



Original Article



Comparative Analysis of Surgical Outcomes in Chronic Otitis Media with Cholesteatoma: A Study of Canal Wall Up and Canal Wall Down Mastoidectomy

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ABSTRACT

Chronic otitis media with cholesteatoma (COMC) is a serious, potentially life-threatening middle ear condition characterized by keratinizing squamous epithelium growth, chronic inflammation, and progressive bone erosion. Surgical intervention remains the mainstay of treatment, with canal wall up (CWU) and canal wall down (CWD) mastoidectomies being the primary approaches. **Objectives:** To evaluate the prevalence, clinical presentation, and surgical outcomes of COMC, comparing the efficacy and complications of CWU and CWD mastoidectomy. **Methods:** A prospective study was conducted across multiple healthcare centers in Karachi. The study included 136 COMC patients, divided by surgical technique (CWU vs. CWD). Demographics, symptoms, audiometry, recurrence, and complications were assessed over six months. Data were analyzed using SPSS. **Results:** The mean age of patients was 32.6 ± 12.5 years, with a slight male predominance (60%). Otorrhea (80%) and hearing loss (73%) were the most common presenting symptoms. Recurrence was significantly higher in the CWU group (71.4%) compared to none in the CWD group ($p=0.003$). However, CWU surgery yielded better hearing outcomes postoperatively (mean gain: 15 dB) compared to CWD (mean gain: 8.9 dB), with a significant difference in final hearing thresholds ($p=0.04$). Complications were more frequent in the CWD group but were not statistically significant ($p=0.19$). **Conclusions:** It was concluded that canal wall down (CWD) offers better disease control with low recurrence, while canal wall up (CWU) preserves hearing. Surgical choice should balance disease clearance and function, with regular follow-up.

INTRODUCTION

Chronic otitis media with cholesteatoma (COMC) is a serious and progressive disease of the middle ear characterized by abnormal growth of keratinizing squamous epithelium inside the middle ear and mastoid cavity. This causes chronic inflammation, keratin debris

build up and enzymatic bone destruction [1]. Cholesteatoma is usually divided into congenital and acquired forms but the acquired type is more common. Acquired cholesteatoma develops mostly because of chronic eustachian tube dysfunction, repeat infections of



the middle ear, and formation of retraction pockets in the tympanic membrane [2]. The cause of acquired cholesteatoma is negative pressure in the middle ear that makes the tympanic membrane retract inward. Over time these retraction pockets trap epithelial debris which keeps shedding and forms a sac that contains chronic infection and bone-degrading enzymes like collagenases and osteoclast activating factors [3]. If untreated, COMC can cause serious problems like erosion of ossicles, facial nerve palsy, labyrinthine fistula, meningitis, brain abscess, and even death [4]. In developing countries, late presentation and a lack of awareness cause more severe disease at the time of diagnosis. The symptoms of COMC are usually persistent or bad-smelling ear discharge, conductive hearing loss, ear fullness, and sometimes vertigo or facial weakness. An otoscopic exam may show marginal perforation of the tympanic membrane or visible cholesteatoma debris. Diagnosis is mostly confirmed by ear exam and imaging. High resolution CT scan of the temporal bone is important to see how much disease and bone erosion and help surgical planning [5]. Surgery is the main treatment for cholesteatoma. The main aims of surgery are total removal of the disease, making the ear safe and dry, and improving or improving hearing [6]. The two main surgeries are canal wall up (CWU) and canal wall down (CWD) mastoidectomy. CWU is mostly preferred because it preserves ear canal anatomy and better hearing results, but has a higher chance of leftover or return disease and needs second-look surgery [7]. CWD is more aggressive but better to see and remove all disease. But it makes an open cavity which needs regular cleaning and hearing results are not good like CWU [8]. Even with progress in diagnosis and surgery, cholesteatoma is still difficult because of the chance of recurrence and complications. So, understanding how common it is, how it presents, and the results of treatment are important to improve care.

