ORIGINAL RESEARCH

Therapeutic Effect of Tympanoplasty on Patients with Chronic Otitis Media with Tinnitus and Influencing Factors

Ke Ma, BM; Qian Wang, BM; Wenqiang Liang, BM; Mingxin Zhang, BM; Youji Zhang, BM; Yongli Wang, BM

ABSTRACT

Objective • This research was conducted to investigate the therapeutic effects of tympanoplasty on patients with chronic otitis media with tinnitus and analyze the possible influencing factors for patient prognosis.

Methods • This is a pre-post control group study, 86 patients with chronic otitis media were included as the subjects and enrolled into tinnitus group (n = 46) and the non-tinnitus group (n = 40). All patients underwent tympanoplasty under microscope or ear endoscopy. A tinnitus severity and efficacy assessment scale was employed for the evaluation of the severity of tinnitus among the subjects. In addition, tinnitus handicap inventory (THI) was utilized to evaluate disease alleviation.

Results • Before treatment, the proportions of the patients with tinnitus at grades I, II, III, IV, and V amounted to 15.22%, 32.61%, 21.74%, 17.39%, and 13.04%, respectively, while they were 30.43%, 45.65%, 13.04%, 8.71%, and 2.17%, respectively 3 months after treatment ($P < .05$). THI scores for the patients in the tinnitus group before and 3 months after treatment amounted to 17.96 ± 3.66 and 16.21 ± 3.29, respectively ($P < .05$). After treatment, the air conduction (AC) and bone conduction (BC) thresholds and air-bone gap (ABG) of the two groups apparently declined ($P < .05$). No statistical significance was detected in the differences in disease classification, disease courses, and whether an electric drill was used among the patients between effective and invalid groups ($P > .05$).

Conclusion • To some extent, tympanoplasty alleviated tinnitus among patients with chronic otitis media and promoted the restoration of hearing. Hence, it is worthy of application in clinical treatment. (*Altern Ther Health Med.* 2024;30(1):289-295).

Ke Ma, BM, Attending Doctor; **Qian Wang**, BM, Resident Doctor; **Mingxin Zhang**, BM, Associate Chief Physician; **Youji Zhang**, BM, Attending Doctor; **Yongli Wang**, BM, Attending Doctor, Department of Otolaryngology, the 80th Group Army Hospital of the Chinese People's Liberation Army, Weifang, China. **Wenqiang Liang**, BM, Attending Doctor, Department of Anesthesiology, the 80th Group Army Hospital of the Chinese People's Liberation Army, Weifang, China.

Corresponding author: Yongli Wang, BM
E-mail: mk106000@163.com

INTRODUCTION

Chronic otitis media generally refers to chronic suppurative otitis media, which is more common in children than adults. Chronic otitis media essentially means the perforation of the ear drum caused by various reasons, which is associated with multiple risk factors such as infection, allergy, family genetics, immune dysfunction, environmental factors, and other ear diseases. Tympanic cavity is connected with outside world and infection repeatedly occurs in the channel, which leads to purulent ear discharge.[1] The main symptoms include repeated purulent discharge in ear such as infectious ear discharge caused by water inhalation and repeated infection and hearing loss (conductive deafness). What's more, patients suffer from tinnitus, vertigo, vomiting, shivering, and headache.[2] Tinnitus refers to temporary or persistent abnormal phonoreception without external stimulation. Temporary tinnitus is considered a normal physiological phenomenon,[3] which may be caused by psychentonia and overwork. In this case, patients don't need to care too much about it and should have a good rest. If patients suffer from persistent tinnitus, with vertigo and headache affecting their quality of life, they need to visit professional otolaryngologists for medical treatment.[4,5] According to related research, tinnitus results from acute or chronic ear inflammation, external acoustic meatus embolism, foreign body entering the ear, middle tympanic membrane perforation, otosclerosis, Meniere's syndrome of the inner ear, and neuroma.[6] Moreover, tinnitus is caused by hemangioma and noise.

