The selection and strategy in otoendoscopic myringoplasty with autogenous adipose tissue

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Abstract

Purpose To summarize the experience and explore the clinical application of myringoplasty with autogenous adipose tissue by endoscope.

Methods In this study, we retrospectively analyzed 56 cases (64 ears) of otoendoscopic myringoplasty with autogenous adipose tissue performed between January 2006 and April 2007.

Result All patients were followed up more than 6 months. The global closing rate was 92.19% (59 perforations among 64 total operations), 95.08% (diameter of perforation ≤ 5 mm), 33.33% (>5 mm).

Conclusion Otoendoscopic myringoplasty with adipose tissue is a simple and minimally invasive technique for tympanic membrane perforations. With optimal choice at indication and correct treatment to complication, the technique will give the advantages of slighter trauma, simpler procedure, lower cost and reduced complication rate.

Keywords Endoscope · Tympanic membrane · Myringoplasty · Adipose tissue

Introduction

In 1967, Mer had done the examination of the middle ear by fiberscope for the first time. In 1974 and 1982, Marguet and Nomura started their research separately for the examination of the middle ear by hard otoendoscopy.

But it could not be accepted by the clinic doctors widely for its low quality of vision and only one hand operation. Then in 1992, with the product of high quality diameter 2.1 mm, 30° and 70° multiangle rigid otoendoscopy, Thomassin and Poe began to apply them not only in otoendoscopic examination, but also in middle ear surgery. Because of the good effect they reported, more otologists worldwide practiced this new technique in their clinic study. Some of them even applied the otoendoscopy in the surgery of lateral skull base diseases such as acoustic neuroma and trigeminal neuralgia.

We used endoscopy for middle ear examination in 2004, and began otoendoscopic myringoplasty and ossicular chain reconstruction since 2005. Due to the satisfactory effectiveness, we introduce the experience of myringoplasty as following.

Materials and methods

Subjects

From January 2006 to July 2007, 64 ears (56 patients) were consisted of 36 ears (32 males) and 28 ears (24 females) with an average age of 38.4 years (range 11 to 65). Operations were procedured in the out-patient clinic for 26 ears (25 patients), 38 ears (31 patients) in the operation room.

Traumatic perforation of tympanic membrane in 21 ears (21 patients) failed healing spontaneously within 3 months, 43 ears (35 patients) were inactive chronic otitis media no <1 month. All of the cases were central perforations; including the diameter of perforation were <3 mm in 35 ears, >5 mm were 3 ears, 26 ears ranged from 3–5 mm. The mean air

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conduction threshold was 28.6 dB HL before operation (500 to 2000 Hz).

Criteria of addition

The perforations of all the cases were in the pars of tensa, and the residual edge were more than 2 mm. Mucosa in middle ear was normal without squamous epithelization. All of the cases were inactive/stable chronic otitis media for <1 month. Pure tone test certified air conduction threshold ranged 30 to 40 dB HL, the mean gap of bone-air conduction was 20 dB HL. Auditory tests indicated integral ossicular chains. Eustachian tubes' function was normal. No cholesteatoma was found in mastoids and/or attic with computer tomography imaging.

Methods

Owing to the relative shorter time course for surgery and the need of comfort for children, the surgical procedure in the adult patients was performed under local anesthesia, while under basal anesthesia in children. The body position and sterilization was the same as routine.

The external meatus were carefully cleaned before surgery, the perforations were revealed clearly and the drums were reached in all cases by using an otoendoscope (4 mm in diameter) without any incisions of the meatus skin. The margin of the perforation was freshened using a sharp pick to take away the marginal epithelium ring. The margin was inspected to ensure that no squamous epithelium was left on the medial surface of the drum for avoiding any acquired cholesteatoma.

