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Analysis of hearing outcome following canal wall up and canal wall down mastoidectomy in squamosal type of chronic suppurative otitis media: A comparative study

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ABSTRACT

Background: Chronic suppurative otitis media (CSOM) is a major health issue in developing countries causing persistent problem and may lead to life-threatening complications. This major health issue and its complications can be best avoided by early and effective treatment. **Aims and Objectives:** The aim is to compare the outcome in terms of hearing improvement following canal wall up and canal wall down mastoid surgery. **Materials and Methods:** This prospective study was conducted in Otorhinolaryngology Department of a Burdwan Medical College and Hospital, Burdwan, a tertiary care hospital in Burdwan from April 2019 to August 2020 and 50 clinically diagnosed cases of COM (Squamous type) were included in this study after through history taking and meticulous clinical examination. Patients were divided in two Groups (Group-A and Group-B) with 25 patients in each group randomly and Group-A patients undergone canal wall up mastoidectomy and Group-B patients undergone canal wall down mastoidectomy (CWDM). Now, before performing surgery, a pre-operative pure tone audiometry was performed for each of the patients and a follow-up pure tone audiometry was done again, 2-month post-operative period. These results were compared to assess the degree of hearing improvement in the two different operative procedures, namely, canal wall up and CWDM. **Results:** In Group-A, the mean hearing gain (mean ± SD) of patients was 12.5700 ± 0.9856. In Group-B, the mean hearing gain (mean ± SD) of patients was 8.4200 ± 5.0051. Difference of mean hearing gain with both groups was statistically significant (P = 0.0002). Chi-square value: 0.1678; P = 0.9195. **Conclusion:** Hearing gain was more with canal wall up compared to CWDM in CSOM which was statistically significant.

Key words: Canal wall up mastoidectomy; Canal wall down mastoidectomy; Hearing outcome

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INTRODUCTION

Chronic suppurative otitis media (CSOM) is typically a persistent, potentially dangerous disease often capable of causing severe destruction and irreversible sequelae such as fatal intracranial complications leading to undue burden on the patient, family, and society.[1] Existence of CSOM dates back to the time of Hippocrates, who had appreciated the potential seriousness of suppurative middle ear disease.[2]

The incidence of CSOM is higher in less developed countries. Malnutrition, poor hygiene, and overcrowding are some of the factors that are associated with higher incidence of infections of the middle ear.[3] The prevalence surveys show that the global disease burden involves 65–330 million individuals with draining ears, 60% of whom suffer from significant hearing impairment.[4] This disease is particularly common in developing countries. According to the WHO survey, INDIA is considered to be in the high prevalence zone.

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Although the major goal of surgery of the middle ear cleft is to render the ear safe and dry by removing the disease, the increasing concern of hearing outcome of patients has led to surgeons resorting to techniques with maximum conservation of hearing and at the same time effective disease clearance.

Two main surgical techniques that are employed in the treatment of squamosal variety of CSOM are – Canal wall up and Canal wall down mastoidectomy (CWDM). CWDM allows for better visualization, greater assurance of cholesteatoma eradication, and a lower recurrence rate than canal wall up mastoidectomy (CWUM). Contrary, CWUM is not associated with mastoid cavity problems and allows for good hearing outcomes.

Modified radical mastoidectomy provides relatively safe surgical access for the removal of chronic middle ear and mastoid disease and gives reproducible results. However, it had been suggested that hearing may not be as good as that after "intact canal wall mastoidectomy" (ICWM).[5,6]

Achieving successful hearing outcomes following tympano-mastoidectomy in patients with CSOM depend on several factors. The types of mastoid surgery such as CWUM and CWDM are considered to be one of these factors because of the structural changes.[7,8] However, the clinical reports related to this issue have been controversial. Tos reported that the hearing results following CWUM are better than that after CWDM.[9]

Aims and objectives

The aim is to compare the outcome in terms of hearing improvement following canal wall up and canal wall down mastoid surgery in squamosal type of CSOM.

MATERIALS AND METHODS

This prospective study was conducted in the Otorhinolaryngology Department of Burdwan Medical College and Hospital, Burdwan, a tertiary care hospital in Burdwan from April 2019 to August 2020 after getting necessary Institutional Ethics Committee approval and 50 clinically diagnosed cases of COM (Squamosal type) were included in this study after through history taking and meticulous clinical examination. Pure tone audiometry was done in all cases preoperatively.

Inclusion criteria

Patients with Squamous type of CSOM aged between 5 year and 60 year were included in the study.

Exclusion criteria

The following criteria were excluded from the study:

- CSOM with major intracranial complications
- Pure SNHL
- Revision surgery
- Mental Retardation and
- Malignancy of ear
- Acute Otitis Media
- Congenital ear anomaly and
- Those who were not giving consent.

