

Research Article

## The Contralateral Ear in Unilateral CSOM, Endoscopic, Audiologic and Radiologic Evaluation

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### Abstract

**Background:** The aim of this study was to assess the contralateral ears in patients with unilateral CSOM with and without cholesteatoma, clinically (using otoendoscopy), audiologically and radiologically, then analyzing and comparing results between the 2 types of CSOM in a trial to examine the continuum theory for the development of the disease process in CSOM. **Patients and methods:** A prospective, observational study including 85 patients with unilateral COM (with or without cholesteatoma), the study was conducted at the Otorhinolaryngology Department, Damietta Faculty of Medicine, Al-Azhar University, Egypt between August 2020 and December 2021. **Results:** In the present study (30.59%) of cases were having a unilateral squamous disease and (69.41 %) were mucosal CSOM, (70.6%) of patients having a diseased contralateral ear, of which (76.9%) having squamous disease and (67.8%) having mucosal CSOM. Pars tensa retraction was the most common abnormality (60%) seen in cases with squamous OM while thin TM was the most common abnormality (50%) of cases with mucosal CSOM. Pars tensa retraction was more severe in CLE of patients with squamous disease, (41.7%) were grade 4, while in mucosal type (50%) were grade 1. HRCT of mastoid revealed abnormalities in (24.7%) of all CLEs, more prevalent (62%) in the CLEs of cases with squamous disease than cases with mucosal COM. Audiologic examination of the CLE revealed (47%) having conductive hearing loss CHL of average 32.1 dB {36.5 dB average hearing loss in (70%) of cases with squamous type and 27.7 dB average hearing loss in (30%) of cases with mucosal CSOM}. Tympanometric evaluation of the CLEs revealed (50.6%) having abnormal curve {(73%) of cases with squamous type where type C curve was found in (84.2%) and type B curve in (15.8%)}, and in (40.7%) of cases with mucosal CSOM. where type C curve was found in (83.33%) and type B curve in (16.7%). **Conclusions:** The present study has confirmed the presence of high incidence of abnormalities in the CLEs of unilateral squamous and mucosal COM which is more in squamous type, it emphasizes the importance of considering both ears as a pair. Disease in one ear especially in squamous type needs a close follow up of other ear, as in most cases there a hidden pathology which needs attention for complete cure. Otoendoscopy can be helpful in diagnosing and documenting masked pathologies.

### Keywords

Contralateral Ear, Otoendoscopy, Continuum Theory, Chronic Suppurative Otitis Media

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## 1. Introduction

The diagnosis of chronic suppurative otitis media (CSOM) implies a permanent abnormality of pars tensa or pars flaccida, most likely a result of earlier acute otitis media, negative middle ear pressure or otitis media with effusion, it is clinically presented by discharge from ear and deafness [1].

There are two types of CSOM, tubotympanic (mucosal type) and attico-antral (squamous type) [2].

Various theories for the pathogenesis of chronic suppurative otitis media (CSOM) were postulated, the most common, named (continuum theory) was adopted by Minneapolis group, According to which a continuous series of events in the epithelial and sub-epithelial levels of middle ear cleft are responsible for development of (CSOM) after the initial triggering episode, this model represents the different pathological stages of the same disease, and this same concept can be detected in the contralateral ear [3].

This continuum model suggests the development of CSOM in a progressive manner. According to this theory, middle ear effusion, retraction, perforation and cholesteatoma represent various pathological stages of the same disease process. The evolution of this continuum can be seen in the contralateral ear (CLE). When CSOM is triggered by Eustachian tube dysfunction, then there is a high probability of both ears affection, however a tendency of bilateral involvement can occur by inflammatory pathologies affecting both middle ears [3].

The contralateral ear (CLE) is defined as the asymptomatic ear in cases of unilateral chronic suppurative otitis media. As reported with other studies a CSOM is rarely an isolated process whereas the factors responsible for the evolvement of the disease process in the diseased ear will affect the CLE in the same manner since both of them have the same nasopharyngeal drainage. Consequently, the assessment of CLEs will provide information about the trigger and progress of the disease pathological process [4].

If we adopted the continuum theory as the basis for the development of the disease process in CSOM, then why only a small percent of cases with OME will end up with CSOM? Also, since there is a high prevalence of bilateral OME, why there is no corresponding high prevalence of CSOM? [5].

