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Original Research Article

Prevalence of causative bacteria on cell phones of patients with chronic suppurative otitis media: a descriptive cross-sectional study

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ABSTRACT

Background: The aim of this study is to identify the prevalence of causative bacteria on the cell phones of patients with chronic suppurative otitis media (CSOM).
Methods: Fifty clinic patients were randomly selected according to the eligibility criteria. Ear swab samples and swabs from the ear-piece area of their cell phones were collected for laboratory investigation. Additionally, 20 controls were recruited for comparison.
Results: Among the 50 subjects, 60% were Females, and the highest prevalence was observed in the 36-45 age group. Ear swab cultures showed bacterial growth in 32 samples (64%), with *Pseudomonas* spp. (24%) being the most prevalent, followed by coagulase-negative *Staphylococcus* spp. (14%) and *Staphylococcus aureus* (14%). Only 11 out of 50 phone swabs (22%) showed bacterial growth, predominantly coagulase-negative *Staphylococcus* spp. (18%). In three cases, the same non-pathogenic bacteria (coagulase-negative *Staphylococcus* spp.) were found in both ear and phone samples. Among the controls, 55% were female, and the highest prevalence was in the 26-35 age group. Four ear swab samples (20%) from the controls grew coagulase-negative *Staphylococcus* spp., but phone samples showed inconsistent laboratory results due to technical issues.
Conclusions: Based on the findings, there is no significant prevalence of CSOM causative bacteria on the cell phones of patients. However, limitations, including sample size and the inability to establish a causal relationship, should be considered. Larger studies exploring multiple environmental reservoirs may better clarify potential transmission routes for CSOM pathogens.

Keywords: CSOM, Cell phones, Mobile phones, Causative bacteria, Ear infection

INTRODUCTION

Chronic suppurative otitis media (CSOM) is a long-standing infection of part or all of the middle ear cleft, characterized by a perforated tympanic membrane with persistent discharge lasting more than 6-12 weeks. It can lead to long-term or permanent changes in the tympanic membrane, including atelectasis, dimeric membrane formation, perforation, tympanosclerosis, retraction pockets, or cholesteatoma.[1] Disease typically begins in childhood as spontaneous tympanic membrane perforation due to acute middle ear infection, known as acute otitis media (AOM)/as sequel to less severe forms of otitis media (e.g., secretory otitis media). Point at which AOM progresses to CSOM is still controversial.[2]

The pathophysiology of CSOM involves irritation and inflammation of the middle ear mucosa, which leads to mucosal oedema. Persistent inflammation results in mucosal ulceration and the breakdown of the epithelial lining. The body's attempt to heal the infection and inflammation manifests as granulation tissue, which can develop into polyps within the middle ear space. This cycle of inflammation, ulceration, infection, and granulation may eventually cause destruction of surrounding bone.[3] The presence of bloody discharge, facial palsy, or a history of pain, vertigo, or severe headache indicates complications. CSOM is often capable of causing irreversible damage, leading to hearing loss.[4]

Although the risk factors for CSOM have not been clearly established, its incidence appears to correlate with socio-economic factors.[4] Poor living conditions, overcrowding, poor hygiene, and malnutrition contribute to its widespread prevalence in developing countries.[5] Similar risk factors are seen in lower socio-economic groups in developed nations. Other risk factors include inadequate antibiotic treatment, frequent upper respiratory tract infections, nasal disease, and limited access to medical care.[4]

Diagnosis is made through careful history taking, otoscopy, and bacterial culture (if available). The primary aims of CSOM management are to eradicate infection and close the tympanic perforation. The standard treatment includes aural toilet (ear cleaning) and topical antimicrobial drops.[2] Although systemic antibiotics (oral or injectable) are sometimes used, they are less common, as topical antibiotics combined with aural toilet provide higher tissue concentrations than systemic antibiotics.[6] Mastoidectomy was traditionally the main treatment, but recent studies suggest that it is not superior to more conservative therapies, such as aural toilet and antibiotics, for uncomplicated cases of CSOM. Tympanoplasty (reconstruction of the tympanic membrane) is a surgical option for patients with persistent perforations after the infection has resolved.[7]

Given high prevalence of CSOM in our clinic, assessing its risk factors and environmental reservoirs is essential. While previous studies have examined common transmission modes, no prior research has evaluated whether communication devices like mobile phones could harbour CSOM pathogens.[4] This study aims to expand CSOM research by examining the prevalence of bacteria on cell phones of patients with CSOM. However, we acknowledge that proving unidirectional transmission route from phone to ear would be difficult and ethically challenging, especially since bidirectional contamination or transmission from other sources (such as hands) is possible. This study offers preliminary evidence for future research but does not claim to establish causality.

