INTEGRATIVE JOURNAL OF MEDICAL SCIENCES
ISSN: 2658-8218
MBMJ

2022, Volume 9, ID 652
DOI: http://10.15342/ijms.2022.652

RESEARCH ARTICLE

Pattern of Otitis Externa in ENT Outpatient Department of BSMMU, Dhaka, Bangladesh

Kishore Kumar Halder [a], A.M. Al Robbani [b], Md. Abdus Sattar [c], A.H.M. Delwar Mamun [d]

[a] Assistant Professor, Department of ENT, Abdul Malek Ukil Medical College, Noakhali, Bangladesh
[b] Professor, Department of ENT, Rangpur Medical College, Rangpur, Bangladesh
[c] Professor, Department of ENT, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh
[d] Associate Professor, Department of ENT, M.A.G. Osmani Medical College, Sylhet, Bangladesh

ABSTRACT

Introduction: Otitis externa is an acute or chronic reaction of the whole or a part of the skin of the external ear arising from local or general causes or a combination of both [1]. It is a very common medical problem affecting 5-20% of patients attending otolaryngologists in the tropical and subtropical regions of the world.

Objective: To assess the Pattern of Otitis Externa in the ENT Outpatient Department. **Methods**: A prospective study was carried out in the outpatient department of Bangabandhu Shelkh Mujib Medical University among 200 patients (220 affected ears) with the aural symptoms suggestive of otitis externa and 110 healthy control (220 ears), from July 2002 to December 2003, with the aims and objectives to find out the pattern of disease among the patients suffering from otitis externa in Bangladesh. **Results**: It is found from the study that the maximum number (35%) of patients were within 21-30 years of age group. Most patients were male (56%), with a male-female ratio is 1.3:1. Higher numbers of patients were fallen within lower and middle-income family groups (up to 2,500 and 3,501-4,000 taka per month, respectively). Most of the patients (30%) were laborers, and most patients were literate. The majority lived in a paka (44%) or semi-paka (38%) house and used tap water for bathing (53.5%). Most patients used cotton buds (49%) for cleaning of ears. Otitis externa was mostly found in the summer and rainy season (69%), with maximum occurrence during June (18.2%) and July (16.4%). In most of the patients, symptoms persisted for less than two months (76.3%), of which itching, pain in the ear, and sense of blocking are the commonest triad of symptoms. Itching is the predominant symptom (98.2%) in fungal, and pain is the dominant symptom (92.8%) in bacterial otitis externa. Acute infection is commonly painful, whereas chronic disease is mostly itchy. The regarding involvement right ear was more involved (60%) than the left one and the ear canal was more commonly diffusely involved (84.5%). Among the predisposing factors for the causation of otitis externa, ear cleaning either by self or others ranked the top 42, 7% of the list. It was mainly associated with acute cases. The fungus was isolated from the affected ear in most instances (49.1%), followed by Isolation of bacteria (31.8%), of which bacteria were often associated with the acute cases, and fungus was found more in the chronic cases. Aspergillus was found in 89.7% of the fungal species, and candida was found in 7.5% of cases. Pseudomonas was the predominant organism (40%), and Staphylococcus was the second most common (37.1%) among the bacterial species isolated. The microbiological finding among the healthy control showed that the external ear canal is less commonly harboring pathogenic organisms. Bacteria were isolated from 18.2% of cases, and fungus was isolated from only 6.3%. **Conclusion**: From this study, it is also evident that although bacteria could be detected from control cases, the Isolation of fungus was negligible. Most of the bacteria were normal commensal. Whereas in diseased ear presence of fungus in the ear canal was highly significant ($p<0.001$), which signifies the prerequisite of an altered aural flora and fauna for the development of fungal infection.

KEYWORDS: Otitis, Externa; fungal infection; Acute infection.

Correspondence: Dr Kishore Kumar Halder, Address : Assistant Professor, Department of ENT, Abdul Malek Ukil Medical College, Noakhali, Bangladesh. Email: kishorhalder27@gmail.com

INTRODUCTION

Otitis externa is an acute or chronic reaction of the whole or a part of the skin of the external ear arising from local or general causes or a combination of both [1]. It is a very common medical problem affecting 5-20 % of patients attending otolaryngologists in the tropical and subtropical regions of the world [2]. It is also a common otologic problem worldwide, affecting 0.2 to 6 % of the population throughout the year [3]. On average, a general practitioner can expect to see 16 new cases per year [4]. Most of the cases are acute and involve the canal diffusely. A few cases

become chronic, with symptoms persisting for more than two months and even years [5]. The unique structure of the external auditory canal contributes to the development of otitis externa. It is the only skin-lined cul-de-sac in the human body. It is warm, dark, and prone to becoming moist, making it an excellent environment for bacterial and fungal growth. The canal is also frequently been affected by other reactive, viral or generalized skin disorders [6]. The skin of the meatus is fragile, and the lateral third overlies cartilage, while the rest has a base of the bone. The canal is easily traumatized. A curve impedes the exit of secretion, debris, and foreign bodies at the junction of the cartilage and bone. The presence of hair, especially the thicker hair common to older men, can further impede. Senturia and associates have described several contributory factors in addition to the well-recognized effects of heat, humidity, and trauma. They noted that the absence of a protective coating of cerumen, particularly due to removing the lipid surface layer by repeated washing, cleaning, or swimming subjects the canal to a greater risk of infection. In addition, the pH in the external auditory canal is usually acidic, a fact that reduces susceptibility to infection. The canal's neutralization or alkalinization impairs the natural ability to ward off bacterial or fungal contamination. Any form of trauma further compounds the problem [2]. Chronic infective disorders of the ear remain a common source of misery for patients and frustration for doctors. Furthermore, the clinical presentation of otitis externa caused by fungi may be almost similar to that caused by bacteria. The treatment of bacterial otitis externa by antibiotic-steroid eardrops makes the problem worse, predisposing the fungal infection to become chronic or recurrent [7, 8]. The confusion concerning otitis externa begins with the failure to distinguish between bacterial and fungal origin cases. In a cold and moderate climate, bacterial otitis externa is the commonest infection of which gram-negative bacilli; especially Pseudomonas is the predominant organism, followed by Staphylococcus aureus, [2, 9, 10, 11] on the other hand, in tropical and sub-tropical countries fungal infection is more prevalent. Most of them are caused by Aspergillus (80-90%), followed by Candida (10-20%) [12]. The disease is worldwide in distribution [13]. It is predominantly a disease of males and the younger population [14]. Viruses are rarely implicated in the causation of otitis externa, of which herpes infection accounts for the majority. Chronic dermatologic conditions are a frequent cause of chronicity. Almost all of the localized forms of otitis externa are caused by Staphylococcus aureus. Otitis externa is one of the common ear conditions causing significant morbidity and a rare cause of mortality. 30-36 % of the patients found otitis externa disabling enough to interrupt their daily activities, and 21% of them require bed rest [11]. Bangladeshi population is particularly vulnerable to fungal infection of the external canal [15]. The majority of our rural population enjoys a free bath in the river, canal, pond, etc., inviting water contamination. Moreover, the hot, humid climate, illiteracy, poverty, poor personal hygiene, peculiar ear cleaning habit, lack of health education, and medical care are some of the favorable factors for acquiring fungal infections of the ear. Many studies were carried out to compare the bacteriological and mycological causes of otitis externa in different countries. Very few of the same studies were carried out in our country. But no studies concerning the pattern of otitis externa have been carried out in our country to date. Considering the clinical importance of otitis externa in the context of Bangladesh, a prospective study was planned to find out the pattern of otitis externa among the patients attending the Ear, Nose, and Throat outpatient department of Bangabandhu Sheikh Mujib Medical University, among the people of different age group and different epidemiological criteria. This will provide ideas about the prevalence of bacterial, fungal, and other causes of diffuse and localized forms of otitis externa and different important diagnostic criteria and species characters. It will obviously help increase the clinicians' awareness and give a guideline for proper early diagnosis and reduce the suffering of the patients.

