The Journal of Laryngology & Otology
May 2003, Vol. **117,** pp. 344–348

Main Articles

Surgical intervention in middle-ear cholesterol granuloma

Manabu Maeta, M.D., Ryusuke Saito, M.D.*, Fumio Nakagawa, M.D.*, Takakazu Miyahara, M.D.*

Abstract
Eleven patients who had been surgically treated from 1988 to 1999 were retrospectively reviewed in order to evaluate the efficacy of ventilation tube insertion and mastoidectomy with, or without, mastoid obliteration for intractable middle-ear cholesterol granuloma. The mean age registered was 17.2 years at the time of surgical treatment. All cases were unilaterally affected. Five ears were treated with simple mastoidectomy coupled with the insertion of a ventilation tube, while six others had additional mastoid obliteration. The hearing prognosis was excellent with an improved post-operative hearing level of 16.5 dB (cf. pre-operative 37.7 dB). However, morphological prognosis revealed two ears had a residual perforated tympanic membrane without otorrhoea after displacement of the ventilation tube. Of the remaining nine ears with intact placement of the ventilation tube, five had dry ears while four had occasional otorrhoea. Although the morphological prognosis was incomplete, treatments involving at least an insertion of a ventilation tube with thorough mastoidectomy were thought to be necessary.

Key words: Granuloma, Foreign-Body; Middle Ear Ventilation; Mastoid, surgery

Introduction

Cholesterol granuloma (CG) is a pathological term that describes a lesion often observed during operative procedures for chronic middle-ear diseases. In cases where partial blockade of the middle-ear cavity is found, mucosal vasculature-derived transudation and cholesterol precipitation are encountered in obstructed peripheral air spaces. As a result of the ensuing foreign body reaction to cholesterol crystals, a granuloma is formed. In other words, middle-ear lesions such as chronic otitis media, adhesive otitis media and middle-ear cholesteatoma, etc., are often accompanied by CG. The existence of major CG in the form of otitis media without other middle-ear diseases causing blockade, however, has reinforced the concept that middle-ear CG is an independent disease per se. As a single disease, CG is intractable and its aetiological/therapeutical perspectives remain unresolved. As CG prevails within the mastoid cavity, surgical intervention has been resorted to as a reliable confirmatory diagnosis of the lesion, despite recent advances in imaging diagnoses. In this study, clinical investigations focusing on surgically confirmed cases of CG as an independent disease were attempted to evaluate the efficacy of surgical treatments for intractable middle-ear CG.

Patients and methods

Eleven cases with histopathologically confirmed middle-ear CG (male: seven; female: four cases) participated in this 11-year study (September

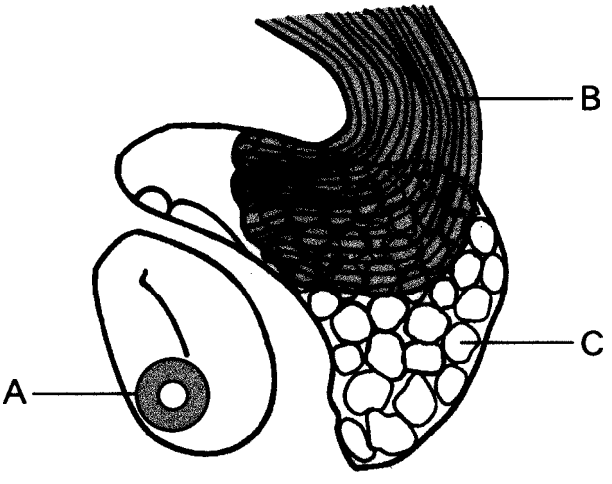

Fig. 1
A schematic diagram illustrating the insertion of a ventilation tube (A), simple mastoidectomy and mastoid obliteration with a Palva flap (B) and hydroxyapatite granules (C).

From the Department of Otolaryngology–Head and Neck Surgery, Okayama University Graduate School of Medicine and Dentistry, and the Department of Otolaryngology*, Okayama Saiseikai General Hospital, Okayama, Japan.
Accepted for publication: 10 January 2003.