After obtaining necessary consents, patients were posted for surgery. Patients were divided in two Groups (Group-A and Group-B) with 25 patients in each group randomly and Group-A patients undergone CWUM and Group-B patients undergone CWDM.

Now, 2 months after performing surgery, a follow-up pure tone audiometry was done again. Pre-operative and 2-month post-operative audiological results were compared to assess the degree of hearing improvement in the two different operative procedures, namely, canal wall up and CWDM.

RESULTS

In Group-A, the mean hearing gain (mean±SD) of patients was 12.5700±0.9856. In Group-B, the mean hearing gain (mean±SD) of patients was 8.4200±5.0051. Difference of mean hearing gain with both groups was statistically significant (P=0.0002). Chi-square value: 0.1678; P=0.9195 (Table 1).

In Group-A, 13 (52.0%) patients were >5–24 years old, 6 (24.0%) patients were 25–44 years old and 6 (24.0%) patients were 45–<60 years old. In Group-B, 13 (52.0%) patients were >5–24 years old, 7 (28.0%) patients were 25–44 years old and 5 (20.0%) patients were 45–<60 years old. Association of Age versus group was not statistically significant (P=0.9195). Chi-square value: 0.3247; P=0.5688. Odds Ratio: 0.7222 (0.2355, 2.2150).

In Group-A, 13 (52.0%) patients were male and 12 (48.0%) patients were female. In Group-B, 15 (60.0%) patients were male and 10 (40.0%) patients were female. Association of sex versus group was not statistically significant (P=0.5688). Chi-square value: 1.2821; P=0.2575. Odds Ratio: 1.9091 (0.6203, 5.8759).

In Group-A, 14 (56.0%) patients had cholesteotoma and 11 (44.0%) patients had cholesteotoma and Granulations. In Group-B, 10 (40.0%) patients had cholesteotoma and 15 (60.0%) patients had cholesteotoma and granulations. Association of pre-operative finding versus group was not statistically significant (P=0.2575). Chi-square value: 1.0270; P=0.5984.

Table 1: Distribution of mean hearing gain (Db)

Group	Number	Mean	SD	Minimum	Maximum	Median	P-value
Hearing gain							
Group-A	25	12.5700	0.9856	10.5000	15.0000	12.5000	0.0002
Group-B	25	8.4200	5.0051	−8.5000	14.7500	9.2500	

In Group-A, 6 (24.0%) patients had >30–39 db and 19 (76.0%) patients had 40–50 db. In Group-B, 6 (24.0%) patients had >30–39 db, 18 (72.0%) patients had 40–50 db and 1 (4.0%) patients had ≥50 db. Association of pre-operative air-bone gap (ABG) (Table 2) versus group was not statistically significant (P=0.5984). Chi-square value: 1.2195; P=0.2694. Odds Ratio: 0.4318 (0.0948, 1.9661).

In Group-A, 3 (12.0%) patients had discharge. In Group-B, 6 (24.0%) patients had discharge.

Association of post-operative complications versus group was not statistically significant (P=0.2694).

Chi-square value: 5.3333; P=0.0209. Odds Ratio: 4.0303 (1.2008, 13.5267).

In Group-A, 14 (56.0%) patients had ≤30 db and11 (44.0%) patients had >30 db. In Group-B, 6 (24.0%) patients had ≤30 db and19 (76.0%) patients had >30 db. Association of post-operative ABG (Table 3) versus group was statistically significant (P=0.0209).

Table 2: Association between pre-operative A-B gap

	Group		
Pre op ABG	Group-A	Group-B	Total
>30–39 db	6	6	12
Row %	50.0	50.0	100.0
Col %	24.0	24.0	24.0
40–50 db	19	18	37
Row %	51.4	48.6	100.0
Col %	76.0	72.0	74.0
≥50 db	0	1	1
Row %	0.0	100.0	100.0
Col %	0.0	4.0	2.0
Total	25	25	50
Row %	50.0	50.0	100.0
Col %	100.0	100.0	100.0

Table 3: Association between Post op A-B Gap

	Group		
Post-operative ABG	Group-A	Group-B	Total
≤30 db	14	6	20
Row %	70.0	30.0	100.0
Col %	56.0	24.0	40.0
>30 db	11	19	30
Row %	36.7	63.3	100.0
Col %	44.0	76.0	60.0
Total	25	25	50
Row %	50.0	50.0	100.0
Col %	100.0	100.0	100.0

DISCUSSION

It was found that in Group-A, 13 (52.0%) patients were >5–24 years old, 6 (24.0%) patients were 25–44 years old, and 6 (24.0%) patients were 45–<60 years old. In Group-B, 13 (52.0%) patients were >5–24 years old, 7 (28.0%) patients were 25–44 years old, and 5 (20.0%) patients were 45–<60 years old. Association of age versus group was not statistically significant (P=0.9195). In Group-A, 13 (52.0%) patients were male and 12 (48.0%) patients were female. In Group-B, 15 (60.0%) patients were male and 10 (40.0%) patients were female. Association of Sex versus group was not statistically significant (P=0.5688).

