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A clinical study of mastoid ventilation tube in tympanoplasty

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ABSTRACT

Background: A ventilated middle ear space is an essential component of a functioning middle ear transformer mechanism. A mastoid ventilation tube (MVT) placed post-aurally in the antrum near the aditus is used in this study for the benefit of improvement in results of tympanoplasty. In support of this concept, very few experimental documents are reported. **Aims and Objectives:** The aims of this study were to find out if the MVT has any effect on the outcome of tympanoplasty in cases of chronic suppurative otitis media (CSOM) tubo-tympanic disease. **Materials and Methods:** This study was performed in 50 cases which were selected from the total number of cases using stratified random sampling method. In the research, patients with CSOM, who did not respond to medical therapy and required a combined approach tympanoplasty, were enrolled. Patients who needed just myringoplasty and those found to have cholesteatoma intraoperatively were not included in the research. **Results:** The study showed significant improvement in graft uptake, air-bone closure, and hearing in cases with MVT, thus resulting in better success rate in cases with MVT than cases without MVT. Furthermore, most of the cases had sclerosed mastoids and very few cases had complications such as MVT block and post-operative discharge. **Conclusion:** The MVT had a beneficial effect on the final outcome of combined approach tympanoplasty in cases of CSOM tubo-tympanic type active stage.

Key words: Mastoid ventilation tube; Tympanoplasty; Chronic suppurative otitis media

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INTRODUCTION

A ventilated middle ear space is an essential component of a functioning middle ear transformer mechanism.[1] An intact tympanic membrane protects the middle ear from the outside world and in so doing makes the normal functioning of the middle ear ventilation mechanism essential.[2] This is provided by the eustachian tube and the middle ear and mastoid mucosa. The eustachian tube acts as a drain and when functioning well can cope effectively with sudden major changes of pressure.[3]

Chronic suppurative inflammation of mucoperiosteal layer of the middle ear cleft is called as chronic suppurative otitis media (CSOM).[4] It is one of the most common ear diseases encountered in developing countries due to poor socioeconomic standards, poor nutrition, lack of health education, and unhygienic habits.[5] It is a major cause for deafness in India and the overall prevalence rate is 46 and 16 persons per 1000 in rural and urban population, respectively.[6]

Surgery is eventually required when there is a failure of initial medical therapy, with combined-approach tympanoplasty being the most commonly performed procedure. Aeration of the middle ear and proper eustachian tube functioning are critical to the success of any tympanoplasty procedure. Aeration allows the tympanic membrane, ossicles, and round window to move.[7] Non-aerated ears often demonstrate 40–60 dB air-bone gaps, because ossicular coupling and stapes motion are reduced as the round window membrane cannot move freely.[8] Besides maintenance of middle ear aeration and static pressure, the post-operative hearing result depends on the efficacies of

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the reconstructed tympanic membrane and ossicular chain.[9] The failure of tympanoplasty is mainly due to insufficient aeration of the middle ear. A continuous dry ear, proper healing of the graft, and improvement in hearing are not achieved in many of our patients in the immediate post-operative period, because the return to normalcy of middle ear mucosa and eustachian tube function for the aeration of middle ear usually takes 3–6 weeks. Complete epithelialization may take 6–8 weeks.[10]

This emphasizes the need for immediate post-operative ventilation by an additional tube. Politzerization, autoinflation, or nasal balloons were used previously for this purpose. The experimental document reported that the most successful approaches are that used drainage tube in the antrum.[9] Researchers found proof that used a middle ear pressure equalizing tube as permanent aeration tube by placing it transmeatally beneath the annulus in the posteroinferior quadrant.[11]

A mastoid ventilation tube (MVT) placed postaurally in the antrum near the aditus is used in this study for the benefit of improvement in results of tympanoplasty. In support of this concept, very few experimental documents are reported.

Aims and objectives

To find out if the mastoid ventilation tube (MVT) has any effect on the outcome of tympanoplasty in cases of chronic suppurative otitis media tubo-tympanic disease.

MATERIALS AND METHODS

Fifty cases were selected from the total number of cases using stratified random sampling method after acceptance by the Institutional Ethics Committee and written informed consent of ENT Department, Government general hospital, Nizamabad. Duration of study was from September 2020 to November 2021.