TABLE I
BACKGROUND OF PATIENTS

Case no.	Sex	Age	Suffering years	Incidence of myringotomy	Ventilation tube insertion times	Eustachian tubal catheterization	Contralateral ear
1	F	11	1	3	0	stenotic	normal
2	M	28	2.5	1	3	good	OME
3	F	14	1	2	2	stenotic	normal
4	M	31	16	2	0	stenotic	normal
5	M	17	8	3	0	stenotic	normal
6	M	18	1.5	2	1	stenotic	normal
7	M	9	7	2	1	good	normal
8	F	22	8	2	1	stenotic	normal
9	M	7	2	3	0	stenotic	normal
10	F	14	7	4	1	stenotic	normal
11	M	18	4	1	1	stenotic	normal

M = male; F = female; OME = otitis media with effusion.

1988–December 1999) at our hospital. The post-operative periods varied from three months to 12 years with an average duration of four years.

Surgical procedures involving simple mastoidectomy and insertion of a ventilation tube were employed in five cases, while six cases had additional mastoid obliteration. Of the latter six cases, mastoid obliteration with a Palva flap alone was performed in one case and complemented with hydroxyapatite granules in the remaining five cases (Figure 1). After displacement of the ventilation tube and closure of the perforation of the tympanic membrane, insertion of the ventilation tube was repeated in cases where effusion in the tympanic cavity was observed.

Results

Background of patients (Table I)

All patients, referred to our hospital from ENT practitioners of other clinics, presented dark brown otorrhoea or a persistent blue eardrum despite previous treatments with myringotomy, insertion of a ventilation tube or steroid therapy. The eustachian tubal catheterization of nine cases was stenotic. The contralateral ears were normal except for one ear showing otitis media with effusion. The age-range of patients was seven to 31 years with a mean of 17.2 years.

Surgical findings (Table II)

The tympanic membranes in all cases showed a blue eardrum; in one case it was bulging, the other cases indicated retractions. The sites of CG were confined to the mastoid cavity in five ears, while CG in the six other ears extended to the attic. Two of these six ears showed attic blockade. Effusion was observed in the mesotympanum and hypotympanum without signs of granulation. Furthermore, all except three patients' ears showed good or excellent development of mastoid air cells.

Prognosis of hearing (Figure 2)

Differences in operative procedures were not noted, and excellent hearing outcomes were obtained except for one ear. The post-operative hearing levels were comprised of air conduction of 16.5 ± 10.9 dB with an air-bone gap of 13.9 ± 9.0 dB compared with respective pre-operative values of 37.7 ± 14.1 and 31.5 ± 14.8 dB. The last follow-up examination was employed as the post-operative hearing level (three months to 12 years with an average of four years).

Prognosis of morphological aspect (Table III)

Ventilation tubes in two ears were displaced with residual perforation of the tympanic membrane without otorrhoea. Myringoplasty was not performed in these cases to preserve middle-ear

TABLE II
SURGICAL FINDINGS

Case no	Tympanic membrane	Location of CG	Development of mastoid air cells	Attic block
1	Blue, retracted	mastoid, attic	excellent	–
2	Blue, retracted	mastoid	good	–
3	Blue, retracted	mastoid, attic	poor	–
4	Blue, retracted	mastoid, attic	good	–
5	Blue, retracted	mastoid	poor	–
6	Blue, retracted, otorrhoea	mastoid, attic	good	+
7	Blue, retracted	mastoid	poor	–
8	Blue, retracted	mastoid	good	–
9	Blue, retracted	mastoid, attic	good	+
10	Blue, bulging	mastoid	good	–
11	Blue, retracted	mastoid, attic	excellent	–

https://doi.org/10.1258/002221503321626366 Published online by Cambridge University Press

