



Research Article

INCIDENCE AND FACTORS CAUSING CAVITY PROBLEMS IN CANAL WALL DOWN MASTOIDECTOMY POST-OPERATIVE PATIENTS

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ABSTRACT

Introduction: A Canal Wall down Mastoidectomy is an effective technique for eradication of advanced Chronic otitis media or Cholesteatoma. Thus, we aimed to find out the incidence and factors causing cavity problems after Canal wall down mastoidectomy.

Material Methods: A total of 46 patients who had undergone Modified Radical Mastoidectomy or Radical mastoidectomy were included for analysis. Detailed history of patients was taken including details of previous mastoid operation and their complaints related to mastoid cavity. Mean Air Bone Gap (ABG) was calculated pre-operatively and 6 months postoperatively. Patients presenting problems related to the mastoid cavity were clinically examined and the findings were confirmed. Statistical analyses was performed and level of significance was set at $p < 0.05$.

Results: Persistent otorrhoea was the commonest symptom. The most common cause for cavity problems was residual tympanic membrane perforation with exposed middle ear mucosa followed by High Facial ridge. No role for systemic antibiotics in patients with cavity problems with underlying granulations was found. Granulations were commonly seen in Mastoid cavity followed by area of Sinodural angle.

Conclusion: A thorough and meticulous surgical approach to canal wall down mastoidectomy gave high percentage of dry ear and better hearing outcomes.

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INTRODUCTION

Chronic suppurative otitis media (CSOM) is a commonly encountered disease entity requiring prompt and effective treatment. It may occur with or without a cholesteatoma, a progressive disease that erodes bone and if left untreated leads to complication. The curative surgeries for treating CSOM with cholesteatoma and chronic otomastoiditis are aimed at eradicating the disease and creating anatomic conditions to prevent recurrence (Kos *et al*, 2004). This primary aim should not be compromised for maintenance or improvement of hearing. Thus surgeon has to carefully chose between two surgical techniques i.e. canal wall-up and the canal wall- down mastoidectomies (Asma *et al*, 2013). The debate concerning the techniques by which cholesteatoma can be successfully removed continues after many years of discussion and research. Supporters of canal wall up surgery contend that following successful removal of cholesteatoma, the ear remains relatively unchanged anatomically and that no further regular maintenance is required to maintain a dry, self-cleaning ear. The Canal wall up technique does, however, normally necessitate a second look operation to ensure that there is no residual disease within the middle ear or mastoid cavity.

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One of the arguments in favour of canal wall down technique is that a canal wall down procedure will leave a mastoid cavity that should, after initial healing, require minimal intervention. It has the advantage of being readily accessible for inspection for recurrence of disease and thus a second scheduled operation is not necessary (Thiel *et al*, 2014). The potential disadvantage includes problems related to the mastoid cavity that needs regular clinical visits for aural toilet and prescription of topical and systemic medications. The cost of these visits and prescriptions can be a significant financial burden with unfortunate adverse socioeconomic consequences (Mokbel *et al*, 2012)

The so called problem cavity is likely to exhibit a small meatus behind which can be found a high facial ridge, partially removed posterior and superior canal walls, a partially removed lateral attic wall, large cavity, a deep tip mastoid cavity, no tympanic membrane or a tympanic membrane perforation, chronically diseased mucosa, inadequate removal of air cells that do not open into the middle ear, especially cells of the sinodural angle, mastoid tip and failure to exteriorize all choesteatoma (Jackson *et al*, 1985). The cavity problems experienced by the patient include discharge, deafness, debris, dizziness, decay, disfigurement, discomfort, distress, dependency on the otologist for cleaning and desperation to be rid of the problem (Black *et al*, 1998).

Various techniques have been used to minimize these potential problems including complete removal of the disease, wide saucerization, elimination of the irregularity within the mastoid cavity, and lowering the facial ridge. Obliteration of the mastoid cavity and meatoplasty are additionally important procedures performed at the end of the mastoidectomy to minimize the potential problems by decreasing the size of the mastoid cavity, and providing ventilation and easy access for postoperative cleaning the mastoid cavity, respectively (Kim *et al.*,2012).

