Journal of Hospital Infection (1996) **32,** 51–55

Holy water—a risk factor for hospital-acquired infection

J. C. Rees and K. D. Allen

Department of Microbiology, Whiston Hospital, Prescot, Merseyside, L35 5DR, UK

Received 10 May 1995; revised manuscript accepted for publication 21 August 1995

Summary: A case of hospital-acquired infection due to *Acinetobacter baumanii* in a burns patient after exposure to holy water is described. In order to assess the infection risk, 13 samples of holy water were cultured for bacteria, (including legionellae) and yeasts. Viable bacterial counts ranged from $1{\cdot}3 \times 10^3$–$3{\cdot}8 \times 10^8$ cfu/L (mean $3{\cdot}1 \times 10^7$ cfu/L). A wide range of bacterial species was isolated including *Pseudomonas aeruginosa*, *Enterobacter* spp. *Escherichia coli* and *Aeromonas hydrophila*. *Candida* spp. were isolated from two samples, but legionellae from none. Holy water would, therefore, seem to be a potential risk factor for hospital-acquired infection.

Keywords: Holy water; nosocomial infection.

Introduction

Water obtained from the Christian shrines at Lourdes, Walsingham, and other sites across the world is frequently used by hospitalized patients. Holy water is often administered by topical sprinkling but may also be ingested, instilled into the eye or used to bathe affected parts of the body. In view of its widespread use it is perhaps surprising that there has only been one documented instance of infection contracted from holy water.[1] We report a further case and the result of microbiological study of 13 samples of holy water.

Case report

In May 1994, a 53-year-old man was admitted to the Regional Burns Unit with 80% full-thickness burns caused by drilling through an electrical cable. On arrival he was resuscitated, intubated, and transferred to the intensive-care unit for ventilation. On his fourteenth day he developed pneumonia and clinically infected burns. Swabs of the burned areas of arms, buttock and back, together with a tracheal aspirate yielded *A. baumanii* susceptible only to amikacin, gentamicin and imipenem.

Correspondence to: Dr J. C. Rees.

0195–6701/96/010051+05 $12.00/0

Nurses on the unit reported that in the days prior to his deterioration members of his family had repeatedly sprinkled him with holy water. A sample of the water was obtained and yielded 10^8 cfu/L of *A. baumanii*, with an API profile and antibiogram identical to the clinical isolates. The patient responded to therapy with intravenous imipenem.

It was uncertain whether the water was the source of the patient's infection or became contaminated as a result of its use. In view of this and the previously documented case of infection caused by holy water,[1] a microbiological study of samples of holy water was performed.

Materials and methods

Thirteen samples of holy water were obtained (nine from Lourdes, two from Walsingham and two from the River Jordan) and stored in either their original container or sterile Universal Containers at 4°C until cultured.

Counts of the total viable populations of bacteria were obtained by plating 0·01 mL, 0·1 mL and 1·0 mL samples of holy water on blood agar (Oxoid Columbia agar base with 5% horse blood) and then spreading the sample evenly over the agar surface with a sterile loop. The inoculated plates were incubated at 37°C for 72 h. Total yeast counts were determined by plating 0·01 mL, 0·1 mL and 1·0 mL samples of holy water onto Malt agar (Oxoid), spreading evenly with a sterile loop and incubating at 37°C for 72 h.

All bacterial isolates were identified to species level using API 20E, API 20NE, API Staph, API Strep, API CHB and API Coryne systems (Bio-Merieux, France). Yeast isolates were identified using the API 20 C Aux system (Bio-Merieux, France).

The total viable count of legionellae was determined using a standard method.[2]

Results

Total viable counts of bacteria ranged from 10^3–$3{\cdot}8 \times 10^8$ cfu/L (mean $3{\cdot}1 \times 10^7$ cfu/L). A wide range of organisms was isolated (Table I), but yeasts were isolated from only two samples (Table II). Legionellae were not isolated from any of the samples.

