

## Contaminated medicaments in use in a hospital for diseases of the skin

By ROSAMUND M. BAIRD, Z. A. AWAD, R. A. SHOOTER

*Departments of Medical Microbiology and Pharmacy, St Bartholomew's Hospital, West Smithfield, London, EC1A 7BE*

AND W. C. NOBLE

*Department of Bacteriology, St John's Hospital for Diseases of the Skin, Homerton Grove, London E9 6BX*

(Received 28 May 1979)

### SUMMARY

Topical medicaments used by patients with diseases of the skin were examined for microbial contamination. *Ps. aeruginosa* was isolated from stock pots of a diluted emulsifying ointment used as a soap substitute in the bath. Cross-contamination between patients and medicament was subsequently shown to have occurred.

### INTRODUCTION

Pharmaceutical products used for topical application in hospital are prone to contamination by *Pseudomonas aeruginosa* and *Staphylococcus aureus* (Noble & Savin, 1966; Baird *et al.* 1979). Inadvertent use of such products by several patients may be associated with the development of cross-infection. Certain groups of patients, such as those with broken skin or bedsores, seem to be more at risk of infection from using these products than others. In the present study we report the results of an examination of contaminated medicaments used by patients with diseases of the skin.

### METHODS AND MATERIALS

#### *Examination of patients*

Patients in the male and female wards of St John's Hospital for Diseases of the Skin were examined for *Ps. aeruginosa* 2–3 h after having taken a bath. Swabs were taken from the ear, hand, axilla, umbilicus, groin, perineum and toewebs. Moistened swabs were incubated aerobically overnight at 37 °C in nutrient broth and then sub-cultured on cetrimide agar.

#### *Examination of medicaments*

Samples of 1 g were homogenized in 20 ml of nutrient broth containing 4% Lubrol W using a Stomacher 80 Blender (Colworth). Broths were incubated over-

night at 37 °C and then subcultured on cetrinide agar (0.03%) and mannitol salt agar. Colony counts were carried out in duplicate on those medicaments from which *Ps. aeruginosa* and *Staph. aureus* were isolated.

#### *Examination of environment*

Baths and sinks were examined for *Ps. aeruginosa*. Swabs were incubated overnight aerobically at 37 °C in nutrient broth and then subcultured on cetrinide agar.

#### *Identification and typing of Ps. aeruginosa and Staph. aureus*

*Ps. aeruginosa* was identified by pyocyanin production or by biochemical methods, as described previously (Shooter *et al.* 1969). Strains were typed at the Central Public Health Laboratory, Colindale, using a combination of serological and bacteriophage typing techniques. *Staph. aureus* was identified as a coagulase positive, gram-positive coccus.

### RESULTS

One hundred and ninety-two topical products, comprising 132 steroid ointments and a few creams, five antibiotic preparations and 55 other medicaments, were examined for contamination in the two wards. Of these, 139 products had been made in the hospital pharmacy and packed in multi-dose plastic disposable pots. The remainder were proprietary products packed in tubes. Routine microbiological quality controls of products was not carried out by the pharmacy, thus all samples were of unknown microbial content when issued to the wards.

Products packed in stock pots were more frequently found to be contaminated (10 out of 123) than those packed in tubes (1 out of 53). Similar results were seen in the male and female wards. Of 95 samples examined in the male ward, two were found to be contaminated with *Ps. aeruginosa* (sulphur cream and cetomacrogol cream) and three with *Staph. aureus* (cetomacrogol cream, hydrocortisone ointment and vaseline). Of 97 samples in the female ward, *Ps. aeruginosa* was isolated from two products (aqueous cream and calamine lotion) and *Staph. aureus* was isolated from six products (four samples of hydrocortisone cream, a steroid cream and vaseline). With the exception of two products, unopened containers of the above medicaments were examined retrospectively and found to be free of contamination, indicating that contamination had occurred during use, rather than in preparation.

During a second examination of topical medicaments in these wards, *Ps. aeruginosa* was isolated from a large number of samples of emulsifying ointment. This ointment was issued in large plastic disposable pots and was used mainly by eczematous patients as a soap substitute in the bath. Investigations revealed that, in order to facilitate handling of the products, the nursing staff diluted the ointment with hot tap water in the treatment room on the day before it was required for use. A fresh supply for use on several patients was prepared daily in a large metal container; this container was rinsed out between preparations with tap water. Emulsifying ointment in an undiluted form was used by patients with photosensitive eczema for face and hand washing only. Table 1 shows the

Table 1. Isolation of *Ps. aeruginosa* from diluted emulsifying ointment

	No. examined	No. contaminated
Female ward	21	16
Male ward	20	14
Total (%)	41	30 (73%)

Table 2. Comparison of strains isolated from patients, medicaments and environment

Strain	No. patients	No. medicaments	No. environmental sites
A	1	5	2 } Female 1 } ward 2 }
B	1	—	
C	—	1	
A	1	—	1 } Male — } ward 1 }
I	1	1	
L	2	4	

number of partly used samples contaminated with *Ps. aeruginosa* in each ward. Bacterial counts ranged between  $10^4$  and  $10^7$  organisms/gram. *Pseudomonas* spp., *Proteus* spp., and *Staph. aureus* were also isolated from some of the samples. Examination of unopened samples of emulsifying ointment from the pharmacy showed no detectable microbial contamination.

