

Retained Foreign Body in the Eustachian Tube in a Case of Skull Base Osteomyelitis: A Case Report and Review of Literature

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Received: November 29, 2021

Published: January 20, 2022

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Abstract

Retained foreign bodies in eustachian tubes can lead to dreaded complications and should be tackled meticulously. We present a case report of impacted ear mold in the eustachian tube leading to skull base osteomyelitis and its management. We also did an extensive literature review of foreign bodies in eustachian tube and its sequel.

Most common foreign bodies in the middle ear in adults are tympanostomy tubes, impression material used to make ear molds and sludge from welding. In case of dislodgement of ear mold into the middle ear, the site of impaction was eustachian tube opening in 46% cases. The literature review showed that the most common complication was hearing loss (36%) and ossicular disruption. In our case it also resulted in skull base osteomyelitis leading to facial nerve palsy.

Extreme caution and expertise is required in the management of the same. Piecemeal removal should be avoided and such cases should be managed by an experienced otologist. Simultaneous single stage Cochlear Implant for hearing restoration is a possibility in such cases where complete disease clearance is confirmed.

Keywords: Ear-mold Fitting; Foreign Body; Eustachian Tube; Skull Base Osteomyelitis; Sensorineural Hearing Loss; Facial Palsy; Subtotal Petrossectomy; Cochlear Implant

Abbreviation

FB: Foreign Body; SBO: Skull Base Osteomyelitis; ET: Eustachian Tube; ICA: Internal Carotid Artery, HRCT: High Resolution Computed Tomography; MRI: Magnetic Resonance Imaging; CI: Cochlear Implant; HB Grading: House Brackmann Grading

Introduction

Foreign bodies in the external ear are common, but they getting impacted in the Eustachian tube area are relatively rare and can lead to grave complications [1,2]. Using ear molds for sizing the hearing aid is a routine practice among audiologists. It is unusual that such molds accidentally dislodge and cause traumatic perfora-

tion of the tympanic membrane leading to serious complications like skull base osteomyelitis [3].

We also present a literature search into other commonly found aural foreign bodies, the presentation and complications caused by impacted ear mold material in the ear and its management. Through this article we highlight the possibility of skull base osteomyelitis developing in cases of retained foreign bodies in the ear. Management of such cases demands complete understanding of the critical structures encountered in the surgical approach. We would also like to stress upon the feasibility of hearing restoration, by an ipsilateral simultaneous cochlear implantation, in cases where complete disease clearance is certain.

Case Report

A 56 year old lady who is diabetic presented to our Skull base institute with a history of right ear discharge and ear pain for 8 months and facial deviation for 3 months. She had gradually decreasing hearing in both ears for which she underwent pure tone audiometry testing in a hospital elsewhere and was diagnosed to have sensorineural hearing loss. She underwent a hearing aid trial and ear-mould fitting 8 months ago following which she developed the above symptoms. She also gave history of undergoing a procedure at a local hospital to remove the same.

On arrival to our clinic she was conscious and oriented, vitals were stable. ENT and head neck examinations showed a large central perforation of the right tympanic membrane with granulations filling the perforation (Figure 1a) and right facial palsy, House Brackmann (HB) grading V. Pure tone audiometry showed profound hearing loss in the involved side and severe sensorineural hearing loss on left side. Rest of the ENT and head and neck examination and CNS examination was within normal limits. Pre-operative ear swab culture showed moderate growth of *Staphylococcus aureus* – sensitive to Cotrimoxazole, tetracycline, oxacillin and linezolid. She was started on Cefuroxime and Linezolid as per the reports. The total blood counts were within normal limits at the time of presentation. Random plasma glucose was 286 mg/dl and endocrinology opinion was sought for optimisation of blood sugars.

Radiological imaging was requested with the diagnosis of skull base osteomyelitis (SBO) kept in mind. HRCT temporal bone showed soft tissue thickening along the right external auditory

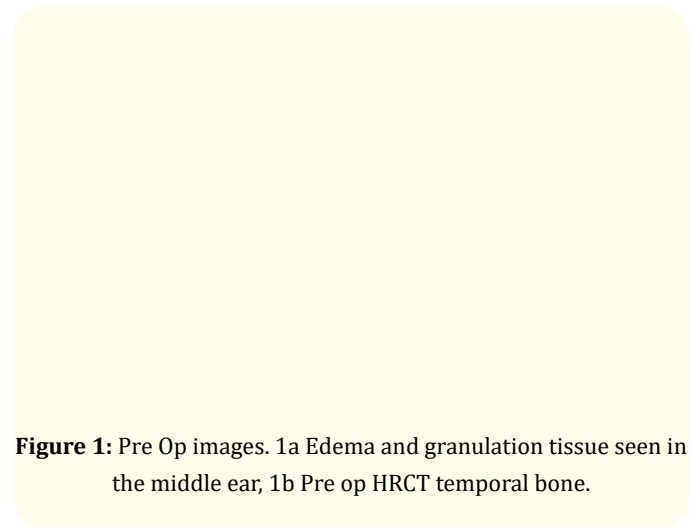


Figure 1: Pre Op images. 1a Edema and granulation tissue seen in the middle ear, 1b Pre op HRCT temporal bone.