Gupta and Kalsotra[10] found that maximum number of patients belonged to the age group of 10–20 years (34%), followed by 20–30 years (30%), whereas least number of cases was found in the age group of >50 years. Hearing loss and otorrhea were present in majority of the cases (100% and 72%, respectively). The average pre-operative air conduction (AC) in the present study was found to be 46.6 dB ranging from 20 dB to 112.5 dB, while the average post-operative AC was found to be 39 dB with an average gain of 7.6 dB. The four frequency average pre-operative and post-operative ABG were found to be 26.48 dB and 20.17 dB respectively, with the average gain of 6.3 dB. The average ABG closure within 0–30 dB was seen in 33 (82%) of the cases.

Khan et al.,[11] found that hearing impairment was compared in each patient before and after the operation. Among the 85 patients, 54 (63.5%) were males and 31 (36.5%) were females, with the age ranged between 18 and 63 years, mean age being 42.31±4.8 years. The mean increase in hearing loss after radical mastoidectomy in AC was 7.19 dB, bone conduction was 4.16 dB, and ABG was 3.75 dB (<0.001). The ear became dry and safe in 82 patients (96.5%) out of a total of 85, and only three patients required revision surgery at a second stage. Radical mastoidectomy has a least negligible effect on hearing status and one should not limit this technique due to the concern of aggravated hearing in patients with extensive cholesteatoma at the cost of dry and safe ears, which should be of prime importance.

Heywood and Narula[12] found that there has been fierce debate regarding the optimal surgical technique for the management of cholesteatoma for over 50 years. Choice of technique depends on factors relating to the surgeon, the patient and the disease process. Much literature has been devoted to the benefits and pitfalls of canal wall up and canal wall down techniques and their respective effects on measures such as number of operations required for disease eradication, adequate surgical access, complications, residual/recurrent cholesteatoma, hearing outcomes, and long-term follow-up.

Ho and Kveton[13] found that to demonstrate the efficacy of intact canal wall procedure coupled with a second-stage exploration for the treatment of cholesteatoma. Retrospective case study of patients with cholesteatomas treated with staged surgical extirpation. A minimum of 6 months' post-operative follow-up time was required for inclusion into the study. A total of 35 adult and pediatric patients, ranging from 9 to 65 years of age, who underwent two-stage procedures for removal of cholesteatomas. The presence or absence of cholesteatoma on second-stage look and the subsequent surgical treatment for recurrent cholesteatoma. The overall hearing results after the completion of the two-staged procedure were calculated. Disease was controlled in 26 (74%) of the patients. Residual and/or recurrent cholesteatomas were found in 9 (26%) of the patients during the second-stage operation. Of these patients, 5 (14% of the total group) ultimately required conversion to canal-wall-down procedure. Average hearing gain at the completion of the second-stage procedure was 9 dB. A planned two-stage procedure that uses the posterior tympanotomy approach for the control of cholesteatoma is an effective technique. This approach offers significant potential for hearing preservation and restoration.

Karamert et al.,[14] found that instead of a CWD surgery, a CWU surgery seems applicable in cases of cholesteatoma when the bone in the external auditory canal is not eroded by the disease.

We found that in Group-A, 14 (56.0%) patients had cholesteotoma and 11 (44.0%) patients had cholesteotoma and granulations. In Group-B, 10 (40.0%) patients had cholesteotoma and 15 (60.0%) patients had cholesteotoma and granulations. Association of pre-operative finding versus group was not statistically significant (P=0.2575). In Group-A, 6 (24.0%) patients had >30–39 db and 19 (76.0%) patients had 40–50 db.In Group-B, 6 (24.0%) patients had >30–39 db,18 (72.0%) patients had 40–50 db, and 1 (4.0%) patients had ≥50 db. Association of pre-operative ABG versus group was not statistically significant (P=0.5984).

Kim et al.,[15] found that the aim of this study was to compare the hearing outcomes between CWUM and CWDM. One hundred and seventy-one CSOM patients were enrolled in this retrospective study. The pre-operative ABG in both groups (CWUM and CWDM) were 28.4±15.6 dB and 31.8±14.5 dB, respectively (P=0.18). Both groups did not show any significant difference (10.9 dB vs. 13.5 dB, respectively) (P=0.21) for the post-operative ABG closure. The proportion of patients with an ABG <20 dB was 58.6% of the CWDM patients and 68.4% of the CWUM patients (P=0.25).

