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Otoscopic, radiological and audiological status of the contralateral ear in patients with unilateral chronic suppurative otitis Media

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ABSTRACT

Aim: As the disease process does not affect both the ears simultaneously in all the cases, it is possible to identify in early stages of the disease process and arrest further progression by timely intervention. Hence, we aim to study the anatomical and functional changes in contralateral ear (CLE) in pts with unilateral CSOM.

Materials and Methods: prospective observational study, of 75 patients attending the OPD of JLN hospital and research center, Bhilai, with unilateral CSOM, with intact TM in CLE were evaluated by otoscope, PTA, Impedance audiometry and CT temporal bone. Above observations were recorded and analyzed.

Results: 44% in our study showed abnormal TM, most common was TM retraction, seen in 22.66%. PTA showed mixed hearing loss in 5.33% and normal hearing in 66.66%. Impedance audiometry had A type graph in 82.66%, As type in 10.66%. Compliance was normal in 82.66% and decreased in 10.66%. Pressure was normal in 97.33% and was decreased in 2.66%. Normal, well pneumatized air cells in HRCT temporal bone seen in 90.66% and opacified in 12%.

Conclusion: A detailed otoscopic evaluation of the contralateral ear plays a vital role in early diagnosis of the pathology affecting the contralateral ear. Audiological evaluation of the contralateral ear by audiometry and tympanometry provides a pathway for detecting the functional abnormalities in the contralateral ear at an early stage. Knowing the radiological status of the contralateral ear can guide us to monitor the disease progression and plan accordingly.

1. Introduction

Chronic suppurative otitis media (CSOM) is an irreversible inflammatory pathological condition in which there is damage to the mucosal lining of the middle ear cleft leading to permanent perforation of the tympanic membrane, it is clinically presented by ear discharge and deafness.[1] Different theories have been postulated regarding the pathogenesis of chronic otitis media and the most commonly accepted theory is given by the Minneapolis group. According to this theory there is development of continuous chain of events that occur at subepithelial and epithelial levels in the middle ear cleft.[2] Severe forms of chronic otitis media results in retraction and perforation of tympanic membrane, effusion in middle ear or cholesteatoma formation.[1]

The diagnosis of chronic otitis media (COM) implies a permanent abnormality of the pars tensa or flaccida, most likely a result of earlier acute otitis media, negative middle ear pressure or otitis media with effusion. It has a higher prevalence in lower socioeconomic groups and there is no sex difference in prevalence of CSOM. Stress is placed upon the multifactorial nature of the otitis media.

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Inadequate antibiotic treatment, frequent upper respiratory tract infections, nasal disease and poor living conditions with poor access to medical care are related to development of CSOM.[3] Prevalence of CSOM in developing countries represents a wide range from 4% to 33.3%.[2]

Taking into the prevalence of CSOM, the different countries can be classified into following four groups: India falls under highest group (>4%) thus facing a massive health problem. The incidence of COM in India was found to be 7.8%.[2]

Bilateral CSOM is a well-known entity and it is more common in patients with associated conditions like cleft palate, rhinitis and chronic adenotonsillitis. The contralateral ear (CLE) is defined as the asymptomatic ear in unilateral chronic otitis media.[4] The common portal for drainage for both ears is nasopharynx, and hence factors responsible for COM on one ear may also affect the other ear.[4] The affected ear may be the end point of the pathology in the contralateral ear. The "crystal ball effect" also postulates the same.[5] In patients with unilateral cholesteatoma, the presence or absence of mastoid pneumatisation of the contralateral ear may indicate the presence of COM.[6]

Limited data are currently available in the literature relating to status of the CLE in patients with CSOM. Examination of the contralateral ear is very much helpful in evaluation of aetiology and progression of the disease. As the disease process does not affect both the ears simultaneously in all the cases, it is possible to identify in early stages of the disease process and arrest further progression by timely intervention, if assessed by otoscopical, audiological and radiological aspects.[7]

With this background in this study, we want to study the otoscopic, radiological and audiological status of the contralateral ear in patients with unilateral chronic suppurative otitis media.