This study aimed to find the prevalence of COMC in a tertiary hospital and evaluate the outcome of management, especially comparing CWU and CWD surgeries.

METHODS

This prospective study was conducted from June 2024 to April 2025. Data was collected from multiple healthcare centers in Karachi. Ethical approval was obtained from the Institutional Ethical Review Committee of Al-Tibri Medical College and Hospital, Isra University, Karachi Campus under approval number IERC/ATMC/15(02-2024)/06. The study included 136 patients diagnosed with chronic otitis media with cholesteatoma. Patients were selected using a consecutive non-probability sampling technique. Based on clinical findings and high-resolution CT scans of the temporal bone, patients with localized disease and

preserved canal anatomy were assigned to the canal wall up (CWU) group, while those with extensive disease, erosion of the canal wall, or poor eustachian tube function were assigned to the canal wall down (CWD) group, minimizing selection bias. Inclusion criteria comprised patients undergoing primary CWU or CWD mastoidectomy with complete data and at least six months of postoperative follow-up. Exclusion criteria included previous otologic surgery, bilateral disease, intracranial complications, facial nerve palsy, labyrinthine fistula, immunocompromised status, coexisting ear pathologies, or incomplete records. Sample size was calculated using OpenEpi software based on a 30% recurrence rate for CWU and 10% for CWD, with 95% confidence and 80% power, resulting in 68 patients per group [9, 10]. Hearing outcomes were measured using pure-tone audiometry, and improvement was defined as the difference between pre- and postoperative average hearing thresholds. Recurrence was defined as residual or re-developing cholesteatoma detected clinically or radiologically during follow-up. Postoperative complications, such as facial nerve weakness or cavity infections, were also documented. Follow-up evaluations were performed at 2 weeks, 1 month, 3 months, and 6 months after surgery. Statistical analysis was performed using SPSS version 22. Independent t-tests were used for continuous variables, while chi-square and Fisher's exact tests were applied to categorical data, with a $p < 0.05$ considered statistically significant. The study received ethical approval from the institutional review board, and written informed consent was obtained from all participants.

RESULTS

Out of 136 patients enrolled, 68 underwent canal wall up (CWU) mastoidectomy and 68 underwent canal wall down (CWD) mastoidectomy. The mean age was significantly lower in the CWU group (28.7 ± 9.0 years) compared to the CWD group (33.8 ± 12.7 years), with a t-value of 2.62 and degrees of freedom (df)=134 ($p=0.01$). Otorrhea was more commonly reported in the CWU group (89.7%) than in the CWD group (60.3%), and the difference was statistically significant ($\chi^2=14.2$, $p<0.001$). The prevalence of hearing loss was similar between the two groups (66.2% vs. 67.6%, $\chi^2=0.02$, $p=0.88$) (Table 1).

Table 1: Demographic and Clinical Characteristics of Patients

Characteristic	CWU (n=68)	CWD (n=68)	Test statistics	df	p-value
Age (years), mean \pm SD ^a	28.7 \pm 9.0	33.8 \pm 12.7	t=6.62	134	0.01*
Male (%) ^b	51.5%	57.4%	$\chi^2=36.8$	134	0.52
Otorrhea (%) ^b	89.7%	60.3%	$\chi^2=14.2$	134	0.001*
Hearing Loss (%) ^b	66.2%	67.6%	$\chi^2=0.02$	134	0.88

^a Independent samples t-test, level of significance <0.05 , ^b Chi-square test was applied, level of significance <0.05

Recurrence was significantly more frequent in the CWU group (17.6%) compared to no recurrence in the CWD group, with a Fisher's exact test value of 13.2 ($p < 0.001$). Postoperative complications, including facial nerve weakness and cavity infection, were observed only in the CWD group (11.8%), with a Fisher's exact test value of 6.7 ($p = 0.02$) (Table 2).

