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Surgical considerations and safety of cochlear implantation in otitis media with effusion

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ABSTRACT

Objective: To evaluate the effects of otitis media with effusion on surgical parameters, patient safety, perioperative and postoperative complications.
Methods: Total 890 children who underwent cochlear implantation between 2006 and 2015 were included. The ages ranged from 12 months to 63 months (mean: 32 months). The patients were divided into two groups according to the presence or absence of otitis media with effusion; otitis media with effusion group and non-otitis media group.
Results: Of 890 children, 105 had otitis media with effusion prior to surgery. In non-otitis media with group, there were 785 children. The average duration of surgery was 60 min (ranged from 28 to 75 min) in non-otitis media group, and 90 min (ranged from 50 to 135 min) in otitis media with effusion group ($p < 0.05$). Granulation tissue and edematous middle ear and mastoid mucosa were observed in all cases of otitis media with effusion during the surgery. There was no significant difference between the complications of groups with or without otitis media with effusion ($p > 0.05$). In 5 of 105 patients, there was a ventilation tube inserted before cochlear implantation, which did not change the outcome of implantation.
Conclusion: There is no need for surgical treatment for otitis media with effusion before implantation since otitis media with effusion does not increase the risks associated with cochlear implantation. Operation duration is longer in the presence of otitis media with effusion. However, otitis media with effusion leads to intraoperative difficulties like longer operation duration, bleeding, visualization of the round window membrane, cleansing the middle ear granulations as well as mastoid and petrous air cells.

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1. Introduction

Cochlear implant is the best option for patients with profound sensorineural hearing loss who do not benefit from hearing aids. Widespread implementation of newborn hearing screening and emerging evidence on benefits of implantation at early ages caused a significant decrease in age at implantation [1,2]. Otitis media with effusion (OME) is a common childhood disease, and can be seen before age of one year as well [3]. Since the age at which a child will receive cochlear implant has decreased, some cochlear implant candidates may have OME at the time of surgery, which may impact on auditory assessments and create surgical difficulties. The incidence and

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severity of the otitis media do not increase after implantation [4], which may be attributed to decreased overall otitis media prevalence by age, and mastoidectomy performed during cochlear implantation. In addition, inner ear malformations, cerebrospinal fluid leak, otitis media may also increase the risk of infectious complications, mainly meningitis [4].

There may be high incidence of bleeding and inflamed mucosa in the middle ear and mastoid bone in cases of OME, which may impede proper visualization of the anatomic structures and carry higher risk of intraoperative complications [5]. In addition, middle ear effusion may also increase the risk of infectious complications, mainly meningitis [4]. Although ventilation tube (VT) insertion may help improve the inflamed mucosa and decrease the incidence of complications, it may possess several disadvantages like disruption of the tympanic membrane which makes children susceptible to infectious complications. In addition, VT insertion may delay cochlear implantation and in turn the duration of auditory deprivation. On the other hand, cochlear implantation surgery consists of mastoidectomy with posterior tympanotomy. Therefore, healthy and aerated middle ear can be provided following cochlear implantations, which help eliminate the need of a previous VT insertion.

The aim of this study was to evaluate the effects of OME on surgical parameters, patient safety, perioperative and postoperative complications in cochlear implantation.

2. Materials and methods

This retrospective study included 890 children who underwent cochlear implantation between 2006 and 2015 by the same surgical team at different centers. There were 523 boys (59%) and 367 girls (41%) with ages ranging from 12 months to 63 months (mean 32 months).

The patient selection was made according to the following criteria; absence of inner ear malformation or ossification, signs and symptoms of acute or chronic otitis media or cholesteatoma, systemic or neurological disease, and absence of cerebrospinal fluid leak and partial implant electrode insertion. There were no otitis prone children as evidenced by history.

Data were collected from medical and surgical records of the patients and included the age and gender of the patient, presence of OME, peri and postoperative complications, duration of surgery and follow-up period. A detailed medical history was obtained and a thorough otologic and audiologic assessment was performed on all patients. All patients underwent magnetic resonance imaging (MRI) for the evaluation of cochlear nerve and/or high resolution computed tomography (CT) of the temporal bone.

The patients were divided into two groups according to the presence or absence of OME; OME group and non-OME group. Diagnosis of OME was based on history, otoscopic findings, audiologic work-up and preoperative CT scans, and a bacterial cultivation was not performed [6]. One stage cochlear implantation with full electrode insertion was performed in all cases independent of OME. A preoperative VT placement or medical treatment was not made in the presence of OME unless a VT placement was performed in another center before cochlear implantation.

All operations were performed under general anesthesia using double flap transmastoid technique. A mastoidectomy was performed in all cases. After identification of mastoid antrum and short process of incus, posterior tympanotomy was performed. Cochlear implant was inserted through the round window or cochleostomy which was anterior inferior to the round membrane. All patients were followed up at least 12 months postoperatively. A tympanic membrane atelectasis was not encountered in the follow up period. Chi square or independent samples-t test was used in the statistical analyses.