2. Materials and Methods

A prospective observational study of 75 patients attending the OPD of JLN hospital and research center, Bhilai with chronic ear discharge or hearing loss during 10^{th} November 2020 to 31^{st} May 2022.

Patients with Unilateral CSOM in active/inactive stage of mucosal or squamosal type of age above 12 years and below 60 years were included. Patients with previous operation in the study ear, Otitis externa or inner ear diseases in the study ear, traumatic perforation were excluded.

Informed and written consent is taken, detailed history is obtained prior to enrolling the patients into the study. Patients are subjected to thorough clinical examination of both the ear examination with a Welsch Allyn pocket LED otoscope 22870- BLU. Patients who are found to have perforation in one ear will be evaluated further to assess the disease progress in the contralateral ear.

Status of the CLE TM is assessed with *Welch Allyn pocket led otoscope.* PTA of the CLE performed with *Elkon eda 3N3 multi*; where presence, type and degree of hearing loss is assessed. Tympanometry and stapedial reflex of the CLE tested with *interacoustics impedance audiometer AT235H* reveals compliance, volume, pressure of the middle ear. Xray mastoid Schuller's view obtained with 700 *mA GE 18A, Siemens 18 B, Siemens 18 C* to determine the extent, distribution, degree of aeration of the air cells and the status of trabecular pattern. CT Temporal bone obtained with *Hitachi Scenara 128 slice, NMCT (25 NO): 6 Slice + Spect Siemens* to view excellent bony details about the EAC, middle ear, mastoid, ossicular chain, inner ear and the facial nerve canal.

3. Results

Among 75 patients the mean age of presentation was 48.09 years. Commonest age group being 51-60 years with 44 patients. Sex ratio was 1.33:1 with slight female preponderance. Right ear was affected in 31 cases, left ear in 44 cases. Table 1 shows age distribution of patients.

Out of 75 ears, 66 (88%) ears had mucosal disease and 9 (12%) ears had squamosal disease. 50 (66.66%) patients are falling into 6 Months to 1 year of duration of CSOM, and maximum patients (58 patients (77.33%)) had asymptomatic CLE. Among symptomatic patients hearing loss was found to be the highest – 15 pts (20%). Table 2 shows symptoms of CLE.

Otoscopic examination showed 33(44%) patients with abnormal TM. Among them most common was TM retraction (17 (22.66%) pts). Table 3 shows otoscopic findings of CLE.

PTA had normal hearing levels in 50(66.66%) of the patients and sensorineural type in 20(26.66%) pts.

Tympanometry had normal A type graph in majority (62(82.66%) pts). Among the abnormal types, As type was found to be the maximum, seen in 8(10.66) pts. Stapedial reflux was present in 44 (58.66%) pts and absent in 31(41.33%) pts. Table 4 shows tympanometry findings.

CT temporal bone revealed normal, well pneumatized air cells in 68(90.66%) pts. In rest opacification was present, with diploeic type in 6 (8%) pts and sclerosed type in 3(4%). Middle ear cavity was normal in all the patients and the ossicular chain was intact in all the pts. CT findings shows the significant association with contralateral ear. Table 5 shows CT findings of CLE.

Among 75 patients the total number of abnormal contralateral ear was 50(66.66%) pts, which is depicted in table 6.

Table 7 shows correlation between otoscopical, radiological and audiological assessment in contralateral ear.

Table 1: Age distribution of patients

Age Group	**N (%)**
12-20 years	4(5.33)
21-30 years	5(6.66)
31-40 years	14(18.66)
41-50 years	8(10.66)
51-60 years	44(58.66)
Total	75(100)

Table 2: Symptoms of contralateral ear

Symptoms	**Mucosal N (%)**	**Squamosal N (%)**	**Total (N)%**
Asymptomatic	50(66.66%)	7(10.66%)	57(77.33%)
Hearing loss	15(20%)	1(1.33%)	16(21.33%)
Aural Fullness	1(1.33%)	1(1.33%)	2(2.66%)