This study was aimed to find out the incidence and various factors causing mastoid cavity problems of patients who have undergone modified radical or radical mastoidectomy as their primary procedure and is also compared with the incidence rate in other hospital centres.

MATERIAL AND METHODS

This is a Prospective Observational hospital based study conducted in department of E.N.T of Dr.B.R.A.M. Hospital ,Raipur between March 2017 to September 2018. Study was approved by institutional ethical committee of Pt. J. N. M. Medical College Raipur. Patients of all age groups and either sex who underwent canal wall down mastoidectomy for Chronic Otitis media Atticoantral disease and presented on postoperative follow up were included in the study. Patients with CSOM AAD with intracranial complications who underwent canal wall down mastoidectomy, patients with Diabetes mellitus who underwent canal wall down mastoidectomy, Patients with Tuberculosis who underwent canal wall down mastoidectomy, patients who underwent Revision Canal wall down mastoidectomy were excluded from the study. Forty six Subjects were recruited based on inclusion and exclusion criteria and postoperative complaints of the patients who have undergone modified radical mastoidectomy or radical mastoidectomy as primary procedure were noted. Detailed history of patients were taken including details of previous mastoid operation and their complaints related to mastoid cavity. Blood - Hemoglobin%, total leukocyte count, Differential leukocyte count, Erythrocyte sedimentation rate. Urine routine, Pus for culture and sensitivity, Xray mastoid schuller’s view, Pure tone audiometry were performed. Mean Air Bone Gap (ABG) was calculated at 500 Hz, 1 kHz and 2 kHz pre-operatively and also at 6 months postoperatively. Patients were followed up every month for 6 months. Patients presenting with problems related to the mastoid cavity after modified and radical mastoidectomy as their primary procedure were clinically examined and also by using otoscope. The findings were confirmed with the help of microscope and endoscope. Following the above procedures the findings were noted in the proforma.

Statistical analyses was performed using SPSS for windows version 22.0. Descriptive analysis of all the explanatory and outcome parameters will be done using mean and standard deviation for quantitative variables, frequency and proportions for categorical variables. Data comparison was done by applying specific statistical tests to find out the statistical significance of the obtained results. Depending upon the nature of the data, the statistical tests were chosen. The level of significance was set at p<0.05.

OBSERVATIONS AND RESULT

The general characteristics of study subjects were noted. Majority of patients were in between 11 and 30 years of age. Of the 46 patients available for study there were 28 (60.9%) male and 18 (39.1%) female patients. The duration of otorrhoea in our patients varied from less than a year to even extending upto 15 years. Majority of the patients complained of persistent otorrhoea for 5 years (Table 1).

Table 1 General characteristics of study subjects

Characteristics	No. of subjects	Percentage
Age	< 10 yrs	3 6.5%
	11 - 30 yrs	29 63.0%
	31 - 60 yrs	13 28.3%
	61 - 80 yrs	1 2.2%
Gender	Males	28 60.09%
	Females	18 39.1%
Duration of ear discharge Left ear	< 1 yr	0 0.0%
	1 - 5 yrs	14 58.3%
	6 - 10 yrs	7 29.2%
	11 - 15yrs	3 12.5%
Duration of ear discharge Right ear	< 1 yr	0 0.0%
	1 - 5 yrs	2 33.3%
	6 - 10 yrs	3 50.0%
	11 - 15yrs	1 16.7%

Microscopic features in ear examination were studied. All the subjects showed persistent otorrhoea followed by polyp in 8(17.4%) subjects and granulations in 2 (4.3%) subjects. The most common type of perforation that was observed was the attic perforation (52.2%) followed by central perforation (17.4%) and marginal perforation (4.3%). About 28% of study population developed postero-superior retraction pocket. Cholesteatoma was the most common finding in the middle ear in 47.8% patients; followed by polyps (17.4%) and granulations (4.3%) (Table 2).

