

# The causative agents of malignant otitis externa among the patients referred to Ayatollah Rohani Hospital in Babol, Northern of Iran

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## Abstract

Malignant otitis externa is an invasive, inflammatory and necrotic form of the external ear canal. The aims of the present study was to determination of causative agents of malignant otitis externa. In a cross-sectional study, 112 patients with otitis externa referred to Ayatollah Rohani hospital in Babol city from 2020-2021 entered the study. The diagnosis of the malignant otitis externa was based on clinical findings and the cause of the disease was based on laboratory finding. The diagnosis criteria were mainly clinical, which was the presence of necrotic tissue in the canal floor and histopathological findings. The demographic information of the studied patients, 48 cases (55.8%) were less than 41 years old, 52 cases (60.5%) were women, and 62 cases (72.1%) had diabetes. Out of 112 patients, 86 patients had otitis externa, and malignant infection was observed in 4 patients (4.7%) by bacterial culture. Also, 26 cases were excluded from the study due to fungal infection with filamentous and yeast causative agents. Out of 4 patients with malignant otitis externa, 3 had diabetes. According to the results of present study, the frequency of malignant otitis externa was less than 5%, and the high-risk groups for malignant otitis externa were women, and diabetic patients. Early diagnosis and treatment play a very important role in preventing complications disease and reducing the hospitalization.

**Keywords:** Malignant, Otitis externa, Bacterial agents, Diabetes

## 1. Introduction

Malignant otitis externa is an invasive, inflammatory and necrotic form of the external ear canal [1]. The malignant otitis externa is more

common in diabetic, elderly and cases with immunocompromised [2], and the death rate due to this disease is reported to be 53% [3]. The onset of the disease is inflammation of the external ear canal,

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which later penetrates into the deeper parts including the skull bone and leads to osteomyelitis of the base of the skull [2, 4]. The symptoms of the malignant otitis externa appear in the form of pain, pus, sensitivity of the ear to touch, edema, discharge, hearing loss, ear fullness and tissue granulation [5, 6]. The predisposing factors of malignant otitis externa are including diabetes, cranial nerve involvement, old age, cancer and chemotherapy [7, 8]. The clinical findings in the diagnosis of the malignant otitis externa are including severe pain, laboratory findings (histopathology tests, increased erythrocyte sedimentation rate and white and red blood cell counts) and computerized tomography (CT) scan studies [9]. *Pseudomonas aeruginosa* is the main cause of malignant external ear, but other bacteria such as *Staphylococcus epidermidis*, gram-negative bacteria and fungi are also known as disease-causing agents [10]. The different treatment methods such as surgery and removal of necrotic samples and mastoidectomy are the main ways of treatment, while the use of antibacterial antibiotics (ceftazidime, aminoglycosides, etc.) and antifungal for at least 3 weeks helps to speed up the treatment process [11]. In some patients, after 3-12 months after the treatment, a recurrence of the disease has been seen, and the pain sometimes remains [12]. In this regard, there is no scientific research has been done on malignant otitis externa due to the lack of correct diagnosis of the disease based on the laboratory results causes the disease to prolong and aggravate the complications of this disease. Therefore, the aim of present study was to determine the frequency and causes of malignant otitis externa.

## **2. Materials and Methods**

### *2.1 Type of study*

A cross-sectional-laboratory study was conducted on 112 patients with otitis externa complication who referred to the ear, nose and throat clinic of Ayatollah Rohani Hospital in Babol city during 2020-2021. The inclusion criteria of the patients were the observation of granulation tissue at the connection between the cartilage and bone, destruction of the canal and skin of the canal, swelling and unbearable pain.

