

Pediatric Tympanoplasty: An Analysis on Affecting Factors

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ABSTRACT

Introduction: Chronic otitis media (COM) is a common otological problem globally, especially in developing countries. As per the population based survey in India in 2003, the estimated prevalence of childhood onset of deafness was 2%, whereas global burden of illness from COM involves 65–330 million individuals with a chronically discharging ear, 60% among these suffer from a significant hearing loss. It is a matter of concern as tympanoplasty in children is challenging as various prognostic factors play a major role. Reported success rate for tympanoplasty in children ranged from 56% to 94%. This study has been done with a view to determine the importance of certain prognostic factors in outcome of tympanoplasty in children. **Materials and Methods:** This is a 1-year hospital based prospective interventional study at a tertiary care teaching hospital in western Uttar Pradesh on all patients <18 years of age and with mucosal type of COM. **Observation and Results:** Most affected age was 15–18 years and with the highest successful graft uptake with the overall success rate of 81.94%. Cases with posterior perforation, subtotal, and small central perforation showed a highest percentage of successful graft uptake. Cases with Dry ear, patent Eustachian tube function and absent adenoids have also showed significant graft uptake. **Conclusion:** Tympanoplasty in pediatric age group should be performed as early as possible for early rehabilitation of child and for speech development.

Key words: Adenoids, chronic otitis media, Eustachian tube, pediatric tympanoplasty

INTRODUCTION

Chronic otitis media (COM) is a common otological problem globally, especially in developing countries. Type I tympanoplasty of tympanic membrane seems to be an effective treatment of perforation repair although even in this modern era, its difficult to achieve a 100% success rate in tympanoplasty surgery. As per the

population-based survey in India in 2003, the estimated prevalence of childhood-onset of deafness was 2%, whereas the global burden of illness from COM involves 65–330 million individuals with a chronically discharging ear, 60% among these suffer from a significant hearing loss. Out of this, a large portion can be easily corrected by tympanoplasty thereby restoring the hearing mechanism.^[1]

Pathologically, COM can be divided into mucosal and squamous types, on the basis of clinical evaluation and histological features of the middle ear mucosa. Mucosal type is associated with central perforation with active discharge or without active ear discharge involving the ossicles of the middle ear in various degrees. In an early acute phase squamous disease presents with essentially mucosal and bony pathological changes which later continue to a late chronic phase with the well-established intractable mucoperiosteal

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disease. Squamous type mainly presents with marginal perforation/attic perforation and cholesteatoma. The recurrent episode of otorrhoea and mucosal changes is characterized by bone erosion and inflammation of the temporal bone and ear ossicles. This is followed by ossicle destruction and/or ankylosing which together with the perforation of the tympanic membrane contributes the hearing loss. Complication risk is high in the squamous type in comparison to the mucosal type.

Perforation in the tympanic membrane might create a negative impact on the patient's quality of life; especially in the pediatric population, surgery is, therefore, often required. The most adequate age for surgery remains unclear and is always in debate in the current literature. In this study, we, therefore, examine the impact of age and other factors such as site and size of perforation, adenoid hypertrophy, dry or wet ear, Eustachian tube function, and presence of deviated nasal septum, on surgical outcome.

Foreseeing the possibilities of the high incidence of otologic contribution in squamous disease line of management of squamous type is Mastoid exploration regardless of age but lots of controversies exist regarding the management of the mucosal type of ear disease among the pediatric age group. The major challenges include the maturation of Eustachian tube function, recurrent upper respiratory tract infection, and adenoid hyperplasia to enlist a few. All these pose a major challenge in the outcome of tympanoplasty. Over the period of time, many studies have been done in the field for early restoration of hearing in the pediatric population as this affects further development of the child and has a lot of bearing on the parent's psychology.

It is a matter of concern as tympanoplasty in children is challenging as various prognostic factors play a major role, but seeing the burden of the disease in early childhood, one needs to move ahead of barriers. Previously reported success rate for tympanoplasty in children ranged from 56% to 94%.^[2]

Eustachian tube shows marked morphological changes after the age of 7 years that usually accompany improvement in function. Therefore, many surgeons prefer doing surgery after this age. Technical difficulties associated with pediatric tympanoplasties include narrow external auditory canal, smaller size of the ear, surgical techniques, and composition of graft. The goals for pediatric tympanoplasty are three folds reasons. First, to have an intact tympanic membrane to prevent middle ear contamination and allow unrestricted

water activities, second an intact tympanic membrane will provide a good serviceable hearing, and finally, it provides an aerated sound conducting middle ear space.

This study has been done with a view to determine the importance of certain prognostic factors in outcome of tympanoplasty.

MATERIALS AND METHODS

This was a 1-year hospital based prospective interventional study carried out in Department of Otorhinolaryngology and Head and Neck surgery, Rohilkhand Medical College and Hospital, Bareilly, a tertiary care and teaching hospital in western Uttar Pradesh from November 1, 2019, to October 31, 2020, on all patients <18 years of age and mucosal type of COM attending and fulfilling the inclusion criteria. The estimated sample size was 40 and the study was approved by Institutional Ethical Committee.