In China, chronic otitis media is traditionally classified into simple, caries, and epidermoidoma otitis media.[7] Bacterial infection (*Bacillus proteus*, *Escherichia coli*, and *Staphylococcus aureus*) is the commonest cause of chronic otitis media. In addition, chronic nasopharyngeal inflammations, such as respiratory tract infection and sinusitis, lead to chronic otitis media.[8,9] It is suggested that chronic otitis media usually occurs among people suffering from acute otitis media, chronic nasopharyngeal diseases, rhinitis, sinusitis, anaphylactoid

diseases, hypo-immunity, and chronic systemic diseases (anemia and diabetes), and swimming frequently. Therefore, the above risk factors must be eradicated to prevent chronic otitis media.[10,11] Patients with suspected chronic otitis media are often diagnosed by doctors according to medical history (surgery, when symptoms occur, frequency, and change), tympanic membrane examination (the morphology of external acoustic meatus and tympanic membrane), and audiological examination (whether hearing loss occurred and the severity). What's more, otoscope examination and high-resolution computed tomography (CT) scan on temporal bone are carried out to observe ear lesions and determine whether hyperemia and perforation has occurred in the tympanic membrane.[12]

The selection of the treatment methods for otitis media mainly depends on whether epidermoidoma has occurred. Patients with epidermoidoma must undergo surgical treatment as soon as possible, otherwise severe complications will occur. In contrast, patients without epidermoidoma receive selective surgical treatment. If patients and their family can't afford medical costs or surgical treatment can't be performed due to other reasons, drug therapy should be adopted to relieve symptoms.[13] The main therapeutic drugs include antibiotics and glucocorticoids, such as ofloxacin eardrops, dexamethasone, and prednisone. The above drugs can quickly suppress inflammatory reactions and control bacterial infection. In most cases, doctors select antibodies based on their experience.[14,15] For patients who seldom suffer from purulent ear discharge, tympanic membrane perforation should be repaired as soon as possible not only to regain the natural barrier of protecting the middle ear and preventing the relapse of otitis media but also to improve hearing. Patients without obvious effects of drug therapy or with tympanic membrane perforation often receive surgical treatment, which is tympanoplasty. During tympanoplasty, the lesions in the middle ear and mastoid process are cleared, the tympanic membrane is repaired, and hearing is constructed for the radical treatment of chronic otitis media.[16]

With the improvement of otomicrosurgical technologies, the effect of domestic tympanoplasty is almost as significant as that of tympanoplasty performed at foreign otology centers. Related research reveals that the cure rate of patients with otitis media reached 95% (drying ear rate) and hearing was improved among about 70% of patients after tympanoplasty.[17] Nevertheless, there is only limited literature and research into the effectiveness of tympanoplasty for tinnitus and sequelae among patients with otitis media and factors influencing the prognosis for tinnitus patients. Hence, this research was conducted for in-depth investigation and study to investigate the therapeutic effects of tympanoplasty on patients with chronic otitis media with tinnitus and analyze the possible influencing factors for patient prognosis, providing related references for clinical treatment.

PATIENTS AND METHODS

Subjects

86 patients with chronic otitis media hospitalized in the 80th Group Army Hospital of the Chinese People's Liberation Army and underwent tympanoplasty between September 2018 and December 2020 were included as the subjects. All patients were diagnosed with chronic otitis media after medical history examination, pure tone test, and preoperative CT imaging examination. Based on whether tinnitus occurred, they were enrolled into tinnitus group (n = 46) and non-tinnitus group (n = 40). The implementation of this research has been approved by the Hospital Ethics Committee. Patients and their families had been informed of the research content and methods and had agreed to sign informed consent forms.

The inclusion criteria are listed as follows. (i) Patients diagnosed with chronic otitis media after medical history examination, pure tone test, and preoperative CT imaging examination. (ii) Patients aged between 20 and 70 years. (iii) Patients with complete clinical data and imaging examination data. (iv) Patients who had agreed to undergo the included therapy and volunteered to engage in the research.

The exclusion criteria are listed as follows. (a) Patients with incomplete basic data and medical record. (b) Patients who had received surgical treatment. (c) Patients at lactation or pregnancy. (d) Patients with liver, kidney, and coagulation insufficiency. (e) Patients with central nervous system and endocrine system diseases and other serious somatic diseases.

Research methods

Preoperative preparation. Patients' medical history was understood and recorded in detail. Before treatment, routine pure tone test was carried out for the understanding of hearing. After that, the hairs around auricle at the surgical site were removed and the discharge in external acoustic meatus was cleared and then external acoustic meatus was disinfected.