Table 3: Otoscopic findings of contralateral ear

Otoscope Findings	**Mucosal N (%)**	**Squamosal N (%)**	**N (%)**
Normal TM	38(50.66)	4(5.33)	42(56)
TM Retraction	15(20)	2(2.66)	17(22.66)
Distorted COL	14(18.66)	2(2.66)	16(21.33)
Neomembrane	10(13.33)	-	10(13.33)
Tympanosclerotic Patch	8(10.66)	1(1.33)	9(12)
Absent COL	8(10.66)	-	8(10.66)
Opaque TM	4(5.33)	1(1.33)	5(6.66)
TM Thinning	4(5.33)	-	4(5.33)

Table 4: Compliance, volume, pressure of contralateral ear

		Normal	**Increased**	**Decreased**
Mucosal	Compliance	56(74.66)	2(2.66)	7(9.33)
	Volume	66(88)	-	-
	Pressure	65(86.66)	-	1(1.33)
Squamosal	Compliance	6(8)	1(1.33)	1(1.33)
	Volume	9(12)	-	-
	Pressure	8(10.66)	-	1(1.33)

Table 5: CT findings of contralateral ear

CT findings	**Mastoid air cells**			**Middle ear Cavity**		**Ossicular Status**	
	Normal N (%)	Diploeic N (%)	Sclerosed N (%)	Normal N (%)	Opacified N (%)	Intact N (%)	Not intact N (%)
Mucosal	60(80)	3(4)	3(4)	66(88)	-	66(88)	-
Squamosal	6(8)	3(4)	-	9(12)	-	9(12)	-
Total	66(88)	6(8)	3(4)	75(100)	-	75(100)	-

Table 6: Total number of normal and abnormal contralateral ear in otoscopical, radiological and audiological assessment

	Mucoal N(%)	**Squamoal N (%)**	**Total N(%)**
Abnormal	44(58.66)	6(8)	50(66.66)
Normal	22(29.33)	3(4)	25(33.33)

Table 7: Correlation between otoscopical, radiological and audiological assessment in contralateral EAR

		Otoscopical Findings	**Audiological Findings**	**Radiological Findings**
Muosal	Normal N (%)	38(50.66)	33(44)	60(80)
	Abnormal N (%)	28(37.33)	33(44)	6(8)
Squamosal	Normal N (%)	4(1.33)	5(6.66)	6(8)
	Abnormal N (%)	5(6.66)	4(1.33)	3(4)

4. Discussion

To define the evolution of COM in aspects of speed and direction, the Contralateral ear is studied. The focus is also placed on etiology and the established pathology as the contralateral ear might turn into COM in the future.

The main aim is to study the otoscopic, radiological and audiological status of the contralateral ear of patients with unilateral CSOM, by history taking, otoscopic examination, pure tone audiogram, impedance audiometry and HRCT temporal bone. This study was assessed in 75 patients, coming to OPD of Dept of ENT and Head and Neck Surgery, J.L.N hospital and research Centre, with the complaints of hearing loss or history of ear discharge with the possibility of having unilateral CSOM, during the period 10th November 2020 to 31st May 2022.

In this study of 75 patients, the youngest patient was 19 years old, and the oldest patient was 59 years. The age group has the highest number of patients was 51- 60 years with 44 patients. The second-highest number of patients (14 patients) was in the age group of 31- 40 years. The mean age in the study is 48.09 years. In a study by *Raphella Khan et al., 2018*[8] mean age of the study was 28.47 years. In a study by *Sady Selaimen da Costa et al.,* 1999[9] mean age of patients is 26.3 years which is consistent with our study. A study by *Mohammad Ali Damghani et al., 2013*[10] concluded that CSOM affects the younger population with a mean age of 23.03 years. This shows that the prevalence of chronic otitis media is more in the older age group in our study area compared to other previous studies. The late presentation may be due to less awareness of health issues.