Azevedo et al.,[16] found that cholesteatoma treated with canal wall-down and canal wall-up tympanomastoidectomy. Disease eradication and post-operative auditory thresholds were assessed. Patient records from the otorhinolaryngology department of a tertiary hospital were assessed retrospectively. Patients who underwent canal wall-up tympanomastoidectomy had a higher rate of revision surgery, especially those with cholesteatoma. However, there were no statistically significant differences in post-operative hearing thresholds between the two techniques. The canal wall-down technique is superior to the canal wall-up technique, especially for patients with cholesteatoma.

Bhat et al.,[17] found that hearing gain was better in CWUM (18.36 dB) than CWDM surgeries. Hearing outcome was better in ICWM than CWDM in the study.

Lucidi et al.,[18] found that in the CWD group, significant improvements were observed in all CES subscale scores and total scores over time (P<0.001) whereas in the CWU Group their found a partial improvement. Inter-group comparison showed no significant differences in administration of CES in CWD versus CWU (P>0.05 for all subsections and overall scores). A significant difference was found only in the COMOT-15 "Hearing Function" subsection, in favor of CWU over CWD (61 vs. 39 respectively; P<0.05). A significant association was found between PTA and COMOT-15 "Hearing Function" subsection scores. According to the results, a significant difference in the post-operative QoL between CWD and CWU should not be taken for granted.

Verhoeff et al.,[19] found that cholesteatoma is an abnormal accumulation of squamous epithelium usually found in the middle ear cavity and mastoid process of the temporal bone. Granulation tissue and ear discharge are often associated with secondary infection of the desquamating epithelium. Cholesteatoma is most often detected by careful otoscopic examination in children or adults with persistent discharge that does not respond to treatment.

Lv et al.,[20] found that after a mean 6-month follow-up, the mean post-operative ABG decreased from 33.8±4.8 to 17.1±5.1 dB in 30 patients who underwent mastoidectomy with simultaneous tympanoplasty.

Kim et al.,[21] found that the traditional CWDM can prevent various complications of the classical CWDM technique using autologous tissues for mastoid cavity obliteration. It is also an appropriate method to obtain adequate volume for safe obliteration.

Bhat et al.,[17] found that outcomes of hearing gain in canal wall up versus CWDM surgeries. Hearing gain was better in CWUM (18.36 dB) than CWDM surgeries. Hearing outcome was better in ICWM than CWDM in the study.

Wood et al.,[22] found that the average short-term ABG was 26±11 dB HL; 26% achieved an ABG <20 dB, and 58% achieved an ABG <30 dB. Fifteen had follow-up at least 1 year postoperatively (mean=33±16 months). At longer-term follow-up, mean ABG was 25±10 dB HL; 33% achieved an ABG <20 dB, while 66% achieved an ABG <30 dB. Hearing remained stable over time (P=0.52). At date of last clinical follow-up, only 1 (5%) patient had undergone revision for recurrent disease. In some patients undergoing CWDM for advanced or recurrent cholesteatoma, Type 3 tympanoplasty with stapes columella grafting yields marginal hearing benefit.

Our study showed that in Group-A, the mean hearing gain (mean±SD) of patients was 12.5700±0.9856. In Group-B, the mean hearing gain (mean±SD) of patients was 8.4200±5.0051. Difference of mean hearing gain with both groups was statistically significant (P=0.0002).

It was found that in Group-A, 3 (12.0%) patients were discharge. In Group-B, 6 (24.0%) patients were discharge. Association of post-operative complications versus group was not statistically significant (P=0.2694).In Group-A, 14 (56.0%) patients had ≤30 db and 6 (24.0%) patients had >30 db. In Group-B, 11 (44.0%) patients had ≤30 db and 19 (76.0%) patients had >30 db. Association of post-operative ABG versus group was statistically significant (P=0.0209).

Limitations of the study

Study was done in a single centre and also the sample size was small. Long term follow up is also essential to come to a final conclusion.

CONCLUSION

We found that hearing gain was more with canal wall up compared to CWDM in CSOM which was statistically significant. It was found that cholesteotoma and granulations were more with canal wall down compared to CWUM in CSOM. We found that post-operative complications were more with canal wall down compared to CWUM in CSOM though it was not statistically significant. In our study, post-operative ABG ≤30 db was more with canal wall up compared to CWDM in CSOM which was statistically significant.

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MS- Concept, Design of the study, revision of manuscript, and coordination; **GCG**- Concept, coordination, statistical analysis and interpretation, preparation of manuscript, and revision of the manuscript; **RR**- Interpreted results, reviewed the literature, and manuscript preparation.

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