Surgical operation. All patients underwent microscopic or ear endoscopic tympanoplasty. After general anesthesia, patients were instructed to take supine lateral position. The upper site of auricle was selected as the transverse incision. Then, a small right angle crochet hook was inserted into tympanic cavity to thoroughly remove lesion tissues. After that, posterior tympanic cavity, ossicular chain, and facial nerve recess were checked and hearing was restored. Next, absorbable gelatin sponge was placed on the perforation plane in tympanic cavity and the prepared repairing materials and tragus perichondrium were placed and paved between tympanic membrane and the gelatin sponge. In addition, wadding was fixed in external acoustic meatus. After treatment, antibiotics therapy was adopted. What's more, external adjuvant materials needed to be regularly replaced. Patients were advised to keep ears dry and avoid squeezing noses hard. During postoperative recovery, epithelium crawled. At this stage, patients should regularly visit hospitals for dressing changes and wound cleaning. In addition, tympanic membrane growth was observed and crust was removed every two months.

Observation indicators

Symptom remission: Tinnitus severity and efficacy assessment scale was employed for the evaluation on the severity of tinnitus among the included patients. The scores

ranged from 1 to 21 points. A higher score suggested more severe symptom. The scores were divided into 5 different grades, including I (1 to 6), II (7 to 10), III (11 to 14), IV (15 to 18), and V (19 to 21). According to the severity of tinnitus, surgical efficacy was determined. If tinnitus disappeared or the grade declined by more than 1 level 3 months after treatment, the treatment was effective. Tinnitus handicap inventory (THI) was utilized for the evaluation of symptom remission.

According to the results of preoperative and postoperative tests, air conduction (AC) and bone conduction (BC) thresholds were summarized and recorded. Then, the air-bone gap (ABG) was calculated based on AC and BC (*ABG = AC - BC*). In addition, the visual analogue scale (VAS) was adopted to evaluate tinnitus. The scores ranged from 0 to 10 points. A higher score indicated more severe tinnitus.

Postoperative follow-up

The data on preoperative tinnitus among all included patients was collected and recorded. After treatment, hearing data were collected and tinnitus improvement was statistically analyzed through on-site and telephone follow-up. All patients needed to receive outpatient subsequent consultation 3 months after treatment. The follow-up was mainly performed on patients with chronic otitis media with tinnitus for the evaluation of tinnitus improvement and severity.

Statistical analysis

Statistical Product and Service Solutions (SPSS) 23.0 software package (IBM, Armonk, NY, USA) was utilized for statistical data analysis. According to Shapiro-Wilk test, whether the data conformed to normal distribution was determined. Normally distributed measurement data among several groups were compared using one-factor multi-sample means, while those between two groups were compared using independent sample *t* test. In contrast, measurement data that didn't conform to normal distribution were compared using rank-sum test. Enumeration data were compared using χ^2 test. $P < .05$ revealed that the difference suggested statistical significance.

RESULTS

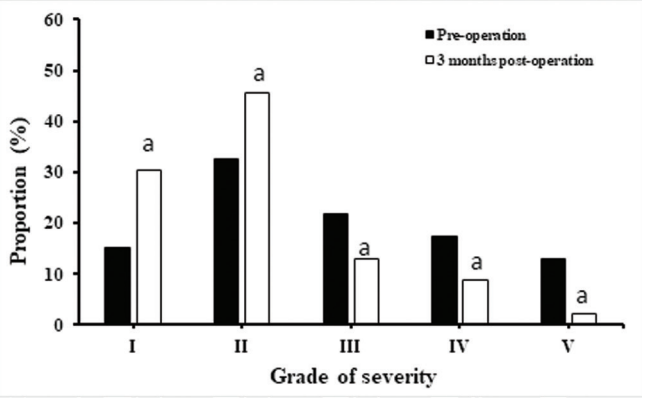
Comparison of the general data between the two groups

Age and the number of males and females in tinnitus and non-tinnitus groups amounted to 25 to 66 years (an average of 48.2 ± 3.4 years) vs. 23 to 64 years (an average of 46.3 ± 4.1 years), 25 vs. 22, and 21 vs. 18, respectively. In addition, no statistical significance but comparability was detected in the differences in disease courses, years of education, and the proportions of patients with different sites of affected ears and types of otitis media between the two groups ($P > .05$).

Grades of tinnitus among patients in tinnitus group before and after treatment

The grades of tinnitus among patients before and 3 months after treatment were evaluated (Figure 1). The proportions of the patients with grades I, II, III, IV, and V before and 3 months after treatment amounted to 15.22% vs. 30.43%, 32.61% vs. 45.65%, 21.74% vs. 13.04%, 17.39% vs. 8.71%, and 13.04% vs. 2.17%, respectively ($P < .05$). The proportions of patients with tinnitus at grades IV and V notably declined after the treatment.