METHODS

Study design

We conducted a descriptive cross-sectional study at the ENT clinic of district general hospital, Trincomalee, Sri Lanka, selecting 50 patients with CSOM and 20 control patients without CSOM. Ethical approval was granted by the ethics review committee of the faculty of health-care sciences, eastern university, Sri Lanka, on March 28, 2018. The study was conducted over a period from May 2018 to December 2018.

Sampling technique

Swabs were taken from the specific areas of the cell phone likely to be in contact with the ear (e.g., speaker grille and proximity sensor). This method ensured that samples were collected from regions most likely to harbour bacteria from skin or ear contact.

Inclusion criteria for subject patients

Patients must have presented to the ENT clinic at district general hospital (DGH) Trincomalee during the study period, patients must be over 18 years old, patients must already have a diagnosis of CSOM or be diagnosed with CSOM by an ENT specialist at the time of presentation, patients must have a wet central perforation at the time of presentation and patients must have brought their usual cell phone, which they had been using for at least three months were included.

Inclusion criteria for control patients

Patients must have presented to the ENT clinic at DGH Trincomalee for medical check-ups unrelated to CSOM during the study period, patients must not have had any history of CSOM and patients must be over 18 years old were included.

Exclusion criteria

Patients with chronic skin conditions or chronic wounds were excluded from the study.

Data collection

Patients who met the eligibility criteria were recruited after giving informed written consent. An interviewer-administered questionnaire was used to collect socio-demographic details from both subject and control patients. Ear discharge swabs and swabs from the part of the cell phone in contact with the ear were collected for culture and antibiotic sensitivity testing (ABST) from the subject group. For the control group, only swabs from the part of the cell phone in contact with the ear were collected. All swabs were sent to the microbiology lab with duly filled request forms. Data was collected from culture reports and ABST results of the ear discharge and phone swab samples.

Data analysis

The collected data was entered and analysed using SPSS version 22, employing basic statistical methods.

RESULTS

A total of 50 patients diagnosed with CSOM were randomly selected as subjects, and 20 patients without CSOM were selected as controls, based on the eligibility criteria.

Demographics

Among the 50 CSOM subjects, 60% were Female, while the remaining 40% were male (Figure 1).

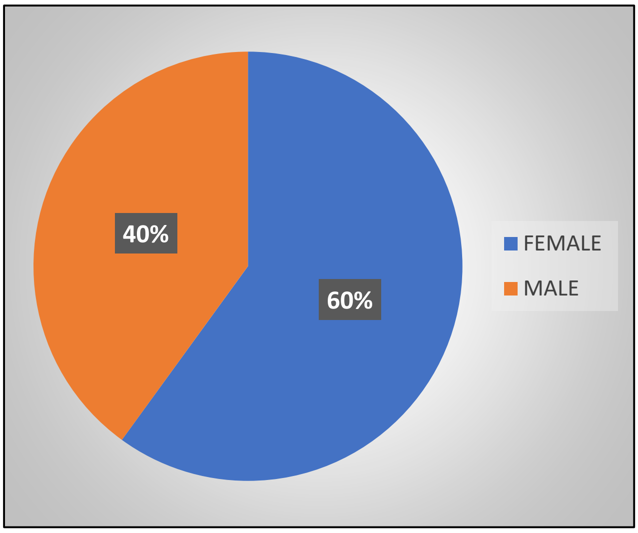

Figure 1: Gender distribution of the CSOM patients.

The highest number of CSOM cases were recorded in the 36-45 age group (Figure 2).

