ORIGINAL ARTICLE

Intracranial Spread of Infections Among the Patients of Chronic Suppurative Otitis Media

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ABSTRACT

Objective: To determine the frequency of intracranial spread of infections among the patients of chronic suppurative otitis media presenting at a tertiary care hospital in Karachi.

Study Design: Cross-Sectional Study.

Place and Duration of Study: The study was carried out at the Department of ENT, Head and Neck Surgery, Dow Medical College, Dr. K.M Ruth Pfau Civil Hospital, Karachi, Pakistan, from January 2021 to January 2022.

Methods: Out of 87 patients with Chronic Suppurative Otitis Media were included using a non-probability sampling technique. Possible routes of spread of infections were identified based on per operative findings. The Descriptive statistics were applied to all parameters. On inferential statistics, Chi-square test was used for stratification, considering *p*-value ≤0.05 as significant.

Results: 75 (86.2%) were male and 12 (13.8%) were female. 21 (24.1%) patients were found with meningitis, 11 (12.6%) with lateral sinus thrombosis, and 2 (2.3%) with otitis hydrocephalus. As far as signs and symptoms are concerned, 87 (100%) patients had a headache, 74 (85.1%) had nausea and vomiting, 44 (50.6%) patients had vertigo, 43 (49.4%) had a fever, 18 (20.7%) had diplopia, and 73 (83.9%) had altered consciousness. 69 (79.3%) of patients' route of infection in the patients of chronic suppurative otitis media had bone erosion, 12 (13.8%) had thrombophlebitis, and 6 (6.9%) had anatomical pathways. Among different sites of spread of infection, the most common site was sinodural angle 45 (51.72%).

Conclusion: Bone erosion, with 79.3%, was the most prevalent route of intracranial spread, followed by thrombophlebitis and anatomical pathways.

Keywords: *Chronic Suppurative Otitis Media, Complication, Intracranial Spread of Infections, Middle Ear, Routes, Sites.*

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Introduction

An episode of acute infection initiates the CSMO (Chronic suppurative otitis media). It all starts with symptoms of inflammation and irritation of the mucosa of the middle ear.[1] Infections can enter the cranial cavity through various methods, including direct bone erosion, thrombophlebitis, and natural anatomical pathways.[2]

Chronic suppurative otitis media (CSOM) is a long-lasting ear infection that involves persistent discharge from the middle ear through a perforated

eardrum. The sequence of ulceration, infection, swelling, and the production of granular tissue may persist, damaging the adjoining bone borders, eventually leading to CSOM problems.[3]

The study by Cheng X et al., illustrated that infection spread routes were bone erosion at 80%, thrombophlebitis at 14%, and anatomical pathways at 6%.[4] Even in the antibiotic age, intracranial complications (ICC) of CSOM might develop. Patients with poor hygiene, rural reside, low socio-economic status, nasal allergy[5], and inadequate immunity are more likely to develop this complication.[6] Intratemporal and intracranial problems are two types of otitis media complications.[7] The temporal bone and its environs are involved in intratemporal problems (e.g., facial nerve paralysis, mastoiditis, labyrinthitis, petrositis, labyrinthine fistula).[8]

Meningitis, brain abscesses, sigmoid sinus thrombosis, extra Dural abscess, subdural abscess, CSF otorrhea, and otitic hydrocephalus are all intracranial complications.[9] Intracranial complications of CSOM are rare but can have severe consequences. Anyone with CSOM who experiences severe headaches, neurological symptoms, or signs of systemic infection should seek immediate medical attention, as early diagnosis and intervention are essential for a better prognosis.[10]

Similar literature illustrates that ≤20 years confirmed that the most common place intracranial trouble turns out to be brain abscess (58.5%) accompanied by meningitis accounted for 24.6%, 6.3% lateral sinus thrombosis and a couple of 8 % extradural abscess.[11] The reason for intracranial headache is the spread of infection from the ear and temporal bone, which causes otitis media.[12,13] The Spread of infection occurs via 3 routes: hematogenous dissemination, direct extension, and thrombophlebitis.[14] The intracranial abscess, tympanosclerosis sequelae include hearing loss, and acquired cholesteatoma are the complications of Intracranial.[15,16]

The objective of this research was to report the routes of intracranial spread of infections in patients with CSOM at tertiary care hospitals. Knowledge of the intracranial spread of chronic ear infections would be of great help in managing such cases both for ENT and Neurosurgeon. It would also help prevent the recurrence of intracranial complications by adequately addressing and clearing these routes preoperatively. No previous study is available in local or international literature.

