

Otitis externa: the analysis of relationship between particular signs/symptoms and species and genera of identified microorganisms*

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ABSTRACT: Objective. To investigate a relationship between the etiological factor of external otitis and occurrence of particular signs/symptoms. **Design.** A special questionnaire was designed and completed by all patients covering personal details, medical history, results of otolaryngological examination and bacteriological and mycological investigations. **Subjects.** 249 patients of the Outpatient Department of Laryngology at the Regional Hospital in Bełchatów with symptoms of external otitis. For analysis of relationships between particular signs/symptoms and species/genera of microorganisms, statistical tests were used: χ^2 test, χ^2 test with Yate's modification, C-Pearson index, and Fisher exact test for very small samples. **Results.** There is a statistical dependence between discharge, hearing loss, swelling of skin, scant, dried discharge with fetid odour and bacteria isolated from the external ear canal. Similar dependence exists between pain, hearing loss, no smelly discharge or wet, black plug of fetid odour and fungi. Also there is a statistical dependence between pruritus, red skin and grey, fetid discharge and mixed flora. **Conclusions.** Some of symptoms and signs are connected with definite etiological factors which is important not only for correct diagnosis but also for institution of appropriate and effective treatment. On the basis of some characteristic symptoms and signs it is possible to make a tentative diagnosis as to the etiological pathogen responsible for external otitis.

Key words: bacteria, fungi, external otitis

Introduction

Conclusive determination of the species of pathogen responsible for ear pathology is essential to institute appropriate therapy. However, in acute inflammations the patients are routinely given antibacterial ear drops to relieve the symptoms whereas microbiological cultures are frequently omitted due to economic factors and to necessity to wait for the results – bacteriological cultures with an antibiogram can be obtained after a few days, and mycological after more than a fortnight. Only if no response is achieved the otolaryngologist undertakes an attempt to identify the etiological factor and determine drugs sensitivity; it is important because some of strains have primary or secondary resistance to drugs.

In view of own observations that diseases of the external auditory meatus constitute an important and common problem in the ambulatory practice, it seems reasonable to match particular signs and symptoms to the etiological factor of disease, such as bacteria or fungi or both bacteria and fungi in order to accordingly choose the form of treatment, especially in cases in which aural toilet and astringents or antiseptics are not sufficient.

The aim of the study was to look for relationship between the etiological factor and occurrence of particular signs and symptoms.

Material and methods

The study consisted of 249 patients (293 ears) who presented with symptoms of external otitis to

* This work was supported by Grant No 503-1013-1 from the Medical University of Łódź

the Outpatient Department of Laryngology at the Regional Hospital in Bełchatów and who were divided into 3 groups: I – bacteria infected, II – fungi infected and III – bacteria and fungi infected.

The group studied comprised 162 women ($65.1 \pm 3.02\%$) and 87 men ($34.9 \pm 3.02\%$) aged 2–82 years (mean – 37.6 years).

A special questionnaire was designed and completed by all patients covering personal details, medical history, results of otolaryngological examination and bacteriological and mycological investigations.

A complete otolaryngological examination was performed in all patients by the same examiner (J. Filipiak) and special attention was paid to skin lesions of the external auditory meatus, their character, presence of discharge within the ear, its colour and odour, as well as the state of the tympanic membrane. The ears were examined under binocular microscopy.