MATERIALS AND METHODS

This prospective study was carried out on the patients suffering from aural symptoms suggestive of otitis externa in the ENT outpatient department of BSMMU. The total study population was 200. Each affected ear was considered as one unit. Accordingly, a total of 220 unilateral and bilaterally affected ears were included in our study from the 200 study population. We also included age and sex-matched 110 healthy individuals to serve as a control, which provided 220 control units. The patients having symptoms suggestive of otitis externa were randomly selected from the ENT outpatient department of BSMMU, Dhaka, Bangladesh. At first, all the patients were evaluated by detailed history and then through ear, nose, and throat examination performed. Finally, swabs were taken from the affected ear and sent for culture to identify both the bacterial and fungal species, and the report was correlated clinically. The clinical diagnosis of otitis externa is made based on history, presenting symptoms, examination findings, and culture report. The relevant information of the study subjects (case and control) was recorded in a preformed datasheet, and statistical analysis was performed.

Selection of Patients:

Inclusion criteria:

1. Age and sex matched patients attending to the E.N.T. outpatient department with typical signs and symptoms of otitis externa were included for the study. Symptoms considered were itching in the ear, pain in the ear, feeling of blocked ear, ear discharge, tinnitus and deafness.
2. Patients who gave consent to participate in this study.

Exclusion criteria:

1. Patients with otitis externa secondary to otitis media and infected mastoid cavities were excluded.
2. Patients with any abnormalities of the external auditory meatus e.g. stenosis, exostosis, tumor etc. were excluded.

Selection of control:

Inclusion criteria:

1. Normal persons with no known ear, nose, or throat disease.
2. Age and sex were matched with that of patients.
3. The persons who gave consent to participate in this study.

Exclusion criteria:

1. The persons with any known history of ear disease.
2. The persons with anatomical abnormalities of the external ear.

Sample Size: The sample size was determined by applying the appropriate statistical methods. The initial sample size was determined by using the following formula of sample size determination for the study:- $n = \frac{2^2pq}{d^2}$

As we were not aware of any value of p, we opted from the previous study for p=15% to maximize the sample size. This assumption has yielded a sample size of 195. We have taken the sample as follows:

Case: A total number of 200 patients were included. Of them, samples were collected from one ear of 180 and both ears of 20 cases. Therefore, the sample size was 220.
Control: A total of 110 healthy subjects were included, and samples were collected from both ears. Therefore, the sample size was 220.
Laboratory Methods: Ear swabs of the debris for mycological studies from infected ears and healthy control ears were considered. Ear swabs for bacterial studies from infected and healthy control ear canals were also considered. Mycological studies comprise microscopic examination of specimens to demonstrate fungal elements like yeast, hyphae, spores, etc., and culture for isolation and identification of fungal species.
Specimen collection: The laboratory samples were collected from the external ear canals with three dry sterile cotton-wool swab sticks from the affected ears and kept in a sterile test tube. Three swabs were also collected from the healthy control ears.
Microscopic examination: For the bacterial study, smear and gram staining were done over a clear glass slide from one sample. For microscopic examination of fungus, one sample from each ear was mounted in a drop of 10% potassium hydroxide (KOH) over a clear glass slide. The KOH preparation was examined under a microscope for demonstration of fungal elements like yeast, hyphae, and spores.
Culture: One sample from each ear was cultured in Sabouraud Dextrose Agar (SDA) medium. The inoculated tube was incubated at room temperature and 37°c for 14 days. Another sample from each ear was inoculated on a blood agar plate and one in MacConkey's agar plate at 37°c. The plates were examined after 24 hours and 48 hours, and the organisms were identified by using standard procedure. The fungal species were identified based on gross colonial characteristics and microscopic morphology of the colony [16]. Final identification of the organisms was made by culture, staining, motility, and various biochemical tests.
Statistical Analysis of Data: All relevant collected data were compiled and then organized by a scientific calculator and standard appropriate statistical formulae. Percentages were calculated to find out the proportion of the finding. Further statistical analysis of the results was done by using software devised with a statistical package for social sciences (SPSS). The results were presented in Tables, Figures, and Diagrams. Statistical tests for significance of differences were done using the 'Z' test where applicable. A p-value <0.05 was considered to be statistically significant.

RESULTS

After collection, the data were analyzed according to the variables for the purpose of the study. For better understanding, all data were compiled and tabulated accordingly. The results have been shown in tabular forms. The interpretations of the tables are as follows:

Table 1: Distribution of the patients by age group (n=200)

Age of the study population	Patient No (%)	Control No (%)
<1-10 years	10(50%)	4(3.7%)
11-20 years	46(23%)	20(18.1%)
21-30 years	70(35%)	26(23.7%)
31-40 years	30(15%)	16(14.5%)
41-50 years	18(9%)	18(16.4%)
51-60 years	8(4%)	16(14.5%)
>60 years	18(9%)	10(9%)
Total	200(100%)	110(100%)

Table-1: Shows that the maximum of 70 (35%) patients were in the 21 -30 years age group, followed by 46 (23%) were in the 11 -20 years, age group. 30 (15%) patients were within 31 - 40 years. 18 (9%) patients were within both 41 -50 years and > 60 years of age groups. 10 (5%) patients were within less than 1-10 years, and the remaining 8 (4%) patients were within 51 60 years of age. From the data, it was seen that young adolescent and adult patients suffered the most.

