

Application of Eustachian Tube Balloon Dilation in Secretory Otitis Media after Radiotherapy for Nasopharyngeal Carcinoma

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Abstract

Objective: To discuss the application value of Eustachian tube balloon dilation in patients with secretory otitis media (SOM) after radiotherapy for nasopharyngeal carcinoma.

Method: We retrospectively analyzed 27 in patients with recurrent SOM due to radiotherapy for nasopharyngeal carcinoma at the Department of Otolaryngology, University of Chinese Academy of Sciences Shenzhen Hospital from January 2013 to December 2019. All patients had received one to five tympanostomy tube insertions before Eustachian tube balloon dilation while hospitalized. The Eustachian tube function was assessed before surgery and one year after surgery using acoustic immittance measurement and Eustachian Tube Scores (ETS). Statistical analysis was performed to determine whether Eustachian tube balloon dilation improved the Eustachian tube function among the patients.

Result: After the Eustachian tube balloon dilation, there were 34 ears with type A tympanogram. The cure rate was 75.6%. Five ears changed from type B to C tympanogram, indicating marked efficacy (marked efficacy rate 11.1%). There were no changes in tympanogram before and after surgery in six ears, indicating inefficacy. The overall effective rate was 86.7%. According to the ETS analysis, the preoperative ETS was 1.58 ± 1.314 , and the postoperative ETS was 7.40 ± 2.117 . There were significant differences in the ETS before and after surgery.

Conclusion: Eustachian tube balloon dilation achieved significant efficacy in SOM after radiotherapy for nasopharyngeal carcinoma. This technique is worthy of further popularization.

Keywords: Eustachian Tube Balloon; Secretory Otitis Media, Nasopharyngeal Carcinoma, Radiotherapy

Introduction

Secretory otitis media (SOM) is a common complication in patients with nasopharyngeal carcinoma, which typically occurs during or after radiotherapy. SOM before radiotherapy is generally caused by a tumor invading the Eustachian tube [1]. SOM occurring during or after radiotherapy is usually associated with the swelling, stenosis, or atresia of the Eustachian tube induced by radiotherapy [2]. SOM after radiotherapy for nasopharyngeal carcinoma is treated primarily by tympanostomy tube insertion. However, since some patients are combined with the stenosis and atresia of the Eustachian tube, the tympanostomy tube may fall out, leading to recurrent hydrotyimpanum. As a result, some patients have to receive repeated tympanostomy tube insertions. However, the residual tympanic membrane perforation does not heal or even get infected, with pus coming from the wound. The existing reports have shown that Eustachian tube balloon dilation offers a good solution for refractory SOM. However, the use of Eustachian tube balloon dilation to treat SOM induced by radiotherapy for nasopharyngeal carcinoma has been rarely reported. In the present study, we applied Eustachian tube balloon dilation to patients who relapsed after one to five tympanostomy tube insertions following radiotherapy for nasopharyngeal carcinoma. This technique proved effective for these patients.

Data and method

Case information

All patients were inpatients at the Department of Otolaryngology, University of Chinese Academy of Sciences Shenzhen Hospital from January 2013 to December 2019. All of them were combined with SOM after radiotherapy for nasopharyngeal carcinoma. Among 27 patients in the present study, there were 45 ears with SOM (27 patients in total, with 18 patients affected bilaterally and 9 patients unilaterally). There were 17 males and 10 females, aged 23 to 72 years old. They received radiotherapy for nasopharyngeal carcinoma 1-6 years ago, with 1-5 tympanostomy tube insertions.

Evaluation of the Eustachian tube function

Symptom/testing	2 points	1 point	0 point
Clicking sound when Swallowing	Often	Occasional	Never
Clicking sound during The Valsalva maneuver	Often	Occasional	Never
TMM 30mbar	$R \leq 1$	$R > 1$	R value incalculable
TMM 40mbar	$R \leq 1$	$R > 1$	R value incalculable
TMM 50mbar	$R \leq 1$	$R > 1$	R value incalculable

Table 1: ETS score table

No gold standard has been established yet for the assessment of Eustachian tube dysfunction (ETD). Currently, the judgment is mainly based on medical history, clinical symptoms, and examinations. The commonly used clinical examination techniques for ETD include acoustic immittance measurement and tubotympanometry (TMM). The Eustachian tube function can be assessed by the acoustic immittance measurement that produces a tympanogram. Type A tympanogram is considered normal; type B tympanogram indicates hydrotyimpanum, and type C tympanogram a middle ear with negative pressure. Both type B and C tympanograms indicate ETD. The severity is higher with type B than with type C. TMM [3] is an objective method for measuring

Eustachian tube opening. A nasopharyngeal pressure (30, 40, 50 mbar) is applied via a TMM device, and the patients are told to make a swallowing movement. Then the changes in air pressure in the middle ear are monitored using a pressure transducer at the outer ear. The opening latency index (R value) is calculated automatically. The Eustachian tube function is normal if $0 < R < 1$; the opening of the Eustachian tube is delayed if $R \geq 1$; $R < 0$ or an incalculable R value indicates that the Eustachian tube fails to open. The Eustachian tube score (ETS, see Table 1) is a combination of the TMM results and subjective symptom evaluation (whether there is a clicking sound during the Valsalva maneuver or swallowing). In this study, the Eustachian tube function before and after surgery was evaluated by combining acoustic immittance measurement and ETS.

