ISSN 2515-8260 Volume 10, Issue 04, 2023

Original Article

A Clinical Study on the Effect of Pre-operative Mastoid Ventilation tube in Tympanoplasty

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Running Title: Pre-operative Mastoid Ventilation tube in Tympanoplasty

Abstract

Background: One of the most frequent otolaryngological diseases is chronic otitis media (COM). Pathophysiological processes like bacterial infection and biofilm are carried by COM. It has been established that cholesteatoma, chronic otitis media with effusion, and atelectatic ear diseases are all associated with a reduction in the mastoid air cells.

Aims and Objectives: This research aimed to examine the connection between the volume of the mastoid air cells and the efficacy of the graft after tympanoplasty.

Material and Methods: Retrospective analysis of patients having type I tympanoplasty and antrostomy was done in this research. Of the 52 patients who fulfilled the criteria of the research, 32 (61.54%) were male and 20 (38.46%) were female, with a mean age of 28.96±SD (range 12-58) included in the study. At the first, sixth, and twelfth months, the patients were asked for a control visit during which otoscopic exams and audiometric tests were carried out. To determine

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the mastoid air cell volume, the temporal bone computed tomography pictures were viewed with a 4800 Dpi optic resolution scanner and transmitted to the computer system in JPG format.

Results: Although the well-ventilated group's graft success was found to be superior, no substantial difference between the groups' graft success at the first, sixth, and twelfth months ($P > 0.05$) could be detected. In terms of the preoperative and postoperative hearing improvements, there was no statistically significant variation between the three groups ($P > 0.05$).

Conclusion: In conclusion, no statistically significant relationship could be found between the preoperative mastoid cell ventilation and the postoperative graft success in patients who had undergone only antrostomy together with tympanoplasty as chronic otitis surgery.

Keywords: Chronic otitis media, Mastoid Ventilation tube, Tympanoplasty.

Introduction

Chronic otitis media (COM) is a common problem. Genetic and environmental factors affect the progression of otitis media to chronicity [1]. Cholesteatoma, chronic otitis media with effusion, and atelectatic ear disorders have all been linked to a reduction in mastoid air cells [2, 3]. It has not yet been established whether otitis media is caused by or a consequence of inadequately formed mastoid cells. It hasn't been adequately discussed, and there hasn't been much research on it, whether mastoid air cell ventilation (MACV) impacts the results of tympanoplasty. The effect of preoperative mastoid ventilation (MV) on tympanoplasty results is controversial.

This research looked into the connection between mastoid air cell volumes and graft effectiveness following tympanoplasty. Investigations were also conducted into the associations between preoperative mastoid air cell ventilation and the measured hearing benefits, air-bone gaps, and ventilation levels according to patient gender and age.

Material and Methods

Place of study

Department of otorhinolaryngology, Government Medical College and Government General Hospital, Mahabubabad, Telangana, India.

Period of study

February 2022 to January 2023

Study design

Ours is a Comparative Study

Study procedure

The research included patients who had been identified with chronic otitis media, had surgery scheduled for them and had had temporal bone computed tomographies. The research included patients who had undergone type I tympanoplasty, antrostomy, audiometry, otoscopy, microscopy, and computed tomography studies. The research omitted patients whose follow-up results were lacking, revision cases, and those whose intraoperative diagnosis of cholesteatoma was confirmed. The same physician performed type 1 tympanoplasty procedures on patients, and the same operative method was applied. Following a postauricular excision, only an antrostomy was carried out (as pathology was not detected in the other cells). The research only included

patients with complete, mobile ossicles. The research omitted patients who were discovered to have experienced problems like bleeding and infection. Temporal muscle fascia was used as a graft in all the patients. On the control visits, otoscopy examinations and audiometry tests were performed and the results were recorded. Of the 52 patients who met the criteria of the study, 32 (61.54%) were male and 20 (38.46%) were female, with a mean age of 28.96 ± SD (range 12–58).

A Hitachi-Pronto helical scanner was used to conduct temporal bone computed tomographies. The orbitomeatal line ran parallel to the 2mm-thick CT slices. To determine the mastoid bone volume using the Cavalieri method, the temporal bone computed tomography pictures were scanned using a 4800Dpi optic density scanning and transmitted to the computer system in JPG format. Calculations were made regarding the mastoid volumes of CT pictures that had been uploaded to a computer system. On a CT scan, the skeletal portion of the mastoid was not taken into account when calculating the air cell area in the mastoid bone on the treated side. The capacity of the air cells was calculated without taking into account soft tissue regions with active inflammation. According to the MACV found on the temporal bone CT did before surgery, the patients were divided into three groups: those with poor ventilation, those with middling ventilation, and those with good ventilation.

Statistical analysis:

The average ± SD was reflected by quantitative figures. It was a percentage reflecting categorical and nominal data. The observations reported in the two groups were tabulated, and the student t-test (paired for intergroup and unpaired for intergroup comparison) and Chi-square test were used to conduct a statistical analysis of demographic data and group comparison. To be statistically relevant, $P < 0.05$ was taken. With SPSS v 18, all the statistical research was carried out.

Results

Of the 52 patients who met the criteria of the study, 32 (61.54%) were male and 20 (38.46%) were female, the male and female ratio was 1.6:1. with a mean age of 28.96 (range 12–58).

With the aid of the preoperative temporal CT, measurements were taken following the Cavalieri principle, resulting in the division of the total MACV into three groups: Group I: ventilated, Group II: moderately ventilated, and Group III: poorly ventilated (Table 1). The average mastoid volume of all the patients was measured as 3.92cm^3 (range 0-15cm^3). The mean volume was 11.92cm^3 for Group I, 7.65cm^3 for Group II, and 2.18cm^3 for Group III.