Patients who had been diagnosed with CSOM, and for those not responding to medical line of treatment, requiring a combined approach tympanoplasty were included in the study. Patients who were found to have cholestea to maintraoperatively and those who required only myringoplasty were excluded from the study.

A combined approach tympanoplasty under general anesthesia was performed on all the 50 cases, 25 cases with MVT and 25 cases without MVT (WMVT). Autologous temporalis fascia was used for tympanic membrane grafting in all the cases.

As the MVT, a polyethylene tube of size 2–3 inches that was cut from a perforated catheter of a Romo Vac set (Negative suction drain) of size FG 12, was employed.[4] The MVT was placed near the aditus and was extended outside through the most dependent portion of the postauricular incision and anchored by sutures. Postaural dressing was put after the mastoid dressing was removed the next morning. The patient was then sent home with instructions to avoid getting water into the operated ear, clean the tube's secretions with cotton, and undergo routine follow-up. After a week, earplugs and sutures were removed. After 6 weeks, the MVT was removed and a post-operative audiogram was performed and documented. After then, the patient was examined every month for the next 2–6 months. In certain instances when a dry clot was discovered inside the tube in the post-operative period, it was removed using an artery forceps or by cutting off the excess tube length. Because it causes a negative pressure in the middle ear and graft displacement, suctioning through the tube was avoided.

Air-bone closure, hearing improvement, graft uptake, occurrence of post-operative discharge, and blockage in the MVT are the parameters that were used for comparing the results of the study.

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

A total of 50 cases were performed, 25 cases with MVT and 25 cases WMVT. In our study, patients' ages were in the range of 11–60 years. In our study, out of 50 patients, 17 were female and 33 were male, the ratio was 1:1.9.

Out of 25 cases of MVT, 17 (68.0%) were male and 8 (32%) were female, and out of 25 cases of WMVT, 16 (64.0%) were male and 9 (36%) were female. A non-significant association was observed between sex and groups, revealing that the pattern of distribution of scores of male and female subjects was the same in both the groups statistically. However, a significant difference was observed between frequencies of different sexes indicating that most of the cases were male.

Table 1 showing X-ray mastoids of the cases both MVT and WMVT ($P<0.556$) revealed similar pattern of distribution

Table 1: X-ray mastoids of the cases

Variable	Groups		Total (%)	P-value
	MVT (n=25) (%)	WMVT (n=25) (%)		
Cellular	8 (32.0)	10 (40.0)	18 (36.0)	0.556
Sclerosed	17 (68.0)	15 (60.0)	32 (64.0)	0.048

n: Number of patients; values of P: Probability value; *Calculated using Chi-square test and compared with the baseline values. P<0.005 considered statistically significant, MVT: Mastoid ventilation tube, WMVT: Without MVT

of scores of cellular and sclerosed mastoids. The study also documented that when X-ray mastoid alone is considered, a significant difference was observed between frequencies of different mastoids (P<0.048) indicating that most of the cases had sclerosed mastoids.

Table 2 shows the air-bone closures of the cases both MVT and WMVT. A highly significant difference was observed between frequencies of different air-bone closures indicating that most of the cases had good and fair air-bone closures.

Hearing improvement was seen in 23 (92%) cases in MVT group and 21 (84%) cases (P<0.384) in WMVT group, revealing that the pattern of distribution of scores of different categories of hearing improvement was almost same in both the groups statistically. However, when hearing improvement alone is considered, a highly significant difference was observed between frequencies of hearing improvement indicating that hearing in most of the cases was improved and deteriorated in only (6) 12.0% of the cases.

Regarding the graft uptake in the cases of both MVT and WMVT, a highly significant difference was observed between frequencies of graft uptake indicating that the graft was taken up in most cases. Results are shown in Table 3.

The post-operative discharge of MVT and WMVT was observed between the groups. A highly significant difference was observed between frequencies of post-operative discharge indicating that most of the cases had no post-operative discharge and very few of them had post-operative discharge.

MVT was not blocked in 23 (92%) cases and blocked only in 2 (8%) cases, revealing a significant difference between these frequencies. The highly significant difference between the frequencies of success and failure had a total success of 43 (86%) as against 7 (14%) failure.