Materials

The Eustachian tube balloon dilation system (manufactured by Manxenmed (Guangzhou) Co., Ltd.) consisted of a Eustachian tube balloon, a guiding device and a pressure pump (Figure 1). The inflatable balloon was attached to the distal end of the catheter, with a length of 20 mm. The balloon was dilated to a diameter of 3 mm upon contact with water. The guide consisted of a grip and a guider. A pressure pump was also included. The T-shaped aeration tube was manufactured by Medtronic USA.

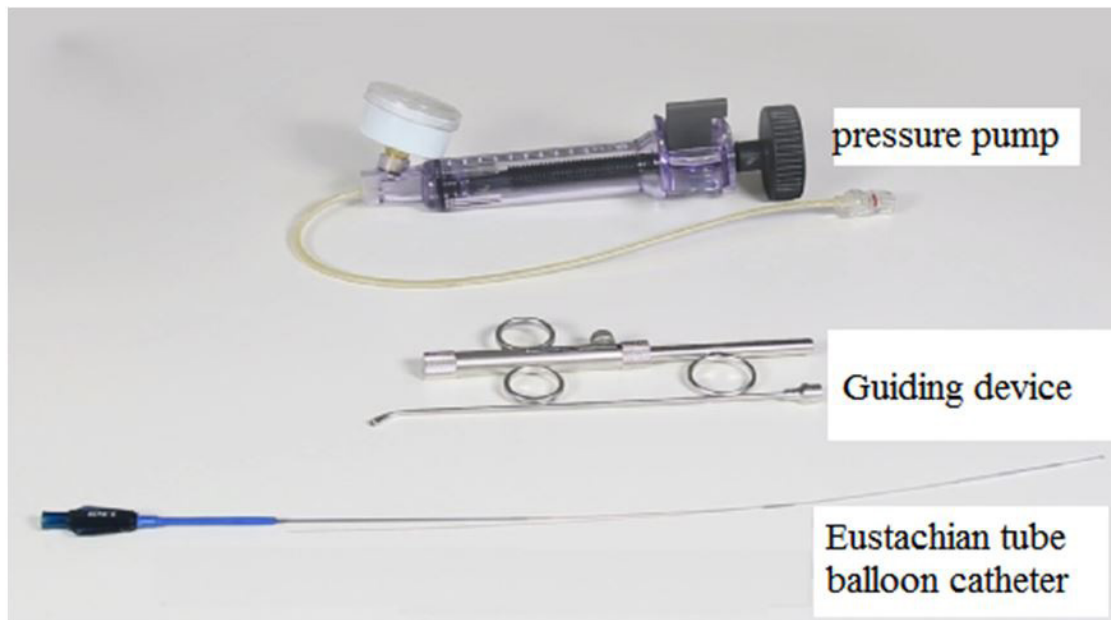


Figure 1: Eustachian tube balloon dilation system

Surgical method

Eustachian Tube Balloon Dilation

All surgeries were performed with tracheal intubation under general anesthesia. Before surgery, the contraction of the nasal mucosa was induced with oxymetazoline. Under the direct view with the nasal endoscope, the guider was placed into the pharyngeal opening of the Eustachian tube. Then, the balloon catheter was delivered to the Eustachian tube. The balloon catheter was immobilized, and the pressure pump was connected. Pressurization was performed until 12 atm, which was maintained for 2 min. The pressure was released, and the balloon was withdrawn. Once the balloon was retreated to the pharyngeal opening of the Eustachian tube, it was fixed there. Pressurization was performed again until 12 atm, which was maintained for 2 min. The mucosa and cartilage of the Eustachian tube were dilated around the pharyngeal opening of the Eustachian tube. If the patients had bilateral SOM, the contralateral Eustachian tube was dilated using the same procedure.

Tympanostomy Tube Insertions

The tympanic membrane was cut using a myringotomy knife in the anteroinferior quadrant of the under the endoscope. The tympanum was explored. An aspirator was used to draw the pus if there was any. An aeration tube was placed through the incision in the tympanic membrane.

Postoperative follow-up

The patients were followed up once every month after the surgery. It was observed whether the aeration tube was blocked or fell off. If the blood scabs blocked the tube, the tube was cleared with hydrogen peroxide. If the tube was still clogged, it was removed and disinfected before another insertion. The aeration tube was removed six months after surgery. The Eustachian tube function was assessed by acoustic immittance measurement and ETS one year after surgery. The results were compared against those before surgery to determine whether there were any differences.

Statistical analysis

All statistical analyses were conducted using the SPASS18.0 software. The ETS scores were analyzed using the paired t-test. The results of acoustic immittance measurement were analyzed by the chi-square test. The significance level was set to $P < 0.05$.

