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Lessons Learnt from Aetiopathogenesis of Otomycosis: An Observational Study in a Tertiary Care Centre

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ABSTRACT

Otomycosis is a commonly occurring infection in the humid climate of this state. The recent floods which affected this place resulted in people living in damp houses. This cross-sectional observational study aims to find the socio-demographic factors, aetiopathogenesis and other factors related to otomycosis in today's changing scenario. About 118 patients who attended the ENT OPD were recruited by non-probability sampling for the study. The swabs were sent for KOH stain, fungal stain and culture. Data analysis was done by SPSS software. Of the total of 118 patients recruited for the study, females constituted a slight majority of 58%. The most common age group affected was 40-50 years. Trauma was the incriminating factor in around 45% of cases. This included self-cleansing of ears and ear procedures. Use of hair dyes, herbal remedies like heated coconut oil in dried red chilli pod and over-the-counter ear drops were a few of the novel risk factors that we could discern. In 94% of cases, the culture was positive with *Aspergillus niger* topping the list. It is important to diagnose otomycosis, thus avoiding antibiotic ear drops. Careful and diligent ear suctioning would avoid trauma, thus preventing bacterial infections and further fungal infections. Newer studies indicate the use of Artificial Intelligence and Machine Learning in helping to diagnose diseases in remote areas where specialists are not available.

INTRODUCTION

Otomycosis although not life-threatening in the usual circumstances, can cause distress in the form of itching and ear block. This state being a coastal area is very humid and is rainy for around 75% of the duration of the year. The devastating floods happened during this study period. Houses were flooded and the walls were damp. Of all patients who attend our ENT-OP in a year approximately 6% of cases with external otitis have otomycosis. The aims and objectives of the study were to determine the socio-demographic and aetiopathogenesis, risk factors and mycological agents of otomycosis.

MATERIALS AND METHODS

Study Design: This was a cross-sectional study done by recruiting patients by convenience sampling who attended the ENT Department with otomycosis from December 2017 to May 2019. Ethical principles regarding human research according to Helsinki guidelines were adhered to (revised in 2000). Approval from the IRB and IEC was obtained. Informed consent, or assent, was also taken in appropriate cases. Confidentiality of patient data was adhered to at all stages.

Inclusion Criteria: All patients of all age groups and genders with clinical symptoms and signs of otomycosis-itching, ear block, hearing loss, ear discharge and tinnitus-ear debris with wet blotting paper or black, yellowish-green, or bluish-green detritus[2].

Exclusion Criteria: (1) Patients who were not willing to undergo ear suctioning and an ear swab examination. (2) Patients who were already on treatment for otomycosis. (3) Secondary otomycosis due to COM, systemic illnesses like diabetes mellitus, SLE, post-radiation, chronic granulomatous diseases, and malignant otitis externa.

Sampling Technique: Convenience sampling was used.

Sample Size: The sample size was derived using OpenEpi software version 3, with the expected prevalence of the sensation of blocked ears among otomycosis being 76.6%. The sample size arrived at 118, with a 95% confidence interval and 10% relative precision[1].

Study Procedure: A detailed questionnaire to elicit demographic and clinical symptoms like itching, ear pain, discharge and hearing loss was noted. History regarding self-cleansing, URI, allergic rhinitis, use of antibiotic ear drops, hearing aids, earphones, trauma and Dip baths was asked. Few people confessed to using heated coconut oil in chili pods, which many of our present-generation doctors were not aware of. An ENT examination was done to assess anatomical problems in the external ear. An otoscopic examination to confirm the fungal mass was done. Ear canal stenosis or widening, the presence of stiff hair and seborrheic dermatitis, if any, were also noted. Anterior rhinoscopy was done to find out if the patient had allergic rhinitis and its consequent Eustachian tube dysfunction. Meticulous ear suctioning was done to clear otomycotic debris after collecting specimens for KOH, fungal stain and fungal culture.