Table 2: Air-bone closures of the cases studied

Variable	Groups		Total (%)	P-value
	MVT (n=25) (%)	WMVT (n=25) (%)		
Excellent	4 (16.0)	3 (12.0)	7 (14.0)	0.724
Good	9 (36.0)	9 (36.0)	18 (36.0)	1.00
Fair	10 (40.0)	9 (36.0)	19 (38.0)	0.845
Poor	2 (8.0)	4 (16.0)	6 (12.0)	0.447

n: Number of patients; values of P: Probability value; *Calculated using Chi-square test and compared with the baseline values. P<0.005 considered statistically significant, MVT: Mastoid ventilation tube

Table 3: Status of the graft in the cases studied

Variable	Groups		Total (%)	P-value
	MVT (n=25) (%)	WMVT (n=25) (%)		
Taken-up	23 (92.0)	20 (80.0)	43 (86.0)	0.7372
Not taken-up with perforation	1 (4.0)	4 (16.0)	5 (10.0)	0.2293
Not taken-up with displacement	1 (4.0)	1 (4.0)	2 (4.0)	0.5813

n: Number of patients; values of P: Probability value; *Calculated using Chi-square test and compared with the baseline values. P<0.005 considered statistically significant

DISCUSSION

It is commonly known that CSOM often affects only one ear, and the current investigation has validated this (92%). The middle ear physiology of the mastoid air cell system is crucial. Asserted that mastoid cells served as an air reservoir for the middle ear and that they contributed to the control of middle ear pressure. Dexian et al.,[12] also provided evidence for this theory. The first person to examine the connection between the size of the mastoid air cell and the prognosis of middle ear illness was Flisberg et al.[13] Later, researchers looked into that matter and shown how important mastoid cell ventilation was for middle ear surgery success. The pre-operative X-rays to quantify the mastoid volumes. They demonstrated that individuals who received tympanomastoidectomy experienced more middle ear retraction than those who had tympanoplasty without mastoidectomy.[14,15] As a result, they promoted against intervening during surgery on well-ventilated mastoid cells.[14] Bonding hypothesized that the mastoid cell system was responsible for pediatric tympanomastoidectomy failures. In investigations, they conducted with 63, 61, and 52 chronic otitis media patients, respectively, several researchers found evidence of such connection. Some investigations discovered that the graft success in ears with diploic mastoiditis was superior to that in ears with pneumatic mastoiditis and they came to the conclusion that

there was no correlation between the quantity of mastoid ventilation and the success of myringoplasty.[16]

They had mastoidectomy in their research despite the fact that it is known that mastoidectomy reduces the mastoid volume and has an impact on middle ear pressure. They looked at the impact of mastoid ventilation on the success of tympanoplasty. According to this viewpoint, some scientists[17] investigated the regeneration of mastoid air cells. Studies on mastoid ventilation have shown conflicting findings. Studies by Holmquist and Bonding showed that mastoid ventilation had an impact on surgical outcomes. However, other researchers failed to find this connection.[15-17] In our investigation, we too got similar findings. We evaluated superior outcomes in the well-ventilated group in terms of graft success and hearing improvement.

Limitations of the study

The MVT had a beneficial effect on the final outcome of combined approach tympanoplasty in cases of CSOM.

CONCLUSION

We conclude that majority of cases studied showed sclerosed mastoids, and this decreased pneumatization is an effect of chronic middle ear inflammation. The results, thus, confirmed that cases with MVT showed better air-bone closures and hearing improvement than cases WMVT. The post-operative discharge and graft failure were significantly more in cases of WMVT. Complication of MVT such as MVT block was seen in some cases. Cases with MVT showed better overall success rate than cases WMVT. Hence, the MVT had a beneficial effect on the final outcome of combined approach tympanoplasty in cases of CSOM tubotympanic type active stage.

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HSD- Concept and design of the study, prepared first draft of manuscript; **KB-** Interpreted the results; reviewed the literature and manuscript preparation; **SKP-** Concept, coordination, statistical analysis and interpretation, preparation of manuscript and revision of the manuscript.

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