



RESEARCH ARTICLE

OTOENDOSCOPE ASSISTED EAR SURGERY

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ABSTRACT

Endoscopic examination of the middle ear cleft visualizes whole tympanum and the ear canal from multiple angles without any need to manipulate the patients head or the microscope. Endoscope allows the surgeon to visualize the middle ear completely and to simultaneously check the ossicular continuity and mobility. The present study was conducted for a period of one year in 70 patients who were admitted for surgical management of tubotympanic CSOM (safe type), atticoantral CSOM (unsafe) and secretory otitis media. Regarding safe type of CSOM cases, in endoscopic group it was observed that in 95% cases post operative AB Gap was less than 20db as compared to only 5% pre operatively and in microscopic group it was observed that in 85% post operative AB Gap was less than 20db as compared to only 5% pre operatively. Regarding unsafe type of CSOM cases, in 3 (37.5%) patients out of 8 patients, cholesteatoma left inadvertently after microscopic canal wall down mastoidectomy surgery was identified and removed by otoendoscope from sinus tympani and anterior attic area. Similarly in 2 (40%) patients out of 5 patients cholesteatoma left inadvertently after microscopic canal wall down 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. 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.

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INTRODUCTION

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). 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 reduce 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.

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Aims and objectives

The objective of this study was to evaluate the effectiveness of otoendoscopy in transcanal endoscopic myringoplasty and in the management of cholesteatoma.

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.

- **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)
- **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)).
- **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. A 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. 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.

RESULTS

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. 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.

Table 1. Postoperative 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]

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. 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.

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

Airbone Gap (db)	Preop.	Postop.	Preop.,	Postop.
	Endoscopic n=20	Endoscopic n=20	Microscopic n=20	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	

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.

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

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

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.

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.

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. 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. 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.

DISCUSSION

Myringoplasty group/ safe type of CSOM

In the present study, mean age at diagnosis in endoscopic group was 28.1 years and mean age of patients in microscopic group at diagnosis was 27.2 years. There was no significant difference recorded with respect to age distribution of patients in two groups under comparative study. Black JH, 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 (Black and Wormald, 1995). They could not find any statistical relationship between the age and success of graft take up and hearing. However, Albera *et al.*, 1998 reported that younger patients had better outcome results (Albera *et al.*, 1998). Majority of patients were females in the endoscopic group i.e. (60%) and in microscopic group also (65%). There was no significant difference recorded with respect to ratio of sex distribution in the two groups. Sharma *et al.*, 2009 studied various factors including sex which influence surgical outcome in myringoplasty. They concluded that sex of patient among other factors had no bearing on graft uptake rate (Sharma *et al.*, 2009). In our study we too did not observe any significant correlation between sex of the patient and success rate. 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. Raj A and Meher 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% (Raj A and Meher R, 2001). 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. We observed 80% success rate with respect to both the graft materials (tragal perichondrium & temporalis fascia). Awan *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% (Awan *et al.*, 2008). 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. In our study, we found a significant difference between preoperative and postoperative A-B gap on PTA in both the study groups (endoscopic and microscopic).

Mastoidectomy group/ unsafe type of CSOM

In our study, mean age recorded was 28.1 years with 8 male and 7 female patients. Ayubi and Rafiq Gill, 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 (Ayubi and Rafiq Gill, 2011). 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. 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 (Tarabichi, 2004). Ayubi and Rafiq Gill, 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 (Ayubi and Rafiq Gill, 2011). The pre-operative AB-gap recorded in our study was more than the above quoted references. Overall incidence of cholesteatoma observed & removed from hidden areas by endoscope in endoscope assisted class was 33.3%. Sajjadi, 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) (Sajjadi, 2013). In our study post-operative AB-Gap was reduced by 10 db in 10 (66.7%) patient. Tarabichi, 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 (Tarabichi, 2004). 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 *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 (Toran *et al.*, 2004).

Conclusion

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. 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.

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