Abdomen or ear lobe which was depending on the patients' will was chosen as the site for harvesting fat graft. As to location of abdomen for fat graft, an incision of 1 cm was made in a skin pleat close to the center of the umbilicus. The fat swab was taken from the anterior side of the ipsilateral pretragal area. An incision was on the medial surface of the inferior lobule. This graft was twice or thrice the size of the perforation. It was positioned into the perforation with a sharp needle such that it took on the shape of dumbbell. The graft could be affixed firmly without the use of any biologic glue. Some small pieces of dry gelatin sponge was placed on the lateral surface of the fat graft. A cotton ball is placed in the meatus and kept in place for 1 week, and then antibiotic drops were used for the following 2 weeks.

Follow-up

Follow-up studies for all the patients were performed with otoscopy, with or without endoscope, at 7d, 2w, 1m, 2m, 6m and 1 year. No postoperative complications were recorded.

Pure tone tests were performed at the 6th postoperative month.

Result

The surgical procedures were successfully performed in all the patients at one time, follow-up studies were performed with otoscopy, with or without endoscopy, at 7 days, 1 month, 3 months, 6 months and 1 year. The global closing rate was 92.19% (59 perforations among 64 total operations), 95.08% (diameter of perforation ≤ 5 mm), 33.33% (>5 mm). During the follow-up periods, 7 cases occurred middle ear infection because of upper respiratory tract infection. Finally, two of the 7 left residual perforation after anti-infection therapy. 6 months, after the operation, when pure tone audiometry was performed for all recovered ears (59 ears), 10–20 dB HL improvement at speech frequencies was obtained in 46 cases. Seven cases <10 dB HL improvement and another 6 cases showed no change of their hearing level.

With follow-up periods ranging from 6 months to 1 year, no significant difference was observed with regard to patients' sex (32 men, 24 women) or age (one adult; three children, 8 to 10-year-old).

The residual perforations were successfully healed later with a classic method using temporalis fascia in all four of these patients. Table 1 and Table 2 summarizes these results. The four residual perforations comprised one inferior (25%), two anterior (50%), and one posterior (25%) perforations, which were the primary areas of those perforations.

Discussions

Adipose tissue has its characteristic features of histology and physiology in myringoplastic operation [1, 2]: A) Secretion

Table 1 Results of myringoplasties with different cause

Cause of perforation	Number of cases	Success rate (%)
Trauma	21	95.24% (20)
Otitis media	43	90.69% (39)
Total	64	92.19% (59)

Table 2 Results of myringoplasties with different diameters of perforation

Diameter of perforation (mm)	Number of cases	Success rate (%)
I <3	35	97.14% (34)
II 3–5	26	92.31% (24)
I + II ≤ 5	61	95.08% (58)
III >5	3	33.33% (1)

of cytokine with anti-inflammatory effect, adiponectin and acylation stimulating protein play an important negative regulation in inflammatory reaction, which are secreted by adipocytes. B) Theory of “Cell Survival”. In 1959, Peer suggested that adipocytes could not be replaced by host’s epithelial cells. While the host’s cells act as scavenger to get rid of dead adipocytes, the living adipocytes could survive provided that blood supply is sufficient. C) Stable support, because of physical characteristic in semisolid, stability and plasticity, adipose tissue provides a better platform for epithelial cells in margin of perforation to creep on.

In the past few years, the effectiveness of utilizing adipose tissue in myringoplasty had been confirmed by many researchers, we utilized endoscope and adipose tissue to perform the myringoplasty in some selected patients. Several advantages with regard to this method had been certified as follows: A) Avoiding of any incisions: The endoscope can offer favourable illumination and visual fields of the total ear drum, ignoring the shape of external acoustic meatus. In all cases, no incision was introduced, which effectually lessens the trauma and pain of patients. B) The main advantage is that the otoendoscopy is closer to the surgical site which can make the lighting brighter and surgical field clearer. C) Multiple directions in examination of tympanic cavity. Endoscopes with different angles can be used to explore the tympanic cavity especially in attic, incudostapedial joint, and the tympanic segment of facial nerve canal, round window and tympanic opening of auditory tube. D) The operating procedure is easy to perform and cost-effective. It can even be undertaken at out-patient clinic and easily be generalized [3].

