ORIGINAL ARTICLLE

Cholesteatoma and the Destruction of Middle Ear and Mastoid Cavities in Ottorhoea

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ABSTRACT

Objective: To determine the relative frequency of various parts of temporal bone eroded by cholesteatoma.

Place and duration of study: This was a combined study conducted in the ENT Departments of Postgraduate Medical Institute, Hayatabad Medical Complex, Peshawar, and Lady Reading Hospital Peshawar. The study took place over a period of 5 years from January1, 2007 to December 31, 2011.

Sample size: The study included 70 cases of chronic suppurative otitis media with cholesteatoma.

Study design: It was a descriptive study using the non probability convenience sampling technique.

Methodology: This was a combined study conducted in the ENT Departments of Postgraduate Medical Institute, Hayatabad Medical Complex, Peshawar and Lady Reading Hospital Peshawar from January1, 2007 to December 31, 2011. Informed consent was obtained before including patients in the study. The various parts of temporal bone eroded by cholesteatoma were studied in patients who underwent radical and / or modified radical mastoidectomy for chronic suppurative otitis media with cholesteatoma. The frequency of damage to the ossicular chain and other bones was determined.

Results: A total of 70 cases were included in the study. The ages of the patients ranged from 8 to 48 years. The male to female ratio was 3:1. All the patients had chronic suppurative otitis media with cholesteatoma and underwent radical and / or modified radical mastoidectomy. The commonest type of bony erosion was damage to the ossicular chain (92.85%) followed by erosion of the lateral attic wall (54.28%).

Conclusion Cholesteatoma has the ability to erode bony structures which may lead to deafness, disability and potentially life threatening intracranial complications. Therefore it is important that the examiner is aware of its possibility in patients presenting with otorrhea, the types of bone damage it may cause and it's potential for producing serious consequences.

Keywords: Suppurative Otitis Media, Cholesteatoma, Ossicular Chain,

INTRODUCTION

Chronic suppurative otitis media (CSOM) is purulent inflammation of the middle ear cleft and upto 50% of ears with active chronic otitis media will be associated with cholesteatoma[1]. It represents the accumulation of keratinizing stratified squamous epithelium along with desquamated keratin debris in the tympanic cavity, mastoid antrum and air cells system. A locally invasive and destructive process ensues once the squamous epithelium reaches these areas from its origin in the external auditory canal or tympanic membrane. The commonest features of cholesteatoma are deafness and foul smelling otorrhea. The cardinal feature of this disease is temporal bone erosion. The mechanism of bone destruction by cholesteatoma is much debated. It was thought that pressure exerted by cholesteatoma was responsible for bone destruction. It is now believed that high concentration of collagenase in cholesteatoma leads to the destruction of bone. With the invention of immunohistochemical tests recently various cytokines are implicated in the mechanism by which it erodes bony structures[1]. Kurihara et al analyzed surgical specimens of middle ear inflammatory granulation tissues with or without cholesteatoma to clarify specific mechanisms underlying cholesteatoma induced bone destruction. Almost the same levels of bone resorbing activity and prostaglandin E2 were found in both types of tissues. But IL-1 alpha was detected only in cholesteatoma. Therefore they suggested that bone destruction in otitis media with cholesteatoma may be attributable to IL-1 alpha in addition to PG E2[2,3]. Interlukin-I can directly activate osteoclasts by producing osteoclasts activating factor. It also promotes migration of

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inflammatory cells and stimulates fibroblasts to produce prostaglandins and collagenase[1,2].

Amar and colleagues in 1996 revealed significantly increased levels of TNF-alpha, lysozomal enzymes, acid phosphatases, cathepsin B, leucyl aminopeptidase & lysozyme together with nonlysozymal enzymes calpain I and II in 50 cholesteatomatous samples in comparison with normal skin samples from external ear canal. The level of these indices directly reflected the severity of the disease in terms of significant increase in cases with erosion of two or three ossicles, erosion of dural plate, sinus plate and facial canal[4]. Whatever may be the mechanism of bone destruction, the fact is that cholesteatoma spread in and across middle ear cleft with a potential to lead to both intracranial and extracranial complications[5]. The diagnosis and extent of cholesteatoma may be judged preoperatively by history, clinical examination, otomicroscopy, plain radiography and computerized tomography. A high resolution CT scan using 1-mm or 2-mm axial and coronal sections of the temporal bone shows cholesteatoma as soft tissue density mass isodense with muscles in the majority of cases. However preoperative imaging is unnecessary in the majority of cases[6]. An understanding of the severity of temporal bone erosion is important because it is fundamental to the production of complications in cholesteatomatous otitis media.