To determine the genera and species of bacteria and fungi responsible for external otitis, the material was collected with sterile swabs from the external auditory meatus and placed on the medium of the Bacteriological Transport Set No.1. Then the material was seeded on the solid media of: agar with blood (agar Columbia), chocolate agar on the basis of Mueller-Hinton medium, MacConkey medium and also into liquid trypticase-soy broth medium (bioMérieux). The microorganisms cultures were incubated in aerobic conditions at 35–37° C. First readings from the solid media were made after 24 h. After 24 h the culture was inoculated from the liquid medium (enriched, containing growth factors that enable the development and reproduction of bacteria fastidious about nutrition) on the solid media and kept for further 24 h in a thermostat at 37° C in aerobic conditions. In case of the microorganisms growth in media, the colony morphology was evaluated taking into account: shape, size, edges, surface, colour, transparency, consistency, odour, and the type of hemolysis on blood media. After determination of the colonies features, in order to identify further the isolated bacteria and determine their metabolic features, biochemical tests were applied using API 20E tests for Gram-negative bacteria, API STAPH and API STREP for Gram-positive bacteria, API NH for non-fermenting Gram-negative bacteria or eventually API 20E (bioMérieux).

To determine the genera and species of fungi, the material was seeded directly on liquid Sabouraud's

medium incubated at 37° C for 24 hours, and the culture was left at room temperature for further 48 hours. Then direct preparations were made of all the grown colonies, in 0.9% solution of sodium chloride, and examined under microscope (100x, 400x or 800x) for fungal structures; if such structures were detected, the culture was placed on Sabouraud's agar. Subsequent control preparations were performed in the same manner after 5–10 days and then after further 10 days, and left for observation for up to 8 weeks. The transfer of the colonies on fresh media enabled the isolation of pure bacteria-free strains (axenic cultures). In case of detection of fungi forming fluffy, coat-like colonies, which signalled a possible laboratory contamination, a culture from the same patient was repeated. In differentiating studies, tests based on the morphological and biochemical features of a fungal strain were used. Macroscopic features of the colonies (colour, shape, lustre, edges, surface, relation to agar surface, changes in colour) as well as microscopic aspects of microcultures on special media were evaluated. On the basis of these characteristics, strains forming fluffy colonies were separated from those forming smooth colonies, and their detailed differentiation towards *Aspergillaceae* or *Cryptococcaceae* fungi was performed. Then selected biochemical features of individual *Cryptococcaceae* strains were examined, performing auxanogram and zymogram with API 20C and API 20C AUX (bioMérieux) tests; the strains were classified into appropriate species and genera using the method of numerical identification (Analytical Profile Index, bioMérieux, Lyon, 1990). Bacteriological and mycological cultures were conducted by the same examiner (P. Kurnatowski).

In the evaluation of the hypothesis on independence of two features the following statistical tests were used: χ^2 test, χ^2 test with Yate's modification, Pearson's correlation coefficient, and Fisher exact test for very small samples. In all cases the differences between the means and the relations between features were considered statistically significant where probability of making type I error was $p < 0.05$ [1]. The calculated values of χ^2 test and Pearson's correlation coefficient were used to determine whether any relationship was found between symptoms and signs in particular groups (I, II, III) of patients studied according to the etiological factor inducing external otitis. Next, particular groups were compared with one another (I-II, I-III, II-III). The statistical analysis was performed using the

STATISTICA computer programme for statistical processing of data. Also, a computer programme to analyse data was designed with the use of EXCEL 97 PL calculation sheet (Microsoft) and calculations were made on Hypermedia 300A computer.

Results

The results of the bacteriological and mycological cultures revealed the presence of different types of bacterial species in 191 (53.3±2.63%) ears (group I), fungi in 48 ears (13.3±1.79%) (group II), and both bacteria and fungi in 54 ears (15.3±1.90%) (group III).

In group I *Staphylococcus coagulase negative* (31.9%) and *Staphylococcus aureus* (20.9%) as well as *Pseudomonas aeruginosa* (20.4%) were the most frequently detected bacteria; rare were *Escherichia coli*, *Proteus mirabilis*, *Enterobacter sp.*, *Streptococcus viridans*, *Acinetobacter sp.*, *Klebsiella sp.* and *Streptococcus pneumoniae*. In group III together with fungi were present *Staphylococcus aureus* (48.1%), *Staphylococcus coagulase negative* (20.4%) and *Pseudomonas aeruginosa* (11.1%).