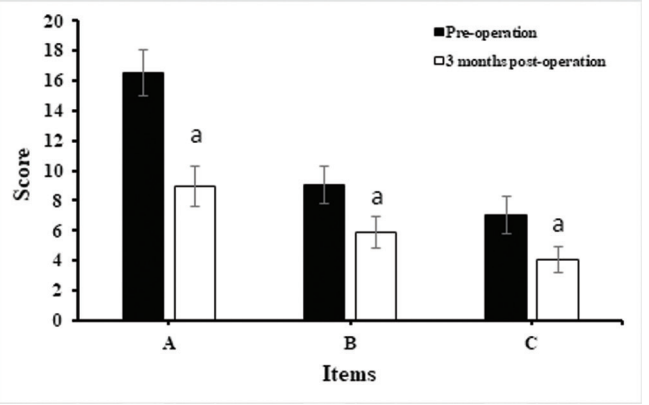
Figure 1. Grades of Tinnitus Among Patients in Tinnitus Group Before and 3 Months After Treatment



[a]Revealed that the difference from grades before treatment suggested statistical significance ($P < .05$).

Notes: I, II, III, IV, and V referred to different grades of tinnitus.

Figure 2. THI Scores for Different Items Before and 3 Months After Treatment



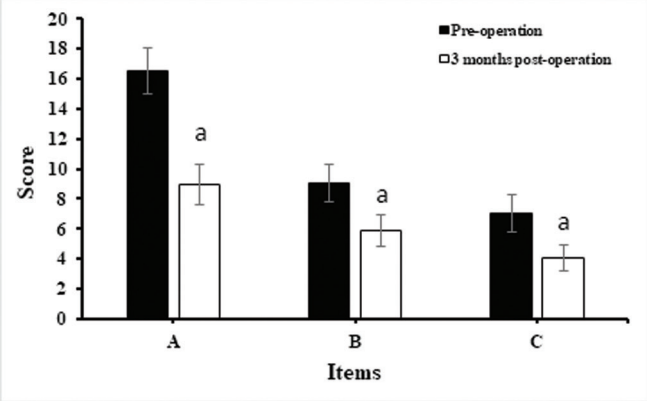
[a]Revealed that the difference from the scores before treatment suggested statistical significance ($P < .05$).

Notes: A, B, and C referred to the scores for function, affection, and severity, respectively.

THI scores for different items before and after treatment

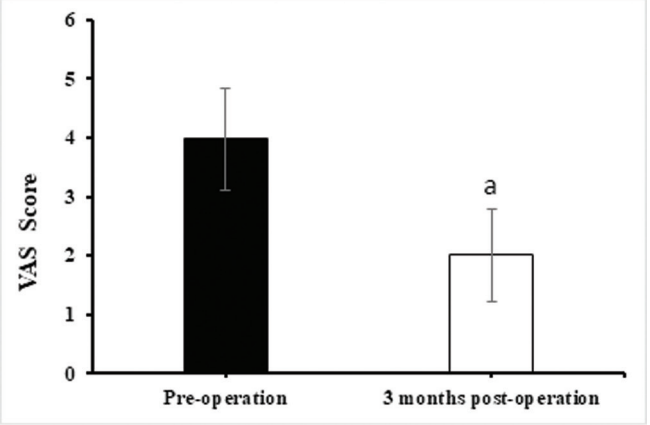
The function, affection, and severity items of THI were employed for the evaluation on the remission and improvement of symptoms and tinnitus by surgical treatment. The scores for all items before and 3 months after treatment were compared (Figure 2). The scores for function, affection, and severity before and after treatment amounted to 16.54 ± 1.53 vs. 8.95 ±1.38, 9.05 ± 1.22 vs. 5.89 ± 1.01, and 7.01± 1.25 vs. 4.03 ± 0.87, respectively ($P < .05$). The scores declined 3 months after treatment.