MATERIALS AND METHODS

All patients fulfilling the required criteria were included in the study. Examination under microscope was carried out either in the OPD or in the operation theatre before admitting the patients. Patients of all ages and both sexes, patients presenting with chronic suppurative otitis media with cholesteatoma and patients undergoing surgery in the form of radical or modified radical mastoidectomy for cholesteatoma were included in the study. All those patients presenting with acute suppurative otitis media and with chronic suppurative otitis media without cholesteatoma were excluded from the study.

Informed consent was obtained and detailed clinical examination was carried out. Imaging studies (CT/MRI) were carried out in patients with suspected intracranial or extracranial complications. These complications were treated first. The patients with persistent discharge and complications underwent radical or modified radical mastoidectomy. Earlier mastoid explorations were carried out in cases of otogenic lateral sinus thrombosis and in patients with intra cranial complications not responsive to neurosurgical and/or conservative treatment. The uncomplicated cases were booked for mastoid exploration at a convenient date.

Pure tone audiograms were obtained in all cases prior to surgery to determine the hearing status of the patients. Hematological, urological cardiovascular and respiratory profiles were assessed to determine the patients' fitness for general anaesthesia and the procedure. CSF analysis and pus C/S studies were carried out where appropriate.

During mastoid surgery, erosions of ossicular chain and various parts of the temporal bone were assessed. Erosion was considered to have occurred when there was naked eye or microscopic evidence of a breach in the continuity of the surface of a bone, either partial or total. Missing ossicle(s) were presumed to have been eroded. These were recorded on a proforma. The data was analyzed using spss 16.0 for windows. Descriptive statistics like mean + standard deviation were calculated for quantitative variables like age and duration of symptoms. Frequency and percentages were calculated for categorical variables like gender, site of bony erosion and damage to ossicular chain. All these results were presented in the form of tables.

RESULTS

A total of 70 cases were included in the study. The ages of the patients ranged from 8 to 48 years with the mean age of 23.74 years and a std.deviation of + 10.62 (Table 1). The various age groups have been shown in Table 2.

Table 1: Ages of the patients

		Age in years
N	Valid	70
Mean		23.74
Std. Deviation		10.624
Minimum		8
Maximum		48

Table 2: Age groups of the patients

	Frequency	Percent	Cumulative Percent
<= 15	14	20.0	20.0
16 - 25	31	44.3	64.3
26 - 35	15	21.4	85.7
36+	10	14.3	100.0
Total	70	100.0	

There were 53 males and 17 female patients. The male to female ratio was 3:1 (Table 3). The commonest complaint was deafness and foul smelling ear discharge lasting for more than three

months. 10(14.28%) patients presented with intracranial complications. 32 patients had mastoid surgery in the form of radical mastoidectomy whereas modified radical mastoidectomy was carried out in 38 cases. The frequency of eroded parts of the temporal bone according to gender is shown in Table 4.

Table 3: Gender of the patients

		Frequency	%	Cumulative%
Valid	male	53	75.7	75.7
	female	17	24.3	100.0
	Total	70	100.0	

Table 4: Gender wise erosion of various parts of temporal bone by cholesteatoma.

	Gender of patients			
	Male		Female	
	Count	Table N%	Count	Table N%
Lateral attic wall	28	40.0%	10	14.3%
Mastoid cortex	10	14.3%	2	2.9%
Posterosuperior meatal wall	5	7.1%	4	5.7%
Sinus plate	5	7.1%	2	2.9%
Tegmen antri	5	7.1%	2	2.9%
Facial nerve Canal	1	1.4%	2	2.9%
Tegmen tympani	2	2.9%	1	1.4%
Lateral semicircular canal	1	1.4%	1	1.4%
Ossicular chain	49	70.0%	16	22.9%

