ACUTE OTITIS EXTERNA BY WATERBORNE PSEUDOMONAS AERUGINOSA

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HISTORICAL REVIEW

• First described by Mayer in 1844

• Until World War II it was thought to be fungal infection

• During World War II due to a high incidence among troops in the South Pacific the bacterial etiology of the disease was established.

DEFINITION

• Acute otitis externa (AOE), a quite common infection of the external auditory canal in children and adults, is associated very often with bathing (swimming-entertainment-sports) in swimming pools, especially during summer months (swimmer’s ear).

• The most common microorganism that is responsible for these infections is P. aeruginosa.
• 53% Gram-negative

• 47% Gram-positive

• 71.33% of Gram-negative bacteria are Pseudomonas aeruginosa (most common opportunistic pathogen in connection to pool and spa environment. It grows at low nutrient levels and stands the stress of chlorine, especially the mucoid strains)

• 70% of AOE linked to swimming in swimming pools are linked to Pseudomonas aeruginosa

*Roland PS, Stroman DW. Microbiology of acute otitis externa. Laryngoscope 2002;112:1166-1177*
RISK FACTORS

• Who is at risk for an infection remains poorly identified

• The infectious dose causing AOE remains deficient and contradictory

• There are uncertainties that need consideration
I. PHYSICAL CONDITION, AGE, GENETIC PREDISPOSITION OF SWIMMERS

• immune system (diabetes, pregnancy, age)

• age <18 years (longer exposure to water and diving)

• P. aeruginosa cultured in 45% of adults and 54% of children with AOE

• Blood group type A

II. ANATOMY OF EXTERNAL EAR, TRAUMA, WAX

• anatomy of external acoustic meatus may help the penetration of the microorganism (volume and surface area of the adult are about 1ml and 6cm² respectively)
• retention of water in external acoustic meatus helps the infection
• normal flora provides protection (helps to repulse dangerous pathogen)
• trauma, psoriasis, eczema, use of hearing aids, history of external otitis and exostosis helps infection
• role of wax is controversial

III. SEASONAL DISTRIBUTION

• During summer AOE is more common because:
  a. heat evaporates disinfectants
  b. pools used by more people
  c. more hair, sweat, saliva, urine (support bacterial growth)

• 80.5% of the cases occurred during summer months while only 19.5% occurred during the rest of the year

IV. WATER QUALITY

Traditional water quality monitoring of swimming pools based on viable cell counting has many limitations (WHO 2006)

1. Small sample sizes

2. Biofilms may not be detected until large number of free-living cells are shed into the planctonic phase

3. Many bacteria respond to various environmental stresses by entry into novel physiological state where the cells remain viable, but are no longer culturable on standard laboratory media (VBNC)
## MICROBIOLOGICAL QUALITY OF WATER

### Contamination factors

<table>
<thead>
<tr>
<th></th>
<th>Human origin</th>
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<tbody>
<tr>
<td>A</td>
<td>Faecal origin</td>
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<tr>
<td></td>
<td>1) Faecal origin</td>
</tr>
<tr>
<td></td>
<td>2) Non faecal origin (mucus-saliva-skin-vomit)</td>
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<tr>
<td>B</td>
<td>Contamination from animals (birds-mice) in outdoor pools.</td>
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<tr>
<td>C</td>
<td>Contaminated objects: towels, toys etc</td>
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<tr>
<td>D</td>
<td>Tap water used to fill pool has an incidence of P. aeruginosa of 2-3%</td>
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<tr>
<td>E</td>
<td>Biofilms that can be found on all surfaces including filters and showers</td>
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INFECTIOUS DOSE

• Infectious dose of exogenous P. aeruginosa in waterborne AOE is of concern when there are more than 50 colonies per 100 ml of water, depending on water retention and colonization rate.

• small dose compared to folliculitis, G.I.tract infection and lung infection

• multiple factors play role

V. ECOLOGICAL INTERVENTIONS

The journey of P. aeruginosa in the pool water

• P. aeruginosa travels in pool water with a speed of 2-4mm/min in order to reach the ear canal

• It moves due to Brown’s forces, turbulence and its flagella

• Approaching the target it tries to adhere. Adherence is a virulence factor involving surface attachment factors that are mediated by stickiness factors.

• Attachment also depends on the strain of P. aeruginosa and the production of genes (elastase)


ONSET OF AOE FROM P. aeruginosa in pool water.
CONCLUSION

• AOE common infection during summer

• Most common microorganism is P. aeruginosa

• Infectious dose needs to be determined

• Many factors play role in the infection

There is a need to understand the ecology and epidemiology of P. aeruginosa in the treated pool environment in order to improve bather safety.
Van Gogh’s Ear swimming pool, Fifth Avenue, NYC

THANK YOU