Methods

This research was a descriptive cross-sectional study conducted after approval from the Dow University of Health Sciences dated September 10, 2021 vide letter no. [IRB-1928/DUHS/Approval/2021], Dow Medical College Dr. Ruth. KM. Pfau Civil Hospital, Karachi, Pakistan, from 11thJanuary 2021 to 10th January 2022. After taking written informed consent, eighty-seven patients diagnosed with various intracranial complications of CSOM presented in the OPD of Ear, Nose, and Throat (ENT) department meeting the eligibility criteria were integrated through a non-probability consecutive sampling approach. The sample size was calculated using an open EPI sample calculator, taking stability of anatomical pathway 6%[3] and 5% margin of errors,95% CI, and 87 were total sample size by using the above parameters. Diagnosing complications of chronic suppurative otitis media (CSOM) typically involves a combination of medical evaluation, clinical symptoms, and sometimes imaging studies. Here's how complications and difficulties were diagnosed:

1. Medical History: The healthcare provider took a detailed medical history, asking about the patient's ear symptoms, previous ear infections, and any treatments received.
2. Physical Examination: A thorough examination of the ear and surrounding structures is performed. The consultant looks for signs of infection, inflammation, and damage to the eardrum or nearby tissues.
3. Clinical Symptoms: Severe ear pain, fever, dizziness, facial weakness, or hearing loss can suggest complications. These symptoms are important indicators for diagnosis.
4. Imaging Studies: In some cases, imaging studies like CT (computed tomography) scans or MRI (magnetic resonance imaging) may be ordered. These can provide detailed images of the ear and help identify complications like abscesses, bone erosion, or involvement of nearby structures.
5. Laboratory Tests: In severe cases or when there is suspicion of systemic infection, blood tests may be conducted to check for signs of infection,

such as elevated white blood cell counts.

6. Audiological Evaluation: Audiological tests, such as pure-tone audiometry, may be performed to assess hearing loss and its severity.
7. Culture and Sensitivity: If there is drainage from the ear, a sample is collected for bacterial culture and sensitivity testing to determine the type of bacteria causing the infection and which antibiotics are most effective.

It's crucial for individuals with CSOM to seek prompt medical attention if they experience worsening symptoms or suspect complications, as early diagnosis and treatment can help prevent serious consequences. Treatment may involve antibiotics, surgery to repair the eardrum or addressingarisen addressing any complications.

Inclusion Criteria: Patients, gender with age 5_60 years, diagnosed with various intracranial complications of CSOM (>3 weeks), who gave consent to undergo surgical procedure were included in our study.

Exclusion Criteria: Patients having a history of previous surgery or Patients unfit for surgery ASA III or IV and with other concomitant neurological diseases were excluded from the study.

Data was analyzed in SPSS software (version 26). Median (range) was determined for quantitative parameters like age in frequencies and percentage. The inferential statistics Chi-square test was applied to evaluate the frequency of different routes of intracranial spread of infections concerning demographic data. The - P-value < 0.05 was taken as statistically significant.

Results

Among 87 patients diagnosed with various intracranial complications of CSOM, 75 (86.2%) were male, and 12 (13.8%) were female, with a median (range) age of 12.00 (36-6) years. The median ear discharge duration was 18 (26-13) weeks. Study results showed that 44 (49.4%) of patients had right ear and 43 (50.6%) had left ear discharge.