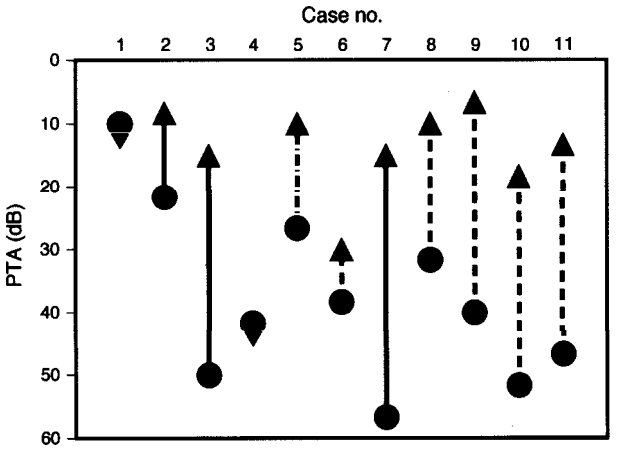

FIG. 2

Prognosis of hearing indicating pure tone average (PTA: 0.5, 1, 2 kHz) before (closed circles) and after (arrow heads) operation. Solid lines represent cases (1, 2, 3, 4, 7) treated by insertion of a ventilation tube and simple mastoidectomy, while broken-and-solid line indicates a case (5) where additional mastoid obliteration was performed with a Palva flap, and broken lines showing cases (6, 8, 9, 10, 11) where additional mastoid obliteration was performed with a Palva flap and hydroxyapatite granules.

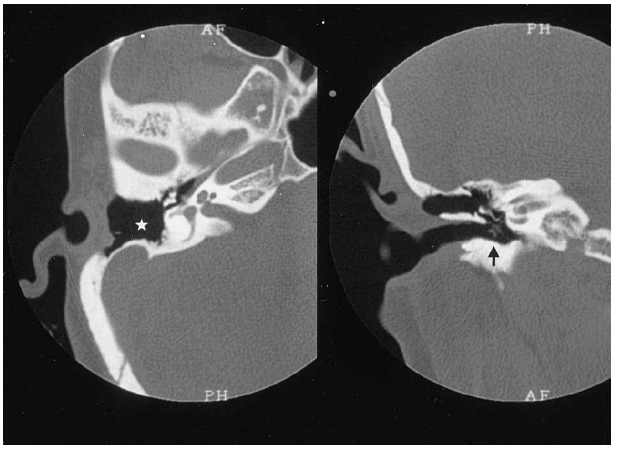

FIG. 3

CT scan of the right ear in *Case 3* at seven years five months post-operation portraying the semiaxial (left) and coronal (right) sections. *Case 3* was treated with simple mastoidectomy (star) and insertion of a ventilation tube (arrow).

ventilation. The remaining nine ears had the ventilation tubes retained, and re-insertion of the ventilation tube was followed-up in cases where long-term insertion was required. Re-insertion of the ventilation tube was required in these cases every one or two years. Of these nine ears, five were persistently dry and four had occasional otorrhoea in the tube or external auditory canal that spontaneously dried without any treatment. Altogether, no further surgical treatment except re-insertion of the ventilation tube was performed.

Illustrative cases

Follow-up computed tomography (CT) scans were evaluated in each case every one or two years. CT scans of two cases showing typically good appearances are indicated (Figures 3 and 4).

In *Case 3*, where simple mastoidectomy and insertion of a ventilation tube were performed, the CT scan at seven years five months post-operation portrayed complete pneumatization of the mastoid and tympanic cavity after mastoidectomy (Figure 3).

In addition, *Case 8* where simple mastoidectomy and insertion of a ventilation tube were complemented with mastoid obliteration, a post-operative CT scan at one year seven months showed excellent pneumatization from the non-obliterated attic to the mesotympanum and hypotympanum (Figure 4).

Discussion

Chocolate brown fluid derived from an alteration of blood inflates the tympanic cavity to induce idiopathic haemotympanum, or blue eardrum. These two clinical terms implicate similar clinical findings. As CG is sited in the mastoid cavity in idiopathic haemotympanum, the two clinical terms, idiopathic haemotympanum and CG as a single disease, are used for similar clinical implications. From one point of view, idiopathic haemotympanum is not a specific disease but 'a phase of otitis media with effusion'.[1,2] However, certain differences are noted when the independent disease, CG, is compared with intractable otitis media with effusion. Comparing special features of CG with those of intractable infant otitis media with effusion, Nakano[3] states that the incidence of CG is highly unilateral, commonly found within the range of 10–19 years of age, affected subjects have eustachian tube dysfunction, are affected by blue eardrums and the symptoms are intractable. Although infant otitis media with effusion has a tendency of spontaneous recovery before the age of eight to 10 years, in intractable cases glue ear often persists even after that age-range causing changes in the tympanic membrane, either developing into adhesive otitis media and middle ear