Figure 3. THI Scores Before and After Treatment



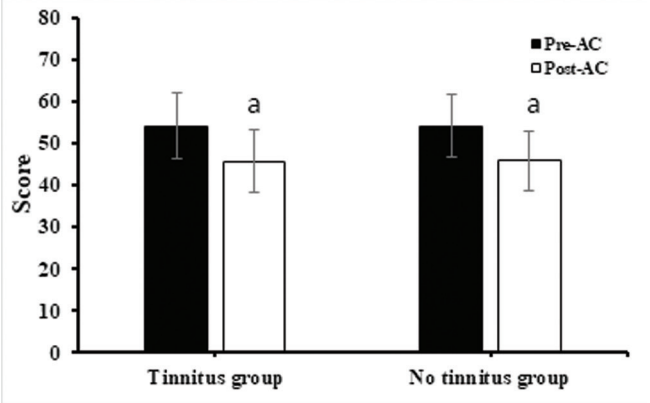
[a]Revealed that the difference from THI scores before treatment suggested statistical significance ($P < .05$).

Figure 4. VAS Scores Before and After Treatment



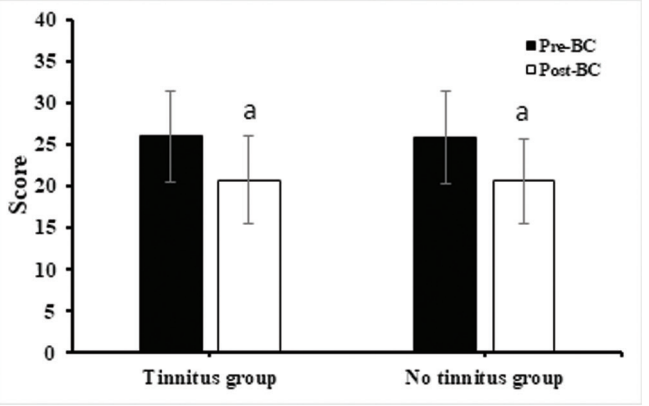
[a]Revealed that the difference from THI scores before treatment suggested statistical significance ($P < .05$).

Figure 5. The Changes of AC in Two Groups Before and After Treatment



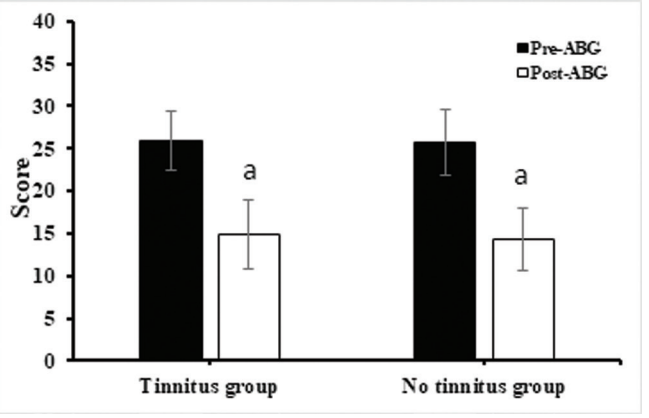
[a]Revealed that the difference from THI scores before treatment suggested statistical significance ($P < .05$).

Figure 6. The Changes of BC in the Two Groups Before and After Treatment



[a]Revealed that the difference from THI scores before treatment suggested statistical significance ($P < .05$).

Figure 7. The Changes of ABG in the Two Groups Before and After Treatment



[a]Revealed that the difference from THI scores before treatment suggested statistical significance ($P < .05$).

Comparison of THI scores before and 3 months after treatment

THI scores for patients in tinnitus group before and 3 months after treatment amounted to 17.96 ± 3.66 and 16.21 ± 3.29, respectively ($P < .05$) (Figure 3). VAS scores for patients in tinnitus group before and 3 months after treatment amounted to 3.98 ± 0.86 and 2.01 ± 0.78, respectively ($P < .05$) (Figure 4). The THI scores and VAS scores both declined 3 months after treatment in the tinnitus group.

Comparison of hearing improvement after treatment

As displayed in Figure 5, preoperative and postoperative AC of patients in tinnitus and non-tinnitus groups were compared, which amounted to 54.08 ± 7.86 vs. 54.22 ± 7.54 and 45.79 ± 7.39 vs. 45.88 ±7.12, respectively. No statistical significance was detected in the differences in the above values between two groups ($P > .05$). Postoperative AC of the two groups were relatively lower ($P < .05$).

