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A B S T R A C T

Water influences skin inflammation of the external auditory canal. The common term for this illness is »swimmer's ear«. Contributory factors are length of exposure to water, type of water and water pollution. The aim of the study was to compare risks for contracting the disease between patients with different exposure to swimming pool water. A retrospective case-control analysis of patients at the ENT-clinic was performed. Swimmers and water polo players swam in a swimming pool chlorinated by an automatic swimming pool cleaning system. Water sport players had a higher risk for ear skin inflammation than football players. Senior football players compared with players younger than 13 were not at increased risk. Swimmers and water polo players older than 13 were at higher risk. Swimmers were at higher risk than football players as well as water polo players. There was no difference for the risk of otitis externa between swimmers and water polo players. Swimmers and water polo players compared with other patients of the ENT-clinic were at higher risk than football players. Frequent and longer exposure to water has been proved to increase the risk of external auditory canal inflammation.

***Key words**: external auditory canal, infection, otitis, pool, swimm, travel, water*

Introduction

External otitis is a very common condition and affects between five to twenty per cent of the patients attending ENT clinics[1]. Infection of the soft tissue of the external auditory canal (»swimmer's ear«) may occur especially in hot, humid climates. The most common triggers are trauma (often self-inflicted with cotton swabs) and exposure to swimming-pool water which has a high concentration of halogens. The most frequently cultured pathogen, Pseudomonas aeruginosa, is not a normal inhabitant of the auditory canal[2]. Other possible pathogens include Staphylococcus epidermidis, gram-negative bacteria, and fungi[3]. Necrotizing (malignant) external otitis, an infection involving the temporal and adjacent bones, is a relatively rare complication of external otitis. It occurs primarily in immunocompromised persons, especially older persons with diabetes mellitus, and is often initiated by self-inflicted or iatrogenic trauma to the external auditory canal[4].

Travellers to tropical or subtropical areas are often exposed to hot climates and warm water in the sea or swimming pools – many comfortable resorts and hotels provide usage of the pool as an integral part of their accommodation. The water may be fresh or seawater in coastal resorts, but must be conditioned to suit hygienic standards. Usually, the water is filtrated and chlorinated and the heated. Chlorination is not quite effective in warm water, and special attention must be paid to the chlorine level and cleanliness of the filters, as well as personal hygiene of users. However, there is evidence on contracting ear disease due to swimming in public swimming pool. There is also the risk of contracting Legionnaires' disease (whirlpools, showers). Another potential risk is the presence of Legionella in hot water pools with activated carbon filters as the site with best growth potential, and a high level of disinfection (at least 1.0 mg free chlorine/litre and pH 7.2) is essential for the prevention of Legionella in pool water at higher temperatures[5].

Besides individual susceptibility and applied hygienic measures, factors which influence their development are length of exposure to water, type of water (salty or fresh)

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and water pollution. Ear skin inflammation can cause discomfort during leisure time, on travel or vacations. Patients with external otitis complain of otalgia and sensitivity to auricular movement. Otorrhea may be present, and obliteration of the external auditory canal by oedema and secretions may cause hearing loss or a sensation of fullness in the ear. The infection may extend to the cartilaginous skeleton of the ear canal and through Santorini's fissures reach the temporal bone, causing osteitis. One of the hallmarks of this extension is granulation tissue in the bone-cartilage junction of the external auditory canal. This otoscopic finding is of extreme importance. Because of significant differences in the natural course and treatment, it is crucial to differentiate severe otitis externa and necrotizing external otitis. Involvement of structures beyond the soft tissues of the auditory canal occurs only in necrotizing external otitis. Osteitis of the skull base usually follows external otitis but may also begin with a middle-ear infection[3].

Numerous pathogenic bacteria are found in water. They can cause several infections, such as conjunctivitis, otitis externa, wound infections, pneumonia, and gastrointestinal illness. However, such infections will probably increase in frequency as more people visit ocean resorts. Prompt elimination of the infective agent, adequate wound care, and avoidance of reexposure can minimize the severity of the condition[6].

The aim of the study was to compare risks for contracting external otitis between groups with different exposure to warm water in swimming: football players *vs.* swimmers and water polo players and other patients treated at the Clinic of Otorhinolaryngology, Head and Neck Surgery, Rijeka University Hospital Center. The results may be applicable as advice to travellers to water resorts (beaches, pools, thermal spas) or tropical areas to take special care with the external auditory skin canal after bathing.