Result

The Eustachian tube function was assessed based on tympanograms from the acoustic immittance measurement. Type A tympanogram was considered normal; type B tympanogram indicated hydrotympanum; type C tympanogram indicated a middle ear with negative pressure. Both type B and C tympanograms indicated Eustachian tube dysfunction. The treatment efficacy was assessed based on changes in the tympanograms. A postoperative change to type A tympanogram was defined as a cure; a change from type B to C tympanogram was defined as marked efficacy; no change from type B or C tympanogram before and after surgery was defined as inefficacy. The number of cases achieving efficacy was the sum of the cases achieving a cure and marked efficacy. In the present study, there were 39 patients with type B tympanogram and 6 patients with type C tympanogram before the Eustachian tube balloon dilation. After surgery, there were 34 patients with type A tympanogram, and the cure rate was 75.6%. Five patients changed from type B to type C tympanogram, and the marked efficacy rate was 11.1%. Six patients had no changes in tympanogram before and after surgery, indicating inefficacy. The overall effective rate was 86.7%.

According to the ETS analysis, the preoperative ETS score was 1.58 ± 1.314 , and the postoperative ETS score was 7.40 ± 2.117 . There were significant differences in the ETS before and after surgery. This result indicated that Eustachian tube balloon dilation plus tympanostomy tube insertion achieved significant efficacy in SOM following radiotherapy for nasopharyngeal carcinoma.

Discussion

Nasopharyngeal carcinoma is highly prevalent in Guangdong, China. At present, comprehensive treatment based on radiotherapy remains a mainstream treatment for nasopharyngeal carcinoma. SOM is one of the common complications associated with nasopharyngeal carcinoma following radiotherapy. Tympanostomy tube insertion was once the preferred treatment for this condition. Tympanostomy tube insertion can prevent further retraction of the tympanic membrane from the negative pressure and release the pus from behind the tympanic membrane. Once the patients recover from the Eustachian tube injury caused by radiotherapy, the mucosa of the tympanic cavity can return to normal. Most patients can restore normal function of the tympanic cavity after the aeration tube is removed. However, pus begins to build up again in the tympanic cavity in some patients after the aeration tube is removed. Residual tympanic membrane perforation may occur after repeated tympanostomy tube insertions. Chronic suppurative otitis media may be even caused by long-term pyorrhea. This condition is closely related to the Eustachian tube injury

caused by radiotherapy. Radiotherapy can damage the transport function of the ciliated cells in the mucosa of the Eustachian tube. As a result, the amount of surface active materials and the surface tension of the luminal mucosa decrease, which further leads to ETD. Radiotherapy can damage the muscle group controlling the opening of the Eustachian tube, and the Eustachian tube fails to open. Besides, radiotherapy-related damage can further decrease the elasticity of the cartilage of the Eustachian tube, resulting in the failure of the Eustachian tube to open. Radiotherapy can also cause mucosal wound incrustation in the pharyngeal opening of the Eustachian tube. The associated fibrosis may induce atresia of the pharyngeal opening of the Eustachian tube. Tympanostomy tube insertion can generally succeed if no stenosis or atresia of the Eustachian tube occurs after radiotherapy, thus restoring the normal middle ear air pressure. If stenosis or atresia of the Eustachian tube occurs after radiotherapy, repeated tympanostomy tube insertions may fail to restore the normal middle ear air pressure. It is necessary to first eliminate the stenosis or atresia of the Eustachian tube before restoring the normal Eustachian tube function. Eustachian tube balloon dilation has been proved effective in achieving these functions.

Ockermann et al [4,5] were the first to apply balloon dilation to the Eustachian tube and achieved good efficacy in the cadaver and clinical studies. McCoul et al. [6] successfully applied the Eustachian tube balloon dilation to ETD. Meyer et al. [7] reported recently that balloon dilation Eustachian tuboplasty could achieve good efficacy in refractory ETD. Yin et al. [8] proved that balloon dilation Eustachian tuboplasty was an effective treatment for recurrent SOM. The purpose of the present study was to discuss the application value of Eustachian tube balloon dilation in recurrent SOM after radiotherapy for nasopharyngeal carcinoma. The effective rate of this technique, assessed based on the acoustic immittance measurement, was 86.7%. According to the ETS analysis, the Eustachian tube function was significantly improved after Eustachian tube balloon dilation than before. Our research indicated that Eustachian tube balloon dilation could eliminate the stenosis and atresia of the Eustachian tube caused by radiotherapy in some patients. The Eustachian tube function was restored, and pus was released from the tympanic cavity, thus restoring equal air pressure on both sides of the tympanic membrane and finally curing SOM. But according to the acoustic immittance measurement, Eustachian tube balloon dilation was still ineffective in 13.3% of the patients. ETS analysis showed that the ETS was below 5 in some patients, indicating that the Eustachian tube function was not yet recovered. This was probably because the Eustachian tube balloon dilation failed to eliminate the stenosis or atresia of the Eustachian tube. It remains unclear whether repeated Eustachian tube balloon dilation is subsequently required for these patients.

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