canal, mesotympanum and epitympanum involving the prussak's space. Demineralisation of the bony canal of the tympanic segment of facial nerve and erosion of the carotid canal was noted (Figure 1b). She underwent subtotal petrosectomy with facial nerve decompression with ipsilateral simultaneous cochlear implantation for hearing restoration.

Intraoperative findings were suggestive of retained foreign body (which was white in colour) in the mesotympanum near the eustachian tube area, with signs of erosion of the bony canal over the carotid (Figure 2a). Granulations were found filling the mesotympanum, around the ossicles, causing erosion of the tympanic segment and the vertical segment of the fallopian canal (Figure 2b). The canal wall down mastoidectomy was followed by removal of as many cell tracts as possible to ensure that there is no residual disease. The peritubal cells were removed as well, because they can form the route for CSF to the nasopharynx, bypassing the closed Eustachian Tube (ET). The skin, annulus, and tympanic membrane with malleus and incus and stapes suprastructure were also removed en bloc to lower the risk of leaving some skin behind. Foreign body was noted abutting the petrous carotid around the eustachian tube orifice. It was removed in toto. Complete disease clearance was achieved with facial nerve decompression and subtotal petrosectomy with blind sac closure. Eustachian tube orifice was sealed with periosteum and bone wax. Ipsilateral simultaneous cochlear implantation was planned. Electrode was inserted through a round window approach (Figure 2c). Electrode position and function was confirmed with intraoperative impedance audi-

ometry and neural response telemetry. Haemostasis achieved and harvested abdominal fat was placed in the operated cavity (Figure 2d). Wound closed in layers.

c d

Figure 2: Intra op images. 2a. Foreign body which was in the Eustachian tube area pulled out into the mesotympanum, 2b. Facial canal found eroded and facial nerve exposed 2c. CI electrode inserted, exposed facial nerve covered using muscle and fascia. 2d. Harvested abdomen fat placed in the operated cavity with cochlear implant in situ.

Histopathology was sent from various areas like external auditory canal, mastoid antrum, middle ear eustachian tube area and from around the facial nerve. It showed signs of chronic inflammation and inflammatory granulation tissue. There was no evidence of malignancy or granulomas. There was no growth in pus culture (aerobic culture) after 48 hours of incubation.

X Ray mastoid - modified stenvers view was taken on post operative day 1, to confirm the position of CI and electrodes were found to be in place. Post operative HRCT showed complete disease clearance and noted CI in position (Figure 3). On 8 months follow up the patient is symptom free and her facial palsy improved to HB grading - III.

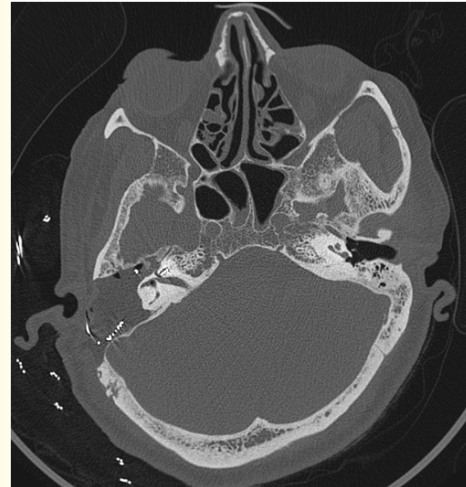


Figure 3: HRCT - axial view showing the extent of surgery, CI electrode noted in position.

Discussion

Aural foreign bodies can be classified based on their nature into organic-inorganic, animate-inanimate, metallic-nonmetallic, hygroscopic-non hygroscopic etc. [4,5]. Animate foreign bodies and metal foreign bodies are the ones that require emergency removal as they are known to cause extensive tissue reaction and infection [5]. Metal objects retained in the body possess the risk of burns if the patient is subjected for an MRI [6].