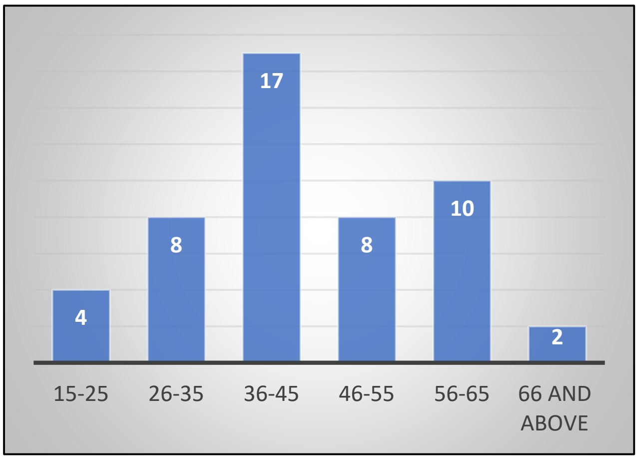

Figure 2: Age distribution of the CSOM patients.

Ear swab results

Among the CSOM patients, the prevalence of bacterial pathogens in ear swabs was 64%, with *Pseudomonas* spp. as the most common organism, consistent with prior findings in similar patient groups. Control patients had primarily commensal organisms, with 20% showing Coagulase-negative *Staphylococcus* spp. in ear swabs. Only 11 out of 50 phone swabs (22%) showed bacterial growth, predominantly coagulase-negative *Staphylococcus* spp., suggesting that phones did not serve as reservoirs for pathogenic CSOM bacteria. Notably, only four samples had matching organisms (Coagulase-negative *Staphylococcus* spp.) in both ear and phone swabs, and these were all commensals rather than CSOM pathogens (Figure 3).

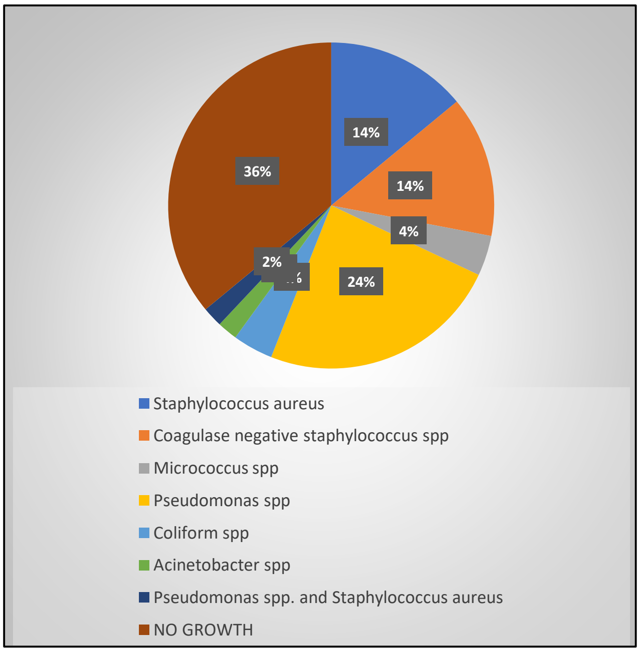

Figure 3: Ear swab infective organisms in CSOM patients.

Phone swab results

Among the 50-phone ear-piece swab samples from CSOM patients, 39 (78%) showed no bacterial growth, while 11 (22%) showed growth of microorganisms. The most frequently isolated organism was coagulase-negative *Staphylococcus spp.* (18%), followed by *Micrococcus spp.* (4%) (Figure 4).

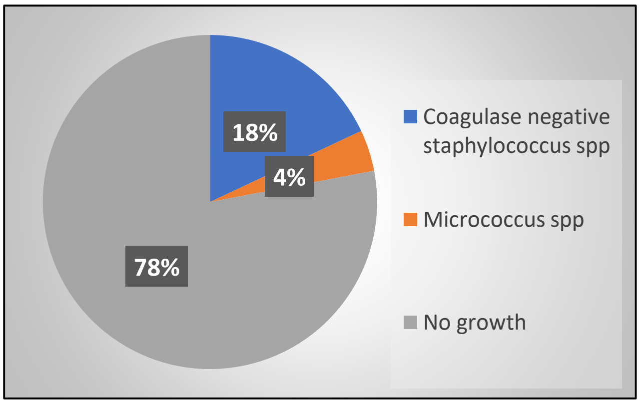

Figure 4: Phone ear-piece swab infective organisms in CSOM patients.

Control group results

In the control group, 55% of the patients were female, and 45% were male (Figure 5). The highest number of controls fell within the 26-35 age group (Figure 6).

