Comunicación Corta - Short Report

Antimicrobial Susceptibility of Bacterial Strains Isolated from Recreational Swimming Pools in Two Provinces of North-Central Venezuela*

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Abstract
Previous studies support the hypothesis that there is a direct correlation between the development of external otitis and other infectious disease, and swimming in water contaminated with some bacterial strains. For this reason periodic evaluations of bacteriological quality of water as well antimicrobial susceptibility patterns of possible isolated organisms, are necessary. We evaluated two provinces of Venezuela, Aragua and Carabobo. In these regions we investigated bacterial contamination in swimming pools and their antimicrobial susceptibility patterns. Setting: Sixty recreational swimming pools of Maracay (Aragua) and Valencia (Carabobo). Study population: Samples from pools corresponded 75% from Valencia and 25% from Maracay. Methodology: Pool water samples were taken according published recommendations, after that samples were processed and bacterial strains identified with standard cultures and biochemical tests. In vitro antimicrobial susceptibility of the isolates was assessed by an agar disk diffusion method using Mueller-Hinton agar as recommended by the National Committee for Clinical Laboratory Standards (NCCLS). Isolates were tested against 14 drugs, including: piperacillin, ceftazidime, cefoperazone, amikacin, gentamicin, ciprofloxacin, meropenem and imipenem, among others. Results: In both regions, 19/60 pools (32%) were bacterial contaminated; 13/15 from Maracay (87%) and 6/45 from Valencia (13%) ($p<0.05$). Pathogens isolated were: *Pseudomonas aeruginosa* (13 strains) (68%), *Streptococcus sp.* (12 strains) (63%) and *Staphylococcus sp.* (10 strains) (53%). From total isolated strains (35), only 6 (17.1%) strains were found resistant at least to one antimicrobial. P. aeruginosa showed resistance only against moxifloxacin (1/13, 7.7%). *Streptococcus sp.* was susceptible to all tested drugs. Five *Staphylococcus sp.* strains were resistant at least to one drug (50.0%); 30% to chloramphenicol, 20% to erythromycin, 10% to TMP-SMX, 10% to methicillin and 10% to clindamycin. Conclusions: As illnesses normally contracted in a swimming pool are mostly those of the skin rather than intestinal, it is suggested that the best indicators of the hygienic condition of water in a swimming pool are staphylococci because of their resistance to disinfection, high numbers in the environment, and ease of recovery. But also, poor-quality water in swimming pools is associated with a substantial risk of external otitis due to *Pseudomonas aeruginosa*. An extensive follow-up study is needed to determine the other possible health risks associated with public pools, including acquire an infection with an antimicrobial resistant bacterial strain.
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Introduction

Diseases associated with recreational water occur when swimming in contaminated water venues. Several diseases in humans can occur after exposure to contaminated water including diarrhoeal syndromes, otitis, dermatitis, etc. Contributing factors in swimming-pool outbreaks are multiple including inadequate attention to maintenance, operation, disinfection, and filtration. The presence of bacteria in these settings is influenced mainly by chlorine

resistance of waterborne pathogens, poor facility maintenance of disinfectant levels, and lack of healthy swimming habits among others. Health care providers have an important mission to provide a strong message to their patients about swimming in clean and safe water pool environments in order to help preventing and controlling this emerging public health problem [1,2].

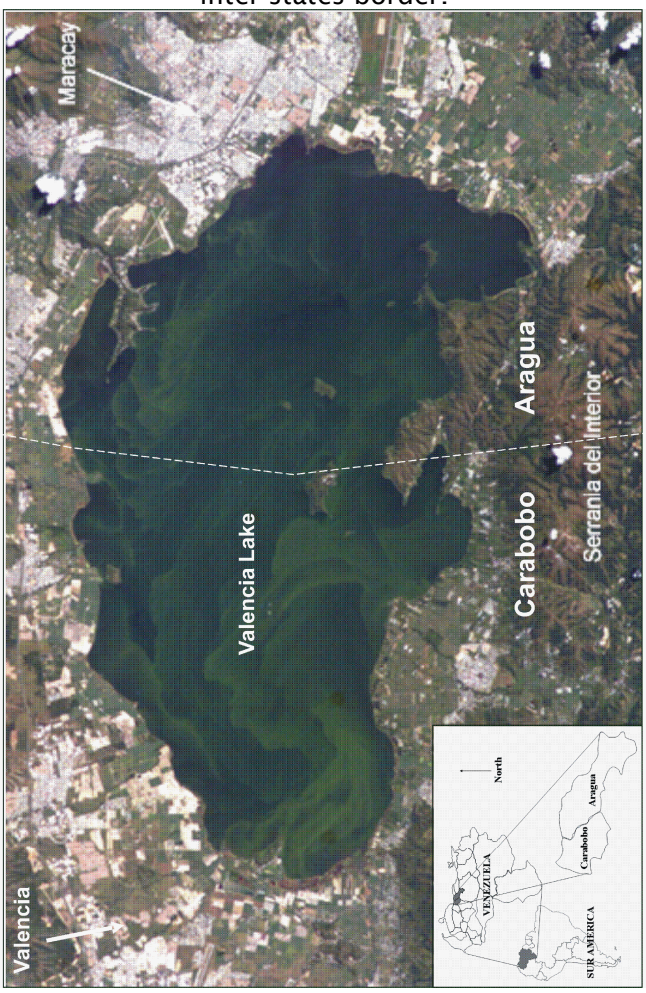
Previous studies support the hypothesis that there is a direct correlation between the development of external otitis and other infectious disease, and swimming in water contaminated with some bacterial strains. For this reason periodic evaluations of bacteriological quality of water as well antimicrobial susceptibility patterns of possible isolated organisms, are necessary [1,2].