Reports of eustachian tube foreign bodies are rare, since bougienage and electrolytic treatment have lost favor. Broken bougies and bougie tips were foreign bodies in late 18th and early 19th centuries [7]. Foreign bodies commonly found in the middle ear are tympanostomy tubes, impression material used to make ear moulds, and sludge from welding [6]. A PubMed search was done using the terms "eustachian tube", "aural foreign body", and "complications". In addition to the above-mentioned objects (these 3 objects were excluded), metal beads, wood parts, cotton wool, alkaline batteries etc. are also reported to be extracted from the middle ear, relevant articles are included in table 1 (Table 1).

Most common site of impaction of the aural foreign body is the external auditory canal followed by middle ear [16]. In our case the foreign body was earmold material used in making an impression for hearing aids which was found in the eustachian tube area.

Serial No:	Journal	Authors	Year of publication	Nature of foreign body	Location of Foreign Body	Complication	Surgical management	Outcome
1	Arch Otolaryngol	Hawke., <i>et al.</i> [8]	1981	Granuloma around ET prosthesis	Eustachian tube	Chronic Otitis media	Mastoidectomy + Tympanoplasty and removal of FB	Symptom regression
2	Nihon Jibiinkoka Gakkai Kaiho.	Tono T., <i>et al.</i> [9]	1996	Cannonball fragments	Bony Eustachian tube	Chronic otitis media with cholesteatoma	Transmastoid approach to bony eustachian tube	Symptom regression
3	Indian J Otolaryngol Head Neck Surg.	Srinivas Moorthy., <i>et al.</i> [4]	2007	Metal stud	Middle Ear and Eustachian tube	Ear discharge, hearing loss	Mastoidectomy + Tympanoplasty and removal of FB	Dry ear
4	Rev Bras Otorrinolaringologia	Ribeiro Fde A., <i>et al.</i> [2]	2008	Wooden skewer	Middle Ear and Eustachian tube	Profound Hearing Loss, Carotid canal erosion, ICA thrombosis	CWD mastoidectomy and removal of FB	Dry ear
5	Br J Oral Maxillofac Surg	Chang Moong., <i>et al.</i> [10]	2014	Surgical gauze	Eustachian tube	Chronic otitis media	Nasopharyngoscopy and eustachian tube exploration	Symptom regression
6	Journal of Acupuncture and Meridian Studies	Igarashi K., <i>et al.</i> [6]	2015	Gold plated ball	Eustachian tube	Hearing Loss, otalgia	CWD mastoidectomy and removal of FB	Symptom free
7	International Journal of All Research Education and Scientific Methods	Rohilla., <i>et al.</i> [11]	2015	Button battery	External auditory canal and middle ear	Temporal bone osteomyelitis	Mastoidectomy + Tympanoplasty and removal of FB	Symptom regression
8	Indian J Otol	Hernot., <i>et al.</i> [12]	2016	Button battery	External auditory canal and middle ear	Chronic Otitis media	Mastoidectomy + Tympanoplasty and removal of FB	Disease free
9	Iranian Journal of Otorhinolaryngology	Parelkar., <i>et al.</i> [1]	2018	Eroded incus	Eustachian tube	Profound Hearing Loss, COM squamosal	CWD mastoidectomy and removal of FB	Symptom regression
10	Case Rep Otolaryngol	Philp., <i>et al.</i> [13]	2019	Metallic foreign body	Middle Ear and Eustachian tube	Otalgia, dizziness	Tympanotomy and eustachian tube exploration	Symptom free
11	BMJ case reports	Woodley., <i>et al.</i> [14]	2019	Cotton wool	Middle ear and Eustachian tube	Necrotising otitis externa with suppurative labyrinthitis	Combined approach tympanoplasty with blind sac closure	Dry ear, regression of symptoms
12	Turk Arch Otorhinolaryngol	Rato., <i>et al.</i> [15]	2021	Stapes prosthesis	Eustachian tube opening	Otorrhoea, hearing loss	Tympanotomy and Eustachian tube exploration	Symptom regression

Table 1: Review of literature - Articles which reported extraction of foreign bodies from the middle ear and eustachian tube, 1980 till date. The ones which report pressure equalization tubes, sludge from welding and impression material for ear mold have been excluded.

Such complications are known to occur in patients with a pre-existing perforation of the tympanic membrane, although traumatic perforation may occur in rare circumstances. 5 out of a cohort of 23 cases (21%), published by Samuel, *et al.* were found to have a traumatic perforation of the tympanic membrane [3]. 38% of aural foreign bodies, other than ear mold, also caused traumatic perforation according to Olajuyin, *et al.* [16]. The foreign bodies retained around the eustachian tube (as in our case) need particular attention due to the close proximity to the carotid canal [1].