Swab Collection and Processing: Three cotton-tipped sterile swabs were taken from the ear with debris using a headlight. Specimens were transported to the laboratory in the Department of Microbiology. The first swab was digested on a slide with KOH and examined under the microscope. The second swab was inoculated in two Sabouraud's Dextrose Agar with 0.05% chloramphenicol to suppress bacterial growth. One of the agar slants is incubated at 25 degrees C and the other at 37°C for 2-3 weeks[3]. Cultures were examined on alternate days. The third swab was used for fungal staining. KOH smear under 10x and 40x magnification was used to identify the septate and septate hyphae, conidia and conidiophore, sporangia, sporangiophore and yeast forms. Cultures were examined for rate of growth, pigmentation, texture and topography.

Identification of Fungi: The molds were identified both by their growth characteristics and microscopic features of growth in a tease mount preparation made using lactophenol cotton blue[4]. Slide culture methods were adopted for confirmation of the identification of saprophytic molds.

Data Collection and Statistical Analysis: Data entry was done in Microsoft Excel and statistical analysis was done using SPSS Version 20. Analysis of categorical variables was done by using proportion or percentage and that of continuous variables by mean, median and range depending on normality with a 95% confidence interval.

RESULTS AND DISCUSSIONS

The study aimed at finding the aetio-pathogenesis and clinicmycological profile of otomycosis. A total of 118 patients were recruited for this study, of which females constituted a slight majority (69 out of 118, i.e. 58%, Confidence interval 49-67%) (Table 1). The most common age group affected was 40-50 years (Fig. 1). Homemakers were the most commonly affected group (Fig. 1). Other groups who were affected included students, children <5 years, various categories of field workers and people who hold jobs in offices. One case

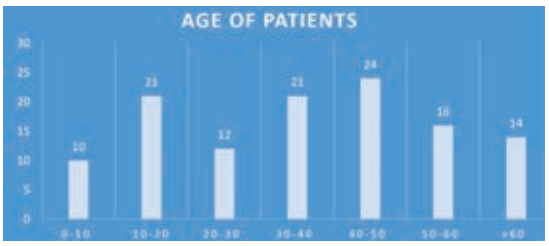

Fig. 1: Frequency distribution of patients with otomycosis according to age

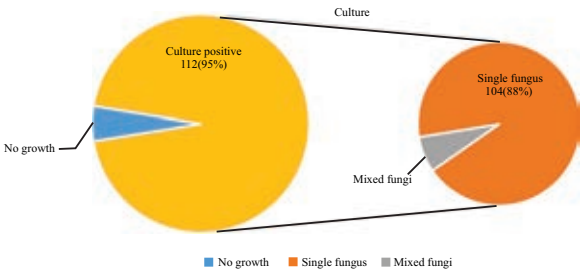

Fig. 5: Fungi isolation by culture

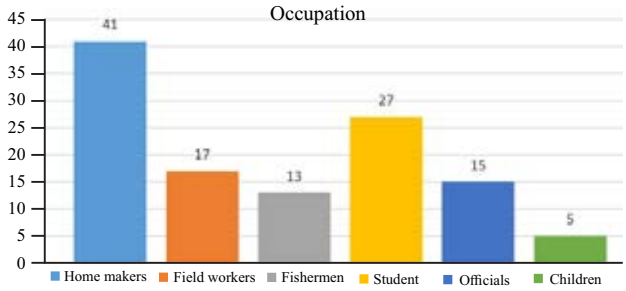

Fig. 2: Frequency distribution of patients with otomycosis according to occupation