Based on the abovementioned argument, assessment of the CLEs may provide us with data regarding the trigger and development of the pathological process of CSOM.

Otoendoscopy is an upcoming day care procedure in the field of otology, it allows a better assessment of middle ear structures than the conventional otoscopy in terms of better resolution, wider visual field, overcoming the anatomical variations that hamper the view of entire TM and feasibility of recording and documentation through camera connection [6].

## 2. Aim of the Work

This is a prospective study based on recording and analyz-

ing the endoscopic, radiologic and audiologic findings in the CLEs in a series of cases with unilateral CSOM with or without cholesteatoma.

## 3. Patients and Methods

A prospective, observational study including 85 patients with unilateral CSOM (with or without cholesteatoma), attending the ENT departments of Al-Azhar University Hospitals between August 2020 and December 2021.

The study protocol was approved by the institutional ethical review committee. Informed consents were taken from all patients.

### 3.1. Inclusion Criteria

- 1) Patients between 12 and 60 years of age, representing both genders.
- 2) Unilateral CSOM (mucosal and squamous types).
- 3) The contralateral ear should have an intact tympanic membrane.

### 3.2. Exclusion Criteria

- 1) History of previous surgery in the CLE.
- 2) History of previous ventilation tube insertion in either ear.
- 3) Cases with bilateral CSOM.

### 3.3. All Patients Were Subjected to

- 1) Full history taking regarding the diseased and the CLE (otorrhea, pain, hearing impairments, tinnitus etc...), nasal allergies, previous ventilation tube insertion and history of previous ear, nose or nasopharyngeal surgery.
- 2) Clinical examination; including nose and nasopharynx.
- 3) Thorough ear examination of CLE; including otoendoscopy (0-degree 2.7 mm otoendoscope), pure tone audiometry, tympanometry and HRCT temporal bone.

The CLE was defined as the ear with intact tympanic membrane. Retractions of pars tensa were classified according to Sade [7], while those of pars flaccida were classified according to Tos [8]. Tympanic membrane was also assessed for the presence of thinning or myringosclerosis. High resolution CT examination was done in all cases to assess the degree of mastoid pneumatization. Audiometric evaluation (PTA) was done to assess the degree of hearing impairment and classified according to the average calculation of air-bone gap (ABG) at frequencies of 250, 500, 1000, 2000, 4000 Hz [9]. Tympanometry was done to assess Eustachian tube function.

## 4. Results

The present study included 85 patients, out of these 55 (64.7%) were males and 30 (35.3%) were females. The mean age was 28.07 years. 26 (30.59%) of cases were having a unilateral squamous disease and 59 (69.41 %) were mucosal CSOM.

The tympanic membrane was abnormal in 60 (70.6%) of all CLEs where in the 26 cases having squamous disease, 20

(76.9%) had abnormalities; {pars tensa retraction was seen in 12 (60%) of cases, pars flaccida retraction was seen in 3 (15%) of cases, thin TM in 3 (15%) of cases and myringosclerosis in 2 (10%) of cases. Among the 12 cases of pars tensa retraction, 5 cases (41.7%) were grade 4 (adhesive otitis media), 3 cases (25%) were grade 3, 2 cases (16.7%) were grade 2 and 2 cases (16.7%) were grade 1, while among the 3 pars flaccida retraction, 2 cases were grade 2 and 1 case was grade 1} (Table 1).

**Table 1.** Distribution of patients according to type of CSOM and otoendoscopic findings.

CSOM	Squamous No. (%)	Mucosal No. (%)
Number	26 (30.59)	59 (69.41)
Abnormal	20 (76.9)	40 (67.8)
Pars tensa retraction	12 (60)	16 (40)
Grade 1	2 (16.7)	8 (50)
Grade 2	2 (16.7)	6 (37.5)
Grade 3	3 (25)	2 (12.5)
Grade 4	5 (41.7)	0
Pars flaccida retraction	3 (15)	3 (7.5)
Thin TM	3 (15)	20 (50)
Myringosclerosis	2 (10)	1 (2.5)

Among 59 mucosal CSOM, 40 (67.8%) had abnormalities; {thin TM in 20 (50%) of cases, pars tensa retraction was seen in 16 (40%) of cases, pars flaccida retraction was seen in 3 (7.5%) of cases and myringosclerosis in 1 (2.5%) of cases. Among the 16 cases of pars tensa retraction, 8 cases (50%) were grade 1, 6 cases (37.5%) were grade 2 and 2 cases (12.5%) were grade 3}.

