

Correlation between the perforation size and patency of eustachian tube and graft uptake in intact canal wall tympanoplasty surgery: a study of 32 benign-type chronic suppurative otitis media patients

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CORRELATION BETWEEN THE PERFORATION SIZE AND PATENCY OF EUSTACHIAN TUBE AND GRAFT UPTAKE IN INTACT CANAL WALL TYMPANOPLASTY SURGERY: A STUDY OF 32 BENIGN-TYPE CHRONIC SUPPURATIVE OTITIS MEDIA PATIENTS

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ABSTRACT

Background: Factors that contribute to the success of Intact canal wall Tympanoplasty have yet to be certainly known. Several studies show varied success rates and success criteria.

Objective: To investigate the correlation between the perforation size and patency of Eustachian Tube and the results of graft uptake on benign-type chronic suppurative otitis media patients that undergo intact canal wall tympanoplasty surgery.

Methods: This research used observational descriptive analysis. The participants were patients diagnosed with benign-type chronic suppurative otitis media who were treated with intact canal wall tympanoplasty surgery in 2018. Data such as demographic data, smoking history, clinical findings including perforation size of tympanic membrane, Eustachian Tube patency, results of pure-tone audiometry examination, results of graft uptake, and type of Tympanoplasty were collected from each participant. The statistic tests in use included contingency coefficient correlation test and Fisher exact test.

Result: Most of the participants were male (53.13%), the average age was 28.03 ± 12.32 years old, and most participants do not smoke (71.87%). The overall graft uptake success rate is 71.87% (n = 23), while the failure rate is 28.12% (n = 9). Pure Tone Average (PTA) was 37.19 dB at pre-op and 25.79 dB at post-op, which is a significant improvement (p=0.000) with average hearing improvement (PTA-Gain) of 15.75 dB. The patent Eustachian Tube functions give the best graft uptake results of 88.90%, followed by partial patency at 75% and non-patent at 40% (p=0.020). The highest average of PTA in non-patent function of the tube is 20.94 dB. Hearing threshold improvement (PTA-Gain) on patent, partial, and non-patent ETF groups differs significantly (p=0.046). Results of graft uptake on small and medium perforation size show the highest rate of (81.80%), followed by large perforation (50%). The highest PTA in total perforation size is (18.90 dB), then medium (15.14 dB), and small (6.22 dB). The perforation size of TM before surgery does not correlate with the success of graft uptake (p=0.297). The size of perforation correlates with improvement of hearing threshold (p=0.011).

Conclusion: Eustachian Tube's function has correlation with the success of graft uptake and hearing threshold improvement (PTA-Gain), while the perforation size of TM before surgery correlates with hearing threshold improvement (PTA-Gain).

KEYWORDS: Benign-type chronic suppurative otitis media, Eustachian tube Patency, perforation size, intact canal wall Tympanoplasty, human and disease, biomedical

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11 INTRODUCTION

Chronic suppurative otitis media is a chronic middle ear infection that lasts more than two months characterized by persistent perforation of the tympanic membrane (TM) and continuous or intermittent discharge of secretions from the ear [Acuin J, 2004]. Chronic suppurative otitis media is known to be one of the most common diseases in developing countries, one of which is Indonesia. Data from WHO (World Health Organization) shows that the prevalence of chronic suppurative otitis media in developing countries such as Malaysia, Philippines and Thailand are still relatively high, namely 2-4% compared to that of developed countries in Europe such as Australia, England, Denmark and Finland which is around 0.4% [Mahadevan M et al., 2012; Thakur SK et al., 2017]. Persistent tympanic membrane perforation and continuous discharge from the ear can cause conductive hearing loss up to 60 dB, which is considered a serious disability. If intervention is not carried out, it can cause serious complications [Morris P, 2012]. The surgical therapy approach to benign-type chronic suppurative otitis media is the intact canal wall tympanoplasty. The removal of middle ear and mastoid disease is performed by maintaining the posterior wall of the external acoustic canal. The goals of intact canal wall tympanoplasty surgery are to eradicate disease in the middle ear and mastoid and to reconstruct the hearing mechanism with or without tympanic membrane grafts [Syms III CA et al., 2010]. Factors influencing the success of intact canal wall tympanoplasty surgery are still in debate.