Table 1: Grouping of Mastoid volume

Groups	Mastoid volume (cm^3)	Patient number	% (Mean volume)
Group I	10cm^3 and above	6	11.92 cm^3
Group II	Between 5 and 10cm^3	14	7.65 cm^3
Group III	Between 0 and 5cm^3	32	2.18 cm^3

Statistical analyses were performed between the MV groups and the graft success (Table 2).

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Table 2: Graft success rates of the MV groups in the twelfth month

Mastoid ventilation	Graft success	*P*
Group I (n=6)	5 (83.33%)	0.32
Group II (n=14)	10 (71.43)	
Group III (n=32)	21 (65.62%)	

Transplant success was evaluated in the mastoid cell groups from the first month to the 12th month. In the 12th month, Group I's 6 patients had a transplant success rate of 83.33% (5/6). In the 12th month, the transplant success rate in Group II was 71.43% (10/14 patients). In the 12th month, the transplant success rate in Group III was 65.62% (21/32 individuals). Regarding the success rates of the grafts at the 12-month mark, there was no statistically significant variation found between the MV groups (P = 0.32).

The mean threshold values of the side that would be operated on, as well as the mean threshold values of the air conduction and bone conduction thresholds at the first, sixth, and twelfth months, were determined in the patients' prior audiometry (Table 3). Statistical analyses including air-bone gaps and air conduction gains were performed between the MV groups (Table 3). A statistically significant decrease was found between the mean air-bone gaps and the air conduction thresholds at the postoperative 12th month compared to the preoperative values ($P < 0.001$). However, there was no significant difference between ventilation groups in terms of audiometry results at the end of the 12th month ($P > 0.05$).

Table 3: Preoperative and postoperative hearing threshold averages and air-bone gaps measured in all the patients and the MV groups.

	Preoperative			**1st month**			**6th month**			**12th month**		
	AC	**BC**	**AG**	**AC**	**BC**	**AG**	**AC**	**BC**	**AG**	**AC**	**BC**	**AG**
Group I	38.25	17.25	35.42	33.62	14.21	22.1	26.52	13.22	13.65	22.87	11.9	10
Group II	44.69	24.68	36.20	35.22	18.11	17.22	31.56	17.22	13.98	31.2	17.56	13.8
Group III	47.26	21.22	37.92	37.61	17.78	19.26	34.58	18.62	15.72	32.92	17.69	17.65

AC: airway conduction; BC: bone conduction; AG: air-bone gap.

The right ears of 22 (42.30%) patients and the left ears of 30 (57.70%) patients were operated on.

No statistically significant difference was determined between the right and the left sides in terms of graft success rates at the end of the 12th month.

Discussion

The MACV is crucial to the function of the middle ear. Mastoid cells, according to Tumarkin [4] and Metin et al [5] supplied an air reservoir for the middle ear and showed how they contributed to the middle ear's pressure control. Sade et al. [6] also backed up this theory. Frisberg et al [7] were the first who examined the link between the mastoid air cell size and the prognosis of middle ear illness. The efficacy of middle ear operation was shown to be dependent on mastoid cell ventilation by Holmquist and Bergstroem [8]. Using Sch uller X-Rays taken before surgery, Holmquist and Bergstroem assessed the mastoid volumes in their research [8].

They demonstrated that individuals who had tympanomastoidectomy experienced more middle ear protrusion than those who had tympanoplasty without mastoidectomy. As a result, they promoted against intervening during operation on well-ventilated mastoid cells [8].

Bonding hypothesized that the mastoid cell system was responsible for pediatric tympanomastoidectomy failures [9, 10]. However, in the trials, they conducted with 63, 61, and 52 patients with chronic otitis media, respectively, Siedentop, Palva, and Gimenez failed to discover such a link [11–13].

In the research by Onur et al. [14] with 255 patients, they noticed that the transplant success in ears with diploic mastoiditis was better than that in ears with pneumatic mastoiditis, and they concluded that there was no correlation between the MV amount and the success of myringoplasty.

The authors used Sch¨uller X-Ray as the imaging method for measurement of the mastoid volume. In our research, mastoid volumes were calculated using high-resolution computed tomography and then assessed as three-dimensional objects. The method used in our research may yield more accurate findings because the Schuller X-Ray only offers two-dimensional imaging. Additionally, writers of earlier research [14]. Studied how MV affected tympanoplasty success, but during their research, they underwent mastoidectomy which is known to reduce mastoid volume and impact middle ear pressure. Some writers conducted research on the renewal of mastoid air cells based on this theory. According to Kanemaru et al. [15–17], the re-growth of MACV can successfully cure refractory COM. The capacity of regenerated MACV to improve eustachian tube function and gas exchange was examined by Kanemaru et al. in a different research [18]. Their findings showed that tissue-engineered regeneration of MACV enhances eustachian tube function and gas exchange in the middle ear. The efficacy of tympanoplasty is assessed in connection to the link between preoperative mastoid volume and patient outcomes in our research, where all patients underwent only antrostomy without mastoidectomy. The findings of MV research are debatable. Studies by Holmquist and Bonding suggested that MV had an impact on surgery outcomes [19, 20], but other researchers did not find this connection.

In our research, we also got similar findings. There was no statistically significant difference between the well-ventilated group and the inadequately ventilated group in terms of graft effectiveness, although we evaluated superior outcomes in the well-ventilated group. Furthermore, no statistically significant variations were found between the mastoid cell ventilation and the postoperative airway gains.

Conclusion

In conclusion, no statistically significant relationship could be found between the preoperative mastoid cell ventilation and the postoperative graft success in patients who had undergone only antrostomy together with tympanoplasty as chronic otitis surgery. Additionally, no statistically significant difference between the MV and postpartum hearing improvements could be found.

Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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