Table 2: Distribution of the patients by sex (n=200)

Sex of the patient	Patient No (%)	Control No (%)
Male	112(56%)	62(56%)
Female	88(44%)	48(44%)
Total	200(100%)	110(100%)

Table-2: Out of the total 200 patients, 112 (56%) patients were male, and the remaining 88 (44%) were female. The male-female ratio was 1.3:1. The maximum number-80 (40%) families had a monthly income of taka up to 2,500. The highest number 60 (30%) patients were laborers, followed by 36 (18%) were businessmen, 32 (16%) were office executives, 16(8%) were housewives, 16 (8%) were drivers, 12(6%) were a farmer and remaining 28 (12%) were unemployed. 104 (52%) patients were smokers, and 96 (48%) patients were non-smokers.

Table 3: Distribution of the patients by education (n=200)

Educational status	Patients No	Percentage
Illiterate	5	2.50%
Primary	66	33%
Secondery	44	22%
Higher secondery	35	17.50%
Degree/Hons	27	13.50%
Masters	21	10.50%
Technical	2	1%
Total	200	100%

Table-3: Among 200 patients 5(2.5%) were illiterate, 66(33%) were primary, 44 (22%) were secondary, 35 (17.5%) were higher secondary, 27 (13.5%) were graduates, 21 (10.5%) were masters and remaining 2 (1%) had technical education. 88 (44%) patients were living in the building, 76(38%) in semi paka house, 34(17%) in kancha house, and the remaining 2 (1%) patients were living in zhupri house. This shows that 107 (53.5%) patients were using tap water for bathing purposes, whereas 89 (44.5%) patients were a swimmer in an open pond or river water. 4 (2%) patients were using tube well water for bathing purposes.

Table 4: Distribution of patients by eat cleaning habit (n=200)

Cleaning materials	Patients No	Percentage
Cotton bud	98	49%
Match stick	31	15.50%
Feathers	16	8%
Cloth and stick	35	17.50%
Others	20	10%
Total	200	100%

Table 4: Reveals that 98 (49%) patients were habituated to clean their ears with cotton buds, 31 (15.5%) with match sticks, 16 (8%) with feathers, 35 (17.5%) with cloth and sticks, and 20 (10%) patients used many other materials for cleaning of their ears.

Table 5: Month wise distribution of otitis externa among study population (n=220)

Month of the year	No of EAR (Units)	Percentage
January	6	2.70%
February	10	4.50%
March	13	5.90%
April	13	5.90%
May	23	10.40%
June	40	18.20%
July	36	16.40%
August	27	12.30%
September	25	11.40%
October	13	5.90%
November	8	3.70%
December	6	2.70%
Total	220	100%

Table 5: Reveals that the maximum number of affected ears were seen during June, which was 40(18.2%), followed by 36(16.4%) during July, 27(12.3%) during August, 25(11.4%) during September, 23(10.4%) during May, 13 (5.9%) each during March, April, and October, 10 (4.5%) during February, 8 (3.7%) during November and 6(2.7%) patients each during December and January.

Table 6: Seasonal variation of the prevalence of otitis externa among study population (n=220)

Season	No of EARS (Units)	Percentage
Summer and rainy	152	69%
Winter and spring	68	31%
Total	220	100%

Table 6: Shows that the maximum number of patients were affected during the summer and Rainy seasons (between March to August), which were 152(69%). Rest 68 (31%) was seen during winter and spring (between September to February).

Table 7: Distribution of patients according to duration of illness (n=220)

Type of illness	No of EARS (Units)	Percentage
Acute	168	76.30%
Chronic	52	23.70%
Total	220	100%

Table-7: Shows that the maximum number of 168(76.3%) cases were acute otitis externa, which had been suffering for less than two months. Rest 52 (23.7%) were chronic cases suffering for more than two months.

Table 8: Age-wise distribution of acute and chronic cases (n=220)

Age (years)	Acute No (%)	Chronic No (%)	Total
<1-10	8(4.7%)	2(3.8%)	10(4.5%)
11-20	46(27.3%)	6(11.5%)	52(23.6%)
21-30	60(35.8%)	7(13.4%)	67(30.5%)
31-40	23(16.6%)	16(30.8%)	39(17.7%)
41-50	10(6%)	8(15.4%)	18(8.2%)
51-60	8(4.8%)	6(11.6%)	14(6.3%)
>60	13(7.8%)	7(13.5%)	20(9.2%)
Total	168(100%)	52(100%)	220(100%)

Table-8: Shows that of all the acute cases, 8(4.7%) patients were within less than 1 - 10 years, 46 (27.3%) were within 11-20 years, 60 (35.8%) were within 21-30 years, 23 (13.6%) were within 31-40 years, 10 (6.0%) were within 41-50 years, 8 (4.8%) were within 51-60 years, and 13 (7.8%) cases were over 60 years of age. Among the chronic cases, 2 (3.8%) were within less than 1 -10 years, 6 (11.5%) were within 11-20 years, 7 (13.4%) were within 21-30 years, 16 (30.8%) were within 31-40 years, 8 (15.8%) were within 41-50 years, 6 (11.6%) were within 51-60 years, and 7 (13.5%) patients were over 60 years of age.

Table 9: Distribution of patients according to presenting symptoms (n=220)

Complaints	No of EARS (Units)	Percentage
Itching	202	91.80%
Earache	176	80%
Sensation of blockage	132	60%
Discharge	114	51.80%
Deafness	26	11.80%
Tinnitus	17	7.70%

Table-9: Symptoms of each affected ear were considered separately. Most of the ears had multiple complaints of which commonest was itching in 202 (91.8%) affected ears, followed by earache in 176 (80%) ears, sense of blocked ear in 132 (60%) ears, discharge in 114 (51.8%) ears, deafness in 26 (11.8%) ears and tinnitus in 17 (7.7%) affected ears.