3. Results

Of 890 children, 105 had OME prior to surgery. There were 63 boys and 42 girls with a mean age of 34 months. In non-OME group, there were 785 children. Non-OME group included 460 boys and 325 girls with a mean age of 47 months (Table 1).

The average duration of surgery was 60 min, ranging from 28 to 75 min in non-OME group and 90 min, ranging from 50 to 135 min in OME group. There was a significant difference between two groups regarding the mean duration of surgery ($p < 0.05$) (Table 1).

Granulation tissue and edematous middle ear and mastoid mucosa were observed in all cases of OME during the surgery. Inflamed mucosa and pathological granulations obscuring the round window were removed for identification of the round window membrane. In some of the cases glue was aspirated from attic or through posterior tympanotomy. In 14 cases the incus was removed to clean the granulations in the attic and middle ear. In 6 cases further drilling is performed in the attacked petrous air cells around the semicircular canals, and mastoid and geniculate segments of the facial nerve (Table 1).

Table 1
Comparation of main parameters (mean of patients age, duration of surgery, operative difficulties and complications) between OME and non OME group.

Parameter	OME group N = 105	Non OME group N = 785
Mean patient age (months)	34	47
Duration of surgery (min)	90 (50–135)	60 (28–75)
Operative difficulties	Incus removal n = 14 Extra drilling of petrous air cells n = 6	Narrow facial recess n = 3
Complication	None	Temporary facial paresis n = 1 Explantation due to biofilm formation

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No complication was encountered in OME group in peri or postoperative period. In non-OME group, complications were encountered in 2 patients; one temporary facial paresis due to thermal injury in the mastoid segment of the fallopian canal, which resolved spontaneously within a few months; and the other patient had an infection of the receiver-stimulater of the cochlear implant due to biofilm formation, and needed revision surgery. There was no significant difference between the complications of groups with or without OME ($p > 0.05$) (Table 1).

In 5 of 105 patients, there was a VT inserted in another center before cochlear implantation. These VTs were removed at the time of implantation and tympanic membrane perforations were repaired using dumbbell fat graft. None of the patients who had a VT preoperatively had complication. In the patient who had a previous VT insertion due to OME, granulations in the mastoid air cells and middle ear mucosal edema were persisting to some extent.

4. Discussion

OME is a common problem in young children and many cochlear implant candidates may present with OME prior to implantation. The rate of OME may be up to 44% at the time of implantation [3]. Management of OME in cochlear implant candidates remains controversial. Treatment of the middle ear effusion and delaying the implantation, VT insertion at the time of implantation, and performing the implantation without delay are the possible options in cochlear implant candidates with OME [7]. Additionally, short term medical treatment with antihistamines and steroids are also suggested [8].

Timing of cochlear implantation in the presence of OME is a major challenge confronting physicians. Theoretically, an implant placement into the sterile inner ear through an inflammed middle ear bears risk of implant extrusion and spread of inflammatory mediators to the inner ear which may result in an intracranial infection [9,10]. In addition, the presence of OME before implantation is associated with the need of removal of obscuring granulation tissues and inflammed mucosa, as well as bleeding in the surgical field. Therefore, consequences of OME seem to increase the risk of complications associated with cochlear implant surgery.

Many surgical difficulties can be seen during CI surgery. These can be in the mastoid like anteriorly located sigmoid sinus, Körner's septum, narrow facial recess. These can be overcome by the known surgical techniques and adjunctive use of endoscopes. In OME, opening the facial recess is somewhat time consuming because the granulations in the perifacial area may interfere with locating the fallopian canal. Sometimes incus removal and drilling the bone in posterior buttress may be needed. In addition, it is difficult to visualize the round window due to inflamed or hyperplastic middle ear mucosa and granulations. These factors elongate the duration of operation.

VT insertion prior to implantation and medical treatment for OME may allow for providing a sterile middle ear. VT insertion reduces granulation tissue and heals inflammed mucosa and consequently may help to reduce intraoperative difficulties associated with obscuring bleeding and diseased mucosa [11]. By contrast, the placement of VT may lead to several potential complications including recurrent or chronic otorrhea and persistent tympanic membrane perforation [12–14]. Disruption of the tympanic membrane and recurrent otorrhea may increase the risk of infectious complications following the surgery. However, VT insertion, waiting for the middle ear to heal, removing the VT and waiting for the tympanic membrane to heal also cause a delay in cochlear implantation [10]. As the early implantation is critical to yield better outcome, a delay in cochlear implantation may impact on speech, language and education [15].

Previous reports suggest that there is no benefit of treating OME before cochlear implantation [10,14,16], and cochlear implant candidates with OME can be safely implanted without preimplantation VT insertion [14]. These contentions are comparable with the findings in our study, which is one of the largest series comparing children with and without OME who underwent cochlear implant surgery.

5. Conclusion

In conclusion, there is no need for surgical treatment for OME before implantation since OME does not increase the risks associated with cochlear implantation. Operation duration is longer in the presence of OME. However, OME leads to intraoperative difficulties like longer operation duration, bleeding, visualization of the round window membrane, cleansing the middle ear granulations as well as mastoid and petrous air cells.

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Ethics

This study was approved by local institutional ethical committee.

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