We describe the bacterial contamination of swimming pools in central Venezuela, and to study their antimicrobial susceptibility to common clinical antimicrobial drugs used in clinical practice. The objective herein was to investigate the bacterial contamination of swimming pools and antimicrobial susceptibility among isolated species.

Materials and Methods

We evaluated two provinces of Venezuela, Aragua and Carabobo (Fig. 1). In these regions we investigated bacterial contamination in swimming pools in public recreational parks and private gyms & spas. From bacteria isolated from samples, we performed antimicrobial susceptibility patterns as well. The study setting was sixty recreational swimming pools of Maracay (Aragua) (25% from this location) and Valencia (Carabobo) (75% from this location) (Fig. 1). Pool water samples were taken according to published international recommendations. Samples were then processed and bacterial strains identified on standard media cultures and biochemical tests. In vitro antimicrobial susceptibility of the isolates was assessed by an agar disk diffusion method using Müeller-Hinton agar as recommended by the Clinical Laboratory Standards Institute (CLSI). Isolates were tested against 16 drugs, including: piperacillin, methicillin, ceftazidime, cefoperazone, amikacin, gentamicin, ciprofloxacin, moxifloxacin, erythromycin, clindamycin, chloramphenicol, TMP-SMX, meropenem, imipenem, teicoplanin and vancomycin.

Figure 1. Relative position of Venezuela and the states of the study with a satellite image of Carabobo and Aragua, showing the cities of Valencia and Maracay (where swimming pool samples were taken), as well Valencia Lake and inter-states border.

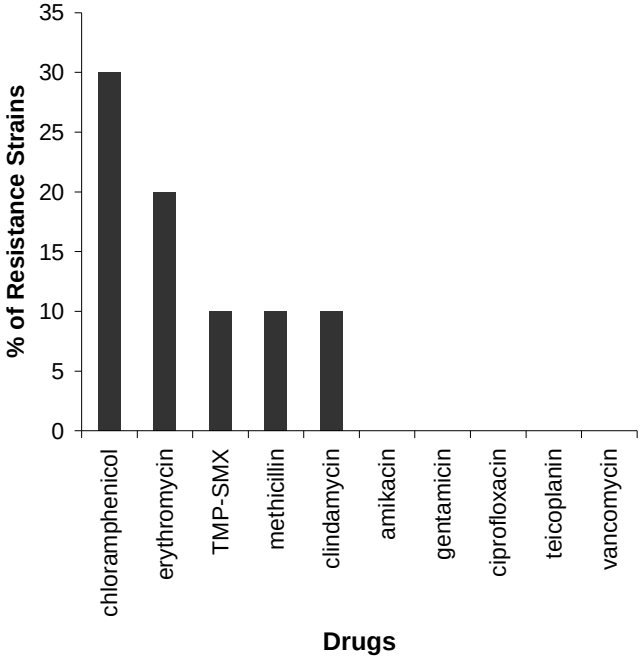


Results

In both regions, 19/60 pools (32%) were contaminated by bacteria; 13/15 from Maracay (87%) and 6/45 from Valencia (13%) (p<0.05). The isolated pathogens were: *Pseudomonas aeruginosa* (13 strains) (68%), *Streptococcus pyogenes* (12 strains) (63%), and *Staphylococcus aureus* (10 strains) (53%). In about half of pools there were more than

one pathogen species isolated. From a total of 35 isolated strains, only 6 (17.1%) strains were found resistant at least to one antimicrobial. One strain of *P. aeruginosa* showed resistance only against moxifloxacin (1/13, 7.7%). Five strains of *Staphylococcus aureus* were resistant to Methicillin (MRSA) (5/10, 50.0%). No resistance for teicoplanin and vancomycin was found in the *Staphylococcus aureus* isolates. *Streptococcus pyogenes* was susceptible to all tested drugs (Fig. 2).