Table 10: Presenting symptoms in acute and chronic cases of otitis externa among study population (n=220)

Complaints	Acute No (%)	Chronic No (%)
Itching	147(87.5%)	50(96.1%)
Earache	165(98.2%)	12(23%)
Sense of blockage	126(75%)	5(9.6%)
Discharge	46(27.3%)	14(26.9%)
Deafness	35(20.8%)	2(3.8%)
Tinnitus	5(2.9%)	12(23%)

Table-10: Shows that of all acute cases, 147(87.5%) were presented with itching, 165 (98.2%) with an earache, 126 (75%) with blocked feeling, 46 (27.3%) with discharge, 35 (20.8%) with deafness and 5 (2.9%) patients were presented with tinnitus. Of all the chronic cases, 50 (96.1%) were presented with itching, 12 (23%) with an earache, 5 (9.6%) with blockage of ear, 11 (26.9%) with discharge, 2 (3.8%) with deafness and 12 (23%) with tinnitus.

Table 11: Distribution of patients according to site of involvemint (n=220)

Ear involved	Number	Percentage
Right ear	132	60%
Left ear	88	40%
Total	220	100%

Table-11: Out of 200 patients, 20 (10%) had bilateral involvement, and 180 (90%) had unilateral involvement. Of the 200 study population, we had included 220 affected ears for study purposes, of which 132 (60%) were right ears, and 88 (40%) were left ears.

Table 12: Predisposing factors in acute and chronic cases of otitis externa among study population (n=220)

Predisposing factors	Acute No (%)	Chronic No (%)
Ear cleaning	85(56.2%)	9(13.0%)
Swimming	26(17.2%)	13(18.8%)
Head cloth	4(2.7%)	14(14.5%)
Ear drops	3(2.0%)	19(27.5%)
Hearing aid	1(0.7%)	4(5.9%)
No factor	32(21.2%)	14(20.3%)
Total	151(100%)	69(100%)

Table-12: Shows that of all acute cases, ear cleaning was responsible for 85 (56.2%) cases, followed by swimming for 26(17.2%), headcloth 4 (2.7%), hearing aid 1 0.7%), and no factor could be identified. Of the chronic cases, ear cleaning was responsible for 9 (13%), swimming for 13 (18.8%), headcloth for 10 (14.5%), ear drop for 19 (27.5%), hearing aid for 4 (5.9%), and no factor could be identified for 14 (20.3%) of cases.

Table 13: Distribution of patients according to pattern of involvement of external ear canal (n=220)

Pattern of involvement	No of EARS (Units)	Percentage
Localized	34	15.50%
Diffuse	186	84.50%
Total	220	100%

Table-13: shows that 34 (15.5%) of cases were involved by localized disease affecting the hair follicle of the cartilaginous auditory canal. The remaining 186 (84.5%) cases were diffuse, involving the entire outer canal.

Table 14: Distribution of the patients by causative organisms (n=220)

Isolates on culture	Acute No (%)	Chronic No (%)	Total
Pure bacteria	47(21.3%)	10(4.6%)	57(25.9%)
Pure fungus	73(33.2%)	22(10%)	95(43.2%)
Mixed bacteria and fungus	16(7.3%)	10(4.6%)	26(11.8%)
Contaminatio n/no growth	32(14.5%)	10(4.6%)	42(19.1%)
Total	168(76.3%)	52(23.7%)	220(100%)

Table-14: From the results of microscopic examination and culture of ear swab, we detected pure bacterial growth in 47 (21.3%) acute cases and 10 (4.6%) chronic cases, pure fungal growth in 73 (33.2%) acute cases, and 22 (10%) chronic cases, mixed bacterial and fungal growth in 16 (7.3%) acute cases and 10 (4.6%) chronic cases, no growth or contamination in 32 (14.5%) acute cases and 10 (4.6%) cases.

Table 15: Distribution of ears according to growth of the causative organisms (n=220)

Isolates on culture	Number of patients	Percentage
Bacteria	70	31.80%
Fungus	108	49.10%
No growth or Contamination	42	19.10%
Total	220	100%

Table-15: Shows that most of the ears were affected by a fungal infection, accounting for 49.1% (108 cases), followed by a bacterial infection in 31.8% of ears. No growth or contamination is seen in the remaining 19.1% of cases.

Table 16: Distribution of symptoms among the patients of funfgal otitis externa (n=108)

Symptoms	Number of patients	Percentage
Itching	106	98.20%
Earache	82	76.00%
Sense of blocking of ear	69	64.10%
Discharge	53	49.10%
Deafness	14	12.70%
Tinnitus	10	9.10%

Tube-16: Reveals that the commonest symptom of fungal otitis externa was itching which was seen among 108 cases (98.2%), followed by earache, which constitutes 82 cases (189). The third significant symptom is a sense of blocking of the ear seen among 69 cases (54.1%). Very few cases present with deafness or tinnitus.

Table 17: Distribution of symptoms among the patients of bacterial otitis externa (n=70)

Symptoms	Number of patients	Percentage
Itching	58	84.00%
Earache	65	92.80%
Sense of blocking of ear	39	55.90%
Discharge	38	54.50%
Deafness	8	10.90%
Tinnitus	5	6.30%

Table-17: Shows that earache was the most common symptom in bacterial otitis externa, 92.8%, followed by itching, which was 84%. Discharge and deafness were the next most common symptoms, 55.9% and 54.5%, respectively.

Table 18: Distribution of fungal otitis externa according to causative agents (n=108)

Name of fungus	Member	Percentage
Aspergillus niger	78	72.20%
Aspergillus fumigatus	19	17.50%
Candida albicans	8	7.50%
Penicillium	3	2.80%
Total	108	1005.00%

Table-18: Shows that out of 108 cases of otitis externa caused by a fungus, 78 (72.2%) were due to Aspergillus niger, 19 (17.5%) were due to Aspergillus fumigatus, 8 (7.5%) were due to Candida albicans, and 3 (2.8%) were due to Penicillium strains, From the table, it is evident that Aspergillus group constitutes about 90% of the total cases.

Table 19: Distribution of bacterial otitis externa according to causative agents (n=70)

Name of organisms	Member	Percentage
Pseudomonas aeroginosa	28	40.00%
Staphylococcus aureus	26	37.10%
E. coli	10	14.30%
Proteus	6	8.60%
Total	70	100%

Table-19: Shows that out of 70 cases of otitis externa caused by bacteria 28 (40%) were due to Pseudomonas aeroginosa, 26 (37.1%) were due to Staphylococcus aureus, 10 (14.3%) were due to E.coli and 6 (8.6%) were due to Proteus mirabilis.