Ear molds are routinely made of polyvinyl chloride (also known as vinyl or PVC), polyethylene, acrylic or medical grade silicone [17]. They are commonly available as Otoplast or Otoform. Individuals who are prone for allergies need to test their compatibility with a certain earmold material prior to insertion. Otoplast is a UV light-cured synthetic resin provided with a ceramic filter comprising at least 50% by weight of aluminum trioxide [18]. This is preloaded in a syringe and injected to take the impression of the ear canal. Incorrect use of the injection gun or syringe, can lead to forceful injection of mold material into the middle ear in the presence of a perforation or cause a traumatic perforation [3,17-19]. Such cases remain highly underreported. Only 11 such studies have been published till date (ours would be the 12th).

The symptoms at presentation depend not just on the duration of retention of the foreign body but the immune status of the patient and the tissue reaction elicited by the material. The longest time interval reported between removal of the foreign body (widely spread from 1 day to 9 years) in the middle ear and iatrogenic ear mold impression is 9 years [18,20].

The common symptoms include ear pain, ear block, tinnitus, dizziness etc. in acute cases to hearing loss, Intractable otorrhea and granulations in chronic cases [21,22]. In our case even though the duration of retention was less than an year it had progressed to skull base osteomyelitis with cranial nerve palsy. There was erosion of the petrous carotid and erosion of part of tympanic and vertical segments of facial nerve. Low immunity and hyperglycemia in the setting of uncontrolled diabetes might have led to the quick progression of disease.

Pseudomonas aeruginosa remains the most common pathogen involved in typical SBO but there are increasing rates of sterile or fungal cultures due to previously applied antibiotics/steroids [23].

SBO secondary to foreign bodies in the ear have been reported, but seldom [24].

Culture directed intravenous antibiotics and surgical removal of the foreign body along with complete disease clearance is the mainstay of treatment. Depending on the type of foreign body, its position, extent of tissue reaction and disease, the method of removal varies [2,3,25]. Radiological imaging is required to assess the extent of the disease, in chronic cases the findings may be non specific [20,21]. Proper visualization and safe removal of impacted impression material is feasible by common otological procedures like tympanomastoidectomy (with facial recess approach), atticotomy, modified radical mastoidectomy etc. [18,21,26].

In rare situations such as ours, in which most of the air cell tracts in the mastoid and middle ear were involved by disease, one needs to do a subtotal petrosectomy (STP). STP is indicated in any disease primarily involving the middle ear and mastoid with limited extensions into deeper parts of the temporal bone that leaves behind a large cavity. The most common indication for STP is recurrent chronic otitis with or without cholesteatoma. A well performed STP enables a simultaneous CI and the surgery must be staged only in case of doubt regarding disease clearance [27]. STP helps in isolating the cavity from the external environment after removal of disease, improves the exposure and access, reduces risk of infection and cerebrospinal fluid (CSF) leaks and facilitates CI [28]. Eradication of the disease, restoration of hearing, prevention of recurrence and implant infection or extrusion should be the primary goals in such cases [29]. In cases with bilateral hearing loss, hearing rehabilitation should be considered as soon as feasible (with the goal of restoring hearing in at least one ear) thereby improving the quality of life. Various implantable hearing solutions are available, such as cochlear implants, osseointegrated hearing implants, OSIA (osseointegrated steady state implant) and auditory brain-stem implants (ABIs), which needs to be considered in individuals who have undergone skull base surgery involving the inner ear. In our case, we chose ipsilateral simultaneous hearing restoration, by cochlear implantation, with the conviction of total disease clearance.

Conclusion

Audiologists should be aware that ear mold fitting can lead to perforation of tympanic membrane while it is delivered using the

gun. It is prudent to use some form of protection shield like sponge, medial to the syringe to protect the tympanic membrane from inadvertent injury. Otoscope examination of ear canal and tympanic membrane is a must before taking the impression. Regular auditing of the complications following such procedures is recommended.

Extreme caution is required while removal of aural foreign bodies and piecemeal removal is to be avoided in such cases. Where the complications are extensive, patients should be explained about the magnitude of the problem, criticality of the surgery and hearing restoration goals. High index of suspicion is required in such cases, histopathological examination to rule out malignancy and other granulomatous disorders is a must. Simultaneous single stage CI for hearing restoration is a possibility in such cases where complete disease clearance is done.

Acknowledgements

There are no acknowledgements, competing interests, or conflicts of interest to declare.

Conflict of Interest

There aren't any conflicts of interest.

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