Table 2 Microscopic features in ear examination

Characteristics	No. of subjects	Percentage
External Auditory Canal	Discharge	46 100%
	Polyp	8 17.4%
	Granulations	2 4.3%
Tympanic Membrane	Central Perforation	8 17.4%
	Attic Perforation	24 52.2%
	Marginal Perforation	2 4.3%
	Post. Sup. Retr. Pocket	13 28.3%
Middle Ear	Cholesteatoma	22 47.8%
	Polyp	8 17.4%
	Granulations	2 4.3%

Extent of cholesteatoma in patients was studied. It was found that the most commonly affected sites were epitympanum (97.8%) and antrum (95.7%). While, hypotympanum (2.2%), Sinodural angle (4.3%) and sinus tympani (10.9%) were the least affected (Table 3). Ossicular Chain Status in patients suggested that the ossicular chain was eroded in 93.1% of the cases. The incus was eroded or absent in 91.4%, malleus in 71.8% and the stapes eroded or absent in 30.4% (Table 4).

Table 3 Extent of cholesteatoma in patient

Extent	N	Percentage
Epitympanum	45	97.8%
Mesotympanum	15	32.6%
Hypotympanum	1	2.2%
Antrum	44	95.7%
Sinodural angle	2	4.3%
Mastoid tip	1	2.2%
Sinus tympani	5	10.9%

Table 4 Ossicular Chain Status in patients

Ossicles	Category	No. of subjects	Percentage
Malleus	Eroded	13	28.3%
	Absent	20	43.5%
Incus	Eroded	21	45.7%
	Absent	21	45.7%
Stapes	Eroded	7	15.2%
	Absent	7	15.2%

Table 5 shows procedures done in patients. In our study 80.4% underwent modified radical mastoidectomy with tympanoplasty followed by radical mastoidectomy (19.5%). Out of 46 patients who underwent CWDM, mastoid obliteration was done in 4.3% of patients.

Table 5 Procedures done in patients

Procedures	N	%
Radical Mastoidectomy	9	19.5%
MRM with Tympanoplasty	37	80.4%
MRM without Tympanoplasty	0	0
CWDM with Mastoid Obliteration	2	4.3%
CWDM without Mastoid Obliteration	44	95.6%

In the first month of follow up, 8 patients (17.4%) presented with otorrhoea which subsequently improved with time. At the 6th month follow up, incidence of otorrhoea significantly reduced to 8.7%. At 1 month of follow up, none of the study participants developed debris. 2nd to 4th month of follow up however showed increase in debris accumulation in patients (8 patients) (Figure 1).

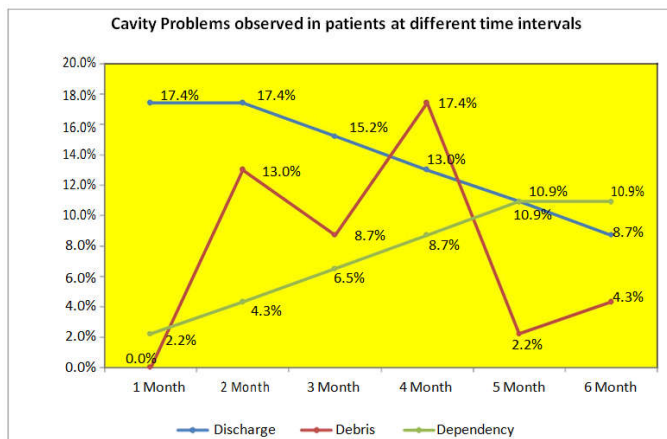


Figure 1 Cavity problems observed in patients at different time interval

In our study we recorded an incidence of residual tympanic membrane perforation of 10.9 % which developed 6 months after surgery. 4 patients had granulations. Out of 8 patients with discharging cavity 5 patients (10.9%) had high facial ridge. Inadequate meatoplasty was found in 2.2% of patients (Table 6).

Comparison of mean air bone gap between preoperative and 6 months postoperative time periods was assessed using Wilcoxon signed rank test. Significant difference was noted between pre-operative and post-operative time periods ($p < 0.001$) (Table 7). Table 8 shows distribution of patients according to postop ABG of 10 dB interval. It was found that 52% of the subjects had postoperative ABG less than 30dB.