Table 20: Distribution of findings of ears among healthy control of study population (n=220)

Isolates on culture	Number	Percentage
Pure bacteria	40	18.20%
Pure fungus	14	6.30%
Mixed bacteria and fungus	18	8.20%
No growth	148	67.30%
Total	220	100%

Table-20: Shows the microbiological and culture finding of ear swabs among the healthy population of which pure bacteria were isolated from 40 (18.2%) ears, pure fungus from 14 (6.3%) ears, mixed bacteria, and fungus from 18 (8.2%) ears and no growth from 148 (67.3%) ears.

Table 21: Distribution of fungal strains among the culture positive ears of control healthy population (n=32)

Types of fungus	Number	Percentage
Aspergillus	12	37.50%
Candida	8	25.00%
Penicillium	6	18.70%
Mucor	3	9.40%
Others	3	9.40%
Total	32	100%

Table-21: Shows that among the culture-positive ears, 12 (37.5%) were due to Aspergillus, 8 (25%) were due to Candida, 6 (18.7%) Penicillium, 3 (9.4%) Mucor, and 3 (9.4 %) were due to other fungal strains.

Table 22: Distribution of bacterial strains among the culture positive ears of control healthy population (n=58)

Types of organisms	Number	Percentage
Staphylococcus aureus	10	17.20%
Staphylococcus epidermidis	24	41.40%
Diphteroids	8	13.80%
E. coli	7	12.00%
Proteus	3	5.20%
Pseudomonas aerginosa	6	10.40%
Total	58	1005.00%

Table-22: shows the microbiological and culture finding of ear swabs among the healthy population of bacterial isolates, of which 10 (17.2%) were Staphylococcus aureus, 24 (41.4%) were Staphylococcus epidermidis, 8 (13.8%) were Diphtheroids, 7 (12%) were E. coll. 3 (5.2%) were Proteus and 6 (10.4%) were Pseudomonas aeroginosa.

DISCUSSION

Otitis externa is one of the most common otologic conditions encountered in ENT and general practice. Patients who have been suffering from it seek advice from the general practitioner, neighboring quacks, pharmacy holders directly or are referred to the otolaryngologist. Although it is sometimes dismissed as a simple disease easily amenable to treatment, there is an increasing concern nowadays due to difficulty in the eradication of this infection on account of its notorious rate of recurrence. Bangladesh is situated in the tropics, where the climate is hot and humid, especially in the summer and rainy seasons. Many studies in different parts of the world were carried out to evaluate the comparative prevalence of fungal and bacterial causes, to find out predisposing factors responsible for its occurrence, its prevention, and treatment, and to search out the causes of its recurrence and chronicity. Considering the importance of otitis

externa, especially of fungal gin, in our country, a prospective study was carried out from July 2002 to December 2003 to find out the pattern of otitis externa in our country, its bacteriological and mycological criteria, as well as other important clinical and environmental aspects, we have included 200 patients of different age groups with complaints relating to otitis externa and studied total 220 ears attending to ENT Outpatient department of BSMMU during this period. The age range of the study population was from less than 1 to more than 60 years because no age is immune. Most patients were found between 21-30 years, constituting 35% of the total study population. Fifty-six percent of the total population was male, and forty-four percent were female. These findings are in accordance with those of Yassin et al. [14] in Egypt, Rahman and Nhan et al. [17] and Khan A.F.M. et al. [15] in Bangladesh, Anwarullah and Jayader et al. [18] in Visakhapatnam, India, and then in Myanmar [19]. Hawke et al. [20] in Canada, Mungliston et al. [21] in London had also shown similar incidence in male and female patients in their studies. Walsh et al. [9] and Bojrab et al. [12] of America, Rowland and Smith et al. [22] of U.K. found no gender predilection and a similar 12-month prevalence for individuals aged 5-64 years and a slight increase in the prevalence for those older than 65 years. Waitzman et al. [23] and Timon et al. [24] of the U.S.A. found otitis externa to be most prevalent in the older pediatric and young adult population, which affects both sexes equally. Maximum incidence in young adult males in Bangladesh may be explained by the fact that they are the main working force of the country, who are to work in hot, humid climates and are more exposed to moisture and dusty environment than females. In the present study, the monthly family income revealed that 40% population has an income of up to 2,500 taka, and 27% was in the 3,501 - 4,000 taka group. This indicates that otitis externa is more prevalent in lower and middle-income family groups in Bangladesh. In our study population, the maximum number of patients were Labourer constituting 30%, who were engaged to work in hot, humid, and overcrowded places, maintaining very poor personal hygiene. Studies of Yassin et al. [14] in Egypt and Khan and Rahman et al. [17], and Khan A.F.M et al. [15] in Bangladesh also showed Similar results while than of Myanmar had shown higher prevalence among children, school teachers, and office staff [19]. In the present study, educational status showed that only 2.5% were illiterate, and the remaining patients were literate, varying from primary education to master level. Nazma K et al. [25] reported a higher number of chronic middle ear inflammation in the illiterate population. It is also seen from the study that the majority (44%) of the patients lived in the paka building, followed by 38% of patients who lived in semi-paka houses. The ear cleaning habit of patients revealed that most patients (49%) used cotton buds. The ear cleaning habit of the present series is in accordance with the finding of Nazma K et al. [25]. This residence pattern is explained by the fact that this study is conducted among the patients of BSMMU, which is situated in Dhaka city. The patients could bear a paka or semi-paka house and could also buy cotton buds for ear cleaning purposes. It has been seen from our study that 69% of the total cases occurred during the summer and rainy season, of which maximum number (18.2%) were scored during June, and 31% cases were seen during spring and winter. This observation indicates that otitis externa, especially fungal otitis externa is a disease of hot and humid climates. Yassin et al. [14] of Egypt, Khan and Rahman et al. [17] and Khan A.F.M. et al. [15] of Bangladesh, Pulsivia et al. [26] of Pune, India, and Hawke et al. [20] of Canada had also provided similar results in their studies. Marcy et al. [27] found an incidence 10-20 times higher in the summer than during cooler months, and Roland and Stroman et al. [28] of America found 80.5% cases occurred during the summer months and remained during the rest of the year. Depending on the duration of the disease, either less or more than two months, cases were categorized as acute and chronic, respectively. The diagnosis of otitis externa is primarily based on the presenting symptoms and signs. Accordingly, in our study, 91.8 % of diseased ears had complained of itching, 80% had pain, 60% had a sense of blocking of ears. These triad symptoms were more prevalent in different combinations. In addition, discharge, deafness, tinnitus, etc., were also present in a few cases. Khan et al. [17] and Khan A.F.M. et al. [15] of Bangladesh, Pahwa et al. [26] of Pune, India had similar findings. But Than et al. [19] of Myanmar and Paulose and associates from Bahrain added tinnitus with these as a common symptom. Hawke et al. [20] of Canada did not mention the sense of blocking as the main symptom. Regarding the involvement of ears, it was seen in our study that 90% of ear involvement was unilateral, and 10% were bilateral. Out of the total of 220 ears, 60% were right ears, and 40 % were left ears. As most of the patients were right-handed, chances of manipulation and contamination of the right ear by the organisms of anterior nares through fingernail is a more common possibility than left. Anwarullah et al. [18] also showed similar findings, but Mugliston et al. [21] and Clark et al. [20] claimed equal incidence of right and left ears from their study. Several predisposing factors were detected in patients' history. Of these, self-ear cleaning was found in 94(42.7%), swimming in open water in 39 (17.7%), headcloth in 14 (6.3%), ear drop in 22 (10%), hearing aid in 5 (2.3%) and no factor could be identified in 46 (21%) ears. Ear cleaning as a predisposing factor was also supported by Than et al. [19] and Pahwa et al. [26]. Swimming with water contamination was reported by Hawke et al. [20]. On the other hand, the use of topical eardrops was reported as less significant by Mugliston and O' Donghue et al. [21] and Lucente et al. [29]. Marcy et al. [27], Hirsch et al. [30], and Raza et al. [4] found otitis externa five times more common in a swimmer. As a predisposing factor, self-ear, cleaning, and water contamination by swimming are important in the context of Bangladesh, as the majority of the patients have habits of self-manipulation and free bath in the river, canal, and ponds. From the microscopic and culture characters of aural swabs, it was found that fungus was the dominant pathogen constituting 49.1% (108 cases) a+nd bacteria was found in 31.8 % (70 cases), and remaining were either contaminated or show no growth. The clinical features for the diagnosis of fungal or bacterial disease also differ. It was seen that itching was the dominant symptom (98.2%) in the case of fungal infection, whereas pain in the ear is the main symptom (92.8%) in cases of bacterial infection. This finding is similar to that of Khan AFM et al. [15] Khan & Rahman et al. [17]. In this study, from the microscopic and culture characters of an aural swab from

