gap was 31.75 dB in speech frequencies. The pre-operative AB-gap recorded in our study was more than the above quoted references.

Pre-Operative High Resolution Computerized Tomography Suggestive of Cholesteatoma

In our study on pre-operative HRCT in group-A, 2 (13.3%) patients had an isolated soft tissue shadow localized to the epitympanum with erosion of ossicles (Malleus and Incus head) suggestive of cholesteatoma. In group-B, 4 (26.6%) patients had an isolated opacification of attic, mastoid and posterior mesotympanum with erosion of ossicles suggestive of cholesteatoma. In group-C, 9 (60%) patients had total opacification of attic, mesotympanum/hypotympanum and mastoid with erosion of ossicles suggestive of cholesteatoma. Multi focal disease was seen in 13 (86.70%) patients which included patients of group B & C. **Tarabichi M (2004)** studied endoscopic management of limited attic cholesteatoma. Among 69 patients preoperative CT scan was performed in 46 (66.6%) ears and CT was suggestive of cholesteatoma with presence of bony erosion in 26 (56.5%) ears. Total opacification of middle ear and mastoid air cells was observed in 7 (15.2%) ears and isolated opacification of middle ear and attic was evident in 11 (23.9%) ears. Overall in our study 13 (86.7%) patients had multifocal disease unlike the above mentioned studies which had less than 40 % multifocal disease.

Surgical Procedures Done

In our study in surgical procedures done were canal wall down mastoidectomy (Posterior to anterior) in 8 (53.4%) patients followed by canal wall down mastoidectomy (inside out) in 5 (33.3%) patients and atticotomy in 2 (13.3%) patients. **Badr-El-Dine M (2009)** studied the endoscopic assisted surgery of sinus tympani cholesteatoma. Of the 294 cases 212 (72.1%) cases were operated upon using canal wall up (CWU) technique and 82 (27.8%) cases were operated upon using canal wall down (CWD) procedure**.** In our study out of 15 patients 13 (86.7 %) patients underwent Canal wall down mastoidectomy, 2 (13.3%) patients underwent atticotomy with attic reconstruction.

Cholesteatoma Detected by Otoendoscope from Hidden Areas

In our study in, 3 (20.0%) patients out of 8 (53.3%) patients who underwent canal wall down mastoidectomy (Posterior to anterior) residual cholesteatoma was detected and removed by otoendoscope from sinus tympani and anterior attic, whereas in 2 (13.3%) patients out of 5 (33.3%) patients who underwent canal wall down mastoidectomy (Inside out) residual cholesteatoma was detected and removed by otoendoscope from sinus tympani, anterior attic and protympanum. No cholesteatoma remnants left inadvertently were observed by otoendoscope in 2 patients of microscopic atticotomy. Overall incidence of cholesteatoma observed & removed from hidden areas by endoscope in endoscope assisted class was 33.3%. **Sajjadi H (2013)** studied endoscopic middle ear and mastoid surgery for cholesteatoma in 249 patients. Of the 182 (73.09%) cases receiving primary

closed cavity technique, once the microscopic cholesteatoma was resected and the surgeon was confident there was no visible cholesteatoma, endoscopy revealed a 22% incidence of cholesteatoma residual at the time of the primary operation (40 patients).

Post-Operative Ab-Gap in Respective Class on PTA

In our study post-operative AB-Gap was reduced by 10 db in 10 (66.7%) patient. **Tarabichi M (2004)** studied endoscopic management of limited attic cholesteatoma in of 69 patients. Audiologic testing at last follow-up visit for the individual patient showed closure of their AB gap to within 20db, in 47 (64.3%) ears.

Post-Operative Complications

In our study 2 (13.3%) patients had post-operative wet ear and 2 (13.3%) patients had mild retraction of tympanic membrane. None of these required further intervention. No cholesteatoma pearl, iatrogenic facial nerve injury, vertigo, sensorineural hearing loss or recurrence/residual cholesteatoma was seen in any patients. **Toran KC et al. (2004)** studied surgical management of sinus tympani cholesteatoma. They operated 164 patients with unsafe CSOM. 64 (39%) ears had sinus tympani extension of the cholesteatoma or granulations or both and were included in their study.

Results

The present study was done on 70 patients and following conclusion were made:-

1. Results of endoscope assisted myringoplasty were comparable to the conventional microscopic myringoplasty. In terms of cosmesis and post operative recovery patients in the endoscopic group had the added advantage. Thus endoscopic myringoplasty was found to be equally effective and less morbid.
2. Endoscope assisted surgery allows a better understanding of cholesteatoma and improved eradication of residual/recurrent disease from hidden areas such as facial recess, sinus tympani, anterior epitympanic space, protympanum and hypotympanum than with conventional microscopic surgery alone.
3. Grommet insertion can be done effectively using otoendoscope.

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