### *2.2 Data collection method*

The diagnosis of the disease was based on clinical findings and the causative agent was based on laboratory results. After performing the early clinical

diagnostic procedures by ENT specialist physician, biopsy samples from the damaged tissues was obtained from patients ears and these samples were sent to histopathology, microbiology, and medical mycology departments. In the histopathology laboratory, tissue sections prepared in paraffin were examined by a pathologist after hematoxylin-eosin (HiMedia, India) staining. In the laboratory of medical microbiology and mycology, samples after homogenization are subjected to direct microscopic examination for gram and methylene blue staining. The samples were cultures on were blood agar (Merck, Germany) and sabouraud dextrose agar (HiMedia, India) and it incubated at 37 °C. The bacterial colonies were identified via Gram-staining results, from the shape of the bacteria, and the appropriate diagnostic test results. After isolation of bacteria from culture, bacteria were cultured in other media, such as TSI (Merck, Darmstadt, Germany), Urea agar (Merck, Darmstadt, Germany), Simmon's citrate agar (Merck, Darmstadt, Germany), SIM (Merck, Darmstadt, Germany), and lysine decarboxylase (HiMedia, Mumbai, India), according to the primary culture results. Finally, the results of the detection of microbial agents at species level by using biochemical tests and the results of the pathobiology laboratory diagnosis under the supervision of a clinical expert along with the CT scan findings determined the definitive diagnosis of malignant bacterial infection, based on which the treatment with effective drugs for the patients has been done.

### *2.3 Data analysis methods*

The statistical analysis in the descriptive statistics section, central indices (mean, median, and mode) and dispersion indices (variance, standard deviation, range of changes, and coefficient of variation) were used for quantitative variables, as well as frequency, percentage and prevalence for qualitative data. In the present study, the independent t-test, Chi-square and Fisher exact test were used in SPSS v.21 software. The significant level was considered at  $p < 0.05$ .

## **3. Results**

After examining 112 patients with bacterial infection of the external ear with an average age of  $41.14 \pm 17.45$  years (the youngest age is 7 and the oldest age is 78 years), 26 patients due to reports of fungal agents (4 cases), tympanic membrane rupture (3

cases) and mixed bacterial-fungal infection (19 cases) were excluded from the study, and only 4 cases were diagnosed with malignant otitis externa based on laboratory and clinical findings. In examining the variables of age, gender, occupation, and place of residence of the patients (Table 1), it was found that 48 cases (55.8%) were less than 41 years old, 52 cases (60.5%) were women, and 62 cases (72.1%) were suffering from diabetes.

In the examination of the type of bacterial strains in the samples of bacterial ear infections in patients, *P. aeruginosa* was the common species in 31 cases (36%) and *Staphylococcus aureus* was the second most common cause of otitis externa in 18 cases (20.9%) (Table 2). In the study of demographic variables based on patients with and without malignant otitis externa, it was found that 3 cases (out of 4 patients) with diabetes had a malignant infection, and of these 4 patients, in three and one cases were identified *P. aeruginosa* and *Klebsiella pneumoniae*, respectively. Histopathological findings confirmed the presence of bacteria in the tissues of these 4 patients. No significant difference was observed in terms of age, gender, occupation, and residence in patients with and without malignant infection ( $P > 0.05$ ).

#### 4. Discussion

In this study, the frequency of malignant otitis externa was 4.7%. One of the most important findings

of the present study was that all patients with malignant otitis externa were women, but this difference was not statistically significant ( $P > 0.05$ ). In the study of Araghi et al. (2016), they found that 51.6% of the patients with malignant otitis externa were female, and like the present study, they stated that there was no significant relationship between gender and malignant otitis externa [13]. In contrast to present study, Marina et al. (2019), in India reported that 92.8% of 14 patients with malignant otitis externa were male [14]. This difference in the results can be considered due to are difference in various cultural, health and social situations in different geographical region. One of the main findings of the present study was the relationship between diabetes and malignant otitis externa. In the research of Saki et al. (2015), 100% of cases with diabetes were reported as the underlying disease of malignant otitis externa [15]. Gussen et al. stated in their study that patients with diabetes are prone to these infections due to weak immunity [16]. In the present study, *P. aeruginosa* was the most common cause of one of the main findings of the present study was the relationship between diabetes and malignant otitis externa. The results of Asghari et al.'s study (2018), showed that it was bacteria in 89.1% of cases and fungus in 10.9% of cases. In this study, the most common bacteria were *Pseudomonas* spp. with a frequency of 21 (31.8%) and *S. aureus* with a frequency of 19 (27.8%) [17].