Among fungi in group II *Candida albicans* (33.3%), *Aspergillus niger* (20.8%), *Candida parapsilosis* (16.7%) and *Aspergillus flavus* (12.5%) were detected, and in group III together with bacteria *Candida albicans* (31.5%), *Candida parapsilosis* (27.8%), *Aspergillus niger* (9.26%) were the most common.

Table 1. Frequency of symptoms of otitis externa in patients studied according to etiological factor

Symptoms	Flora		
	bacteria n = 191 %±SEs	fungi n = 48 %±SEs	bacteria and fungi n = 54
Pain	88 46.1±3.61	17 35.4±6.90	34 63.0±6.57
Pruritus	147 77.0±3.05	42 87.5±4.77	48 88.9±4.28
Burning	42 22.0±3.00	7 14.6±5.09	8 14.8±4.83
Discharge	100 52.4±3.61	30 62.5±6.99	28 51.9±6.80
Fullness	86 45.0±3.60	28 58.3±7.12	29 53.7±6.79
Tinnitus	53 27.7±3.24	20 41.7±7.12	16 29.6±6.21
Hearing deterioration	63 33.0±3.40	1 35.4±6.90	16 29.6±6.21

Table 2. Frequency of signs of otitis externa in patients studied according to the etiological factor

Signs	Flora		
	bacteria n = 191 %±SEs	fungi n = 48 %±SEs	bacteria and fungi n = 54
Skin of external ear canal			
Swelling	100 52.4±3.61	22 45.8±7.19	24 44.4±6.76
Red	43 22.5±3.02	10 20.8±5.86	8 14.8±4.83
Pink	29 15.2±2.60	8 16.7±5.38	16 29.6±6.21
Discharge			
Scant	48 25.1±3.14	12 25.0±6.25	18 33.3±6.42
Dry	33 17.3±2.74	6 12.5±4.77	7 13.0±4.57
Dry plug	18 9.42±2.11	4 8.33±3.99	12 22.2±5.66
Wet plug	20 10.5±2.22	12 25.0±6.25	9 16.7±5.07
Abundant	20 10.5±2.22	7 14.6±5.09	3 5.56±3.12
Smell of discharge			
Vapid	40 20.9±2.94	10 20.8±5.86	15 27.8±6.10
Fetid	14 7.33±1.89	4 8.33±3.99	4 7.41±3.56
Absent	137 71.7±3.26	34 70.8±6.56	35 64.8±6.50
Colour of discharge			
Aqueous	5 2.62±1.16	0 0.00±0.00	1 1.85±1.83
White	77 40.3±3.55	18 37.5±6.99	24 44.4±6.76
Yellow	9 4.71±1.53	2 4.17±2.88	0 0.00±0.00
Brown	13 6.81±1.82	2 4.17±2.88	2 3.70±2.57
Grey	32 16.8±2.70	14 29.2±6.56	20 37.0±6.57
Black	0 0.00±0.00	5 10.4±4.41	2 3.70±2.57

Frequency of symptoms and signs of otitis externa in patients according to the etiological factor are listed in Table 1 and 2.

In group I there was basis to reject the null hypothesis of the χ^2 test; a statistically significant relationship was revealed between bacteria and the following signs: discharge from the ear ($\chi^2=13.4172$; $p<0.001$), complaint of deterioration of hearing ($\chi^2=4.9379$; $p<0.05$), swelling of the

external auditory meatus skin ($\chi^2=10.4254$; $p<0.001$) and also scant ($\chi^2=3.3360$; $p<0.05$) and dried discharge ($\chi^2=6.4339$; $p<0.01$) with fetid odour ($\chi^2=13.5751$; $p<0.001$); C-Pearson correlation values for the mentioned characteristics ranged from +0.138 to +0.224.

