Cohort Study

Endoscopic transcanal myringoplasty with anterior tab flap underlay technique: An analysis of 35 cases

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ABSTRACT

Introduction: The repair of the tympanic membrane can present a problem, especially in anterior perforation, because the anterior portion was not enough to inadequate contact between tympanic membrane remnant and graft. Various surgical techniques were recommended to achieve an acceptable graft success rate in anterior perforation. Endoscopic transcanal myringoplasty with anterior tab flap could provide the better stability of the graft.

Objective: The aim of this study was to report the minimally invasive technique for the anterior tympanic membrane perforation closure and investigate the graft success rate of this technique.

Patients and methods: We performed a prospective, randomized study of 35 patients who consulted the otorhinolaryngology department at the university hospital for surgery of perforation tympanic membrane repair.

Results: The average age was 35.1 ± 11.9 years. The size of the perforation was dominant at small-size and large-size, 51.4%, 34.3%, respectively. There was a significant difference between the Preoperative air conduction of small and large perforations (34.4 8.68 and 49.79 14.54, respectively). Of 35 patients, 31 (88.6%) had closure of their perforations. The mean preoperative ABG was 24.11 ± 10.79 dB, while The mean postoperative ABG was 13.97 ± 10.03 dB (p < 0.05). Approximately 34.3% patients had ABG within 20 dB preoperatively, which increased to 82.9% after intervention (p < 0.05).

Conclusions: The endoscopic transcanal myringoplasty with anterior tab flap underlay technique is a safe, suitable and effective method for cases with anterior tympanic membrane perforations, and showed improvement in postoperative hearing.

1. Introduction

Myringoplasty known as tympanoplasty type I, introduced a long time ago, used to repair tympanic membrane perforations in chronic otitis media or unhealed traumatic eardrum perforations. The aim of the surgery is to reconstruct the anatomic tympanic membrane to prevent infection and improve hearing function for patients [10]. There is a wide range of techniques of myringoplasty that were described and the two most common techniques are the underlay and the overlay techniques [8,9]. The underlay technique is easier to perform, less time-consuming and suitable for posterior perforations, thus, it is often preferred by otologists [7]. However, for anterior tympanic membrane perforations, especially close to the anterior annulus, the underlay technique is difficult to repair because of the anterior bony overhang and lack of vascularity and the graft may fall to the middle ear cavity [12]. This is always a challenge for surgeons. According to a recent study by Sajid T (2017), anterior perforations were found to fail in 41.7% of the cases, while central perforation failed in only 5.4% of the cases; the intact graft success rate of the marginal perforation was significantly decreased, only 47.1% while it was 94.9% in cases where annulus was not involved [11]. Therefore, ear surgeons have constantly tried to improve surgical techniques to apply to these cases.

One of the innovative surgical methods for this case is pulling a small tab of the graft through a small tunnel under the anterior annulus, called the “anterior hitch method”, introduced by Primorse and Kerr in 1986. Then many otologists applied techniques with the same approach but in various names and showed that the graft success rate is increased compared with standard underlay [6].

In Vietnam, this technique has not been popular. Therefore, this study aimed to apply the underlay myringoplasty with anterior tab flap...
for the anterior tympanic membrane perforations close to the anterior margin and estimate the efficacy of this technique.

2. Material and methods

35 patients with an anterior quadrant tympanic membrane perforation were enrolled in this study and they underwent the procedure at the medical institution between October 2019 and December 2020. All patients completed the minimum three-month follow-up period. The patients with prior otologic surgery, ossicular chain disease, cholesteatoma and retraction pockets were excluded in this study. All procedures conducted in this study were by the 1964 Helsinki Declaration. The research ethics committee (decision number H2018/031) on May 10, 2018.

3. Results

Thirty-five patients were enrolled in the study. The average age of the participants was 35.1 ± 11.9, with the youngest patient was 19 years old and the oldest being 64. Of all, 34.3% were men and 65.7% were women. As to the perforation side of the TM, 60% (21 patients) had it on the left ear and 40% (14 patients) on the right side. According to the size of perforations, 51.4% of the patients had a small-size perforation (<25%), 34.3% of the patients had big perforation (>50%), whereas only 5% had medium-sized perforation (25%–50%) (Table 1). The mean time consumption was 55.71 min, and there were no cases of complications such as anterior blunting or lateralization of the graft.