many factors have been investigated to determine what influences the success of graft closure and hearing improvement. various studies that have been conducted have shown varying success rates and success criteria. several studies have shown that the success factor of intact canal wall tympanoplasty surgery depends on the size and location of



To overcome it is possible, due to the uniting the knowledge and will of all doctors in the world

the perforation, the ossicular status, the type of graft and the function of the Eustachian tube. Other influencing factors include operating technique, operator experience, previous surgical history and smoking status [Alam M. et al., 2017; Dangol K, Shrivastav RP, 2017]. The purpose of this study is to learn the relationship between the size of the perforation and patency of the Eustachian tube and the results of graft uptake in benign-type chronic suppurative otitis media patients undergoing intact canal wall tympanoplasty surgery.

MATERIALS AND METHODS

13 Participants of this study were benign-type chronic suppurative otitis media patients who underwent surgery in 2018 at Dr. Soetomo Hospital, Surabaya, Indonesia. This study used an observational descriptive analysis. Inclusion criteria included patients diagnosed with benign-type chronic suppurative otitis media who underwent intact canal wall tympanoplasty surgery. Exclusion criteria were the presence of underlying disease such as diabetes or immunodeficiency, cholesteatoma and revised surgical cases and incomplete data. There were 136 patients diagnosed with benign-type chronic suppurative otitis media and 56 of them (41.18%) underwent intact canal wall tympanoplasty surgery. The number of samples that met the inclusion criteria was 32 patients (57.14%). Participants were identified on their demographic data, smoking history, clinical findings including size of eardrum perforation, Eustachian tube patency, pure tone audiometry (PTA) examination, graft growth results and type of tympanoplasty. Perforation size was assessed in small (less than 50%), medium (50% to 75%) and large (more than 75%). Eustachian tube patency is measured by means of ETF-P (Eustachian Tube Function-Perforated) in Impedance tympanometry. Results of the PTA before and after surgery are measured in decibels (dB). Results of postoperative PTA examination and graft uptake were evaluated after 3 months after surgery and analyzed. Data analysis was conducted using contingency coefficient correlation Test and Fisher exact test on SPSS statistical package (version 16.0; SPSS). The level of significance was $p < 0.05$.

RESULTS

A total of 56 participants (41.18%) underwent intact canal wall tympanoplasty surgery, 32 of which (57.14%) met the inclusion criteria. The majority of participants were male (53.13%). The average age was 28.03 ± 12.32 years, with median age of 25.50 (13.00-68.00) years. The youngest participant was 13.00 years old and the oldest was 68.00 years old. Most of the participants do not smoke (71.87%). The distribution of patients according to graft uptake success rate is provided in Table 1. Out of the 32 participants that underwent intact canal wall tympanoplasty, the overall success rate of graft uptake rate is 71.87% (n = 23), failure rate is 28.12% (n=9), and the highest success rate of graft uptake is in ≤ 20 years (81.81%) age group. Smoking has significant correlation with graft uptake success with the rate of 82.60% (p=0.031). Tympanoplasty type does not correlate with the graft uptake success (p=0.447) (Table 1).