In group II, on the basis of the χ^2 test a statistically significant relationship was observed between fungi identified in the external auditory meatus and pain of the ear ($\chi^2=4.4205$; $p<0.05$), complaint of deterioration of hearing ($\chi^2=4.1606$; $p<0.05$), aural discharge ($\chi^2=15.0144$; $p<0.01$) without odour ($\chi^2=10.9188$; $p<0.001$), wet plug ($\chi^2=9.9660$; $p<0.001$) with fetid odour ($\chi^2=11.6983$; $p<0.001$), and grey colour ($\chi^2=6.1765$; $p<0.01$). C-Pearson correlation values for the presented characteristics varied from +0.188 to +0.342. In group III basing on χ^2 test, there was a statistically significant relationship between the presence of bacteria and fungi and pruritus ($\chi^2=3.5695$; $p<0.05$), external auditory meatus congestion ($\chi^2=4.1727$; $p<0.05$), discharge ($\chi^2=8.2834$; $p<0.01$) of grey colour ($\chi^2=11.6025$; $p<0.001$), and with fetid odour ($\chi^2=17.4503$; $p<0.001$). C-Pearson correlation values for the presented characteristics varied from +0.171 to +0.358.

The data indicate that pain in the ear should be associated with cases of otomycosis, while the presence of pruritus suggests a concomitant bacterial infection. Swelling and pink colour of the external auditory meatus skin as well as occurrence of dried discharge are related to the presence of bacteria, whereas a wet plug or grey discharge to fungi causing the disease.

The differences in frequency of wet ($\chi^2=6.9825$; $p<0.01$), grey ($\chi^2=3.8027$; $p<0.05$) or black in colour ($\chi^2=15.3402$; $p<0.001$) plug were found to be statistically significant when comparing group I and II. C-Pearson correlation values for the presented characteristics varied from +0.125 to +0.246.

The differences in frequency of dried ($\chi^2=6.4169$; $p<0.01$), grey ($\chi^2=10.3586$; $p<0.001$) discharge were found to be statistically significant when comparing group I and III. C-Pearson correlation values for the presented characteristics varied from +0.160 to +0.201. The differences in frequency of pain in the ear (7.7130; $p<0.01$) and a dry plug ($\chi^2=3.7064$; $p<0.05$) were found to be statistically significant when comparing group II and III. C-Pearson correlation values for the presented characteristics varied from +0.187 to 0.265.

Discussion

Literature data as well as our experience show that one of frequent reasons patients come to see an otolaryngologist are symptoms of otitis externa. In acute otitis, when an immediate treatment is necessary, often microbiological culture is overlooked and the diagnosis is made only on the basis of symptoms and signs of disease.

In our study the most frequent symptoms were as follows: pruritus (group I – 77,0%, group II – 87,5%, group III – 88,9%) and discharge (respectively: 52,4%; 62,5%; 51,9%), pain (respectively: 46,1%; 35,4%; 63,0%) and ear fullness (respectively: 45,0%; 58,3%; 53,7%). In Manni's et al. report [2], prevalence of symptoms was different; the proportion of patients complaining of pruritus was 93%, pain – 82% and discharge – 64%. Most authors [3–7] agree that the most frequent is pruritus. Patients examined by Bambule et al. [3], Paulose et al. [4] and Pavlenko [5] had also tinnitus and dried discharge.

In our study in objective examination we found swelling (group I – 52.4%, group II – 45.8%, group III – 44.4%) and redness (respectively: 22.5%; 20.8%; 14.8%) of skin of external ear canal, which is in accordance with the literatura data [8, 9]. We did not observe in any our patient pustule, ulcer or periostitis or perichondritis, the manifestations which were found by other authors [10, 11].

Among our patients we found scant (group I – 25.1%; group II – 25.0%; group III – 33.3%) or dried (respectively: 17.3%; 12.5%; 13.0%) discharge, of fetid odour (respectively: 20.9%; 20.8%; 27.8%), white colour (respectively: 40.3%; 37.5%; 44.4%) or grey (respectively: 16.8%; 29.2%; 37%), which is in accordance with the literature data [2, 5, 12, 13].