Tomographic assessment of mastoid pneumatization revealed abnormalities in 21 ears (24.7%) of all CLEs, in 13 (62%) of cases with squamous disease, 9 cases (69.2%) with sclerosed mastoid and 4 cases (30.8%) with hypopneumatized mastoid. And in 8 (13.6%) of cases with mucosal disease, 3 cases (37.5%) with sclerosed mastoid and 5 cases (62.5%) with hypopneumatized mastoid (Table 2).

**Table 2.** Distribution of patients according to mastoid pneumatization.

CSOM	Squamous No. (%)	Mucosal No. (%)
Abnormal	13 (26)	8 (13.6)
Sclerosed mastoid	9 (69.2)	3 (37.5)
Hypopneumatized mastoid	4 (30.8)	5 (62.5)

Audiologic examination of the CLE revealed 40 ears (47%) having conductive hearing loss CHL of average 32.1 dB, distributed as follows; 36.5 dB average hearing loss in 28 (70%) of cases with squamous type and 27.7 dB average

hearing loss in 12 (30%) of cases with mucosal CSOM (Table 3).

**Table 3.** Distribution of patients according to audiological evaluation.

CSOM	No. (%)	Average hearing loss (dB)
Squamous	28 (70)	36.5
Mucosal	12 (30)	27.7
Total	40 (47)	32.1

Tympanometric evaluation of the CLEs revealed 43 ears (50.6%) having abnormal curve, distributed as follows; 19 (73%) of cases with squamous type where type C curve was found in 16 (84.2%) and type B curve in 3 (15.8%). And 24 (40.7%) in cases with mucosal CSOM. where type C curve was found in 20 (83.33%) and type B curve in 4 (16.7%) (Table 4).

**Table 4.** Distribution of patients according to Tympanometric evaluation.

CSOM	Squamous No. (%)	Mucosal No. (%)
Abnormal	19 (73)	24 (40.7)
Type C curve	16 (84.2)	20 (83.33)
Type B curve	3 (15.8)	4 (16.7)

## 5. Discussion

Studying the pathological process of the CLEs in cases of unilateral CSOM is crucial for understanding and interpreting the trigger and sequence of events that lead to CSOM. In other words the CLE is today what the diseased ear was yesterday [4].

In the present study (30.59%) of cases were having a unilateral squamous disease and (69.41 %) were mucosal CSOM, the lower incidence of squamous CSOM was also reported by (Ritu and Rajesh 2020) [10], being 17.33% in squamous CSOM and 82.66% in mucosal CSOM. similar findings were reported by (Ashish et al., 2002) [11] where they reported a lower incidence of squamous CSOM (34%) as compared to mucosal CSOM in 76% of patients. (Shireen et al., 2017) [4] findings were in agreement with findings in the present study where (26.25%) had squamous CSOM compared to (73.75%) had mucosal CSOM. This can be attributed to the lower incidence of squamous CSOM compared to mucosal CSOM and the fact that patients having squamous CSOM only seek medical advice only when they suffer marked diminution of hearing or complications related to CSOM.

In the present study, Otoendoscopy revealed (70.6%) of patients having a diseased contralateral ear, of which (76.9%)

having squamous disease and (67.8%) having mucosal CSOM, those findings were in agreement with (Adhikari et al., 2009) [12], they reported that 68.4 % of CLEs had some form of abnormality. They found that (71.4 %) were abnormal in cases having squamous disease and (62.9 %) were abnormal in cases with mucosal COM. In the study by (Dawood, 2018) [13], this incidence had been reduced to (47.91%) of all CLEs, (45.83%) in squamous and (50%) in mucosal COM. (Sweta and Nandita, 2019) [6] reported 80% of patients to have a diseased contralateral ear.

Pars tensa retraction was the most common abnormality (60%) seen in cases with squamous OM while thin TM was the most common abnormality (50%) of cases with mucosal COM, those findings were agreed with findings by (Dawood, 2018) [13], where he found Pars tensa retraction was the most common abnormality in (squamous type) and the thinning of the TM was the most common abnormality in (mucosal type). This correlates with the study by (Shireen et al., 2017) [4], where PT retraction was the most common abnormality in CLE of squamous type (52.3%), whereas thinning was the most common abnormality in CLEs of mucosal diseases (40.7%), followed by pars tensa retraction.