Discussion

Water is well recognized as both a reservoir and mode of transmission of infectious disease. More recently, it is being increasingly perceived as a nosocomial infection hazard, both as a source of organisms[3] and a vehicle for their transmission;[4] in addition unusual organisms may be involved.[5]

The bacteria and fungi isolated from the holy water specimens cover a broad spectrum of pathogenicity. The majority of organisms isolated from the water samples were Gram-negative bacilli, and 10 out of the 13 samples

Table I. *Bacteria isolated from holy water*

Specimen	Total viable count (cfu/L)	Gram-positive organisms	Gram-negative organisms
1	$1{\cdot}3 \times 10^8$	*Micrococcus* sp.	*Pseudomonas aeruginosa*
2	$1{\cdot}0 \times 10^3$	*Staphylococcus hominis*	—
3	$3{\cdot}8 \times 10^8$	—	*Aeromonas hydrophila* *Enterobacter cloacae* *Enterobacter sakazakii* *Pseudomonas putida*
4	$3{\cdot}1 \times 10^4$	*Bacillus stearothermophilus*	*Stenotrophomonas maltophilia*
5	6×10^3	*Corynebacterium aquaticum*	*Pseudomonas fluorescens* *Pseudomonas diminuta*
6	1×10^4	*Staphylococcus chromogenes* *Staphylococcus haemolyticus*	—
7	$1{\cdot}4 \times 10^7$	—	*Escherichia coli* *Stenotrophomonas maltophilia* *Pseudomonas vesicularis*
8	$3{\cdot}1 \times 10^5$	—	*P. aeruginosa* *Sphingomonas paucimobilis* *Oligella urethralis*
9	$1{\cdot}0 \times 10^5$	*C. aquaticum* *S. haemolyticus*	—
10	$4{\cdot}9 \times 10^6$	*C. aquaticum*	*P. fluorescens*
11	$1{\cdot}4 \times 10^6$	*S. haemolyticus* *C. aquaticum* *Aerococcus viridans*	*Acinetobacter baumanii*
12	$3{\cdot}8 \times 10^6$	*C. aquaticum*	*Alcaligenes xylosoxidans* subsp. *xylosoxidans* *Moraxella osloensis*
13	$1{\cdot}0 \times 10^5$	*Bacillus cereus* *Bacillus brevis*	*A. baumanii* *Alcaligenes xylosoxidans* subsp. *xylosoxidans* *Ochrobactrum anthropi* *Flavobacterium indologenes*

Table II. *Fungi isolated from holy water*

Specimen	Total viable count (cfu/L)	Organism
1	1.3×10^5	*Candida parapsilosis* *Candida famata* *Candida humicola*
5	$6{\cdot}0 \times 10^3$	*Candida glabrata*

were heavily contaminated. Important causes of hospital-acquired infections were found, including *P. aeruginosa*, *E. coli* and *Enterobacter* spp.[6] *P. aeruginosa* infection can be a serious complication in burns patients, and the organism has caused outbreaks of hospital-acquired infection by water-borne spread.[7] *A. hydrophila*, which was isolated from one of the water

samples, is an important enteric pathogen but is also a cause of serious infection associated with water exposure.[8]

A. baumanii was isolated from two samples in addition to that from the original case; it has caused several recent outbreaks and is notable for multiple antibiotic resistance.[9] It can survive dessication for prolonged periods, and can be disseminated by airborne spread[10] leading to substantial infection control problems. *Stenotrophomonas maltophilia*, *Sphingomonas paucimobilis* and *Alcaligenes* spp. are all important nosocomial pathogens and have all been described as causes of infection in association with water exposure.[11–13] The Gram-positive organisms isolated were of relatively low pathogenic potential, many of them being regarded as skin commensals. Coagulase-negative staphylococci continue to increase in importance as nosocomial pathogens, particularly in patients in intensive care, and those with impaired host defences. *Bacillus* spp. are important ocular pathogens;[14] holy water is often instilled into the eye to treat conjunctivitis.

Although the water samples were obtained from only three sources, a very wide range of organisms was isolated, with different samples from the same source sometimes having a completely different bacterial flora. This is probably due to the collection and storage of the samples. Pilgrims' own containers are used to collect the water, and are dipped either into the source itself or a reservoir such as an urn containing the water. Thus, many of the organisms isolated may in fact have been introduced by the collector; this particularly applies to those organisms considered skin flora and not usually associated with aqueous environments.

In summary, many of the organisms isolated from holy water have the capacity to cause hospital-acquired infection especially when applied in large numbers to open wounds, intravenous-line sites and eyes. Although such organisms have been described as causing disease in compromised patients only, this is precisely the group on whom holy water is used. In addition the unusual nature of many of the organisms and their unpredictable antibiotic susceptibility may lead to delay in diagnosis and treatment. The risks of infection must be weighed against that of offending the religious sensibilities of patients and their families. It is suggested that the use of holy water should be avoided particularly in the immunocompromised, and patients with severe burns, trauma, post-operative wounds or intravenous lines. Direct application to eyes should also be discouraged. The microbiologist should consider the more unusual microorganisms as a cause of infection when holy water has been applied.

We would like to thank all the staff and patients at the hospital who donated samples of holy water for this study.

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