all of 220 ears, it was seen that out of 168 acute cases, 33.2% were pure fungal isolates, 21.3% were pure bacterial isolate, 7.3% were mixed bacteria, and fungus and in 14.5% ears there were either contamination or no growth. Among the 52 chronic cases, 10% of organisms were pure fungus, 4.6% were pure bacteria, 4.6% mixed bacteria and fungus, and 4.5% revealed no growth. Combining the acute and chronic cases revealed that pure fungus was found in 43.2%, pure bacteria was in 25.9%, mixed infection was in 11.9%, and no growth was found in 19% of cases. The results of this study are consistent with that of Khan A.F.M. et al. [15] of Bangladesh. Bhalla and Sherman et al. [10] of the U.S.A. showed that 40% of all cases of Otitis externa do not produce a dominant pathogen. Our study shows that fungal infection is the single most common cause of otitis externa and is more common in chronic cases. Singer et al. in Florida carried out similar studies in 1952. They recorded 69% of bacterial infections and 31% fungal infections. In 1973, Glasgold et al. [31] of New Jersey reported 57.5% of otitis externa cases due to bacterial infection, 14.7% pure fungal, and 23.5% mixed in their series. In a study, Khan A.F.M. et al. [15] of Bangladesh found pure bacteria in 52%, pure fungus in 11%, mixed infection in 31%, and no growth in 6% cases. In 1984, Hawke et al. of Toronto, Canada, carried out a detailed study on clinical and microbiological characters of otitis externa [20]. They also reported the predominance of bacterial infection. They divided their groups into acute and chronic varieties wherein acute cases bacteria was seen in 80%, and fungus was found in only 7.5%, and the rest were mixed infections. In chronic cases, bacterial infections were found in 51.5%, fungal infections in 17.1%, and 13.1% mixed infections, while 18.11% were found as contamination or no growth. The predominance of fungal otitis externa was reported by Khan et al. [17] and Khan A.F.M. et al. [15] of Bangladesh and in Myanmar by Than et al., [19] in India by Pahwa et al. [26], and by Anwarullah et al. [18]. These findings are quite significant in relation to the pathophysiology of fungal infection in tropical and subtropical countries. It is evident that bacterial infection was more prevalent in otitis externa cases in cold countries like America, Canada, England, etc., ranging from 88-92% cases [29, 28, 23], but in our study, we found that fungal infection is the more common cause of otitis externa, which has also been consistent with some of the studies conducted in India and Myanmar. It was detected that out of 108 cases of fungal otitis externa, 78 (72.2%) had Aspergillus niger, 19 (17.5%) had Aspergillus fumigatus, 8 (7.5%) had Candida, and 3 (2.8%) had penicillium. Khan & Rahman et al. [17] and Khan A.F.M. et al. [15] of Bangladesh, Than [19] of Myanmar, Pahwa et al. [26] of Pune, India, and Anwarullah et al. [18] of India have shown the nearly similar incidence of fungal species, Whereas Singer et al. [32] of Florida, America has shown a higher incidence of Candida among the fungal species. Conley et al. [33] pointed out that the external ear canal fulfills many of the requirements for fungal growth as moisture, warmth, and some protein and carbohydrate. From bacterial culture character of aural swabs, we found that Pseudomonas aeroginosa in 28 (40%) ears, Staphylococcus aureus in 26 (37.1%) ears, E. coli in 10 (14.3%) ears, and Proteus in 6 (8.6%) ears. Singer et al. [34], Glasgold et al. [31], Bojrab et al. [12], Mirza et al. [35] Roland & Stroman et al. [28] also isolated more Pseudomonas aeroginosa among bacterial species. But Mugliston et al. [21] and Khan A.F.M. et al. [17] showed Staphylococcus aureus prevalence in their study groups. A similar finding was also detailed by Anwarullah et al. [18], where they also quoted that maximum association was observed between Aspergillus niger and coagulase-positive Staphylococcus. This is also a similar finding in our observation. We included 110 healthy individuals (220 ears) as control. It revealed that out of 220 ears, 40 (18.2%) showed bacterial growth, 14 (6.3%) fungal growth, 18 (8.2%) mixed growth, and 148 (67.3%) no growth. Khan AFM et al. [15] of Bangladesh found pure bacteria in 52% cases, pure fungus in 11% cases, mixed infection in 31% cases, and no growth in 6% cases. Among the bacteria majority, i.e., 41.4% were Staphylococcus epidermidis, 13.8% Diphteroids, and 17.2% Staph. Aureus, which are normal flora. Rest 16 (27.6%) were bowel commensals as E. coli, Proteus, and Pseudomonas, which can be isolated from any skin surface after a night in bed and the fact that they persist in the external auditory canal. In addition, Staphylococcus aureus and Streptococcus viridian's can frequently be present without causing any ill effects [36]. It is more likely due to a loss of the normal skin protective mechanisms allowing secondary colonization [37]. The pure fungus could be isolated in 6.3% of healthy ears and mixed fungal and bacterial in 8.2% of ears, constituting 14.5% of healthy ears. Among the fungus, Aspergillus was present in 37.5% of the ears, followed by Candida 25%, Penicillium 18.7%, Mucor 9.4%, and others 9.4%. The finding of the distribution of organisms in control ears was in accordance with those of Khan AFM et al. [15] and Singer David et al. [34]. It has been suggested that ear wax's saturated and unsaturated fatty acids have an inhibitory effect on most fungi [2]. Yet, it may support the growth of Aspergillus as identified by Akobjanoff et al. [38]. From the observations of the control ears, it is again evident that in a healthy individual, though few pathogenic bacteria can be seen, the presence of fungus is insignificant. But once the integrity of the external ear canal is compromised for whatever reason, the resultant exudates provide a humid atmosphere encouraging both fungal and bacterial proliferation, and the resultant debris provides nutrition. Finally, a warm and dark canal supports their growth [21].

