The Laryngoscope

How I Do It

Closure Technique for Labyrinthine Fistula by "Underwater" Endoscopic Ear Surgery

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INTRODUCTION

The appropriate management of labyrinthine fistulas has been debated in the literature for years. Complete removal of the cholesteatoma matrix over the fistula site with repair of the bony defect has been performed as a one- or two-stage procedure. Alternatively, a thin layer of the matrix in situ has been preserved over the fistula site and exteriorized cavity. Both approaches are likely to preserve cochlear function, thus preventing the risk of sensorineural hearing loss with careful management, but are not perfect because of the difficulty in treating the fistula in an obscured operative field while avoiding direct suction.[1] Saline water irrigation has been recommended as a method to preserve inner ear function, but often hinders the operative view under the surgical microscope.

To overcome these problems, we propose a novel technique to remove the matrix endoscopically after completely filling the mastoid cavity with saline water by perfusion. This "underwater" endoscopic ear surgery (UWEES) technique provides a clear operative field without requiring suction and protects the inner ear from unexpected aeration that may damage its function.

MATERIALS AND METHODS

A 68-year-old male had suffered from cholesteatoma otitis media in the right ear. He developed vertigo and acute sensorineural hearing loss, so was hospitalized to receive intravenous treatment with antibiotics and steroids. Computed tomography (CT) revealed bone destruction of the scutum and a fistula of the lateral semicircular canal (Fig. 1). Surgery was subsequently performed for removal of the cholesteatoma and closure of the fistula. Retroauricular incision was chosen because of the extensive lesion, using an intact canal skin method with soft wall reconstruction.[2] The cholesteatoma was extirpated except for the island lesion of the matrix over the fistula under the operating microscope. Subsequently, saline solution was infused into the mastoid cavity until both the island residual matrix and the tip of the inserted endoscope were filled completely. The endoscope was a 0° type (2.7 mm in diameter, 18 cm in length) coupled to a high-definition camera and video system (Karl Storz GmbH & Co. KG, Tuttlingen, Germany). The saline water was continuously perfused using a syringe by an assistant. The island residual matrix was exfoliated using a double-ended dissector (SKU: 226211, Thomassin double-ended dissector; Karl Storz GmbH & Co. KG) and plugged with temporal fascia endoscopically (Fig. 2). The level of the saline water was then reduced to just above the fascia by gentle suction and the fascia covered with bone paste. More fascia was applied onto the bone paste to seal the labyrinthine fistula completely (see Supporting Information, Video 1, in the online version of this article). Reconstruction of the ossicular chain used harvested tragal cartilage as columella (type IIIc). Superiorly based temporal muscle flap and bone paste were used for soft wall reconstruction.

RESULTS

Our novel surgical technique, UWEES, for closure of labyrinthine fistula provided a clear operative field of view with saline perfusion, and closure of the fistula after removal of the matrix was easier than under the microscope (see Supporting Information, Video 1, in the online version of this article). No particular complication occurred during the surgical procedure, and postoperatively the patient did not feel vertigo, only slight dizziness without nystagmus. Absence of postoperative tinnitus and no deterioration of the bone conduction threshold in his right ear indicated that cochlear function had been preserved. The preoperative audiogram showed bone conduction thresholds of 20, 20, 15, 35, and

Additional Supporting Information may be found in the online version of this article.

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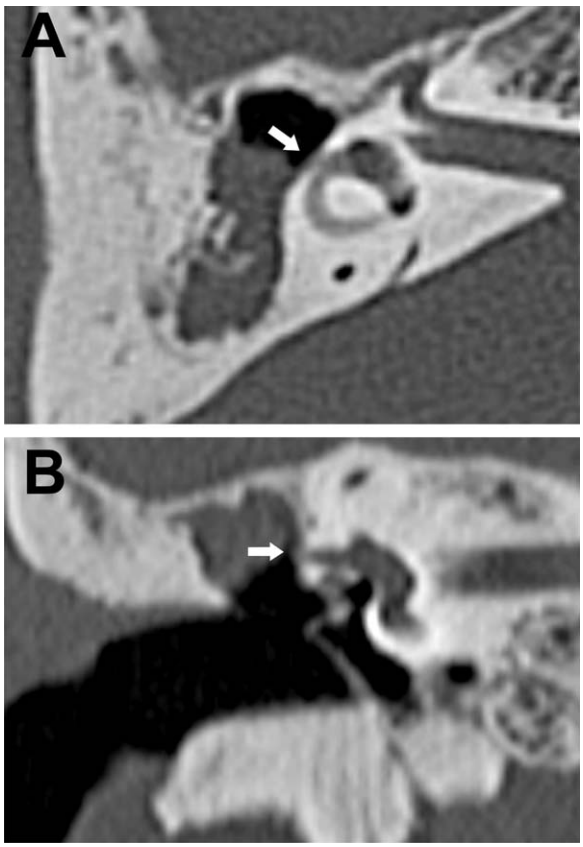

Fig. 1. Axial (A) and coronal (B) computed tomography scans showing a cholesteatoma with destruction of the temporal bone and a labyrinthine fistula of the lateral semicircular canal of the right ear (white arrow).