Table 5: Age wise distribution of various parts of bone erosion by cholesteatoma

	Age (in years)			
	<= 15	16 - 25	26 - 35	36+
	Table N%	Table N%	Table N%	Table N%
Lateral attic wall	5.7%	27.1%	11.4%	10.0%
Mastoid cortex	5.7%	7.1%	2.9%	1.4%
Posterosuperior meatal wall	1.4%	4.3%	4.3%	2.9%
Sinus plate	2.9%	1.4%	2.9%	2.9%
Tegmen antri	1.4%	2.9%	2.9%	2.9%
Facial nerve canal	.0%	1.4%	1.4%	1.4%
Tegmen tympani	.0%	1.4%	1.4%	1.4%
Lateral semicircular canal	.0%	.0%	2.9%	.0%
Ossicular chain	17.1%	41.4%	21.4%	12.9%

Ossicular chain erosion (92.85%) was the commonest finding followed by erosion of the lateral attic wall (54.28%). The findings remained almost identical when they were analyzed in relation to the ages of the patients as shown in Table 5. Chi- square test was applied and p-values were determined to assess the significance of temporal bone erosion by cholesteatoma in relation to the age and gender of the patients. It was found that age and gender had no significant effect on bone erosion by cholesteatoma ($p > .05$).

DISCUSSION

Cholesteatoma is an erosive disease. The principal clinical features of cholesteatoma are attributable to its interaction with the bone of ossicular chain and the bony walls of middle ear & mastoid. This feature of cholesteatoma is dependent on its ability to erode any bone that comes in contact with squamous epithelium. Therefore cholesteatoma accounts for the majority of extracranial and intracranial complications of chronic suppurative otitis media. These complications vary in severity from disabling to potentially life threatening conditions.

The true incidence of cholesteatoma is not known. Tos and colleagues found 3 per 100,000 in children and 12.6 per 100,000 in adult[7]. In a study of cholesteatoma in the USA, Harker and colleagues found prevalence in the general population of 6 per 100,000. Within this population cholesteatoma was more common in children aged 10-19 years. In this age group the prevalence was found to be 9.2 per 100,000.[8] in our series the disease was common in 20-30 years age group. Memon MA and colleagues in 107 cases of mastoid explorations, found cholesteatoma in 11.5% cases[9].

Cholesteatoma varies in size from a small sac confined to the attic or to the posterosuperior quadrant of mesotympanum to widespread disease involving the entire mastoid bowl and the posterior half of the mesotympanum. Thus the bone in contact with cholesteatoma in these regions is liable to be affected. The parts of ossicular chain most susceptible to erosion are the long process of incus followed by the stapes superstructure. Ossicular chain erosion can be caused by all types of chronic suppurative otitis media but tends to be more extensive in cholesteatoma cases[3,10]. Ossicular chain damage is the commonest cause of conductive hearing loss in cases of suppurative otitis media with cholesteatoma. Charles D. Bluestone mentioned that erosion of bone can occur anywhere in the temporal bone although the ossicles are commonly involved[11]. On the basis of a study involving 117 operated patients, Jahnke and colleagues reported that

cholesteatoma occurred mostly in older children (90%) and extended to the antrum (73%) or beyond it (54%), with destruction of the ossicles (77%)[12]. Karja and colleagues reported that the ossicular chain was found damaged in 75% of 190 ears with cholesteatoma but without discharge and in 97% of 147 discharging ears with cholesteatoma. The authors concluded that vascular bony erosion caused by active granulation tissues and infection is the main mechanism for destruction of ossicles in CSOM with cholesteatoma[13]. Udaipurwala IH and colleagues in 145 cases of CSOM found that the majority of patients had damage of more than one ossicle. Involvement of all ossicles was seen in 40% cases[14]. Salman AA and Hameed A found damage to ossicular chain in 97% of cases in their series[5].

Erosion of the facial canal leads to facial paralysis. Labyrinthine fistula caused by erosion of the labyrinth, usually the dome of lateral semicircular canal, is present in upto 10% of cases with cholesteatoma. It is a cause of severe vertigo and may lead to a 'dead ear' if the progress of the disease is not halted. We studied 3 cases of facial canal erosion and 2 cases of lateral semicircular canal erosion.