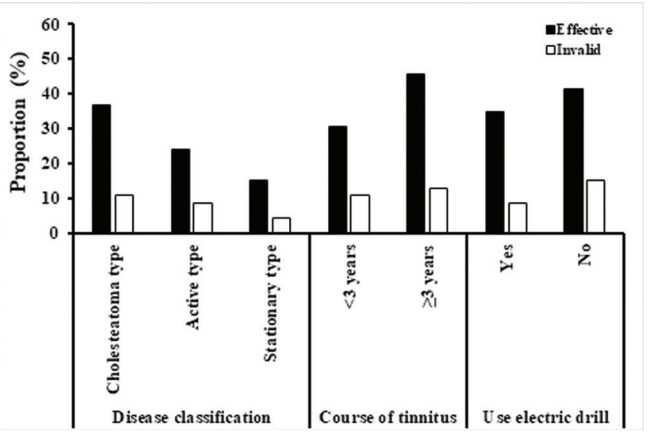
As presented in Figure 6, preoperative and postoperative BC of the two groups were compared, which amounted to 26.01 ± 5.41 vs. 25.89 ± 5.31 and 20.75 ± 5.64 vs. 20.64 ± 5.12, respectively. No statistical significance was detected in the differences in the above values between the two groups ($P > 0.05$). Postoperative BC of the two groups were relatively lower ($P < .05$).

As illustrated in Figure 7, preoperative and postoperative ABG of the two groups were compared, which amounted to 25.94 ± 3.52 vs. 25.77 ± 4.08 and 14.97 ± 3.82 vs. 14.32 ± 3.66, respectively. No statistical significance was detected in the differences in the above values between the two groups ($P > .05$). Postoperative ABG of the two groups were relatively lower ($P < .05$).

Correlation between types of otitis media as well as course and prognosis

Among all included patients, there were 46 cases with tinnitus (tinnitus group), including 35 with significant remission (effective cases) and 11 without significant remission. According to whether tinnitus was alleviated, the above patients were enrolled into effective (n = 35) and invalid (n = 11) groups. The proportions of patients with different types of diseases (epidermoidoma, active, and static), different courses (less than and more than 3 years), and the use of electric drill or not in effective and invalid groups were compared (Figure 8). No statistical significance was detected in the differences among patients between the two groups. In other words, types and courses of tinnitus and the use of electric drill had no apparent impacts on prognosis ($P > .05$).

Figure 8. Correlation Between Types and Courses of Tinnitus and the use of electric drill for Tinnitus Patients



DISCUSSION

Chronic otitis media is often caused by residual perforation resulting from acute otitis media in childhood. Recurrent purulent ear discharge leads to hearing impairment, causing great pain to patients in daily life.[18] In most cases, inflammations can be temporarily controlled after antibiotics therapy. Nonetheless, residual tympanic membrane perforation and recurrent symptoms sometimes result in granulation hyperplasia. Obviously, chronic otitis media can't be cured only by antibiotics.[19,20] Otitis media leads to tympanic membrane perforation and auditory ossicles absorption or destruction and affects internal ear, facial nerve, and intracranial tissues. If nerve tissues are affected, nervous tinnitus will occur, which is like high sound of cicadas or the roar of machines.

The treatment of tinnitus is mainly performed based on the cause.[21,22] Otitis media should be timely treated and symptomatic treatment should be carried out to supply nutrients to nerves and improve the micro-circulation of internal ear. Alternatively, glucocorticoid can be used for a short time. The decoction promoting blood circulation for removing obstruction in collaterals can also be used, such as the decoction unblocking stuffy orifice and activating blood circulation.[23] Moreover, the treatment based on syndrome differentiation using Chinese therapies is also effective, including acupuncture and moxibustion, Chinese medicine smoking, and point injection therapy. The toxins released by bacteria destroy the nerve cells of internal ear, resulting in sensorineural deafness. In addition, tympanic membrane perforation and auditory ossicles impairment lead to hearing loss, which is progressively exacerbated with recurrent inflammation.[24] To prevent further hearing loss, patients with otitis media are still advised to undergo surgical treatment as soon as possible even if they don't want to improve hearing through surgery. Consequently, inflammatory lesions are eradicated and tympanic membrane perforation is repaired. For patients who seldom suffer from purulent ear discharge, tympanic membrane perforation should be repaired as soon as possible not only to regain the natural barrier of protecting middle ear and prevent the relapse of otitis media, but also to improve hearing.[25] For patients with frequent purulent ear discharge or middle ear epidermoidoma, the lesions in middle ear and mastoid process must be cleared. In addition, tympanic membrane is repaired and hearing is restored, which is called tympanoplasty.[26] Patients with prolonged and intractable otitis media and middle ear epidermoidoma should undergo radical mastoidectomy. However, in this procedure tympanic membrane is not repaired and hearing loss is not restored. Consequently, radical mastoidectomy is not as useful as tympanoplasty for patients suffering from chronic otitis media and tinnitus.