Participants and Methods

The study was a retrospective case-control analysis of athletes treated regarding their inflammatory disease of the skin of the external auditory canal at the Clinic of Otorhinolaryngology, Head and Neck Surgery, Rijeka University Hospital Center and healthy persons from the same sportsmen groups. Two main groups of athletes were studied and compared: swimmers and water polo players and football players. In addition, each group was stratified in accordance with participants younger than 13 vis-a'vis older players at higher risk. Risk assessment of exposure to water during sport activities was based on a regular one-hour per day training. Swimmers and water polo players swam in a swimming pool chlorinated by an automatic swimming pool cleaning system of at least 1.0 mg free chlorine/litre and pH 7.2. Football players did not take part in any activities in swimming pools during the study period. No special precautions, preventive measures or cleaning procedures were performed amongst participants in the study. The external auditory canal was left to dry spontaneously after the patient took his postexercise shower. The water in the swimming pool was controlled weekly on a regular basis by the laboratory at the Institute of Public Health.

The risk of contracting the disease was examined by calculation of the odds-ratio (OR) and statistical significance by calculation of its 95% confidence interval (CI). Data management and statistical analyses were performed by epidemiological statistical software package EpiInfo ver. 6.04d (freeware released by Centres for Disease Control and Prevention, Atlanta, USA).

The research project was approved by the Ethics Committee of the Faculty of Medicine Rijeka, Croatia.

Results

A grand total of 341 athletes were examined. In the tested group 66 affected and 275 unaffected forms of inflammatory ear skin pathology were found.

Water sport players had a twofold statistically significant higher risk for ear skin inflammation than football players (OR=2.51; 95% CI=1.28–5.01). Senior football players compared with players younger than 13 were not at increased risk for external auditory canal skin disease (OR=2.59; 95% CI=0.69–9.82). On the other hand, swimmers and water polo players older than 13 were at higher risk (OR=2.57; 95% CI=1.35–4.87) than their younger colleagues under 13. Swimmers, including water polo players, were at higher risk of the disease than football players (OR=2.74; 95% CI=1.35–5.57) (OR=2.30; 95% CI=1.13–4.70). There was no difference of risk between swimmers and water polo players (OR=1.19; 95% CI=0.64–2.22). Swimmers and water polo players compared with other patients of the ENT-clinic were at higher risk of the disease (OR=14.28; 95% CI=10.32–19.75) than football players (OR=5.68; 95% CI=3.23–9.97). (Table 1)

While the athletes contracted the disease throughout the year, other ENT patients were affected only seasonally, during the summer.

The most common pathogen was Pseudomonas aeruginosa, followed by Staphylococcus spp. Water in the swimming pool was found to conform to sound good hygienic conditions and was unpolluted.

Discussion

Swimmers and water polo players proved to be more susceptible to external auditory canal skin diseases than football players. It is necessary to pay special attention to skin hygiene and reduce exposure as much as possible. Older athletes have longer life-time exposure to water. The water was found without pathogens, but those findings are not 100% accurate because there is always the possibility of transitory contamination between two samplings. The same can be applied to findings of chlorine level. The risk is augmented by the fact that the pool is in public use by citizens. Investigation of the contami-

TABLE 1
FIGURES OF EXAMINES

	Group	Grand total	Without OE	Without OE
Grand total		341	275	66
Football players	Total	125	111	14
	Older than 13	23	20	3
	Younger than 13	102	98	11
	Seniors	23	20	3
	Juniors	25	21	4
	Kadetts	28	24	4
	Older pioneers	20	18	2
	Younger pioneers	29	28	1
Water athletes	Total	216	164	52
	Older than 13	23	13	8
	Younger than 13	193	149	44
Swimmers	Total	105	78	27
	Older than 13	7	5	2
	Younger than 13	98	73	25
	Seniors	7	5	2
	Juniors	13	7	6
	Younger juniors	21	15	6
	Kadetts	38	30	8
	Younger kadetts	26	21	5
Water polo players	Total	111	86	25
	Older than 13	16	10	6
	Younger than 13	95	76	19
	Seniors	16	10	6
	Juniors	17	11	6
	Younger juniors	21	15	6
	Kadetts	25	22	3
	Younger kadetts	32	28	4
Patients ENT clinic		22045	21566	479

nated swimming pools revealed that chlorination was often inadequate, especially when high numbers of people led to overuse of the pools. Although the results of such research showed that otitis externa was strongly associated with the swimming pools due to P. aeruginosa, an extensive follow-up study is needed to determine the other possible health risks associated with public pools[7]. Warm air and water, subjects younger than 18, swimming, and length of time spent swimming correlated with cases of otitis externa. However, water quality, as measured by fecal coliforms, enterococci, and Pseudomonas aeruginosa was not found to be associated with otitis externa[8].