PTA at pre-op amounts to 37.19 ± 18.52 dB

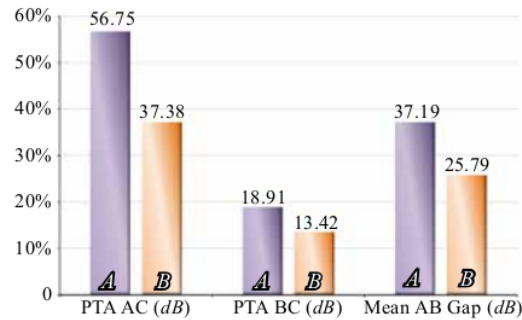


FIGURE 1. Comparison of PacuInTA Results Before (A) and After (B) Surgery

(with a range of 23.00-86.25 dB), and 25.79 ± 15.04 dB at post-op, which statistically saw significant improvement of p=0.000 with PTA-Gain of 11.40 dB (Figure 1). The patent Eustachian Tube’s function provides the best graft uptake results of 88.90%, followed by partial (75%) and non-patent (40%). Eustachian tube patency significantly correlates with the success of the graft uptake (p=0.020). The largest PTA in non-patent tube function is (20.94 dB). The results of PTA-Gain in patent, partial and non-patent ETF groups are significantly different with p=0.046. The strength of the relationship is weak (r=0.304). The graft uptake on small and medium perforations shows the same results, namely 81.80%, while for large perforations it shows 50%. PTA is greatest at total perforation size (18.90 dB) followed by medium (15.14 dB) and small (6.22 dB). The preoperative size of TM perforation does not correlate with the success of graft uptake (p=0.297), but it correlates with improved hearing threshold (PTA-Gain) (p=0.011). This relationship is weak (r=0.403) (Table 2).

DISCUSSION

This research does not show a tendency for sex differences. Out of 32 participants, the age varies from 13 to 68 years old, with an average of 28.03 years old. The highest result is shown by ≤ 20 years age group (81.81%). Several studies show similar results [Shetty S, 2012; Das A et al., 2015]. This indicates the fact that chronic suppurative otitis media is primarily a middle ear infection that tends to occur in the first decade of life [Das A et al., 2015]. This study shows overall graft uptake success rate of

TABLE 1.

Success Rate of Graft Uptake				
	Quantity	Graft Uptake		Success Rates
		Suc	Fai	
Sex				
• Male	15 (53.13%)	12	3	80.00%
• Female	17 (46.88%)	11	6	64.70%
Age				
• ≤ 20	11 (34.38%)	9	2	81.81%
• 21-30	13 (40.60%)	9	4	69.20%
• >30	8 (25.00%)	5	3	62.50%
Education				
• Elementary School	0 (0.00%)	0	0	0.00%
• Junior High School	3 (9.38%)	2	1	66.67%
• Senior High School	20 (62.50%)	14	6	70.00%
• Bachelor	9 (28.12%)	7	2	77.78%
Smoking				
• Yes	9 (28.12%)	4	5	44.44%
• No	23 (71.87%)	19	4	82.60%
p=0.031				
Type of Tympanoplasty				
• Type 1	25 (78.13%)	20	5	75.00%
• Type 2	2 (6.25%)	2	0	100.00%
• Type 3	3 (9.38%)	1	2	33.33%
• Type 4	1 (3.12%)	1	0	100.00%
• Type 5	1 (3.12%)	0	1	0.00%
(p=0.477)				

NOTES: Suc -Success, Fai- Failure

TABLE 2.

Participant No.	Graft Uptake		PTA			
	Rate	Rate (%)	PRE-OP (dB)	POST-OP (dB)	Gain (dB)	
Eustachian Tube Patency						
Patent	18	16	88.90%	49.72	41.06	8.66
Partial	4	3	75.00%	68.75	47.25	21.50
Non Patent	10	4	40.00%	60.94	40.00	20.94
			p=0.020			r=0.304 p=0.046
Perforation Size						
Small	11	9	81.80%	46.67	40.44	6.22
Medium	11	9	81.80%	60.56	45.42	15.14
Total	10	5	50.00%	56.10	37.20	18.90
			p=0.297			r=0.403 p=0.011

71.87% (n=23). This is in accordance with the study conducted by Alam which reported graft uptake results of 71.4% [Alam M et al., 2017]. Several other studies show different results. Shiromany M and coauthor reported 83.6% success rate of graft uptake and Naderpour M et al., reported similar results at 93.3% [Naderpour M et al., 2016; Shiromany A, Belaldavar BP, 2016]. Results of tympanoplasty surgery among smokers and non-smokers continue to be a controversial issue.