44 (50.6%) patients had scanty, and 43 (49.4%) had profuse discharge. Out of 87 patients, 37 (42.5%) were found with mucus discharge type. A total of 21

Table 1: Descriptive Statistics of the Patients (n=87)

Descriptive Statistics	n (%)
Age(Years)	
Median (Range)	12.00 (36-6)
Duration of Ear Discharge (weeks)	
<18weeks	39 (45%)
> 18 weeks	48 (55%)
Median(range)	18 (26-13)
Gender	
Male	75 (86.2%)
Female	12 (13.8%)
Socio-economicStatus	
Poor	63 (72.4%)
Middle	24 (27.6%)
High	0 (0%)
Intra-Cranial Complications	
Meningitis	25 (28.7%)
Lateral Sinus Thrombosis	58 (66.6%)
Otitic Hydrocephalus	4 (4.5%)
Signs and Symptoms of Intra-Cranial Complications	
Headache	87 (100%)
Nausea&Vomiting	74 (85.1%)
Vertigo	44 (50.6%)
Fevers	43 (49.4%)
Diplopia	18 (20.7%)
Altered Consciousness	73 (83.9%)

(24.1%) patients were found with meningitis, 11 (2.3%) with otitis hydrocephalus, and 2 (12.6%) with lateral sinus thrombosis. As far as signs and symptoms of intracranial complications are concerned, all 87 (100%) patients were found with headache, 74 (85.1%) with nausea and vomiting, 44 (50.6%) with vertigo, 43 (49.4%) with fever, 18 (20.7%) with diplopia and 73 (83.9%) with altered consciousness. The detailed descriptive statistics of patients are presented in Table 1.

In our study, 79.3% of patients were found with bone erosion, 13.8% with thrombophlebitis, and 6.9% with anatomical pathways, as presented in Table 2.

Among different sites of spread of infection, the most common site was sinodural angle 45 (51.72%), followed by dural plate 24 (27.58%) and sigmoid plate 20 (22.98%), presented in Table 3

Table 2: Frequency Distribution of Routes of Intracranial Spread of Infections

Intracranial Spread of Infections	n (%)
Bone erosion	
Yes	69 (79.3%)
No	18 (20.7%)
Thrombophlebitis	
Yes	12 (13.8%)
No	75 (86.2%)
Anatomical Pathways	
Yes	6 (6.9%)
No	81 (93.1%)

Table 3: Frequency sites of Spread of Infections in Bone Erosion

Sites of Spread of Infections in Bone Erosion	n (%)
Sinodural angle	45 (51.72%)
Dural Plate	24 (27.58%)
Sigmoid Plate	20 (22.89)

A significant association was found between different routes of intracranial spread of infections spread and gender, age, ear discharge duration, side of ear, education, and socio-economic status as the *p*-value was > 0.05; however, a significant relationship between residential status and different routes of intracranial spread of infections spread was found as *p*-value = 0.000 as presented in Table 4.

Discussion

Although the incidence of intracranial complications of (Chronic suppurative otitis media) has been observed significantly less, over the past 15 years, mainly due to widespread use of broad-spectrum antibiotics.[17] Regardless of this on the whole decrease, *(*Chronic suppurative otitis media*)* causes life-threatening problems continue to exist.[18] Because of poor quality of life style, lack of knowledge, and a lack of medical services, this is especially widespread in developing countries. In rare circumstances, growing bacterial resistance to antibiotics has also been linked to an increase in the number of problems.[19]

Few studies were done at international, local data about its significance is insufficient. Paucity of information in this regard exists in our part of the world (Eastern and southern Asia)[20] which has different geographical setup, climate, dietary habit, lifestyle and economical soundness as compared to western world. Due to the scarcity of data, the work on this subject would also add benefits and formulate policies for managing such patients in the future.[21]

Patients with otogenic problems hadages between 21-76 years old, with 48.5±3.5 years the mean age, in contrast to another study which showed that the ages of patients were 9 to 74 years old and 31.3 years mean age.[22,23] In the literature, most of the patients appeared in the second and third decades of life.[24] The median age in our study was 12, ranging from 6

Table 4: Stratification of Frequency of Routes of Intracranial Spread of Infections Concerning Demographic Data