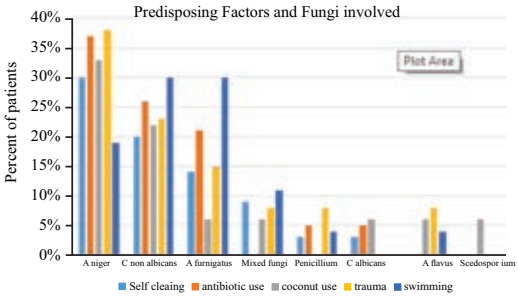

Fig. 6: Association between predisposing factors and fungi involved

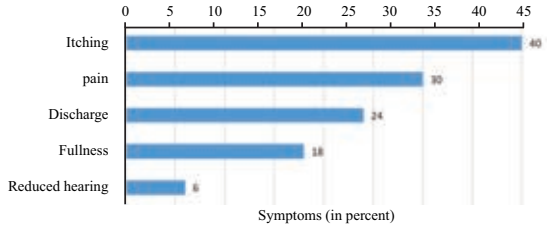

Fig. 3: Clinical symptoms of patients with otomycosis

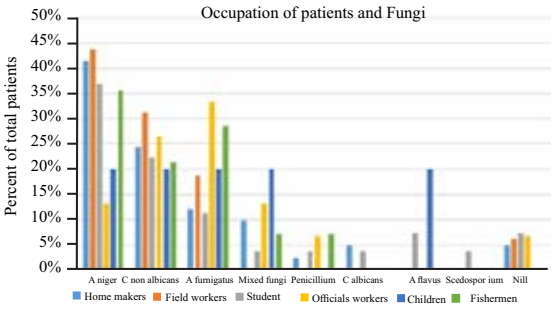

Fig. 7: Association between the occupation of patients and fungi involved

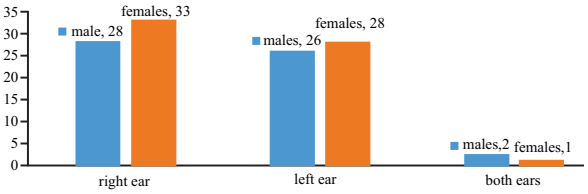

Fig. 4: Otomycosis-side affected

of otomycosis was in a scuba diver with a retracted tympanic membrane. (Fig.2). The itching was the most common symptom (40%). The other clinical features were ear block, hearing loss, ear discharge and pain. Around 12 patients came with a history of ear itching after the use of hair dyes and had otomycosis too.

Hearing aids use was seen in 3 patients. In 2 patients neglected foreign body was surrounded by fungal debris. Otoscopic findings ranged from blackish specks, wet blotting paper and discharge with matted detritus. Canal skin was weepy in 11 patients with granulation, myringitis and severe external otitis. We also found otomycosis in 6 cases of seborrheic dermatitis, 5 cases of an open cavity and 1 case each with keratosis obturans and canal stenosis (Fig. 3).

The right ear was slightly more commonly affected than the left. Both ears were affected in 2.5% of cases. (Fig. 4). Trauma was the incriminating factor in around 45% of cases. Predisposing factors for otomycosis, this ranged from self-removal of wax with bird feathers,

Table 1. Demographic profile of patients with otomycosis

Demographic data		No.
Participants		118
Male		49
Female		69
Age	Range	5-75 years
	Average	37 years
	Median	38.5 years
	Mode	35 years

Table 2. Predisposing factors for otomycosis

Predisposing factors for otomycosis	No. of patients (Percent)
Self-cleaning earbuds/feather/ear scratching	49 (42)
Inserting towels to dry ears/self/others	3 (3)
Use of antibiotic/steroid ear drops	19 (16)
Use of herbal/coconut oil	18 (15)
Ear procedures-wax removal, syringing	12 (10)
Swimming	27 (23)
Earphones/Hearing aids	3 (3)
Neglected FB	2 (2)
Use of hair dye	12 (10)

Table 3. Diagnostic methods

Diagnostic methods	No. of patients
KOH and Fungal culture positive	47
Fungal stain and Fungal culture positive	34
KOH, Fungal stain and culture positive	31
KOH, Fungal stain and culture negative	06

Table 4. Fungi incriminated in otomycosis.

Fungi	Total (Percent)
A. niger	40 (33.89)
Candida Non-albicans	28 (23.73)
A. fumigatus	23 (19.49)
Mixed A. niger and Candida Non-albicans	9 (7.63)
Penicillium spp	4 (3.39)
Candida albicans	4 (3.39)
A. flavus	3 (2.54)
Scedosporium apiospermum	1 (0.85)
Total	112

picks, pins, match sticks, keys and even wooden twigs, most of which were not sterile. Swimming usually in stagnant waters was another important factor In those cases without trauma, it was found that the cause was due to the use of coconut oil or herbal oil which was used for ear pain and ear block. We had patients who used heated oil in chilli pods being poured into the ear canal. Ear procedures like ear wax removal with ear probes or syringing were seen in 12 patients. (Table 2). In 47 patients, the swab was positive for both fungal stain and KOH, while in 34 cases fungus was seen in both fungal stain and fungal culture (Table 3).