In view of the widespread use of the emulsifying ointment in both wards, patients and environmental sites were examined for *Ps. aeruginosa*. This was isolated from sinks and a nail brush in the treatment room and from the baths which the patients used. It was not isolated from the water supply. *Ps. aeruginosa* was isolated from a number of skin sites of patients who had used the emulsifying ointment in the bath; it was not isolated from those patients who had used conventional bar soap. Table 2 shows that a number of common strains were isolated from medicaments, patients and the environment, including one strain that was found in both wards.

Since the results indicated that cross-contamination was occurring between medicament and patients, a more detailed examination of skin sites of patients in the male ward was made over a period of 10 days. Of the 16 patients examined, *Ps. aeruginosa* was isolated at least once from nine patients. Table 3 shows that three strains were found to be common to patients and medicaments. Of particular interest, strain A, previously found in the treatment room sinks, a bath, and in freshly diluted emulsifying ointment, was isolated on a number of occasions from these patients. A similar study carried out in the female ward on ten patients over a period of 16 days showed that although *Ps. aeruginosa* was isolated from supplies of emulsifying ointment (five out of eight containers) it was isolated less frequently from the patients and on two occasions only were the strains similar to medicament strains. These differences may be explained by the fact that men are more heavily colonized with all organisms than are women, men also sweat more, which may result in a micro-climate more suited to microbial survival (Noble, 1975; Singh, 1974).

Table 3. *Common strains of Pseudomonas aeruginosa isolated from emulsifying ointment and male patients*

	Day 1	Day 3	Day 8	Day 9	Day 10
Ointment	A	—	AM	K	K
Patient 1	K	K	—	—	—
2	A	A	A	A	—
3	A	—	—	—	—
4	—	—	—	K	—
5	K	—	—	—	—
6	A	A	A	A	A
7	AM	—	AM	M	K
8	—	—	—	K	K
9	—	—	+	+	+

+ Other strains.

## DISCUSSION

Patients with diseases of the skin are known to have an altered composition of skin flora compared with the normal adult. Skin carriage rates for *Staph. aureus* and *Strep. pyogenes* have been shown to be higher in patients with eczema, psoriasis and pityriasis rosea (Noble, 1975). Gram-negative bacteria, which do not normally survive on the skin for longer than a few hours (Noble & Savin, 1966; McBride, Duncan & Knox, 1975), are also isolated more frequently from these patients. In one study of patients with eczema and psoriasis, gram-negative rods were isolated from the skin of 9% and 5% of patients respectively, and *Ps. aeruginosa* was the most common contaminant (Noble & Somerville, 1974). Several factors are known to increase the survival times of *Ps. aeruginosa* on the skin, including skin damage (Singh, 1974) and occlusion (Savin, 1967), the presence of a high humidity atmosphere (Hoffman & Finberg, 1955) and the suppression of gram-positive bacteria by certain therapeutic agents (Forkner, 1960; Yow, 1952). In the present study, skin damage and the use of steroid and antibiotic preparations may have influenced the recovery of *Ps. aeruginosa* from the skin of these patients.

Topical medicaments are prone to contamination during use. In a previous study of geriatric patients, it was found that 20–25% of medicaments became contaminated during use with *Ps. aeruginosa* and 20–50% with *Staph. aureus* (Baird *et al.* 1979). Topical medicaments used by skin patients might be expected to be equally heavily contaminated but interestingly, medicaments initially examined in this study had a low rate of contamination (5% with *Ps. aeruginosa* and 2% with *Staph. aureus*). This difference may well be explained by the use of a non-touch technique for the application of topical medicaments in this hospital.

In contrast, examination of the emulsifying ointment showed that many samples were contaminated with *Ps. aeruginosa*. At least some of these samples were contaminated before use by the dilution of the ointment with tap water (which may have been an intermittent source of this organism) in an area adjacent to the sinks. Inadequate cleaning of the container used for this purpose may have resulted in fresh diluted supplies becoming contaminated. Subsequent storage of the ointment at room temperature overnight enabled any contaminants to

multiply in this unpreserved product. Laboratory experiments with diluted emulsifying ointment inoculated with  $10^2$  and  $10^4$  cells of *Ps. aeruginosa*/g showed that multiplication occurred overnight and bacterial counts of  $10^5$  and  $10^7$  organisms/g respectively were recorded.