Inclusion Criteria

All children between ages of 6 and 18 years with unilateral mucosal disease willing to undergo Type 1 tympanoplasty were included in the study.

Exclusion Criteria

Children below the age of 6 years, previous history of otological surgery, presence of congenital ear deformity, any history of immune disorder and children with bilateral perforation in tympanic membrane were excluded from the study.

- Enrolled cases were divided into 3 age groups: 6–10 years, 11–14 years and 15–18 years
- Final post-operative assessment was done at 3 months both in terms of Graft uptake and Hearing Status and was compared with various laid down prognostic factors
- Data were analyzed using SPSS version 22 and appropriate statistics will be used.

Pure tone audiometry was performed on all patients before and 3 months post-surgery. Before starting the surgical procedure, examination under microscopy was performed and observations were noted in terms of site of perforation, all the perforations anterior and posterior to handle of malleus were considered anterior posterior perforations. Size of perforation, was categorized as small central involving one quadrant,

subtotal involving two or three quadrant and total involving all the four quadrants. Eustachian tube function, was assessed by Valsalva maneuver, adenoids by X-ray soft-tissue Nasopharynx, Deviated nasal septum was clinically assessed by anterior rhinoscopy, Dry middle ear means free from ear discharge for more than 2 weeks whereas, wet ear means a film of mucoid discharge present in middle ear even after 2 weeks.

OBSERVATION AND RESULTS

The following are the observations made by the present study:

Group C (15–18 years age group) was found to be the most commonly affected age group and it involved 17 (42.5%) cases and the highest success rate for graft uptake was also seen this age group with 94.11% and the overall success rate in the present study was 81.94% [Table 1]. Graft uptake was slightly more in males than in female [Table 2]. Posterior perforation showed a highest percentage of graft uptake in comparison to anterior and both anterior and posterior perforations [Figure 1]. Cases with subtotal and small central perforation showed a higher successful graft uptake [Table 3]. Cases with dry ear has statistically significant graft uptake in comparison to wet ears [Table 4].

A statistically significant graft uptake was obtained in patients with “patent” Eustachian tube function [Table 5]. Effect of DNS on outcome of surgery was found to be not significant [Table 6]. There was a statistically significant successful outcome was obtained in cases with absent adenoids [Table 7].

All out of total of 34 successful graft uptake cases, there was improvement in hearing from the mean pre-op AB gap of 26.04 dB to a mean of 14.94 dB in the post-op [Table 8].

DISCUSSION

In our study, we have seen that success rate, that is, intact graft uptake was highest in the group C of 15–18 years (94.11%), followed by Group B (85.7%) and Group A (66%). Although the success of graft uptake was lower in younger age group, it was not found to be statistically significant. Vrabec *et al.*,^[3] Isaacson and Melaku,^[4] and Umapathy and Dekker^[5] considered pediatric tympanoplasty as a safe procedure and had a comparable success rate in children; therefore, it should be performed. Srivastava and Mohan^[6] and Gupta and Mishra^[7]

Table 1: Effect of age on the outcome of tympanoplasty

Age group	No of Cases	Successful Cases	Failure cases	Success Percentage (%)
Group A (6–10 years)	9	6	3	66
Group B (11–14 years)	14	12	2	85.71
Group C (15–18 years)	17	16	1	94.11
Total	40	34	6	

Table 2: Effect of sex on the outcome of tympanoplasty

Sex	Graft		Success Percentage (%)	P-value
	Uptake	Rejected		
Male	17	2	89.4	0.193 Not Significant
Female	17	4	80.95	

Table 3: Size of perforation and its effect on outcome of tympanoplasty

Size of perforation	Graft uptake	Graft rejected	Success percentage (%)	Failure percentage (%)
Small central	15	2	88.2	11.8
Subtotal	10	1	90.9	9.1
Total	9	3	75	25

Table 4: Dry versus wet ear and its successful outcome on tympanoplasty

Ear Condition	Graft		Success Percentage (%)
	Uptake	Rejected	
Dry	28	1	96.5
Wet	6	5	54.5

P=0.05, significant

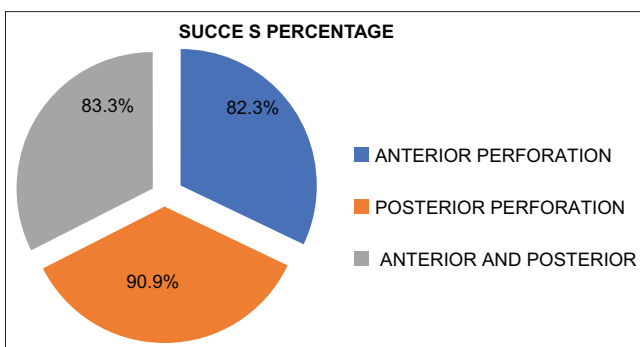


Figure 1: Graft success in different sites of perforation

also observed success percentage higher among older age group children.