In our study chronic otitis media incidence was slightly more in females - 41 patients (54.66%) than in males - 34 patients (45.33%). The sex ratio was 1.33:1**.** In study conducted by *Mohammed Radef Dawood et al.*, 2018[11] there were 56 males (58.33%), and 40 females (41.66%) with a sex ratio of 1.4:1. In a study conducted by *Sruthi et al., 2015* there were 50 males and 30 females with a sex ratio of 1.66:1.[12]

In our study majority of patients i.e., 58 patients (77.33%) had asymptomatic contralateral ear. Among symptomatic patients, 15 patients (20%) had hearing loss and 1pt (1.33%) had aural fullness.

In our study, 66 (88%) pts had mucosal disease and remaining 9 (12%) pts had squamosal disease. In a study conducted by *Mohammed Kareemullah Khan et al., 2020* 180(90%) pts had mucosal disease and 20(10%) had squamosal disease.[13] In a study by *Prabaakharan Jambunathan et al.,2020* mucosal type of COM was present in 435(87%) patients and squamosal type in 65 patients (13%).[14]

In our study of 75 patients the total number of abnormal contralateral ear was 50(66.66%) pts, and the normal contralateral ear was 25(33.33%) pts. Among them the otoscopic findings were normal in 42(56%) pts and abnormal in 33(44%) pts; audiological findings were normal in 38(50.66%) pts and abnormal in 37(49.33%) pts; radiological findings were normal in 66(88%) pts and abnormal in 9(12%) pts. According to Garg payal et al., 2012, 55% pts had pathology in contralateral ear.[15]

In a study conducted by *Scheibe et al., 2002,*[16] 68% of the pts had some sort of pathology in the contralateral ear based on otoscopic examination, PTA, tympanometry, and radiological findings. According to a study by *Sandeep Kumar et al., 2018,*[17] 60% of cases had abnormal contralateral ear. In a study by *Orji et al., 2007*,[18] 80% of pts had abnormal contralateral ear. According to study of *Mohammad Ali Damghani et al., 2012*,[10] 60% of pts had some sort of abnormal contralateral ear based on otoscopic examination, PTA, tympanometry, and radiological study.

In our study 42 (56%) patients had normal and 33 (44%) patients had abnormal contralateral ear in otoscopy. The most common abnormality was TM retraction, which was seen in 17 (22.66%) patients. Other abnormalities include distorted COL in 16 (21.33%) patients, neomembrane in 10 (13.33%) patients, tympanosclerotic patch in 9 (12%) patients, absent COL in 8(10.66%) patients, opaque TM in (5.66%) patients, and TM thinning in 4 (5.33%) patients, in that sequence. According to *Sweta Soni et al*,[19] 80% of patients had abnormal contralateral ear in otoscopy, with 10% having Otitis media with effusion and 38% having a retracted tympanic membrane. Another research by *Vartiainen E et al., 1996*[20] found that 63% of 496 COM patients had abnormal contralateral ear in otoscopy, with retraction being the most frequent finding and tympanic perforation coming in second. According to *Dawood MR et al., 2018*[11] the incidence of abnormal TM of contralateral ear was 47.91%, where TM retraction (27.08%) was the most common structural abnormality detected. In our study 15(20%) pts had grade 1 TM retraction and 2(2.66%) pts had grade 2 TM retraction according to pars tensa grading and no pts had pars flaccida retraction. According to *Luntz et al.,*[21] 52.9% had grade 1 pars tensa retraction, 30.8% had grade 2 pars tensa retraction, 1.4% had grade 4 pars tensa retraction, 13.2%, had grade 1 pars flaccida retraction and 1.4%, had grade 2 pars flaccida retraction. In a study by *Nagle et al.*,[22] grade 1 pars tensa retraction was seen in 60 (35.2%) pts, grade 2 in 15 (8.9%) pts and grade 3 pars tensa retraction in 20 (11.8%) pts.