LIMITATIONS OF THE STUDY

Limitations are quite common in any study, whether short or long, retrospective or prospective, and fewer or larger samples. Still then overcoming limitations is essential to conduct any study. The significant outcome of the study has tried to overcome it as far as possible. Beyond the scope following limitations were faced while doing the study:

1. The study was conducted only among the patients attending the Outpatient department of BSMMU. The samples are neither representing the whole Dhaka city nor the whole Bangladesh. So the findings cannot be generalized to the entire Bangladesh or Dhaka city.
2. Suction apparatus could not be used in all cases to clean the ear, and a microscope was not used to examine the ear because it was not available in OPD.
3. The amount of hearing loss of the cases could not be assessed, as most cases were acute and painful.

4. Samples were collected with a dry sterile cotton swab stick. The use of a swab moistened with nutrient broth, serum, or transport media is ideal (Hsiao-Lou 1957).
5. The study was done on limited samples for a short period.

RECOMMENDATIONS

Based on the findings of the study of the pattern of otitis externa in the ENT Outpatient department, certain recommendations are proposed as follows:

1. Further studies for gathering accurate population-based data for Otitis externa should be undertaken to determine the priority for preventing and management of Otitis externa in the national health program.
2. Certain environmental and behavioral predisposing factors are known to be associated with increased risk of otitis externa. Therefore, it is strongly recommended that general health promotion measures are encouraged and strengthened in the communities concerned to reduce the incidence of otitis externa. Furthermore, possibilities for improved housing, improving nutrition, reduced overcrowding, and adequate access to clean water should be considered wherever possible.
3. Opportunities for cost-effective prevention of otitis externa should be created at all levels of health services, particularly in the community and at the primary level of health care.
4. Primary ear care should be incorporated into primary health care, and primary health care workers need to be given training and facilities for prevention, detection, and management of otitis externa.
5. The diagnosis of otitis externa needs to be made promptly in order to prevent recurrence and chronicity.
6. Health education should be widely introduced in the communities, both urban and rural, through mass media, group discussion, and personal communications to aware people regarding the cause, effects, and remedy of otitis externa.
7. The ear care instruments and equipment like otoscopes, suction apparatus, etc. Should be made available in the health facilities.

CONCLUSION

From our study, it can be concluded that acute fungal otitis externa is more prevalent among patients suffering from otitis externa in Bangladesh. It can also be concluded that Aspergillus usually causes fungal external ear canal infection, and the infection is mostly seen during the summer and rainy seasons. The result of this study obviously will increase the clinical and diagnostic awareness of ENT practitioners. At the same time, it has established some important clinical criteria for diagnosing fungal otitis externa.

ACKNOWLEDGMENTS

None.

AUTHORS' CONTRIBUTIONS

The participation of each author corresponds to the criteria of authorship and contributorship emphasized in the Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly work in Medical Journals of the International Committee of Medical Journal Editors. Indeed, all the authors have actively participated in the redaction, the revision of the manuscript, and provided approval for this final revised version.

COMPETING INTERESTS

The authors declare no competing interests with this case.

FUNDING SOURCES

None.