However, Ryan and Kaylie^[8] concluded in their study that there should not be any minimum age criteria for considering tympanoplasty as

Table 5: Eustachian tube function and its effect on outcome of tympanoplasty

Eustachian Tube Function	Graft Uptake	Success Percentage (%)	Graft Rejected	Failure Percentage (%)
Patent	31	93.93	2	6.06
Not Patent	3	42.85	4	57.14

$P=0.00$, significant

Table 6: Deviated nasal septum (DNS) and its effect on outcome of tympanoplasty

DNS	Graft uptake		P-value
	Uptake	Rejected	
Right	5	2	1.00 Not significant
Left	12	2	
Absent	17	2	

Table 7: Adenoid hypertrophy and its effect on outcome of tympanoplasty

Adenoids	Total (%)	Graft Uptake (%)	Graft Failure (%)
Present	10 (25)	4 (40)	6 (60)
Absent	30 (75)	30 (100)	0
Total	40	34	6

$P=0.00$, significant

Table 8: Status of hearing versus graft uptake

Mean air bone gap		
Outcome	Pre-op	Post-op
Success (Graft Uptake)	26.04 dB	14.94 dB
Failure (Graft Rejected)	26.16 dB	22.83 dB

age does not directly meditate result of tympanic membrane perforation closure. Repair should be done whenever it is clinically necessary for each child as delaying it could lead to progression of hearing loss, developmental delay in speech, long time discharging ear, restricted water activity, and further complications.

Overall mean success rate in our study was 81.94% which is better than the result obtained by Sánchez Barrueco *et al.*,^[9] Yung *et al.*,^[10] Charlett and Knight.^[11]

Success rate reported by Akyıldız *et al.*^[12] and Chandrasekhar *et al.*^[13] was 90% which was better than our case. The probable reason could be larger sample size and contribution of other factors. Our study has found slightly more Graft uptake among males than females. Similar results were seen in the study of Emir *et al.*^[14]

Successful graft uptake was seen more in cases with posterior perforation and failure was seen more in cases with anterior perforation. Similar findings was

seen in the study of Kumar *et al.*^[15] who also found that anteriorly located perforations were more likely to fail. The reason behind this is most likely due to a lack of maturation of Eustachian tube and a negative pressure in anterior recess of tympanic cavity. However, Singh *et al.*^[16] and Pignataro *et al.*^[17] have found that the location of the perforation had no effect on the surgical or hearing result.

A successful outcome was seen in cases with subtotal and small central perforation in comparison to total perforation. Similarly, Emir *et al.*^[14] also found in their series of 607 patients that those patients who underwent tympanoplasty for a greater than 50% tympanic membrane perforation had significantly poorer hearing results and a lower rate of graft success. Abdellatif *et al.*,^[18] Hartzell and Dornhoffer.^[19] also concluded in their study that size of perforation an important prognostic factor for the success of tympanoplasty. Pignataro *et al.*^[17] and Hardman *et al.*^[20] found that surgical success was lower in patients with discharging ears. This was consistent with our results where we found that success rate of surgery was significantly higher (96.5%) in patients with dry ears and lower in wet ears.

A statistically significant successful graft take up was obtained in patients with “patent” Eustachian tube function. Similar results were seen in the study of Manning *et al.*^[21] who concluded in their study that there was significant association between preoperative Eustachian tube function and graft uptake rate in pediatric tympanoplasty. Similar result was seen in the study by Pandey *et al.*^[22] and Undavalli *et al.*^[23]

On the contrary authors Singh *et al.*,^[24] however, found no correlation between graft uptake and Eustachian tube function. Akyıldız *et al.*^[12] concluded in their study that there was no need of deviated septum correction prior surgical correction of tympanic membrane perforation as otological surgery was not affected by nasal function. A higher tympanoplasty success rates was seen in cases who did not had adenoid hypertrophy and was statistically significant. The reason could be that cases without adenoid hypertrophy had a better tubal function thus leading to decreased incidence of otitis media with effusion and a better graft uptake and decrease in the chance of further perforation.

Ribeiro *et al.*^[25] and Gianoli *et al.*^[26] in their study found that children previously submitted to adenoidectomy showed higher success rates.

In the present study, there was mean improvement in hearing from 26.04 decibel to 14.94 decibel in AB Gap among successful tympanoplasty. Similar improvement has been reported by Almazrou *et al.*,^[27] Black *et al.*,^[28] and Pignataro *et al.*^[17]

CONCLUSION

Tympanoplasty in pediatric age group should be performed as early as possible for early rehabilitation of child and for speech development. However, selection of the cases should be meticulous in terms of certain factors such as size and site of perforation, Eustachian tube function, and condition of middle ear and adenoids.

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