The swab was positive for fungus in KOH, fungal stain and fungal culture in 31 patients. No fungi were seen in 6 patients by KOH, fungal stain and culture. In 95% of cases, the culture was positive, of which in 88% only one fungus was isolated (Fig. 5). *Aspergillus niger* topped the list, with *Aspergillus flavus* and *Penicillium* following (Table 4). In swimmers, *Aspergillus fumigatus* and *Candida non-albicans* were more common than *Aspergillus niger* (Fig. 6). When the occupation was studied, it was found that *Aspergillus niger* was most common in Homemakers, field workers and students, however, in office workers, *Aspergillus fumigatus* was more common (Fig. 7). The prevalence of otomycosis is said to vary from 9 to 30% in patients with external otitis[5]. In our institute, 6% of patients who come with external otitis have otomycosis. The study at our center dealt with finding the clinicomycology and Aetiopathogenesis of otomycosis mainly primary in nature. Prasad et al also have classified otomycosis into primary and secondary, the latter being due to factors like immunosuppression, malignancy and radiation[6].

Our results build on the existing evidence that trauma in various forms is a significant causative factor in the development of otomycosis. The pathogenesis here was the loss of integrity of the skin, resulting in bacterial infection, coupled with the use of antibiotic ear drops wiping out the commensal bacteria and the fungal elements growing unopposed[7]. Unsterile tools in self-cleansing for wax removal aggravated the infection in the ear canal. Swimming in stagnant waters resulted in altered pH, which predisposes to external otitis and otomycosis. A few patients gave a history of using heated coconut oil in a chilli pod as ear drops for ear pain. This was being practiced by the older generation and now seems to be in vogue with people googling for self-help through social media. So also the use of herbal oils was seen to be increasing. Chaparbandi also cites the use of hot oil and water as ear drops[3]. Ear procedures being done in not so professional manner is also a causative factor. Syringing being done for wax without any symptoms is to be avoided. Ho has commented on the relationship of otologic procedures in the causation of otomycosis. Various studies show different gender predispositions. In our study, it was female preponderance probably because homemakers constituted a majority of patients. Da Silva Pontes reported an increased incidence in females[8]. Khurshid Anwar *et al.* found the incidence of otomycosis to be more in males 79%[9]. So also Prakash *et al.*'s study[10]. Persons from the age group of 50-60 were affected, as most of this age group were active outdoors and also perhaps there was an increased incidence of hair dye use. Allergic reaction from the hair dye results in intense itching and patients resort to digging their ears with any available tool, most of which are not sterile. This resulted in external otitis and pain. The use of over-the-counter steroids and antibiotic ear drops along with lignocaine in an already inflamed ear canal led to irritant dermatitis and fungal infection. Rawat postulates that people in the age group of 11-30 years have increased incidence as they spend more time outdoors and hence have increased exposure to fungal spores.

The itching was the most common symptom in 40% of our cases, while it was hearing loss in the study by Khurshid *et al*.[9] In a study by Chapparbandi *et al*, again itching was the most common symptom[3]. The right ear was slightly more affected than the left, the reason attributed to the fact that most people were right-handed. Otomycosis was seen in patients with