The current tympanoplasty is a basic operative technique of modern otomicrosurgery. Under high-power microscope, the subtle lesions in the mastoid process of middle ear are completely removed, ossicular chain is restored, and tympanic membrane perforation is repaired.[27] Therefore, most patients don't suffer from purulent ear discharge anymore and hearing is improved after treatment. In addition, tinnitus is alleviated or resolved among most patients.[28] Based on modern otomicrosurgical techniques, patients suffering from purulent ear discharge can be performed with surgery, which can't be realized in the past.[29] At present, surgical methods are improved year by year. Surgeons can perform minimally invasive surgery to remove lesions and restore middle ear. After treatment, scars can hardly be recognized and acoustic meatus and tympanic membrane nearly return to normal. Eroglu et al have found that implemented ear endoscopic surgery was characterized by little trauma and fast recovery.[30] To discuss the therapeutic effects of microscopic or ear endoscopic tympanoplasty on patients with chronic otitis media and tinnitus, patients with chronic otitis media were included as the research subjects for related treatment.

The research findings revealed the statistical significance in the difference of proportions of patients with tinnitus at grades I, II, III, IV, and V before and after treatment ($P < .05$), which was similar to the research result obtained by Ohki et al. (2019).[31] To be specific, the proportions of patients with tinnitus at grades IV and V notably declined after treatment, suggesting that microscopic or ear endoscopic tympanoplasty alleviated tinnitus to some extent.[32,33] At present, ear endoscope is gradually applied for tympanic membrane repair, ossicular chain restoration, the treatment of upper tympanic cavity attic retraction pocket, and stapedectomy in foreign countries.[34] Ear endoscopic tympanoplasty is the most developed technique, which is much more effective than microscopic tympanoplasty, for especially large, anterior inferior, and marginal perforation of tympanic membrane. Moreover, function, affection, and severity items of THI were employed for the evaluation on the remission and improvement of symptoms and tinnitus by surgical treatment. The scores for all items before and 3 months after treatment were compared. It was demonstrated that all the above scores declined 3 months after treatment ($P < .05$). The above research findings indicated that tympanoplasty could be adopted to effectively relieve tinnitus and further restored hearing during the treatment of chronic otitis media.

It was confirmed that acoustic shock and long exposure to noise often affect hearing system and lead to hearing loss and tinnitus.[35,36] In addition, psycho-psychiatric factors also result in tinnitus and emotional or mental nervousness. While emotional fluctuation or overwork can aggravate tinnitus. In turn, tinnitus causes negative emotions and psychological state.[37] In this research, the impacts of different types and courses of otitis media and different environments on the prognosis among patients were analyzed. No statistical significance was detected in the differences in different types and courses of diseases and the use of electric drill between effective and invalid groups. In another word, the above factors had no apparent impacts on patient prognosis ($P > .05$). To sum up, tympanoplasty could alleviate tinnitus and promote hearing restoration among patients with chronic otitis media to some extent. Hence, it is worthy of application in clinical treatment.

Limitation

There are some limitations of this study. Firstly, the sample size of this study is small. In addition, this was a single-center study. Thus, a large sample study, multi-regional and multi-ethnic study is needed in the future.

CONCLUSION

This research was conducted to investigate the therapeutic effect of tympanoplasty on patients with chronic otitis media and tinnitus and the influencing factors for the prognosis. According to the research findings, tympanoplasty could alleviate tinnitus and promote hearing restoration among patients with chronic otitis media. Hence, it is worthy of application in clinical treatment. In addition, no remarkable correlation was detected between the types and course of disease and prognosis. Nonetheless, the sample size was small and the sources were relatively concentrated due to the limitation of disease types. Consequently, the final research findings might not be robust. What's more, only a few possible influencing factors for the prognosis were included and they were not representative. Therefore, the above aspects should be optimized and improved to draw a more accurate and reliable conclusion in subsequent research.

AUTHOR DISCLOSURE STATEMENT

The authors have no potential conflicts of interest to report relevant to this article.

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KM and YW designed the study and performed the experiments, QW and WL collected the data, MZ and YZ analyzed the data, KM and YW prepared the manuscript. All authors read and approved the final manuscript.

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