TABLE III
MORPHOLOGICAL PROGNOSIS

Type of surgery	Retained ventilation tube		Dry perforation	Total
	Dry	Occasional otorrhoea		
Ventilation tube + Mastoidectomy	2	2	1	5
Ventilation tube + Mastoidectomy + Obliteration	3	2	1	6
Total	5	4	2	11

https://doi.org/10.1258/002221503321626366 Published online by Cambridge University Press

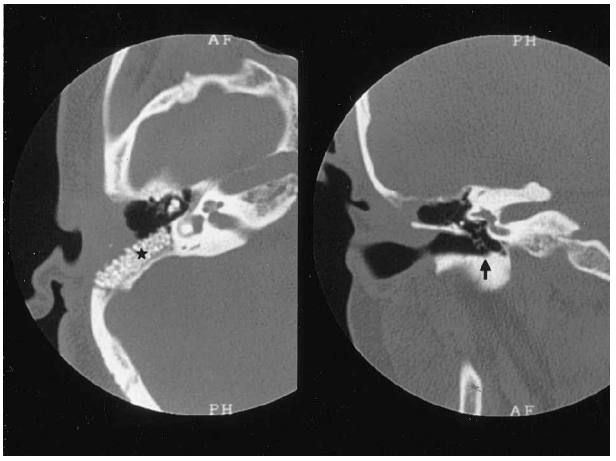

FIG. 4

CT scan of the right ear in *Case 8* at one year and seven months post-operation portraying the semiaxial (left) and coronal (right) sections. *Case 8* was treated by simple mastoidectomy and mastoid obliteration with hydroxyapatite granules (star) as well as insertion of a ventilation tube (arrow).

cholesteatoma or indicating apparent recovery with sequelae. However, in cases of CG, retraction or bulging of the tympanic membrane with chocolate brown fluid persists without adhesive change. Although these two diseases probably result from eustachian tube dysfunction, changes in the tympanic membrane are different. In many cases of otitis media with effusion, insertion of a ventilation tube well compensates for eustachian tube dysfunction. However, as a similar approach can not compensate for CG, abundant secreted fluid was persistently drained from the tubes. Surgical findings revealed good development of mastoid air cells with mild mucosal hypertrophy, while dark brown fluid pooled in them. In addition, abnormality in the ossicular chain has not been reported. Half of the cases in the present study were within the range of 10–19 years of age and they were all unilaterally affected. According to surgical findings, more than half of the cases indicated good or excellent development of mastoid air cells with CG mainly sited at the mastoid cavity, which extended as far as the attic without prevalence of CG in the mesotympanum/hypotympanum. These special features coincide with findings reported by Nakano.[3] Accordingly, based on these special features, the aetiology of CG may be attributable to delayed occurrence of eustachian tube dysfunction after completion of mastoid air cells, while infant otitis media with effusion occurs in the developmental course of mastoid air cells.[3]