40 dB HL at 0.25, 0.5, 1, 2, and 4 kHz, respectively, whereas postoperative audiograms showed that bone conduction thresholds of 10, 10, 10, 25, and 40 dB HL 1 week after surgery and 15, 10, 5, 20, and 30 dB HL 3 months after surgery had not worsened. CT at 1 week after the surgery revealed that the fistula was completely covered with bone paste and soft tissues, and no aeration was seen within the labyrinth.

DISCUSSION

The management of labyrinthine fistula carries the risk that removal of the cholesteatoma matrix would always lead to a dead ear.[3] Larger and/or multiple fistulas involve a higher risk of deterioration in postoperative bone conduction hearing than smaller fistulas after the matrix is removed.[4] Single stage treatment of a small labyrinth fistula removes the matrix and immediately covers the labyrinth with bone paste and overlying fascia. Conversely, treatment of large fistulas has usually preserved the matrix for later removal during a preplanned second-stage procedure at 12 months after the first operation. If the open technique is performed, the matrix may be preserved over the fistula and exteriorized through the fascia.[5] If the fistula is to be repaired, the covering matrix should be removed only under constant irrigation followed by immediate repair with previously harvested autologous tissues. Suction of the open

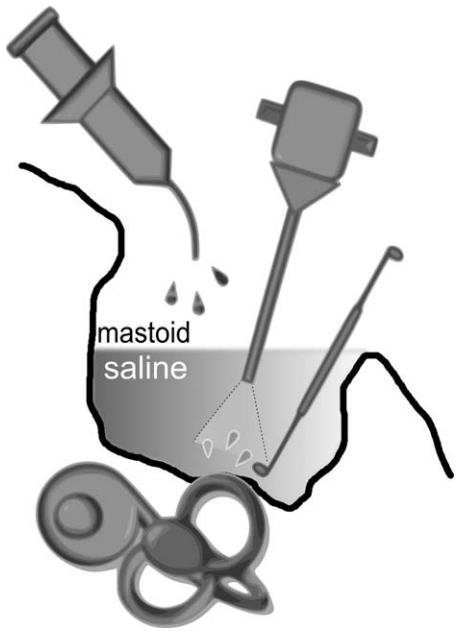

Fig. 2. Scheme of underwater endoscopic surgery. The labyrinthine fistula and tip of the endoscope are immersed completely under the surface of the saline water perfused continuously using a syringe by an assistant.

labyrinth is contraindicated.[1] However, even the most experienced surgeons are often challenged by the delicate management required. Recently, soft surgery for cochlear implant and stapedotomy has focused particularly on better prevention of inner ear damage.[6,7] These cases are also difficult to treat surgically without inner ear dysfunction.

Endoscopic ear surgery has been advocated recently,[8] and our new technique of UWEES can provide a clear surgical field of view during continuous saline water perfusion, resulting in removal of hemorrhage and prevention of refraction effects in the high-definition endoscope. In addition, this technique may prevent the inner ear damage attributed to unexpected aeration perturbing the ion balance of the endolymph, and possibly inner ear damage in vivo.[9] Underwater endoscopic techniques have already been introduced in other surgical fields such as orthopedics, urology, and more recently digestive tract internal medicine.[10–12] Both arthroscopic surgery and cystoscopic surgery are performed under irrigation with water instead of synovial fluid in the articular cavity and urine in the bladder, respectively. The advantages of underwater endoscopic surgery are 1) maintaining a good view by washing out blood and dust from the surgical field and expansion of the small cavity under pressure, and 2) avoiding idiopathic perforation of the digestive tract by dilation under water pressure resulting in maintaining the muscle layer in a state of tension when endoscopic mucosal resection is performed, so called underwater endoscopic mucosal resection. The present case demonstrates the potential of underwater endoscopic surgery for ear surgery and prevention of deterioration of inner ear function.

CONCLUSION

Closure of labyrinthine fistula caused by middle ear cholesteatoma was performed with UWEES. Saline water perfusion cleared the surgical field and prevented refraction effects in the high-definition endoscope, resulting in a clear surgical field and prevention of deterioration of cochlear function. UWEES is expected to prevent risk to inner ear function in other interventions such as cochlear implantation, stapes surgery, and temporal bone destruction corrective surgery.

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