The preoperative and postoperative three-month pure-tone audiometry (PTA) were performed at the following frequencies: 250, 500, 1000, 2000, 3000, 4000, 8000 Hz. Pure-tone averages of air and bone conduction were calculated at the frequencies of 500, 1000, 2000, 3000 Hz. Then, average air-bone gaps were computed at the same frequencies. The closure of the TM after 3 months has been considered successful.

2.2. Statistical analysis

The Statistical Packages for Social Sciences (SPSS) version 22 (Armonk, NY: IBM Corp) was used to analyze the collected data. The analysis of normality was identified by the Shapiro-Wilk test. The differences in audiometric findings pre- and postoperation were evaluated by using the Wilcoxon test. The Kruskal-Wallis Test was used with a 0.05 significance level to determine the relation between the preoperative air conduction and these groups. All study protocols were approved by our research ethics committee (decision number H2018/031) on May 10, 2018.

Table 1

| Participants’ characteristics | Total (n = 35) |
|------------------------------|---------------|
| Age, X ± SD                  | 35.14 ± 11.90 |
| Sex, n (%)                   |               |
| Male                         | 12 (34.3)     |
| Female                       | 23 (65.7)     |
| Affected ear, n (%)          |               |
| Right                        | 14 (40.0)     |
| Left                         | 21 (60.0)     |
| Size of perforations, n (%)  |               |
| ≤ 25%                        | 18 (51.4)     |
| > 25–50%                     | 5 (14.3)      |
| > 50%                        | 12 (34.3)     |
The TM perforation closure rate was a wide range from surgical method developed by Primrose and Kerr for the anterior perforation. In this study, we preferred to apply the variety of graft materials as well as the described techniques. According advantages such as enhanced optics with high amplification and swift failure of perforation closure as well as partial destruction of the middle high risk of collapse of the anterior portion and the consequence was the transition between the positions, visualization of the concealed areas of the ear cavity [18]. Furthermore, the access difficulty, the low level vascularization also contributed to the challenge for the success rate of the closure of the anterior TM perforation. Although the overlay technique had a high success rate for the repair of the anterior perforation, it was more technically challenging and the significant risk of graft lateralization [13].

To avoid such potential disadvantages, as well as to improve the success rate of the anterior perforations, surgeons have developed some of the modified graft techniques. In this study, we preferred to apply the surgical method developed by Primrose and Kerr for the anterior perforations. We used the endoscopy transtympanic approach because of its advantages such as enhanced optics with high amplification and swift transition between the positions, visualization of the concealed areas of the middle ear and proposal a useful tool of image for the residency training. However, endoscopy transtympanic surgery was a one-hand technique. So, the extensive hemorrhage occurring during elevation of the tympanomeatal flap may lead to embarrassment in the endoscopic approach particularly for inexperienced surgeons.

The age of the patients in this study ranged from 19 to 64 years, and their mean age was $35.14 \pm 11.9$ years. This result can be compared with several studies [20]. Our hypothesis for this is that the patients have become more cautious because of hearing impairment at this age.

In our study of 35 patients, 23 patients were female and 12 patients were male with female to male ratio as 1.92:1. This could be due to the length of the eustachian tube being shorter in females compared to males [2]. All ears with perforation were divided into three groups in our study: (I) small sized perforation ($1-32 \, \text{mm}^2$, $<50\%$), (II) medium sized perforation ($>32-48 \, \text{mm}^2$, $50\%-75\%$), and (III) large sized perforation ($>48 \, \text{mm}^2$, $>75\%$). The number of ears in group I and III was dominant ($n = 18, 51.4\%$ and $n = 12, 34.3\%$, respectively). As shown in Table, we noticed that the size of the perforation had an impact on the severity of hearing loss ($p < 0.05$). This implied that the larger the perforation of TM the greater the hearing loss. Similar results were gained in the previous studies [1,3]. To explain this result, we have mentioned two reasons. First, the consequence of the perforation was loss of effective area of the TM. Especially, with the large perforation and involving the manubrium, the lever action of the TM was deficit. This resulted in the 30 dB loss. Second, the phase differential between round window and oval window was either reduce or loss and it especially occurred at the larger perforation that these windows were exposed.