The significance of environmental strains of *Ps. aeruginosa* in the development of patient infections is controversial. Lowbury *et al.* (1970) in a study of respiratory tract infections suggested that environmental strains of *Ps. aeruginosa* were rarely associated with patient infections. In a study of patients with diseases of the skin, White (1971) confirmed that there was little evidence of environment-patient transfer, though Noble & Savin (1966) many years previously had reported contaminated steroid cream as a source of infection in the same hospital. In contrast, Kohn (1966) reported a correlation between *Ps. aeruginosa* types found in sinks and those causing infections in burns patients. In the present study, three strains were shown to be common to the environment, medicaments, and at least one of the patients. The sequence of transfer between these three hosts is not always obvious, but it is known that at least in one instance the isolation of the environmental strain preceded those from the medicament and patient. The question is therefore raised of whether this transfer is simply a matter of chance or whether certain strains are better equipped to survive in different hosts, as shown by the heterogeneity of this organism.

Despite the fact that a fresh stock of emulsifying ointment was issued each day, cross-infection occurred between patients sharing the same pot of medicament and using the same bath. A film of emulsifying ointment left on the sides of the bath may have impaired the cleaning between patients. Unpreserved medicaments used in the bath are clearly exposed to microbial contamination from wet hands repeatedly diluting the product with bath water. There is a strong case for supplying these medicaments for patients with diseases of the skin in individual containers for use on one occasion only, and in a form which does not require further dilution.

We thank the consultant staff of St John's Hospital for permission to examine patients in their care and Dr M. T. Parker, Director of the Cross Infection Reference Laboratory of the Public Health Laboratory Service for typing the strains of *Ps. aeruginosa*.

#### REFERENCES

- BAIRD, R. M., FARWELL, J. A., STURGISS, M., AWAD, Z. A. & SHOOTER, R. A. (1979). Microbial contamination of topical medicaments used in the treatment and prevention of pressure sores. *Journal of Hygiene* **83**, 445.
- FORKNER, C. E. (1960). In *Pseudomonas aeruginosa Infections*. New York: Grune and Stratton.
- HOFFMAN, M. A. & FINBERG, L. (1955). *Pseudomonas* infections in infants associated with high humidity environments. *Journal of Pediatrics* **46**, 626.
- KOHN, J. (1966). A study of *Ps. pyocyanea* cross infection in a burns unit. In *Research in Burns*. Edinburgh and London: E. and S. Livingstone Ltd.
- LOWBURY, E. J. L., THOM, B. T., LILLY, H. A., BABB, J. R. & WHITTAL, K. (1970). Sources of infection with *Pseudomonas aeruginosa* in patients with tracheostomy. *Journal of Medical Microbiology* **3**, 39.

- MCBRIDE, M. E., DUNCAN, W. C. & KNOX, J. M. (1975). Physiological and environmental control of Gram-negative bacteria on the skin. *British Journal of Dermatology* **93**, 191.
- NOBLE, W. C. (1975). Dispersal of skin micro-organisms. *British Journal of Dermatology* **93**, 477.
- NOBLE W. C. & SAVIN, J. A. (1966). Steroid cream contaminated with *Pseudomonas aeruginosa*. *Lancet* *i*, 347.
- NOBLE, W. C. & SOMERVILLE, D. A. (1974). The Gram-negative bacilli. In *Microbiology of Human Skin* (ed. W. C. Noble and D. A. Somerville). London: W. B. Saunders.
- SAVIN, J. A. (1967). *Pseudomonas aeruginosa* infections in a skin ward. *Transactions of the St John's Hospital Dermatological Society* **53**, 75.
- SHOOTER, R. A., GAYA, H., COOKE, E. M., KUMAR, P., PATEL, N., PARKER, M. T., THOM, B. T. & FRANCE, D. R. (1969). Food and medicaments as possible sources of hospital strains of *Pseudomonas aeruginosa*. *Lancet* *i*, 1227.
- SINGH, G. (1974). *Pseudomonas* infections of skin: an experimental study. *International Journal of Dermatology* **13**, 90.
- WHITE, P. M. (1971). *Pseudomonas aeruginosa* in a skin hospital. *British Journal of Dermatology* **85**, 412.
- YOW, E. M. (1952). Development of *Proteus* and *Pseudomonas* infections during antibiotic therapy. *Journal of the American Medical Association* **149**, 1184.