Descriptive Statistics	Routes Of Intracranial Spread of Infections			*P*-value
	Bone erosion (n=69)	Thrombophlebitis (n=12)	Anatomical Pathways (n=6)	
Age(Years)				
5-12	39 (56.5%)	06 (50%)	03 (50%)	0.884
12-65	30 (43.4%)	06 (50%)	03 (50%)	
Duration of Ear Discharge(weeks)				
≤18weeks	35 (50.7%)	09 (75%)	04 (66.6%)	0.249
>18weeks	34 (49.2%)	03 (25%)	02 (33.3%)	
Gender				
Male	59 (85.5%)	10 (83.3%)	06 (100%)	0.585
Female	10 (14.5%)	02 (16.6%)	00 (0%)	
Residential Status				
Urban	58 (84%)	01 (9%)	06 (100%)	0.000
Rural	11 (16%)	11 (91%)	00 (0%)	
Educational Status				
Illiterate	31 (44.92%)	04 (33.3%)	02 (33.3%)	0.946
Primary	20 928.9%)	04 (33.3%)	02 (33.3%)	
Secondary	13 (18.8%)	03 (25%)	02 (33.3%)	
Intermediate	05 (7.2%)	01 (8.3%)	00	
Graduate&Above	00	00	00	
Socio-economic Status				
Poor	52 (75.3%)	08 (66.6%)	03 (50.0%)	0.366
Middle	17 (24.6%)	04 (33.3%)	03 (50%)	
High	00	00	00	
Side of discharge				
Left	35 (50.7%)	07 (58.3%)	02 (33.3%)	0.607
Right	34 (49.2%)	05 (41.6%)	04 (66.6%)	

to 36 years. Younger people are more susceptible to the problems of CSOM, which is likely owing to their underdeveloped immune systems, and they are also more neglectful of self-care.[25]

In research, the ratio of male patients was high as compared to female patients with male patients: female patients ratio of 1.3:1 in accord with the research.[26] with a high proportion of male patients (56.72%), but the results of another study differ in which females were dominant with patients female patients –male patient ratio of 1.2:1.[27,28] In our study 86.2% of the cases were male patients, and 13.8% were female patients.

The present research revealed that the most common intracranial complication was lateral sinus thrombosis i.e., 58 (66.6%)followed by meningitis 25 (28.7%) and otitic hydrocephalus 4 (4.8%). Similarly, another study reported lateral sinus thrombosis as the most common intracranial complication.[29]

However, results of our study are not in-consonance with the findings of the study conducted by Naveen Shahid and co-workers on frequency of intra-cranial complications Shows that meningitis was in 38 (21.50%) sufferers, lateral sinus thrombosis were in 8 (4.50%) patients and otitic hydrocephalus was found in 5(2. Eighty %) patients.[30]

In our study, bone erosion was 79.3%, thrombophlebitis was 13.8%, and an anatomical pathway was 6.9%. The finding is in line with research conducted by Angelo SJ et al. found that routes of spread of infections were bone erosion 80%, thrombophlebitis 14% and anatomical pathways 6%.[30]

Although different routes of spread of (ICOM) have been discussing in the literatures but only one study depicting the frequency and percentage of the various routes of spread of (ICOM) is available. Similar study related to our study concluded that

spread of intracranial infections a few of the patients of chronic suppurative otitis media can follow some of feasible routes: I) Bone demineralized due to acute contamination and inflamed clots inside small veins thru bone and dura venous sinuses. The other cause is traumatic bone defects.

Sample size calculation technique and small sample size and single-center study is the limitation of this study, and might not allow generalization of results to the population. Hence, more structured studies with larger samples are required.

Conclusion

The current study revealed that bone erosion, with 79.3%, was the most prevalent route of intracranial spread. In bone erosion sinodural angle (51.72%) was found to be the most common pathway followed by dural plate (27.58%) and sigmoid plate (22.98%), respectively. Knowing the intracranial spread of chronic ear infections would be of great help in managing such cases both for ENT and Neurosurgeons and in preventing the recurrence of intracranial complications by adequately addressing and clearing these routes preoperatively. More structured multicentre studies are required with larger sample sizes and treatment options considered.

Authors Contribution

MIM: Idea conception, study designing, data collection, data analysis, results and interpretation manuscript writing and proof reading

AFN: Idea conception, study designing, data collection, data analysis, results and interpretation

SUN: Idea conception, study designing, data collection and data analysis

NK: Study designing, data analysis, results and interpretation, manuscript writing and proof reading

AA: Idea conception, study designing, data collection, manuscript writing and proof reading

NA: Idea conception, study designing, data collection, manuscript writing and proof reading

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