Otitis externa due to Pseudomonas in swimming pool bathers

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SUMMARY. An outbreak of otitis externa was observed to affect one third of 230 swimmers using a new swimming pool within three weeks of its opening. *Pseudomonas aeruginosa* was grown from the water and from all of the nine swabs taken from the infected ears of the swimmers. During the same period only six other cases of otitis externa were seen in the local general practice serving 4,000 patients. The disinfection procedures were found to be defective and after they were corrected the outbreak subsided.

Introduction

CONTAMINATED swimming pool water has been incriminated as causing otitis externa in bathers (Stevenson, 1953), and *Pseudomonas aeruginosa* has been isolated from water which has not been disinfected completely (Black *et al.*, 1970; Hoadley *et al.*, 1975). *Pseudomonas* has also been found more frequently in otitis externa occurring in swimmers than in non-swimmers (Hoadley and Knight, 1975).

I recently had the opportunity to study an isolated outbreak of otitis externa due to *Pseudomonas* among bathers in a newly opened private swimming pool, the use of which is restricted to the inhabitants of a single housing estate. The study was conducted by the local general practitioner who cares for about one third of the people on the estate (nearly 80 patients).

Five days after the swimming pool was first opened for use, severe otitis externa was diagnosed in a patient who had been bathing in the new pool. Within the next ten days 19 further cases were seen, all of whom had been swimming. During the same period only six other cases of otitis externa were seen in the practice, which serves a total population of 4,000.

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The localized nature of the outbreak alerted me to the possibility of a specific causative factor, and a sample of the swimming pool water was sent for culture. *Pseudomonas aeruginosa* was isolated.

The pool was closed after three weeks for thorough cleaning and the disinfection procedures were reviewed. A week after it was reopened a second sample of water was sent for culture and no bacterial growth occurred. Subsequently, three more patients with otitis externa were seen during the following month, all of whom had recurrences.

Method

a) The pool

The pool had a capacity of 110 cu m (about 23,000 gallons) with a high bathing load—230 people during the first week. The water was recirculated through a sand filter. Ten per cent hypochlorite was used for disinfection but in far too small a quantity, apparently following inaccurate instructions from the constructors. The orthotolidine test meter showed there was enough chlorination even though there must have been less than 0·3 mg/l total residual chlorine. This is a recognized problem with test meters and is due to the operator failing to use the meter correctly in order to differentiate free available chlorine from total residual chlorine (Black *et al.*, 1970). When the pool was reopened after cleaning, sufficient disinfectant was used.

b) The patients

Swabs of the secretions in the external auditory meatus were taken from all of those patients who had not started self-medication when first seen.

The swimming pool committee had restricted the use of the pool to the inhabitants of the 64 flats on the estate, so that a closed ecological niche was created, suitable for epidemiological study. A questionnaire was sent to all the flats on the estate asking for the total number of inhabitants of the flat, which of them had used the pool during the first week that it was open, and

which of them had subsequently been treated by a doctor for otitis externa.

Results

Nine bacterial cultures were obtained from the 20 patients in the practice who had bathed in the pool and developed otitis externa. All nine cultures grew *Pseudomonas aeruginosa,* in two cases diptheroids were also grown. Four more cultures were obtained from the six patients with otitis externa who did not live on the estate and had not bathed in the pool. In two cases *Pseudomonas aeruginosa* was grown and in two cases other mixed growths were found.

Replies to the questionnaire were obtained from 61 of the 64 flats on the estate (95 per cent), providing information about 268 people, of whom 230 had bathed in the pool during the first week of operation. Seventy-five people, representing 32·6 per cent of the bathers, had subsequently received treatment from a doctor for otitis externa. The age groups most affected were between five and 15 years, and the under-fives were least affected (Table 1). Every 13 or 14 year old who entered the pool subsequently suffered from otitis externa. Complete data on the sex distribution were not obtained, but only five of the 24 over-18s affected were female, whereas in the other age groups the males and females were affected about equally.

One child was already suffering from otitis externa on the day the pool opened, and she could have been the source of the infection. Another child, who had not bathed in the pool, developed the disease, but her brother, who had bathed, was affected; presumably there had been cross-infection in the home.

Table 1. Age distribution of cases of otitis externa associated with bathing.

Age (years)	Total inhabitants	Bathers	Affected	% of bathers affected
Over 18	130	101	24	*32.6*
15 to 17	18	17	4	*23.5*
10 to 14	32	32	21	*65.6*
5 to 9	41	40	21	*52.5*
Under 5	47	40	5	*12.5*
Total	268	230	75	*32.6*

Discussion

Otitis externa is more frequent in the summer months (Morley, 1938), and is more common in children than in adults (Price, 1976). It has been suggested that it may be caused by swimming in contaminated water (Stevenson, 1953). This outbreak illustrates all three associations clearly.

Although it is not a normal inhabitant of the healthy auditory canal, *Pseudomonas aeruginosa* is frequently isolated from infected outer ears (Hoadley and Knight, 1975) and, although it is found more often in swimmers than in non-swimmers, only occasional cases have been reported in the outer ears of swimmers who have bathed in infected pool water (Hoadley *et al.*, 1975).

This outbreak was characterized by a high morbidity, with one third of all swimmers contracting otitis externa in three weeks, compared with six of 82 swimmers reporting earaches during the swimming season in a previous study (Hoadley *et al.*, 1975). Furthermore, *Pseudomonas aeruginosa* was isolated in each of the nine swabs cultured, whereas the organism was isolated in only 77·6 per cent of swimmers with otitis externa in a previous study of swabs taken during a four-year period (Hoadley and Knight, 1975).

The intensity of exposure to the causative agent seems to have been an important factor in the extent of the outbreak. The opening of a new private swimming pool attracted so many of those entitled to use it during the first few weeks that *Pseudomonas,* once introduced into the small pool, was able to spread rapidly through the population. The least susceptible among the users of the pool were children under the age of five and adult females. This suggests perhaps that in these two groups the pool water was less likely to come into contact with the external auditory canal for long periods, since both make determined efforts to keep their heads out of water.

Pseudomonas aeruginosa is not readily killed by chlorine and can often be isolated from insufficiently disinfected pool water containing less than 0·3 mg/l of total residual chlorine (Black *et al.*, 1970). Thus, the misunderstanding of the instructions about the correct amount of disinfectant required allowed the bacteria to grow in the pool water in such numbers that it was possible to isolate *Pseudomonas aeruginosa* in less than 100 ml of the water. This degree of contamination warrants closure of a pool until adequate chlorination is maintained (Favero *et al.*, 1964).

These results extend previous studies of the association of *Pseudomonas aeruginosa* contamination of swimming pool waters and otitis externa, and strengthens the case for the use of *Pseudomonas* as an indicator of swimming pool pollution (Hoadley and Knight, 1975; Favero *et al.*, 1964).

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