Microbial etiology of acute otitis externa - a one year study

Received for publication, August 10, 2015
Accepted, December 9, 2015

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Abstract

Acute otitis externa is a diffuse inflammation of the external ear canal, caused by bacterial and/or fungal infections that may cause persistent, severe pain, swelling of the skin and detritus accumulation in the auditory canal accompanied by mild hearing loss. Microbiological samples were collected from the external ear canal of 59 outpatients and analyzed for the presence of aerobic pathogens responsible for otitis externa and the isolated strains sensitivity to currently tested antibiotics. Staphylococcus aureus was the most common microorganism encountered in the external ear canal (31 of 59 cases), followed by Pseudomonas aeruginosa (12 of 59 cases), Escherichia coli (4 cases) and Proteus vulgaris (3 cases). The unexpected high incidence of Staphylococcus aureus (58% of all cases), compared to data found in the literature that report a much smaller percent, was accompanied by a high level of resistance of the isolated Staphylococcus aureus strains to usual antibiotics such as ciprofloxacin (32%), cefuroxim (36%), azithromycin (40%), gentamicin (26%) and chloramphenicol (27%). Although otitis externa is considered a trivial pathology and many times receives empiric treatment, the results of our survey highlight the need for determination of the specific microbial etiology and of antibiotic susceptibility spectrum to enable a targeted treatment.

Keywords: acute otitis externa, Staphylococcus aureus, antibiotic resistance

1. Introduction

Acute otitis externa (AOE) is a diffuse inflammation of the external ear canal, caused by a bacterial and/or fungal infection, generally without involvement of the tympanic membrane. It may cause persistent, severe pain, swelling of the skin and detritus accumulation in the auditory canal, mild hearing loss. The disease usually results from high humidity, warm swimming pools, local trauma, and the use of hearing aids (BEERS [1], OSGUTHORPE & NIELSEN [2], MOSGES & al. [3]). The most important environmental factor is excessive moisture, which increases the pH and decreases cerumen (SANDER [4], MITTAL & KUMAR [5]).

The most common agents responsible for acute diffuse external otitis are Pseudomonas (P.) aeruginosa followed by Staphylococcus (S.) aureus, Proteus vulgaris, Streptococcus species, Candida albicans, Aspergillus niger and in some cases even mixed infections were found (ANNIKO & al. [6]). The aim of this study was to identify the microorganisms responsible for the cases of otitis externa presenting to ENT Department within Alexandria County Emergency Hospital, Romania, over twelve months period, between August 2014 and July 2015. The authors also investigated the susceptibility of the pathogenic bacteria isolated to selected antibiotics. These findings were compared with previously published studies in order to evaluate whether treatment recommendations currently proposed by the international literature apply to...
this region of Romania and to draw attention to the need of inland data for guiding future empiric treatment. Inland data are needed because the bacterial colonization of a normal ear canal and the microbiology of external otitis may differ due to climate, health seeking behaviors, topical or systemic available treatment, socio-economic level that influences local hygiene or other habits. It is generally accepted for treatment the use of topical antibiotics with or without steroids, antiseptic and anti-inflammatory agents, after a thorough cleaning of the ear canal. Topical drying agents such as Castellani solution, gentian violet or iodopovidone are also recommended (ANNIKO & al. [6]). Clinicians should prescribe non-ototoxic antibiotic (ear drops) when the patient has a known or suspected perforation of the tympanic membrane, including a tympanostomy tube (ROSENFELD & al. [7]). If the ear canal is occluded, topical solutions should be applied on a sterile ear wick. Oral antibiotics are indicated in cases of severe external otitis with cellulitis or lymphadenitis, and always in diabetic patients (ANNIKO & al. [6]). Patients not responding to this therapy or presenting complications should be hospitalized.

2. Materials and Methods

The authors present the results of a retrospective study carried out on a 12 months period between August 2014 and July 2015, on outpatients who addressed the ENT department of Alexandria County Emergency Hospital, Romania, developing signs of acute external otitis (pain, swelling of the auditory canal, discharge, hearing loss etc.). The study included outpatients between 10 and 84 years old, with acute unilateral or bilateral external otitis, disregarding associated mild to moderate general pathology. Patients with chronic external otitis, otitis media or mastoid involvement, recently hospitalized, and recently treated with ear drops containing antibiotics or systemic antibiotics, general diseases associated with severe immunosuppression were excluded. Microbiologic samples from external ear canal were collected by the same otologist on the first contact with the patient before any topical or systemic antibiotic and anti-fungal medication started, using sterile swabs. The specimens collected were immediately transported to the hospital microbiology laboratory for routine aerobic culture and identification. The strains identification was realized using biochemical conventional tests and the antibiotic susceptibility testing was performed by Kirby-Bauer standard disk diffusion method (CLSI, 2014, 2115 editions).