With regard to treatments of CG, a variety of approaches ranging from conservative therapy to surgical intervention are plausible. In addition, as described by Farrior *et al.*,[4] no surgical treatment could be the best treatment as development of a retraction pocket or subsequent cholesteatoma may be prevented by the positive middle-ear pressure in CG. The typical conservative treatment is steroid therapy. Although the outcomes of co-treatment with the insertion of a ventilation tube are excellent, these reported cases may not coincide with our present cases for lack of confirmatory pathological diagnosis of CG.[5] These cases were diagnosed merely with cholesterol crystals in middle-ear fluid, findings of tympanic membrane and CT scan. In our study, steroid therapy was performed for two cases that did not respond favourably to myringotomy and insertion of a ventilation tube. Although hearing was improved with the insertion of a ventilation tube, surgical intervention in the mastoid was resorted to for controlling abundant otorrhoea from the tube despite steroid therapy. As such, cases that indicate the limit of conservative therapy do exist. In surgical treatments for such cases, a variety of choices may be applied. Either simple mastoidectomy with insertion of a ventilation tube[6,7] or with additional mastoid obliteration[2,3] is one of the preferred approaches. Sheehy *et al.*[2] recommended that mastoid obliteration should be added when CG is not visually conspicuous during mastoidectomy, while Nakano[3] advocated mastoidectomy and mastoid obliteration to restrain the volume of air cells under the current status where a therapeutical approach appropriate for eustachian tube dysfunction remains unresolved. We attempted both approaches. There was no significant difference in the incidence of dry ear between cases treated with simple mastoidectomy and those treated with additional mastoid obliteration. Furthermore, repeated insertions of ventilation tubes were required or residual perforation of tympanic membrane was kept in all cases. In addition, some cases showed occasional small amounts of otorrhoea from the tubes. As the major lesion sites in the cases were located in the mastoid cavity without extending to the mesotympanum/hypotympanum, hearing prognosis was excellent on the whole, albeit complete morphological prognosis has not been established. Even though the pneumatized cavity was diminished to a tympanic cavity alone with mastoid obliteration, effusion was generated in the tympanic cavity once the ventilation tube was displaced, requiring re-insertion of the ventilation tube in many cases. Eustachian tube dysfunction in CG is therefore severe and intractable. Continuous middle-ear ventilation through a myringotomy tube for cases resistant to conservative treatment is advocated under the current clinical status, where an appropriate therapy for eustachian tube dysfunction is not available. With regard to hearing and morphological prognosis, the insertion of a ventilation tube was effective particularly for hearing improvement, and simple mastoidectomy was useful for reducing abundant discharge from the middle-ear cavity, although mastoid obliteration aiming to decrease the load of the eustachian tube showed little additional effect for morphological prognosis.

Conclusions

CG, as a single independent disease, prevails in a severe state in patients with eustachian tube dysfunction, and exists in patients resistant to conservative treatment. Under the current clinical status where an

https://doi.org/10.1258/002221503321626366 Published online by Cambridge University Press

appropriate therapy for eustachian tube dysfunction is undefined, treatments involving at least the insertion of a ventilation tube with thorough mastoidectomy were thought to be necessary. Furthermore, ventilation tubes should be persistently inserted as displacement of inserted tubes commonly results in effusion in the tympanic cavity.

References

1 Paparella MM, Lim DJ. Pathogenesis and pathology of the "idiopathic" blue ear drum. *Arch Otolaryngol* 1967;**85**:249–58
2 Sheehy JL, Linthicum FH, Greenfield EC. Chronic serious mastoiditis, idiopathic hemotympanum and cholesterol granuloma of the mastoid. *Laryngoscope* 1969;**79**:1189–217
3 Nakano Y. Cholesterol granuloma. *Practica Otologica* (Kyoto) 1990;**83**:1761–6
4 Farrior B, Kampsen E, Farrior JB. The positive pressure of cholesterol granuloma idiopathic blue eardrum. Differential diagnosis. *Laryngoscope* 1981;**91**:1286–97
5 Takahashi H, Honjo I, Kurata K, Fujita A. A new treatment for middle ear cholesterol granuloma. Prednisolon and ventilation tube insertion. *Practica Otologica* (Kyoto) 1995;**88**:863–6
6 Paparella MM. Blue ear drum and its management. *Ann Otol Rhinol Laryngol* 1976;**85** (suppl 25):293–5
7 Lalwani AK, Jackler RK. Spontaneous hemotympanum associated with chronic middle ear effusion. *Am J Otol* 1991;**12**:455–8

Address for correspondence:
Manabu Maeta, M.D.,
Department of Otolaryngology–Head and Neck Surgery,
Okayama University Graduate School of Medicine
and Dentistry,
2-5-1 Shikata-cho,
Okayama 700-8558,
Japan.

Fax: +81-86-235-7308
E-mail: m-maeta@cc.okayama-u.ac.jp

Dr M. Maeta takes responsibility for the integrity of the content of the paper.
Competing interests: None declared