But there are still some disadvantages in otoendoscopic tympanoplasty.

1) It can only be operated by one hand, and can’t be continued when bleeding a lot. It can’t be used with otologic the electric drill at the same time too. 2) The mirror of the otoendoscopy will be needed to clean many times during the surgery for the reason that it is easy to be blurred by heat gas or blood. 3) Possible otoendoscopy’s luminaire thermal effect injury. 4) It will be difficult to perform the operation in patients with very narrow external auditory canal.

We consider the following factors to be important with regard to the indications of the operation: 1) diameter of perforation: Deddens AE found that the recovery rate of myringoplasty using fat as graft was 86%, corresponding to temporal muscle fascia as graft was 95% [4, 5]. As to our serial study, the recovery rate was 95.8% if the diameter of perforations which located in pars tensa were <5 mm (group I and group II). Among 3 bigger perforations located in pars tensa (>5 mm), failures occurred in 2 cases 2 months after operation. The reasons for failure could be too large a perforation to lock the fat tissue that eventually retracted into the tympanic cavity. Immediately, we cauterized the crevice by using trichloroacetic acid, put new fat tissue to

remedy the new perforations and meanwhile, used biogel to strengthen the contact between recipient bed and graft. At last, among the 2 bigger reperforations, 1 case got healing. We used the same methods to treat the 5 cases of reperforations which belonged to the group which diameter of perforation <5 mm, finally, 4 of the 5 cases got healing. For these reasons, caution should be taken to treat the bigger perforations. 2) Causes of perforation: On the basis of our observation on the trauma-induced perforation, we found that about 50% perforations couldn’t experience natural cure after two months’ conservative treatment. We know, persistent perforation would be bound to add the risk of secondary infection in middle ear, therefore, we performed myringoplasty to the traumatic patient after 1 month’s conservative treatment. 3) Evaluation of the middle ear: Tympanic membrane patch test can be applied to check the integrity of ossicular chain and evaluate the prognostic hearing. Lesions in tympanic cavity can be evaluated by utilizing imaging examinations and endoscopy, which can serve as guidance for removal of lesions, such as granulation in tympanic orifices of the Eustachian tube and small cholesteatoma in the attic. Ventilated function in tympanic cavity, mastoid process and Eustachian tube can be evaluated by tympanogram and CT. 4) Placement of adipose tissue: Adipose tissue should be placed adjacent to the medial wall of middle ear cavity, especially in bigger perforation (diameters of perforation >3 mm). In order to avoid inner part adipose tissue suspending in midair, gel form should be put into hypotympanum to support the graft and decrease the space of middle ear cavity. Meanwhile, adipose tissue should be “incarcerated in” the perforation rim to prevent its prolapse or retraction. Patients should be informed of the possibility of adipose tissue displacement owing to pressure increase in the middle ear by coughing, blowing nose and sneezing. 5) Prevention of postoperative infection: In 7 cases, infection of middle ear occurred due to upper respiratory tract infection or otogenous reasons, finally, 2/7 left residual perforation after anti-infective therapy. The infection mostly occurred between 2 to 4 weeks after operation. Infection might cause fat tissue’s liquefying and delay of perforation rim’s epithelization, which eventually induce failure of operation. It was important to enhance intention of self care, keep clean in external ear canal and intensive follow-up. 6) Expert in one-handed performance: Hematoma and skin’s breakage in external acoustic meatus might be caused by endoscope during operation, therefore, operator should be expert in one-handed performance.

According to our analysis the prognosis for different patients with tympanic membrane perforations, the following points will be important for successful otoendoscopic myringoplasty with adipose tissue: 1) Middle size tympanic membrane central perforation. 2) Dry ear. 3) No auditory canal stenosis.

In conclusion, fat can be used as one of the feasible and reliable tissue grafts in myringoplasty. With proper

indications, the technique will give the advantages of slighter trauma, simpler procedure, lower cost and reduced complication rate.

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