Even when current bathing water standards are met, swimming was found to be associated with a substantial risk of otitis externa because of exposure to P. aeruginosa. People with recurrent ear disease should take special care when swimming in waters containing P. Aeruginosa[9]. A case-control study compared the sites (fresh-water lakes and rivers, chlorinated pools, or the ocean) of recent swimming by 105 patients with otitis externa to 239 controls. Swimming during the week prior to the visit was strongly associated with otitis externa. Otitis externa was also positively associated with swimming in fresh water compared with ocean or pool swimming with the magnitude of this association being more pronounced at higher levels of exposure[10]. A prospective study of 40 cases of acute otitis externa and 99 cases of chronic otitis externa in unselected patients revealed that otitis externa affects males and females with a similar frequency. The peak incidence occurred in the summer and early fall months of the year. The same was noticed in our study. Exposure to water, previous use of ear drops, and cotton-tipped applicators predisposed subjects to both acute and chronic otitis externa[1]. Pathogenic species of Pseudomonas aeruginosa in pools caused a high

incidence of otitis externa, but rarely caused body rashes (pseudomonas folliculitis) unless there had also been prolonged skin wetting. Apart from this contamination, indirect factors such as the tropical climate and intensive exposure to water may play an important role in the aetiology of the external otitis. For individual preventive measures, topical application of paraffin-oil before, and an aqueous solution of alcohol and acetic acid after exposure, are recommended[11].

In many patients with necrotizing external otitis, the initiating event may be self-inflicted or iatrogenic trauma to the ear canal. Therefore, susceptible patients should be instructed to avoid manipulation of the external auditory canal (i.e. they should not use cotton swabs to remove cerumen). Cleaning of the external auditory canal, including aural irrigation by medical staff, should be carried out with extreme caution to avoid injuring delicate skin in the ear canal[12]. Eczematous conditions involving the meatus of the canal should be treated topically, because these conditions may result in pruritus that leads to scratching of the irritated skin[13].

Susceptible patients should be educated to avoid manipulation of the ear canal (i.e. they should not use cotton swabs to clean their ears) and minimize exposure of the ear canal to water with a high chloride concentration. Surface swimming in fresh or ocean water is not contraindicated in children with otitis media or in children with tympanostomy tubes. Hot tub water, bath water, chlorinated water, or water from stagnant ponds may pose a risk for either otitis media or otitis externa[14]. Patients with chronic otitis media with active drainage should avoid swimming, while patients who have undergone mastoidectomy and who have no cavity problems may swim. For children with ventilation tubes, surface swimming is safe in a clean, chlorinated swimming pool. Sudden sensorineural hearing loss and some degree of vertigo may occur after diving because of rupture of the round or oval window membrane[15].

Patients at risk should be referred to an otolaryngologist[4].

Conclusions

It has been proved that frequent and longer exposures to pool water increase the risk of external otitis.

Based on a one-year follow-up study in the ENT health clinic, regarding the influence of water on the pathology of the external auditory canal on different groups of sportsmen (swimmers, water polo players, football players), the following conclusions were reached:

- The younger population is more affected
- It is more common in elderly sportsmen which is connected to longer exposure to water
- It plays an important role in the morbidity of swimmers and water polo players, and represents the most common reason for their inability to practice that sport.
- It is more common in sportsmen as a result of their hygienic habits, and is not season dependent
- In this research is two and a half times more frequent with swimmers and water polo players than with football players
- It occurs seasonally with non-sportsmen: in summer as they only swim during that season
- It is not linked to bacterial indicators of water quality during swimming because the analyzed groups of swimmers and water polo players were exposed to clean fresh pool water without bacterial contamination and low chlorine content.

Intensive exposure of the ear canal skin to water causes in some sportsmen otitis externa. In those cases, careful and reduced exposure to water is necessary while maintaining the competitive ability of the sportsmen.

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UPALA VANJSKOG UHA POVEZANA S VODOM

S A Ž E T A K

Voda utječe na upalu kože zvukovoda. Najčešći je naziv za tu bolest »plivačko uho«. Doprinosni su čimbenici duže izlaganje vodi, vrsta vode i zagađenost vode. Cilj je studije bio usporediti rizik za dobivanje bolesti između pacijenata s različitim izlaganjem bazenskoj vodi. Provedena je retrospektivna case-control analiza pacijenata na Klinici za otorinolaringologiju i kirurgiju glave i vrata. Plivači i vaterpolisti plivali su u bazenu koji je kloriran automatskim sustavom čišćenja bazena. Vodeni športaši imali su veći rizik upale kože zvukovoda od nogometaša. Stariji nogometaši u usporedbi s igračima mlađim od 13 godina nisu imali povećani rizik. Plivači i vaterpolisti stariji od 13 godina imali su veći rizik. Plivači su imali veći rizik od nogometaša isto kao i vaterpolisti. Nije bilo razlike za rizik dobivanja upale kože zvukovoda između plivača i vaterpolista. Plivači i vaterpolisti u usporedbi s pacijentima Klinike za otorinolaringologiju i kirurgiju glave i vrata imali su veći rizik nego nogometaši. Često i duže izlaganje vodi potvrđuje povećani rizik upale kože zvukovoda.