In the current study, we performed the anterior flap technique under endoscopy and our study was compared to the previous studies that used microscopy to repair the perforation with the same technique [14,15]. To secure the anterior graft and prevent the graft retraction, the anterior tab of graft was pulled into the tunnel that was created by dissection between the overlying skin and the anterior bony canal. The graft success rate (GSR) was 93%, 89.8% in the reports of the prospective study of D’Eredita and Lens in 59 individuals sample, the retrospective study of Faramarzi et al. in the sample of 157 patients, respectively. Also, we achieved an acceptable GSR (88.6%) that was in line with the previous studies. The results of our study indicated that the GSR with the size $<50\%$ was 100% while the GSR with the size $>50\%$ was 8/12 (66.7%). Similarly, the success rate of the large perforation was also reported in the prospective studies of Saleh et al. in 52 patients, Jurado et al. (71.4%, 54.54%, respectively). This was probably explained by the larger of the small and moderate perforations and the graft had a better chance to be taken [20]. The hearing restoration was a critical criterion for the rehabilitation in patients who suffered from TM perforation. Therefore, the otorhinolaryngologists were more interested in improving the hearing capacity while treating the pathologies in the middle ear and mastoid cavity. The aim of the myringoplasty was closure of TM perforation and to obtain audiometric gain. The current study used the pure-tone audiometry for the assessment of hearing gain after endoscopic transtympanic myringoplasty at 500, 1000, 2000 and 3000 Hz, which represent fundamental frequencies for understanding speech. The mean restoration of the air conduction hearing in our study was 10, 12, 34.3%, respectively). As shown in Table, we

| Size of perforations | Preoperative air conduction (mean $\pm$ SD) |
|----------------------|------------------------------------------|
| $\leq 25\%$          | $34.44 \pm 6.68$                         |
| $>25-50\%$          | $33.53 \pm 5.96$                         |
| $>50\%$             | $49.79 \pm 14.54$                        |
| Total               | $39.57 \pm 12.90$                        |

Table 3
The graft success rate (GSR).

|        | n  | %     |
|--------|----|-------|
| Healed | 31 | 88.6  |
| Slit   | 4  | 11.4  |
| Total  | 35 | 100.0 |

Table 4
Preoperative and Postoperative air conduction.

|        | $\bar{X} \pm SD$ | Differences $\bar{X}$ | Differences $p$ |
|--------|------------------|------------------------|-----------------|
| Pre-operative | $39.57 \pm 12.90$ | $10.82 \pm 5.99$ | $p < 0.05$ |
| Post-operative | $28.75 \pm 12.82$ | $10.82 \pm 5.99$ | $p < 0.05$ |
Fig. 1. Underlay myringoplasty with anterior tab flap
A. A rim of tissue is removed from the edges of an anterior perforation.
B. Incision just lateral to the anterior portion of annulus.
C. The canal skin is elevated creating a tunnel anteriorly.
D. The anterior tab is pulled through the anterior canal skin tunnel underneath the anterior portion of the annulus.

Fig. 2. Preoperative and postoperative ABG
complementary graft technique was a solution to eliminate the disadvantages of underlay myringoplasty in repairing anterior perforations. Based on the terms of high graft success rate and hearing improvement, this technique provided a favorable outcome, even in difficult cases.

**Ethical approval**

All study protocols were approved by our research ethics committee (decision number H2018/031) on May 10, 2018.

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**Author contributions**

Thanh Thai Le, Doan Minh Nhat Vo, Thi My Duong, Nguyen Nguyen: Data collection, Manuscript writing, Results discussion.

Nguyen Nguyen, Thanh Thai Le, Doan Minh Nhat Vo: Manuscript writing and revision.

Thanh Thai Le: Paper revision.

**Registration of research studies**

1. Name of the registry: N/a
2. Unique Identifying number or registration ID: N/a
3. Hyperlink to your specific registration (must be publicly accessible and will be checked): N/a

**Guarantor**

Nguyen Nguyen is the guarantor of the study and accepts full responsibility for the work and/or the conduct of the study, had access to the data and controlled the decision to publish.

**Provenance and peer review**

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**Consent**

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-chief of this journal on request.

**Declaration of competing interest**

We have no known conflict of interest to disclose.

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**Appendix A. Supplementary data**

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2022.104135.

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