In our study of 75 patients, 25(33.33%) patients had hearing loss in PTA. The most common type was the sensorineural type seen in 20(26.66%) patients, followed by mixed hearing loss in 4(5.33%). The hearing levels were normal in 50(66.66%) of the patients. According to *Shariff M et al., 2019* 12.5% of patients had mixed hearing loss, whereas 87.5% of patients had conductive deafness.[23]

In our study, impedance audiometry showed a normal A-type graph in 62(82.66%) patients. Among the abnormal types, As type was found to be the maximum, seen in

8(10.66) patients, followed by Ad type in 3(4%) patients. C type was seen in 2 (2.66%) of patients. In a study by Drupal *A. Pardhi et al., 2019*,[24] 58.75% had type B graph. According to a study by *Shahnaz N and Polka L et* al,[25] 68% had abnormal tympanometry findings.

In our present study of 75 patients, 65(86.66%) patients had normal mastoid pneumatization in contralateral ear. 10(13.33%) patients had opacified mastoid air cells and among them, 7 (9.33%) patients had a diploeic type and 3(4%) had sclerosed type. According to *Ritu Nigam et al.,* 2014[26] 200(66.6%) contralateral ear had normal pneumatization, 45 (15%) had sclerosed, and 55 (18.33%) had diploeic mastoid pneumatization. Another study by *Roy et al., 2015*[27] reported that pneumatization was seen in 42.6%, diploeic in 31.43% and sclerosed in 25.71% of patients. According to *Gupta DK et al., 2022*[28] in squamosal COM, the contralateral ear had a pneumatic pattern (64.3 percent), followed by a diploeic pattern (33.9 percent). Only 1.8% of patients in the contralateral ear showed a sclerosing pattern. The illness known as chronic otitis media affects both ears equally. The exact and thorough examination of both ears is important not only for the patient's prognosis but also for the early identification of potential disease progression in a patient with unilateral chronic otitis media in the contralateral ear.

Our study shows among 75 pts majority of patients have normal, well-pneumatized air cells – 68(90.66%) patients. And the 2^{nd} most common is the diploeic type which is seen in 6 (8%) patients, followed by the sclerosed type in 3(4%) patients. The middle ear cavity was normal in all the patients. And the ossicular chain was intact in all the patients. According to *Mohammad Radef Dawood et al., 2018*[11] Mastoid air cells opacification was discovered in 34 (35.41 %) pts, middle ear ossification in 28(29.16%) pts and ossicular continuity in 100% pts.

5. Conclusion

A detailed otoscopic evaluation of the contralateral ear plays a vital role in early diagnosis of the pathology affecting the contralateral ear.

Audiological evaluation of the contralateral ear by audiometry and tympanometry provides a pathway for detecting the functional abnormalities in the contralateral ear at an early stage.

Knowing the radiological status of the contralateral ear can guide us to monitor the disease progression and plan accordingly.

In our study of 75 patients the total number of abnormal contralateral ear was 50(66.66%) pts, and the normal contralateral ear was 25(33.33%) pts.

Among them the otoscopic findings were abnormal in 33(44%) pts, with most common finding as TM retraction in 17 (22.66%) pts; audiological findings were abnormal in 37(49.33%) pts, with the most common being sensorineural hearing loss in 20(26.66%) patients and As type of graph in 8(10.66) pts; radiological findings were abnormal in 9(12%) pts, with the most common finding as mastoid pneumatization in 9 (12%) pts.

Hence patients with unilateral COM should be counselled regarding chances of developing some sort of disease in the contralateral ear. The patients should be followed up on a regular basis for evaluation of the contralateral ear so that therapeutic intervention is provided, and further disease progression is stopped.

6. Limitation

A minimal number of patients and a short time frame were used in this investigation. To determine the true prevalence of contralateral ear changes of individuals with unilateral CSOM, the study should encompass many cases across many locations over an extended period of time.

6.1. Recommendations

Contralateral ear tympanic membrane abnormalities increases when COM in the diseased side lasts longer. The right diagnosis and treatment must begin as soon as possible to prevent hearing loss. To raise public knowledge of CSOM and its effects, government health projects at the level of sub centers, primary health centers, and community health centers should build skilled health teams composed of physicians, nurses, and medical technologists. For microsurgical therapy, certain patients should be sent to tertiary hospitals.

7. Source of Funding

None.

8. Conflict of Interest

None.

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