In this study, smoking participants have significant correlation with graft uptake success with the rate of 82.60% (p=0.031). This is in line with Cantrell's study [Cantrell RW, 1970]. Several studies claimed that there are differences in the results of graft uptake and hearing improvements in smoking and non-smoking patients [Naderpour M et al., 2016; Dangol K, Shrivastav RP 2017]. Eustachian Tube dysfunction refers to disruption of middle ear ventilation function caused by abnormal opening of the Eustachian Tube. Good middle ear aeration is essential for the success of the tympanoplasty procedure [Alam M et al., 2017; Li R et al., 2020]. This study shows that patent Eustachian tube function gives the best graft uptake results (88.90%). Eustachian Tube Function (ETF) is significantly related to the success of graft uptake (p=0.020). The rates of improvement of hearing threshold (PTA-Gain) in patent, partial, and non-patent (block) ETF groups differ significantly with p=0.046, despite the weak relationship (r=0.304).

These results are in line with that of several other researchers. Alam M reported significantly different results of average PTA between patients with patent and non-patent (block) Eustachian tubes (p=0.022, t=2.63), while no significant difference in graft uptake results (p=0.629) [Alam M et al., 2017; Perdana RF et al., 2020; Wibowo AP et al., 2020]. Holmquist, Manning et al., and Merchant et al., also claimed that good Eustachian tube function will increase Tympanoplasty success rate [Holmquist J, 1968; Manning SC et al., 1987; Merchant SN et al., 2003]. Different results were reported by Li R et al., who claimed that Eustachian tube function may not have effects on the results of type I tympanoplasty for chronic suppurative otitis media [Li R et al., 2020].

Results of surgery in this study were measured based on the graft uptake success rate and post-op hearing threshold improvement. Various studies used different criteria to assess hearing improvement after Tympanoplasty, such as hearing gain method or average of Air Bone Gap in each frequency [Sarker MZ et al., 2011]. In this study, the TM perforation sizes that give the best graft uptake results are small and medium sizes (81.80%). However, TM perforation size before surgery does not correlate with graft uptake success (p=0.297). This perforation size correlates with hearing threshold improvement (PTA-Gain) (p=0.011), which this study shows 15.75 dB in average. Correlation between perforation size and graft uptake

success and improvement of hearing threshold is reported by several researchers. Al-Ghamdi SA et al., reported that perforation size is a factor in graft uptake results, although statistically there is no significant differences between small and medium perforation in the graft uptake success [Al-Ghamdi SA, 1994]. Saleh et al., in their study reported the highest myringoplasty success rate on small perforation at 93.3%, medium and large perforation at 87.5% and 71.4% respectively. A study by Pfammatter et al., claimed success of complete closure of AB Gap on 20% of the patients and AB Gap of 10 dB HL in 80% of the cases. They also reported that perforation size has the most positive impact on the outcome. Thiel et al., reported AB Gap closure up to 10 dB HL on 53% of the patients and

claimed that in cases with larger perforations, improvement of hearing is possible [Pfammatter A et al., 2013; Thiel G et al., 2013; Saleh C et al., 2020]. Different claim was made by Vartiainen and Nuutinen, in which perforation size affects neither ABG closure and hearing improvement [Vartiainen E, Nuutinen J 1993].

CONCLUSIONS

Eustachian tube patency correlates with the success rate of graft uptake and hearing threshold improvement (PTA-Gain), while TM perforation size before surgery does not correlate with graft uptake success, but does with hearing threshold improvement (PTA-Gain).

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