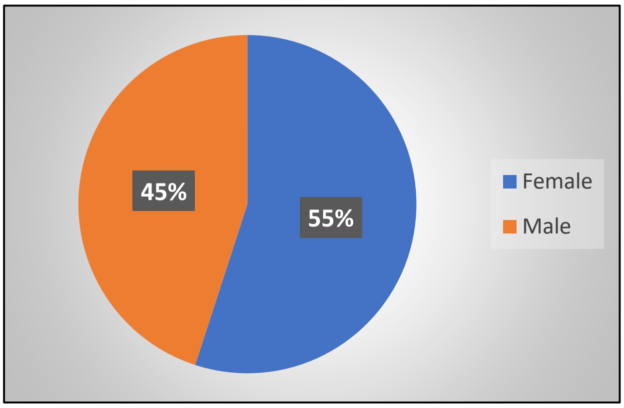

Figure 5: Gender distribution in control group.

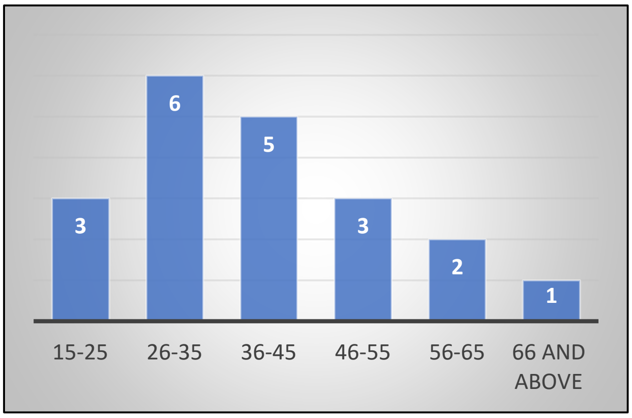

Figure 6: Age distribution of the control group.

Out of 20 ear swab samples from control group, 4 (20%) showed bacterial growth, and all of these were coagulase-negative *Staphylococcus* spp. (Figure 7). In phone ear-piece samples, we encountered lab error; 10 samples showed no growth, and 10 samples showed growth of *Pseudomonas* spp., with identical sensitivity patterns.

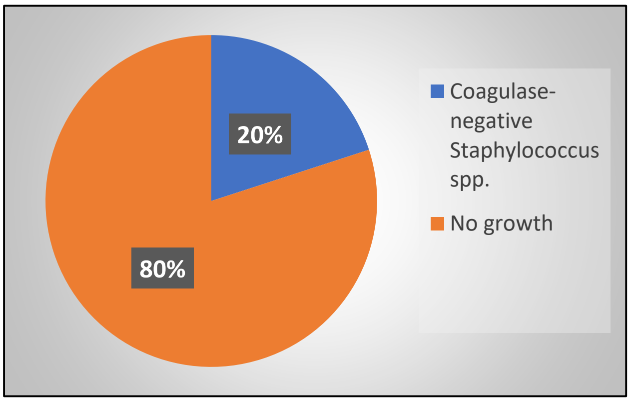

Figure 7: Ear swab results in control patients.

DISCUSSION

CSOM is one of the most common causes of hearing loss in patients who do not properly manage AOM.[2] Beyond hearing impairment, CSOM can lead to severe complications, including intracranial issues.[17] Due to its high prevalence and chronic nature, CSOM remains a significant burden on healthcare systems. The exact point at which AOM becomes chronic is still unclear.[18] Additionally, the causative organisms (both aerobic and anaerobic) vary, and no definitive knowledge exists about the risk factors contributing to CSOM development.[13]

To ensure accuracy in organism identification and interpretation of microbiological data, a microbiologist was included in our research team. This collaboration was instrumental in guiding the sampling process, selecting appropriate culture media, and identifying both pathogenic and commensal organisms with a high degree of precision. The microbiologist's expertise provided essential insights into distinguishing between commensal organisms and true CSOM pathogens, supporting our conclusion that mobile phones are unlikely to serve as reservoirs for CSOM-causing bacteria. This interdisciplinary approach enhances the reliability of our findings and underscores the importance of specialized microbiological input in studies examining environmental reservoirs of infection.