Table 9 indicated distribution of microorganism according to culture sensitivity report. *Staph. aureus* (8.7%) was the commonest organism to be found. This was followed by *P.*

aeruginosa (4.3%). *Proteus mirabilis* (2.2%) and other mixed flora comprising 2.2% of the total.

Table 6 Causes of cavity problems observed at different time intervals.

Variables	Category	1 Month	2 Months	3 Months	4 Months	5 Months	6 Months
Residual perforation	Present	4 (8.7%)	5 (10.9%)	5 (10.9%)	4 (8.7%)	5 (10.9%)	5 (10.9%)
	Mastoid bowl	3 (6.50%)	3 (6.50%)	3 (6.50%)	3 (6.50%)	3 (6.50%)	3 (6.50%)
Granulation	SD angle	1 (2.20%)	1 (2.20%)	1 (2.20%)	1 (2.20%)	1 (2.20%)	1 (2.20%)
		46 (100.0%)	46 (100.0%)	46 (100.0%)	46 (100.0%)	46 (100.0%)	46 (100.0%)
Cholesteatoma	Absent	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
High facial ridge	Present	5 (10.9%)	5 (10.9%)	5 (10.9%)	5 (10.9%)	5 (10.9%)	5 (10.9%)
		45 (97.8%)	45 (97.8%)	45 (97.8%)	45 (97.8%)	45 (97.8%)	45 (97.8%)
Meatoplasty	Adequate	46 (100.0%)	46 (100.0%)	46 (100.0%)	46 (100.0%)	46 (100.0%)	46 (100.0%)
Cavity size	Adequate	46 (100.0%)	46 (100.0%)	46 (100.0%)	46 (100.0%)	46 (100.0%)	46 (100.0%)

Table 7 Comparison of mean air bone gap between preoperative and 6 months postoperative time periods.

Time	N	Mean	SD	Mean difference	Z	P value
Pre-Op	46	38.02	9.87		-	
6M Post-Op	46	34.28	11.84	3.74	3.621	<0.001*

Table 8 Distribution of patients according to postop ABG of 10 dB interval

Post-op ABG	Number of Patients	Percentage
0-10	0	0%
11-20	4	8.6%
21-30	20	43.4%
>30	22	47.8%

Table 9 Microorganisms found in culture sensitivity report

Microorganisms	N	%
<i>P. aeruginosa</i>	2	4.3
<i>Staph. aureus</i>	4	8.7
<i>Proteus mirabilis</i>	1	2.2
Mixed Flora	1	2.2

DISCUSSION

Chronic suppurative otitis media is commonly encountered in our everyday ENT practice. Poor living conditions, overcrowding, poor hygiene and nutrition have been suggested as the basis for the widespread prevalence of Chronic suppurative otitis media in developing countries. Canal wall down mastoidectomy is considered as gold standard and ideal treatment for cholesteatoma (Domhoffer, 2000; Hirsch *et al*, 1992). The chief advantage of canal wall down surgery is the creation of a mastoid cavity that allows disease eradication at the time of surgery and superior visualisation in the postoperative period. This facilitates control for recurrence of cholesteatoma and infection and offers the possibility of outpatient treatment.

The age of patients varied from 6 to 80 years. In our study majority of patients were in between 11 and 30 years of age. The youngest was 6 years old and eldest was 80 years of age. Mean age of study subjects was 26. The sex distribution showed a male preponderance with 61% males and 39% females. It is comparable with the study conducted by Payal *et al* in which 133 patients who had undergone MRM, 78 were males and 55 were females (Mukherjee *et al*, 2004).

The majority of patients had eroded or absent incus followed by eroded or absent malleus. Similar result was observed in Asma *et al* in which the most common ossicle eroded or absent was incus(87%) followed by malleus(54%) and stapes(41%) (Asma *et al*, 2013). Austin reported the most common ossicular defect to be the erosion of incus with intact malleus and stapes in 29.5% of cases (Austin, 1971). Mohammadi *et al* reported incus 86.1%, stapes 66.9% and malleus 43.9% (Mohammadi *et al*, 2012). This propensity for ossicular destruction is much greater in cases of unsafe CSOM (Atticoantral), due to the presence of cholesteatoma and/or granulations.