Table 1. The frequency distribution of demographic characteristics of 86 cases with otitis externa

Criteria	Number	Percentage (%)
Age (years)		
≥41	48	55.8
<41	38	44.2
Gender		
Male	34	39.5
Female	52	60.5
Job		
Housewife	43	50
Free agent	37	43
Employee	6	7
Habitat		
City	82	97.7
Countryside	2	2.3
History of underlying diseases		
None	24	27.9
Diabetes	62	72.1

Table 2. The frequency distribution and percentage of bacterial strain type among 86 patients with otitis externa

Bacterial strain	Number	Percentage (%)
<i>Klebsiella pneumoniae</i>	10	11.6
<i>Pseudomonas aeruginosa</i>	31	36
<i>Enterococcus faecalis</i>	2	2.3
<i>Enterobacter aeruginosa</i>	5	5.8
<i>Escherichia coli</i>	2	2.3
<i>Staphylococcus aureus</i>	18	20.9
Coagulase-negative staphylococci	12	14
<i>Staphylococcus epidermidis</i> + Diphtheroids	4	4.7
<i>E. coli</i> + Diphtheroids	1	1.2
<i>Bacillus</i> spp. + <i>E. coli</i>	1	1.2

In a study conducted by Arshad et al. (2004) on 124 patients under clinical study, the frequency of *S. aureus* and *P. aeruginosa* was reported as 38% [18]. In Rafsanjan city, a study was conducted regarding the frequency of bacterial agents and determining their drug sensitivity in external ear infections. In addition, they reported that *S. aureus* (29%) and *P. aeruginosa* (25.8%) were the most common bacteria [19]. In Ninkovic et al. (2008) study, the bacterial profile of otitis externa was investigated in England. The most common pathogens isolated from the examined samples were *P. aeruginosa* and *S. aureus* [20]. However, Vaidya et al. (2015) reported in Nepal, *S. aureus* was the main causative agents [21]. In the study of Bhat et al. (2015), *P. aeruginosa* is considered as the main cause of bacterial infection of the otitis externa. After the *P. aeruginosa*, *Klebsiella* spp and Diphtheroids were also reported as other causes of this disease [5]. In a research conducted by Soheilipour et al. (2013), it was concluded that *P. aeruginosa* was found in 41.2% of ear sample cultures [22].

The malignant otitis externa has a complex clinical finding and different causative/etiological agents [23]. In our study, most of the samples had a bacterial agent, which is consistent with the results of other studies. In this study, more than 80% of bacterial agents were responsible for otitis externa, which was more than some studies. In some cases, there were differences between our results with other studies conducted in different regions of Iran and the worldwide. The difference can be related to difference in climate, cultural differences and the difference in the level of health of the people of that region with our country. Limitation of this study was the outbreak of the

COVID-19 pandemic, which affected the sampling process.

In summary, based on the results of this study, the frequency of malignant otitis externa was less than 5%, and the high-risk groups for malignant otitis externa were women and diabetic patients, and early diagnosis and treatment play a very important role in preventing complications and reducing the hospitalization period of these patients.

#### Authors' contributions

SS, MTA, MK: Designed and performed experiments, analyzed data and co-wrote the paper. KK: Obtaining samples. JJ, AH, SMO: Analyzed data and co-wrote the paper. AP, SMO, MTA: Designed experiments, supervised the research. All authors read and approved the final version of paper.

#### Conflict of interests

None to declare.

#### Ethical declarations

This study was approved by the Ethics Committee of Babol University of Medical Sciences (IR.MUBABOL.REC.1399.408).

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