This study offers a novel exploration of mobile phones as potential reservoirs for CSOM pathogens. We randomly selected 50 CSOM patients and 20 patients without CSOM as controls. The largest proportion of CSOM cases was found in the 36-45 age group, a finding that contradicts earlier studies by Mansoor et al, Poorey and Lyer, and Wariso and Ibe.[8-10] This discrepancy may be attributed to our exclusion of children (under 18) and the small sample size. Children were excluded because they typically do not regularly use cell phones in Sri Lanka, which is a limitation in our study.

Regarding gender, 60% of our sample population was female, which contradicts the findings of Afolabi et al and Vishwanath et al.[13,14] This discrepancy could be due to differences in demographics, health-seeking behaviours, or cultural settings. Several studies have investigated the microbiology of CSOM, but results vary. According to Kenna and Bluestone, Khanna et al, Afolabi et al and Vishwanath et al *P. aeruginosa* was the predominant organism, followed by *S. aureus*.[11,13,14] In contrast, Prakash et al and Nikakhlagh et al reported *S. aureus* as the predominant organism, with *Pseudomonas* spp. being the next most common.[15,16]

In our study, *Pseudomonas* spp. was the most common organism, found in 24% of CSOM ear swabs, followed by *S. aureus* (14%) and coagulase-negative *Staphylococcus* spp. (14%). Our findings on *Pseudomonas* spp. as the most prevalent organism align with Poorey and Lyer study, where *P. pyocyaneous* accounted for 35.2% of cases, followed by *K. aerogenes* at 25.4%.[9] These variations in findings across studies suggest that the distribution of causative organisms may depend on geographic and ethnic factors.

Our results also indicate that CSOM-causing bacteria were not prevalent on patient phones, as only commensal organisms were identified. However, several limitations in our methodology and sample characteristics may influence these findings. First, our cross-sectional design does not allow for direct causation to be established. Without an experimental design where one group avoids phone use and another group continues, the role of phones in CSOM cannot be directly determined. Interestingly, no prior literature has examined cell phones as potential reservoirs for pathogens in CSOM patients.

Our control group had mostly negative results, with a few samples showing the growth of non-pathogenic commensal organisms such as coagulase-negative *Staphylococcus* and *Micrococcus* spp.

Limitations

This study introduces a new research avenue; however, several limitations should be considered for future research. First, our sample size was small, and the study was conducted within a single geographic region. Expanding the sample size and incorporating data from multiple locations would improve both the sensitivity and specificity of our results, as suggested by Sedgwick's analysis on sample size limitations in research.[20]

Second, patients with CSOM may avoid using the affected ear due to progressive hearing loss, a behavioural adaptation documented in prior research, which may have influenced our results.[21] To counter this, future studies might focus on patients in earlier stages of CSOM to capture more accurate data. Additionally, chronic antibiotic use, which has known effects on bacterial resistance and patient microbiota, could also have influenced findings, as outlined by Ventola's review on antibiotic resistance in chronic use.[22]

Practical implications and recommendations for future studies

While our study does not conclusively identify mobile phones as reservoirs for CSOM infection, awareness of mobile phone hygiene remains relevant to general health. Our findings suggest that educating CSOM patients on mobile phone hygiene may not significantly impact infection prevention, though it could benefit overall hygiene practices. Future research might investigate other environmental reservoirs or factors associated with CSOM patients to inform public health and infection control strategies.

Further research using a larger sample size and a multicentre approach would help validate our findings. Longitudinal studies tracking bacterial contamination on mobile phones over time, as explored in Brady et al work on bacterial contamination in clinical settings, could provide further insights into potential reservoirs.[23]

CONCLUSION

In conclusion, this study contributes to understanding the potential environmental reservoirs for CSOM by assessing the presence of causative bacteria on the cell phones of patients with CSOM. Our findings indicate no significant prevalence of CSOM-causing pathogens, such as *Pseudomonas* spp. and *S. aureus* on patients' cell phones, as only non-pathogenic, commensal organisms (e.g., Coagulase-negative *Staphylococcus* spp. and *Micrococcus* spp.) detected. These results suggest that cell phones are unlikely to serve as reservoirs for CSOM-causing bacteria. This study thus advances knowledge by highlighting that, while cell phones are heavily used and in close proximity to patients, they may not play a major role in CSOM transmission. Further research with larger samples and diverse settings is recommended to validate these findings and explore other possible environmental factors, potentially guiding preventive strategies to reduce public health impact of CSOM.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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