Most authors inform that in bacterial otitis externa discharge is usually abundant, serous or purulent, without any odour [12, 14–17], while in otomycosis discharge can take the form of wet plug or caseous mass (it looks like “wet newspaper”), it can be dry, thin layer of cerumen with deposits similar to cotton wool [6, 12].

Conclusions

1. Some of symptoms and signs are connected with definite etiological factors which is important not only for correct diagnosis but also for institution of appropriate and effective treatment.

2. On the basis of some characteristic symptoms and signs it is possible to make a tentative diagnosis as to the etiological pathogen responsible for external otitis.

References

- [1] Blalock H.M. 1986. Statystyka dla socjologów. PWN, Warszawa.
- [2] Manni J.J., Kuylen K. 1984. Clinical and bacteriological studies in otitis externa in Dar es Saalam, Tanzania. *Clinical Otolaryngology* 9: 351–354.
- [3] Bambule G., Savary M., Grigoriu D., Delacretaz J. 1982. Les otomycoses. *Annales de Oto-Laryngologie et de Chirurgie Cervicofaciale* (Paris) 99: 537–540.
- [4] Paulose K.O., Khalifas S., Shenoy P., Sharma R.K. 1989. Mycotic infection of the ear (otomycosis). A prospective study. *Journal of Laryngology and Otolology* 103: 30–35.
- [5] Pavlenko S.A. 1990. Otomycosis in the Kuznetsk region and organization of medical services for this group of population. *Vestnik Otorinolaringologii* 4: 70–74.
- [6] Selesnick S.H. 1994. Otitis externa: management of the recalcitrant case. *American Journal of Otolology* 15: 408–412.
- [7] Stern J.C., Lucente F.E. 1988. Otomycosis. Little, Brown and Company, Boston.
- [8] Kombila M., Gomez de Diaz M., de Bievre C., Crepet G., Debie J.C., Belembaogo E. 1989. Fungal otitis in Liberville. Study of 83 cases. *Bulletin de la Societe Pathologie Exotique of Filiales* 82: 201–207.
- [9] Yassin A., Mostafa M.K., Moawad M. 1984. Fungus infection of the ear. *Journal of Laryngology and Otolology* 78: 591–602.
- [10] Nielsen P.G. 1985. Fungi isolated from chronic external ear disorders. *Mykosen* 28: 234–237.
- [11] Sagneli M., Cristalli G., Bruno E., Marzullo C., Abramo A., Pollastrini L. 1993. Otomycosis a microbiological study of 147 cases of otitis externa. *Annales Otorrhinolaringologicos Ibero-Americanos* 20: 521–530.
- [12] Mugliston T., O'Donoghue G. 1985. Otomycosis – A continuing problem! *Journal of Laryngology and Otolology* 99: 327–333.
- [13] Talwer P., Chakrabarti A., Kaur P., Pahwa R.K., Mittal A., Mehra Y.N. 1988. Fungal infections of ear with special reference to chronic suppurative otitis media. *Mycopathologia* 104: 47–50.
- [14] Agius A.M., Pickles J.M., Burch K.L. 1992. A prospective study of otitis externa (see comments). *Clinical Otolaryngology* 17: 150–154.
- [15] Boheim K. 1992. Diagnosis and therapy of infectious otitis externa. An overview for the non-ENT physician. *Wiener Medizinische Wochenschrift* 142: 481–484.
- [16] Clark W.B., Brook J., Bianki D., Thompson D.H. 1997. Microbiology of otitis externa. *Otolaryngology, Head and Neck Surgery* 116: 23–25.
- [17] Than K.M., Naing K.S., Min M. 1980. Otomycosis in Burma and its treatment. *American Journal of Tropical Medicine and Hygiene* 29: 620–623.

Wpłynęło 7 listopada 2007

Zaakceptowano 3 grudnia 2007