3. Results

A number of 59 patients (35 men and 24 women) aged between 10 and 84 years old, from which ¼ were children (14 of these 59 patients were between 10 and 19 years old) were analyzed. From all the samples were isolated 34 Gram positive bacteria (31 S. aureus, 2 Streptococcus sp. and 1 Enterococcus sp.) and 20 Gram negative bacteria (12 P. aeruginosa, 4 Escherichia (E.) coli, 3 Proteus vulgaris and 1 Klebsiella sp. strains). In five cases, the cultures were negative (figure 1). An unexpected finding was a significantly high incidence of S. aureus (57% of all cases), compared to data found in the literature that report a much smaller percent, varying by different authors approximately between 7 and 20 percent (PRASANNA & al. [8], DIBB [9]). Most cases were recorded during the warm season, from June to September. In all cases a single species was isolated. In order to orient future empiric treatment, the sensitivity of these strains to usually administrated antibiotics was tested. We mention that all patients included in this study received empiric treatment before finding out the results of bacteriology, topic or systemic antibiotics, based on the clinical severity of symptoms and co-morbidities. An unexpected finding was the high level of resistance to usual antibiotics of some S. aureus strains, as showed in figure 2.
32% of tested staphylococci were resistant to ciprofloxacin that is currently prescribed for external otitis in Romania. Also, 26% were resistant to gentamicin and 27% to chloramphenicol (used in ear drops). We found a 40 % resistance to azithromycin and 50% resistance to clarithromycin in the tested \textit{S. aureus} strains. For cefuroxime, the tests performed by the hospital laboratory, showed 36 percent resistance rate. Only one MRSA in the swabs taken from the ear of a 11 years boy who had no significant history, no previous hospitalization, no previous antibiotic treatment for his external otitis or any known cause of immunosuppression. This boy was referred to a laboratory specialized in infectious diseases in order to benefit of an appropriate antibiotic therapy.

\textit{P. aeruginosa} had a higher sensitivity to the tested antibiotics tested compared to \textit{S. aureus}. All twelve \textit{Pseudomonas} strains proved to be sensitive to ciprofloxacin. A significant degree of resistance was registered to cefuroxime, chloramphenicol, colistin and augmentin, as showed in figure 3.

4. Discussions

Excessive cleaning of the ear canal wax and local trauma are known to decrease local protection and to favor external otitis. The results of this study showed an unexpected high incidence of \textit{S.aureus} isolated from ear patients suffering from external otitis, the most common
organism encountered (31 of 59 cases), followed by *P. aeruginosa* (12 of 59 cases), *E. coli* (4 cases) and *Proteus sp.* (3 cases). Since for this study were chosen only outpatients diagnosed with external otitis by the ENT doctor, who had not recent hospitalization or had been recently treated with antibiotics as ear drops or systemic therapy, the question about the source of contamination is legitimate. Staphylococci are the most abundant skin-colonizing bacteria and one of the most important causes of nosocomial infections and community-associated skin infections (MICHAEL [10]). The nose is the principal site of *S. aureus* colonization (KLUYTMANS & WERTHEIM [11]), but is also found in the pharynx, perineum, axillae and the skin (WERTHEIM & al. [12]). Approximately 50% of the population is non-carriers, 30% carry *S. aureus* transiently while 20% of the population is persistent colonized with *S. aureus* (KLUYTMANS & WERTHEIM [11]). *P. aeruginosa* is a Gram-negative species commonly found in soil and water but also an opportunistic humanpathogen, which could colonize immuno-compromised patients, like those with cystic fibrosis, cancer, or AIDS (BOTZENHARDT & DORING [13]). *P. aeruginosa* has a great capacity to form biofilms, which are complex bacterial communities very hard to destroy that adhere to a variety of surfaces, including metals, plastics, medical implant materials and tissue (BROWN & SMITH [14]). In a study performed on 100 healthy individuals, with normal ear canal, published in 2015, the authors reported *S. aureus* in 24.7% of healthy subjects, *Diphteroids* in 7.5%, *E. coli* in 5.4% and *Pseudomonas* in 3.2% of cases and concluded that some pathogenic bacteria which can cause otitis externa are present as normal commensals in the external ear canal (PRASANNA & al. [8]). Another Norwegian study reported *Staphylococcus aureus* in 7% of cases (DIBB [9]). These data are sustained by the results of this study that proved that in the most of the cases infection is produced by commensal species, normally found in ear canal.

On the other hand, these results are quite different by those found in the literature regarding bacteriological profiles found in external otitis by researchers from other countries. A study of acute otitis externa at Wellington Hospital, 2007–2011, reported that *P. aeruginosa* was the most common organism (46.5%), while *S. aureus* was the second most common (31.9%) (JAYAKAR & al. [15]). Roland et al. studied 2039 subjects with acute otitis externa and reported that the largest percentages of recovered organisms were Gram negative (53%) and 45.3% of all recovered organisms were Gram positive. The most commonly bacterial strains isolated from ear specimens of otitis externa were *P. aeruginosa* (37.7%), *S. epidermidis* (9%) and *S. aureus* (7%) (ROLAND & STROMAN [16]). In 2010 a prospective British study identified *P. aeruginosa* in 45.1% of cases and *S. aureus* in 9% of patients with acute otitis externa referred...
to a large teaching hospital over a six-month period (NINKOVIC[17]). A microbiological study of external otitis in Rosario City, Argentina found *P. aeruginosa* in 18.6% of cases, *Proteus mirabilis* in 10.9% of cases, and *S. aureus* in 10.9% and also three associations of *P. aeruginosa* and *Proteus mirabilis* (1.4%) (AMIGOT & al. [18]). Another observation resulting from this study was the alarming rate of *S. aureus* resistance to usual antibiotics such as ciprofloxacin, cefuroxime, azithromycin, gentamicin or chloramphenicol. This should be an alarm sign that bacteriological profile in external otitis changed and the indiscriminate use of antibiotics by primary care physicians or specialists may generate multiple drug resistance in common pathogens.

5. Conclusions

Otitis externa is considered a trivial pathology and many times receives empiric treatment. The high incidence of *Staphylococcus* and the high rate resistance to antibiotics should be an alarm sign for clinicians and impose routine microbiological sampling and discriminate what antibacterial agents will be used based on antibiotic susceptibility test. Inland data regarding the most common pathogens responsible for external otitis are important in selecting the most appropriate treatment. Thus further studies are necessary to draw conclusions reliable enough to generate recommendations applicable as treatment protocols in otitis externa in Romania.

References