REFERENCES

[1] Gray RF, Hawthorne M. In: Synopsis of Otolaryngology, 5th edn. London; Butterworth-Heinemann. 1992: 83-96.
[2] Senturia BH, Marcus MD, Lucente FE. Disease of the external ear. New York; Grune and Stratton 1980: 6-62: 1-23.
[3] Cambon AC, Khalyfa A, Cooper NG, Thompson CM. Analysis of probe level patterns in Affymetrix microarray data. BMC Bioinformatics. 2007 May 4; 8:146. DOI: 10.1186/1471-2105-8-146
[4] Raza SA, Denholm SW, Wong JC. An audit of the management of acute otitis externa in an ENT casualty clinic. J Laryngol Otol. 1995 Feb; 109(2):130-3. DOI: 10.1017/s0022215100129469
[5] Ruddy J, Bickerton RC. Optimum management of the discharging ear. Drugs. 1992 Feb; 43(2):219-35. DOI: 10.2165/00003495-199243020-00008
[6] Sander D, Grafman J, Zalla T. The human amygdala: an evolved system for relevance detection. Rev Neurosci. 2003;14(4):303-16. DOI: 10.1515/revneuro.2003.14.4.303
[7] Jones EH. External otitis, Diagnosis and treatment. Thomas C (Publisher), Springfield, Illinois, U.S.A. 1965: 50-51.
[8] Cassisi N, Cohn A, Davidson T, Witten BR. Diffuse external otitis: clinical and microbiologic findings in the course of a multicenter study on a new solution. Ann Otol Rhinol Laryngol Suppl. 1977 May-Jun; 86(3 Pt 3 Suppl 39):1-16. DOI: 10.1177/00034894770863s201
[9] Walsh DM, Klyubin I, Fadeeva JV, Cullen WK, Anwyl R, Wolfe MS, et al. Naturally secreted oligomers of amyloid β protein potently inhibit hippocampal long-term potentiation in vivo. Nature. 2002 Apr 4; 416(6880):535-9. DOI: 10.1038/416535a
[10] Bhalla SS. Imagine there's no country: Poverty, inequality, and growth in the era of globalization. Peterson Institute. 2002. [Accessed 2022 Mar 14]. Available from: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.457.3832&rep=rep1&type=pdf
[11] Sander CS, Chang H, Salzmann S, Müller CS, Ekanayake-Mudiyanselage S, Elsner P, et al. Photoaging is associated with protein oxidation in human skin in vivo. J Invest Dermatol. 2002 Apr;118(4):618-25. DOI: 10.1046/j.1523-1747.2002.01708.x
[12] Bojrab DI, Bruderly T, Abdulrazzak Y. Otitis externa. Otolaryngol Clin North Am. 1996 Oct; 29(5):761-82.
[13] Beg MH, Bhukhari AT. Otomycosis in Karachi. Practitioner. 1983 Nov;227(1385):1767-70.
[14] Yassin A, Mostafa MA, Moawad MK. Fungus infection of the ear. J Laryngol Otol. 1964 Jun; 78:591-602. DOI: 10.1017/s0022215100062472
[15] Khan AFM. A comparative bacteriological and mycological study on otitis externa. IPGM&R, Dhaka. July, 1997 [Thesis)
[16] Chessbrough M. Medical laboratory manual for Tropical countries. 15 edition. vol.11. Cambridgeshire, England; Tropical health Technology. 1984:372-382.
[17] Khan AA, Rahman KM. Fungus infection of the ear. Bangladesh Med Res Counc Bull. 1977 Jun;3(1):28-31.
[18] Anwarullah M, Jayakar PA. A microbiological study of otomycosis in Visakhapatnam. J Indian Med Assoc. 1987 Aug; 85(8):229-32.
[19] Than MK, Naing KS, Min M. Otomycosis in Burma and its treatment. Am J Trop Med Hyg. 1980 Jul;29(4):620-3. DOI: 10.4269/ajtmh.1980.29.620
[20] Hawke M, Wong J, Krajden S. Clinical and microbiological features of otitis externa. J Otolaryngol. 1984 Oct; 13(5):289-95.
[21] Mugliston T, O'Donoghue G. Otomycosis, A continuing problem. J Laryngol Otol. 1985 Apr; 99(4):327-33. DOI: 10.1017/s002221510009678x
[22] Rowland S, Donkin P, Smith E, Wraige E. Aromatic hydrocarbon "humps" in the marine environment: unrecognized toxins? Environ Sci Technol. 2001 Jul 1; 35(13):2640-4. DOI: 10.1021/es0018264
[23] Waitzman NJ, Smith KR. Phantom of the area: poverty-area residence and mortality in the United States. Am J Public health. 1998 Jun;88(6):973-6. DOI: 10.2105/ajph.88.6.973
[24] Timón ML, Ventanas J, Carrapiso AI, Jurado A, García C. Subcutaneous and intermuscular fat characterisation of dry-cured Iberian hams. Meat Sci. 2001 May; 58(1):85-91. DOI: 10.1016/s0309-1740(00)00136-4
[25] Nazma K. Prevalence of chronic supporative otitis media among children of two selected slum dwellers in Dhaka city, NIPSOM. Dhaka; 2001 (Dissertation).
[26] Pahwa Vk, Chamyal PC, Suri PN. Mycological study in otomycosis. Indian J Med Res. 1983 Mar;77:334-8.
[27] Marcy SM. Infections of the external ear. Pediatr Infect Dis. Mar-Apr 1985;4(2):192-201.
[28] Roland PS, Stroman DW. Microbiology of Acute Otitis Externa. The Laryngoscopo. 2002 Jul;112(7 Pt 1):1166-77. DOI: 10.1097/00005537-200207000-00005
[29] Lucente EF. Fungal infection of the external ear. Otolaryngol Clin North Am. 1993 Dec;26(6):995-1006.
[30] Hirsch BE. Infections of the external ear. Am J Otolaryngol. 1992 May-Jun;13(3):145-55. DOI: 10.1016/0196-0709(92)90115-a
[31] Glasgold AL, Boyd JE. Otitis externa - control of bacterial and mycological infections - A preliminary report. Eye Ear Nose Throat Mon. 1973 Mar; 52(3):94-6.
[32] William PL, Warwich R, Dayson M, Bannister LH. Development of special sense organs: the ears. In: Gray's anatomy, 37'h edn. Churchill Livingstone, 1987: 204-6.
[33] Conley JC. Evaluation of fungus disease of the external auditory canal. Arch Otolaryngol. 1948; 47(6): 721-745. DOI: 10.1001/archotol.1948.00690030748002
[34] Singer De, Freeman E, Hoffert Wr, Keys Rj, Mitchell Rb, Hardy Av. Otitis externa. Bacteriological and mycological studies. Ann Otol Rhinol Laryngol. 1952 Jun;61(2):317-30. DOI: 10.1177/000348945206100201
[35] Alhozaimy AM, Soroushian P, Mirza F. Mechanical properties of polypropylene fiber reinforced concrete and the effects of pozzolanic materials. Cement Concrete Composites. 1996; 18(2): 85-92. DOI: 10.1016/0958-9465(95)00003-8
[36] Sipila P, Jokiph AM, Jokiph L, Karma P. Bacteria in the middle ear and ear canal of patients with secretory otitis media and non-inflamed ears. Acta Otolaryngilogicia. 1981; 92(1-2): 123-130. DOI: 10.3109/00016488109133246
[37] Browning GG, Picozz GL, Sweeney G, Calder IT. Role of anaerobes in chronic otitis media. Clin Otolaryngol Allied Sci. 1983 Feb; 8(1):47-51. DOI: 10.1111/j.1365-2273.1983.tb01671.x
[38] Akobjanoff L, Carruthers C, Senturia BH. The chemistry of cerumen: a preliminary report. J Invest Dermatol. 1954 Jul; 23(1):43-50. DOI: 10.1038/jid.1954.81