Trans-Aditus Approach: An Alternative Technique for Cochlear Implantation

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Abstract The objective of this study was to report our preliminary experience with an alternative technique for cochlear implantation. Twenty patients underwent cochlear implantation via a trans-aditus ad antrum approach to the round window. The main steps involved in the surgical procedure are cortical mastoidectomy, elevation of tympanomeatal flap, incudostapedial joint dislocation, incus removal, preparation of a bed for the implant, cochleostomy via the external auditory canal, and finally insertion of the electrode into the cochlea via the aditus. Twenty-five implants were performed on 20 patients, 18 children (mean age of 3.2 years) and 2 adults. Twelve patients were males and eight were females. All the children were pre-lingual while the adults were post-lingual. Nucleus freedom cochlear implant system (Cochlear, Lane Cover, NSW, Australia) was used in four patients and a cochlear Nucleus 5 was used in six patients. A Med-el SONATA implant (MED-EL, Innsbruck, Austria) was used in 15 patients. The minimum follow-up was 5 months. Here, we describe a new alternative technique for cochlear implantation and report our preliminary results. The procedure has advantages over the existing techniques and avoids the potential complications of posterior tympanotomy, transcanal, and transmeatal techniques.

Keywords Cochlear implant · Trans-aditus · Alternative · Preliminary

Introduction

Posterior tympanotomy is used as the standard technique for cochlear implantation in our institute, and it is this technique that we teach our residents and fellows. The surgical technique was first described by Clark et al. [1]. The main steps involved in cochlear implantation are postauricular skin incision, mastoidectomy, posterior tympanotomy, and cochleostomy. The facial recess approach is relatively easy to perform, but may have potential complications including facial nerve paralysis [2]. Many trials have attempted to develop alternative techniques, including the suprameatal and transmeatal approach, but complications, such as electrode extrusion, infection of the external auditory canal infection, persistent otorrhea, and cholesteatoma have been reported [3]. In this report we advocate the trans-aditus approach (TAA) and we believe that the TAA has advantages over other available techniques and may avoid the complications associated with posterior tympanotomy transcanal and transmeatal approaches.

Methods

A retrospective chart review of all patients underwent TAA between January 2010 and January 2011 was performed. The age, sex, reasons to use this technique, type of implants and duration of follow-up were studied.

The study was approved by the Ethical Committee, College of Medicine, King Saud University.

Surgical Technique

Cochlear implantation was performed as follows: a postauricular incision was made 5 mm behind the sulcus, with

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the upper part extending posteriorly. The superior-based periosteal flap was elevated. Cortical mastoidectomy was carried out, and the antrum was exposed until the short process of the incus becomes visible (Fig. 1). The tympanomeatal flap was elevated to enter the middle ear while preserving the chorda tympani. Part of the scutum was removed until the stapedial tendon becomes visible. The incudostapedial joint was dislocated using a joint knife and the incus was removed (Fig. 2). The aditus is widened inferiorly by removing the bony buttress between the facial recess and fossa incudis to insert the electrode in a straight line down to planned cochleostomy (Fig. 3). The bed for the implant was drilled. Cochleostomy was performed using a 1 mm diamond burr anteroinferior to the round window membrane. The electrode was inserted through the aditus down to cochleostomy. A piece of the fascia was used to seal the cochleostomy. The periosteal flap was closed, followed by the skin, using absorbable sutures. Ordinary mastoid dressing was used. The patients were sent home on the first day post-surgery and were seen in the ear, nose and throat clinic after 10 days.

Results

Twenty-five implants were performed on 20 patients, 18 children (mean age of 3.2 years) and 2 adults. Twelve patients were males and eight were females. All the children were pre-lingual while the adults were post-lingual. All patients were having bilateral profound sensorineural hearing loss. Five patients had bilateral cochlear implants (two were simultaneous, three were sequential) and the rest were unilateral. Five patients had a very contracted mastoid cavity, forward sigmoid sinus and low dura and two patients had very narrow facial recess which made facial recess quite difficult with increased risk to facial nerve

Fig. 1 Exposure of incus after performing mastoidectomy

Fig. 2 Transcanal view of middle ear showing chorda tympani, stapes, and round window membrane after removal of niche

Fig. 3 The electrode is inserted through aditus with an easy access to cochleostomy

injury. The rest of the patients electively underwent this technique. A nucleus freedom cochlear implant system (Cochlear, Lane Cove, NSW, Australia) was used in two patients, and a cochlear nucleus 5 was used in six patients. A Med-el SONATA implant (MED-EL, Innsbruck, Austria) was used in 12 patients. The minimum follow-up was 5 months.

No complications were observed during the procedure or during postoperative follow-up.

Discussion

The facial recess is fully developed by the age of 2 years [4]. The rate of facial nerve injury that occurs during cochlear implantation using the facial recess approach has decreased in recent years. However, in some cases, such

injury is unavoidable. The introduction of facial nerve monitoring and the increase in the experience may have some contribution for decreasing the facial injury during cochlear implantation. Facial nerve injuries are frustrating for both the patient and the treating physician. In one study, the incidence of facial nerve palsy was 1.7% [4], and in the Melbourne and Hanover study, the rate was 2% [5]. The classical posterior tympanotomy approach for cochlear implantation has not changed since its introduction. However, successful cochlear implantation can be affected by anatomical variations that limit surgical exposure, as well as by pathological changes to the middle and inner ear. A poorly developed mastoid with an anterior sigmoid sinus may limit access to the facial recess. Access to the middle ear and round window niche via the facial recess may be limited by an aberrant facial nerve in the congenitally malformed ear. Further, cochlear dysplasia may obscure anatomical landmarks [6].

Many trials have been performed in an attempt to develop other cochlear implant techniques. The suprameatal approach is an alternative, non-mastoid approach for cochlear implantation. With this approach, the middle ear is exposed from the external auditory canal, and electrodes were inserted into the cochlea through a closed suprameatal tunnel, by passing the mastoid cavity [7]. However, most surgeons prefer not to operate in a closed tunnel all the way to the middle ear or to drill in a very narrow field [8]. This technique is associated with the risk of facial nerve injury, as the tunnel is drilled blindly into the posterior canal wall. Hausler [9] used the pericanal electrode insertion technique, which involves drilling an open-tunnel into the posterior–superior region of the bony external auditory canal from immediately above the incus body towards the outer border of the external auditory canal.

The transmeatal approach is an open-tunnel, transcanal technique developed to overcome some of the problems associated with the above-mentioned two techniques. The transmeatal approach provides an excellent view to the round window and involves drilling a tunnel visibly in the external canal [10]. However, electrode extrusion, external infection with persistent otorrhea, and cholesteatoma are complications that may arise from the transmeatal approach.

The TAA has advantages over both the transmeatal and suprameatal approach by providing direct access to the round window and overcoming any anatomical variations in the round window area that may make cochleostomy and electrode insertion challenging and, in some cases, quite difficult. The TAA also avoids any risk to both the facial

nerve and chorda tympani. Further, the duration of the TAA procedure compared to classical techniques is shortened by at least half an hour, which is of particular importance during bilateral simultaneous cochlear implantation in young children. A limitation of the case series presented here is the relatively short follow-up. Additionally, conservation of residual hearing by hybrid or electroacoustic stimulation is not feasible using this technique.

Conclusion

we have described a simple, quick, and safe alternative technique for cochlear implantation. The only visible limitation of this technique is its lack of applicability in patients who require electroacoustic stimulation.

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