Figure 2. Antimicrobial resistance of *Staphylococcus aureus* strains isolated from contaminated swimming pools.



Discussion

Recreational water contamination is a growing problem worldwide [3]. As illnesses normally contracted in a swimming pool are mostly those of the skin rather than intestinal, it is suggested that the best indicators of the hygienic condition of water in a swimming pool are staphylococci because of their resistance to disinfection, high numbers in the environment, and ease of recovery [1].

But also, poor-quality water in swimming pools is associated with a substantial risk of otitis externa due to *Pseudomonas aeruginosa* specially in immunosuppressed patients such as diabetics [4].

An extensive follow-up study is needed to determine the other possible health risks associated with public pools, including acquire an infection with an antimicrobial resistant bacterial strain, especially when we know the profile of resistant clinical strains of *Pseudomonas, Staphylococcus* and *Streptococcus* in Venezuela [5-10].

Surveillance is needed especially because we could isolate uncommon pathogens, which could be resistant and cause clinical complications (diarrhea, pneumonia, otitis, meningitis) after the exposure (eg. water ingestion), even leading to sepsis (and death in some cases) by emerging bacterial strains, such as *Aeromonas hydrophila* [11], among others.

References

1. Castor ML, Beach MJ. Reducing illness transmission from disinfected recreational water venues: swimming, diarrhea and the emergence of a new public health concern. Pediatr Infect Dis J 2004; 23 (9): 866-870.
2. Craun GF, Calderon RL, Craun MF. Outbreaks associated with recreational water in the United States. Int J Environ Health Res. 2005; 15(4):243-62.
3. Smith A, Reacher M, Smerdon W, Adak GK, Nichols G, Chalmers RM. Outbreaks of waterborne infectious intestinal disease in England and Wales, 1992-2003. Epidemiol Infect. 2006;134(6):1141-9.
4. Rubin Grandis J, Branstetter BF, Yu VL. The changing face of malignant (necrotising) external otitis: clinical, radiological, and anatomical correlations. Lancet Infect Dis. 2004;4(1):34-9
5. Rodriguez AJ, Rodriguez CN, Meijomil P, Garcia A, Duque C, Molina N, Lakatos M. A 10 year study of resistance of Staphylococcus aureus to selected antimicrobials in three Venezuelan centres. Int J Antimicrob Agents 2000; 16 (3): 253.
6. Rodríguez AJ, Samaniego DR, Soskin A, Rodríguez CN, Canese J, Ortellado de Canese J, Molina N, García A, Duque C, Meijomil P, Arena F. Comparative study of antimicrobial resistance of Pseudomonas aeruginosa strains isolated from patients of Caracas and Asunción in a 4-year-period. Chemotherapy 2002; 48 (4): 164-167.
7. Rodríguez CN, Rodríguez AJ, Niño RA, Meijomil P, Molina N, García A, Duque C. Comparative study of antimicrobial resistance of Pseudomonas aeruginosa strains isolated from urinary tract infection in patients from Caracas and Lima. Int J Antimicrob Agents 2002; 20 (6): 476-477.
8. Rodriguez-Morales AJ, Rodriguez CN, Garcia A, Jimenez I, Pastran B, Meijomil P. Surveillance

analysis of decreasing susceptibility of Staphylococcus aureus to vancomycin using a mathematical model. Int J Antimicrob Agents. 2007;29(5):607-9.
9. Rodríguez-Morales AJ, Rodríguez CN, Garcia A, Pastran B, Jiménez I, Meijomil P. Antimicrobial resistance of Pseudomonas aeruginosa in pediatric infections. Int J Infect Dis 2007;11(1):84-5.
10. Rodriguez CN, Rodriguez-Morales AJ, Garcia A, Pastran B, Meijomil P. Antimicrobial resistance of Pseudomonas aeruginosa strains isolated from surgical infections in a 7-year period at a general hospital in Venezuela. Surg Infect (Larchmt). 2006;7(3):269-73.
11. Rodríguez CN, Campos R, Pastran B, Jimenez I, Garcia A, Meijomil P, Rodríguez-Morales AJ. Sepsis due to ESβL producing Aeromonas hydrophila in a Pediatric Patient with Diarrhea and Pneumonia. Clinical Infectious Diseases 2005; 41 (3): 421-422.

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