Patients were regularly followed postoperatively every month till 6 months duration and were examined for the presence of otorrhoea, debris, dizziness, dependency and deafness. Otorrhoea was the most common symptom in first month which gradually reduced up to 6months (8.7%). Open cavity surgery heals slowly often require 3 to 6 months for full epithelisation (Roland and Meyernhoff, 1999). This is one reason that majority of cavity problems in our study presented during the initial postoperative period. Ninety one percent of our patients had dry ears postoperatively at the 6th month follow up which is slightly lower than the study published by Payal *et al*. They reported 95% dry ears postoperatively (Mukherjee *et al*, 2004). In a study conducted by Royal college of surgeons of England, there was a 17% rate of statistically significant wet ears with open cavity techniques (Harkness *et al*, 1995).

We found different causes for discharging cavity in all 8 patients in our study. The incidence of Tympanic membrane perforation after primary modified radical mastoidectomy reported in the literature is 5 to 7% (Kos *et al*, 2004; Khan *et al*, 2014). We recorded an incidence of 10.9% in this study, which developed 6 months after surgery. The rate of successful repair of a tympanic membrane perforation is about 90 to 95%. The chance of a successful repair is improved if the ear is dry and uninfected.

Another significant factor contributing to the development of wet cavity found in our study was high facial ridge. In our study out of 8 patients with discharging cavity 5 patients (62.5%) had high facial ridge. Bercin *et al* and Kasenomm *et al* reported an incidence of 66.7% and 98% respectively of high facial ridge leading to discharging mastoid cavity in their study (Bercin *et al*, 2009; Kasenomm, 2013). The presence of granulation post Canal wall down mastoidectomy indicates inadequate healing. In our study 3 patients had granulations in the mastoid cavity and 1 patient had granulation in the sinodural angle over the follow up period of 6 months. Postoperative stenosis of the meatus is always a consequence of excessive granulations, which are frequently related to infection and fibrosis. Principles of management include control of infection and suppression of granulation tissue (Roland *et al*, 1999; Vincent *et al*, 1995).

An overall statistically significant improvement in hearing (P less than 0.001) was obtained, with the mean pure-tone average air-bone gap decreasing from 38.02 dB to 34.28 dB. Fifty two percent of our patients who had underwent canal wall down mastoidectomy had a postoperative ABG less than 30 dB which is comparable with the hearing results of the previous series conducted by Payal *et al*. (Mukherjee *et al*, 2004). Vartiainen *et al* reported that after long-term

follow-up, hearing level improved significantly (more than or equal to 10 dB) in one third of the patients, it remained unchanged in one third and deteriorated in the remaining one third (Vartiainen *et al*, 2000). Wetmore *et al* found in a series of 161 patients with cholesteatoma, the pure tone average remained unchanged after surgery (Wetmore *et al*, 1987). In our study we found that overall Canal wall down mastoidectomy did not worsen the hearing status.

In our series, Staphylococcus aureus was the commonest organism found, followed by Pseudomonas and Proteus. The patients were given antibiotics according to culture and sensitivity report for 7 days but otorrhoea persisted. Results of antibiotic therapy are similar to the study conducted by Brandow *et al* (Brandow, 1974). Thus, it is clear that there is not much role of antibiotics either in local or systemic form in achieving a dry cavity in the presence of other contributing factors such as cholesteatoma or granulations where surgery is the mainstay of treating such patients. A dry and self-cleaning cavity was obtained in 91% of the cases. The preoperative hearing levels were improved in 52% of the cases. These results are comparable to that recorded by other authors. To that extent the results that were obtained with canal wall down procedure appear satisfactory. Well performed canal wall down mastoid surgery gives comparable results to canal wall up mastoidectomy as regards the incidence of postoperative discharge and hearing results. This study supports this statement because the incidence of a postoperative discharging mastoid cavity appears to be directly related to the technical expertise of the surgeon.

In view of the presence of these cavity problems, post CWD mastoidectomy as primary procedure, we reemphasize the need for meticulous surgery in every patients, as in majority of cases, multiple factors were involved leading to discharging cavity. For further studies in this area, we suggest increased number of follow-up visits before the cavity becomes dry and self cleaning.

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