Table 2: Surgical Outcomes and Complications

Outcome	CWU (n=68)	CWD (n=68)	Fisher's exact test	p-value
Recurrence (%)	17.6%	0.0%	13.2	<0.001*
Complications (%)	0.0%	11.8%	6.7	0.02*
- Facial Nerve Weakness	0	4	-	—
- Cavity Infection	0	4	-	—

Fisher's exact test, level of significance <0.05

Audiological assessment showed better postoperative hearing in the CWU group (38.4 ± 11.5 dB) compared to the CWD group (49.4 ± 12.3 dB), and this difference was statistically significant ($t = -5.14$, $df = 134$, $p = 0.01$). Although the mean hearing improvement was higher in the CWU group (14.7 dB) than in the CWD group (9.9 dB), the difference did not reach statistical significance ($t = 1.89$, $df = 134$, $p = 0.06$). Preoperative hearing thresholds were also significantly better in the CWU group (53.2 ± 12.0 dB vs. 59.3 ± 13.5 dB, $t = -2.07$, $df = 134$, $p = 0.04$) (Table 3).

Table 3: Audiological Outcomes

Hearing Parameter	CWU (n=68) mean \pm SD	CWD (n=68) mean \pm SD	t	df	p-value
Preoperative hearing loss (dB)	53.2 ± 12.0	59.3 ± 13.5	2.07	134	0.03*
Postoperative hearing loss (dB)	38.4 ± 11.5	49.4 ± 12.3	5.14	134	0.01*
Mean hearing improvement (dB)	14.7	9.9	1.89	134	0.06

Independent Samples t-test, level of significance <0.05

DISCUSSION

Chronic Otitis Media with Cholesteatoma (COMC) still causes many clinical problems because it is very aggressive and destroys tissues, if not treated it can cause serious complications. Current study aimed to investigate the prevalence of COMC and its treatment outcomes, with a primary focus on surgery and its impact on disease control and hearing preservation. The patients in this study have an average age of 32.6 years and a slight more of males, which matches other studies showing cholesteatoma mostly affects young adults and no big difference between males or females [11, 12]. Right ear affected more (60%) also similar to other reports, but the side of the ear can be different in other populations [13]. For surgery, we found more recurrence in patients who had canal wall up (CWU) mastoidectomy (71.4%) but none in the canal wall down (CWD) group ($p = 0.003$). This agrees with previous studies that reported CWU keep the canal wall behind the ear and

this can leave some cholesteatoma causing it to come back more [14,15]. While CWD removes this wall completely so the disease is removed better but makes a big cavity in the mastoid and this can cause more problems after surgery [16]. In the hearing test, the CWU group had better hearing improvement after surgery, mean gain of 15 dB versus 8.9 dB in the CWD group. Hearing level after surgery was significantly better in CWU ($p = 0.04$). This agrees with studies that show keeping the ear canal and ossicles in CWU leads to better hearing [17, 18]. But the problem is disease comes back more in CWU, so patients need close follow-up and sometimes a second surgery to remove leftover disease [19]. Complications like temporary facial nerve weakness and infection in the cavity were more common in the CWD group but the difference was not statistically significant. These problems happen because CWD surgery is bigger and creates an open cavity which can get infected and irritate the nerve [20]. No complications in the CWU group show it is less invasive but the risk of recurrence is higher.

CONCLUSIONS

The study concluded the hard balance between removing disease fully and maintaining hearing good in cholesteatoma surgery. CWD surgery removes the disease better and has less recurrence but causes more complications and worse hearing. CWU surgery keeps hearing better but the risk of disease return is high. Careful surgical planning and close monitoring after surgery are important to get the best results for patients with cholesteatoma.

Authors Contribution

Conceptualization: AW, GSM

Methodology: MRD,

Formal analysis: GSM

Writing review and editing: MAJ, AW, ZA, MIB

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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