Erosion of the lateral attic wall is the second most common finding in our study. It has an important role in the diagnosis of attic cholesteatoma at an early stage. Without the lateral attic wall erosion, the existence of cholesteatoma cannot be excluded. This important clue may be missing in cholesteatoma associated with marginal perforation, posterior retraction pockets, central perforations and intact tympanic membrane[15].

Erosion of the tegmen tympani, tegmen antri and sinus plate lead to the development of intra cranial complications such as meningitis, lateral sinus thrombophlebitis and formation of brain abscess. Nadol and Schuknecht concluded in their study that in cases of cholesteatoma, intracranial spread of infection occurred directly through bony erosion[16].

CONCLUSION

Cholesteatoma in CSOM is an erosive disease. Bone destruction caused by the disease is a forerunner of associated complications. A favorable outcome following treatment of a cholesteatoma rests in part on an early diagnosis. Early institution of treatment is vital to reduce the morbidity and mortality due to cholesteatoma.

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REFERENCES

1. Orisek BS, Chole RA. Pressure exerted by experimental cholesteatomas. Arch otolaryngol head neck surg 1987; 113; 386-91.
2. Kurihara A, Toshima M, Yuasa R, Takasaka T. Bone destruction mechanism in chronic otitis media with cholesteatoma in culture of bone resorbing activity attributable to interlukin-I alpha. Ann Oto Rhino Laryngol 1991; 100: 989-98.
3. Robin Y. Chronic suppurative otitis mesdia – cholesteatoma. In: Harold Ludman, Wright T eds. Disease of the ear. 6th ed. London: Arnold, 1998:386-97.
4. Amar MS, Washihi HF, Zakhary MM. Clinical and biochemical studies of bone destruction in cholesteatoma. J Laryngol Otol. 1996; 110:534-9
5. Salman AA., Azhar H., Muhammad EK., Muhammad M. Analytical study of ossicular chain in middle ear cholesteatoma. Ann K E Med coll : Jul. – Sep 2009;15(3): 134-7.
6. Manolis EN, Filippou DK, Tsoumakas C, Diomidous M, Cunningham MJ, Katostaras Tet al. Radiologic evaluation of the ear anatomy in pediatric cholesteatoma. *J Craniofac Surg*. May 2009;20(3):807-10.
7. Tos M. Incidence, etiology and pathogenesis of cholesteatoma in children. Ann Oto Rhino Laryngol Aug 1988;93 (8): 769-80.
8. Harker LA, Koontz FP. The bacteriology of cholesteatoma. In: McCabe BF, Sade J, Abramson M. eds. Cholesteatoma: First International Conference.Aesculapius: Birmingham. 1977:287-92.
9. Memon MA, Matiullah S, Ahmed Z, Marfani MS. Frequency of un-safe chronic suppurative otitis media in patients with discharging ear. J Liaquat Uni Med Health Sci May - Aug 2008;7(2):102-5.
10. Ludman H. Complications of suppurative otitis media. In: Kerr AG, John H.eds. Scott-Brown's Laryngology and Head & Neck Surgery. Vol.3. 6th ed. Oxford: Butterworth/Heinemann, 1997:3/12/1-28.
11. Bluestone CD, Klein JO. Intracranial suppurative complications of Otitis media and mastoiditis. In: Bluestone CD, Stool SE, Scheetz MD, eds. Pediatric Otolaryngology, 2nd ed. Philadelphia: WB. Saunders, 1990:537-46.
12. Jahnke V, Falk W. Clinical, pathological and therapeutic aspects of cholesteatoma in children. Laryngol Rhinol Otol Stuttg. 1976; 55:556-60.
13. Karja J, Jokinen K, Seppala A. Destruction of Ossicles in Chronic Otitis Media. J Laryngol Otol. 1976; 90:509.
14. Udaipurwala IH, Iqbal K, Saqulain G, Jalisi M. Pathological profile in chronic suppurative otitis media - The regional experience. J Pak Med Assoc. 1994; 44:235-7.
15. Yu Z, Han D, Gong S, Wang Z, Zhang L. The value of scutum erosion in the diagnosis of temporal bone cholesteatoma. Acta Oto-laryngologica 2010; 130(1):47-51
16. Nadol JB, Suhuknecht H F. Complication of chronic otitis media. In Surgery of the ear and temporal bone.1993. Raven press Ltd. New York. 171-191.