stenosed ear canals (2 cases) and also in open cavity mastoids (5 cases). In 2 cases of keratosis obturans, debris taken out showed fungal elements. Seborrheic dermatitis involving the ear was seen in 6 patients with otomycosis. The debris from the ear was collected by ear swab and the incriminating fungus was identified by KOH, Lactophenol blue mount and slide culture method. Jahan *et al.* vouch for the cavity slide culture method for diagnosing fungus[2]. The slide culture method is a rapid way to identify fungi without disturbing the fungal colony, the downside is short survival time due to limited nutrients. *Aspergillus niger* was the most common fungus involved in our study. Roohi *et al*. also had a similar finding[11]. Khurshid *et al.* found *Candida spp* in their study as the most common. Chapparbandi *et al.* found *Aspergillus* and other minor *Penicilliums*, *Pityrosporum* in fungal culture. Mila Bojanovi quotes *C. parapsilosis* and *C. Albicans* as some fungi involved in ear infections. The authors also found that those cases which had relapse had the propensity to produce biofilms[4]. In da Silva's cases it was *C. Albicans* and *C. parapsilosis*[8]. While Kaur *et al.* found *Aspergillus fumigatus* to be the most common fungus[12]. Merza found both *Aspergillus* and *Candida* involved in the ear[13]. They used culture morphology and lactophenol cotton wool blue wet mount microscopy. *Candida spp* were identified by using germ tube testing and colony morphology on corn meal agar. Fardusi *et al.* detected *C. parapsilosis* among *Candida non-albicans* (NAC), as the most frequent, which was followed by *C. ciferrii*, *C. tropicalis* and *C. glabrata*. Two isolates from ear discharge were genetically identified as *Kodamaea ohmeri*[14]. Mario Burto found that healthy mycobiome of the ear consisted of *Malazzezia arunolokei* and *M restricta*[15].

Non-albicans *Candida and Aspergillus fumigatus* were the other common fungi incriminated. In a few cases *Penicillium spp, Candida albicans, A. flavus* and *Scedosporium apiospermum* were involved. In 6 cases symptoms and findings were suggestive of otomycosis, but the culture was negative. These cases were resolved with ear debris suctioning and antifungal ointment application.

CONCLUSION

Trauma was the most often incriminating factor and should be avoided. Patients should be educated about wax being a protective substance. It is to be removed. only when impacted, causing hearing loss or pain. Self-removal should be discouraged. In ENT practice ear suctioning should be done meticulously without causing trauma. Foreign bodies of ear especially of organic nature should be removed at the earliest. Removal of foreign bodies should be done by experts preferably under a microscope. Earphones and hearing aids may have to be kept away during times of external otitis and otitis media. Itching in the ears should be addressed appropriately. Patients should be instructed not to put anything in their ears and steer clear of ear buds. Practices of using herbal remedies in ears including heated coconut oil in dried red chilli pod are to be disapproved in the strongest terms. So also the use of over-the-counter antibiotics and steroid ear drops. Such drops are even prescribed by General practitioners. This seemingly innocuous practice is to be avoided by educating the medical fraternity. It needs to be initiated at the level of internship of medical graduates. In immunocompetent individuals, otomycosis may be self-limiting. In cases where there is excessive pain, especially of nocturnal nature in diabetics and immunocompromised, progression to more sinister malignant otitis externa or skull base osteomyelitis is to be considered. Ototopicals in such cases will interfere with the identification of the incriminating fungus, thus affecting its treatment. Allergy and its sequelae of Eustachian tube dysfunction may be the initial trigger for itching and it should be dealt with appropriately. Hair dyes are to be avoided in patients who are allergic to them. Ear infections due to swimming may be allayed to a certain extent by using ear plugs or ear inserts. Swimming is to be avoided in times of infection. While taking swabs for stain and culture, contamination is to be avoided. Awareness of otomycosis and diagnosing it by otoscopy is to be taught to every medical student. Photos of otoscopic images of various ear pathologies are to be taught. Nowadays digital otoscope which can be connected to android phones are available on e-commerce sites. This would go a long way in teaching undergraduate students and interns. Mao explains the use of deep CNN models with several otoscopic images of normal external auditory canal, wax and otomycosis. This utilizes Artificial intelligence and machine learning[16]. Artificial Intelligence and Machine Learning use a repository of otoscopic images in the digital website that can be used to match with the findings in our patients. This is the future of all medical diagnostics and offers a promising future. This can be used by a primary health care professional in identifying and managing otomycosis especially in rural areas, thus ensuring proper medical care. The limitation was that since this was a cross-sectional study, only an association could be made. However, we could find the nature of mycobiome commonly affecting the population. This would help in the treatment of the same, especially in immunocompromised patients.

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