Pars tensa retraction was more severe in CLE of patients with squamous disease, (41.7%) were grade 4 (adhesive otitis media) while in mucosal type (50%) were grade 1, those results correlates with those postulated by (Selaimen et al., 2008) [5] and (Shireen et al., 2017) [4].

In the present study, myringosclerosis was noticed in the CLE of (10%) of cases having squamous disease and in (2.5%) of cases having mucosal CSOM. (Dawood, 2018) [13] reported (12.5%) in squamous and (8.34) in mucosal CSOM.

Tomographic assessment of mastoid pneumatization revealed abnormalities in (24.7%) of all CLEs. Present study findings are in line with (Munish et al., 2016) [14], where they reported 21% radiologic abnormalities in CLEs. (Ritu and Rajesh, 2020) [10] reported radiologic abnormalities in (33.3%) of CLEs.

The incidence of abnormalities in the mastoid air cell system were more prevalent (62%) in the CLEs of cases with squamous disease {(69.2%) with sclerosed mastoid and (30.8%) with hypopneumatized mastoid} than cases with mucosal CSOM (13.6%) {(37.5%) with sclerosed mastoid and (62.5%) with hypopneumatized mastoid}. (Shireen et al., 2017) [4] reported abnormalities in (52.4%) in the CLEs of cases with squamous disease {sclerosed mastoid in (14.38%) and hypopneumatized in (38%)} and in (57.6%) of cases with mucosal disease, {(20%) sclerosed and (37.3%) hypopneumatized}. (Dawood 2018) [13] reported abnormalities in (58.82%) in the CLEs of cases with squamous disease {(60%) sclerotic and (40%) hypopneumatized} and in (41.17%) of cases with mucosal disease, {(57.14%) sclerotic and (42.86%) with diminution of mastoid air cells aeration}.

Audiologic examination of the CLE revealed (47%) having conductive hearing loss CHL of average 32.1 dB {36.5 dB average hearing loss in (70%) of cases with squamous

type and 27.7 dB average hearing loss in (30%) of cases with mucosal CSOM}. This correlates with the study done by (Damghani and Barazin, 2013) [15], where 48% complained of conductive hearing loss in CLE. Dawood (2018) [13] reported (39.58%) having conductive hearing loss of average 31.15 dB {33.76 dB average hearing loss in (45.83%) of cases with squamous type and 28.54 dB average hearing loss in (33.33 %) of cases with mucosal CSOM}.

Tympanometric evaluation of the CLEs revealed (50.6%) having abnormal curve {(73%) of cases with squamous type where type C curve was found in (84.2%) and type B curve in (15.8%)}, and in (40.7%) of cases with mucosal CSOM. where type C curve was found in (83.33%) and type B curve in (16.7%). Results are consistent with those reported by (Sweta and Nandita, 2019) [6], where they noticed 52.5% of patients had an abnormal tympanogram in opposite ear. In their study (Ritu and Rajesh, 2020) [10] reported that in squamous CSOM (19.23%) had type B and (19.23%) had type C and in mucosal CSOM 12% had type B and 8.8% had type C. (Dawood, 2018) [13] reported tympanometric abnormalities in (35.41%) of all CLEs being most commonly of type C-curve in (64.7%) in all CLEs in which (63.63%) was detected in squamous and (36.36%) in mucosal CSOM.

## 6. Conclusions

The present study has confirmed the presence of high incidence of abnormalities in the CLEs of unilateral squamous and mucosal CSOM which is more in squamous type, it emphasizes the importance of considering both ears as a pair. Disease in one ear especially in squamous type needs a close follow up of other ear, as in most cases there a hidden pathology which needs attention for complete cure. Unilateral CSOM shouldn't be addressed as a static phenomenon but as a continuous process in the CLE too. Otoendoscopy can be helpful in diagnosing and documenting masked pathologies. Further studies are needed to assess the influence of intervention on the disease evolution on the CLEs.

## Consent to Participate

Explanation and informed written consent for this research has been taken from all patients.

## Consent for Publication

Formal consent was signed by the patients to share and to publish their data in this research.

## Author Contributions

All authors contributed equally in this work.

## Ethical Approval

All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional research editorial board sand with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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## Data Availability Statement

The data sets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Conflicts of Interest

The authors declare no conflict of interests.

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