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Microbial contamination of topical medicaments used in the treatment and prevention of pressure sores

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SUMMARY

Topical medicaments used in the treatment and prevention of pressure sores in patients in three hospitals were examined for *Pseudomonas aeruginosa* and *Staphylococcus aureus* contamination. Contamination rates were found to vary between hospitals and were affected by differences in the packaging of the product and in the method of application used by the nursing staff.

INTRODUCTION

Pharmaceutical products in hospitals may become contaminated with micro-organisms during preparation in the pharmacy or during use in the ward (Report by a Public Health Laboratory Service Working Party, 1971; Baird, Brown & Shooter, 1976; Baird & Shooter, 1976). Products intended for topical application have been shown to be susceptible to contamination by *Ps. aeruginosa*; inadvertent use of such contaminated products has been associated with the development of patient infections (Noble & Savin, 1966). In this study we set out to assess whether certain factors, namely the form of packaging and the method of application, play a part in determining whether topical products become contaminated during use.

The study took place in two geriatric hospitals, A and B, and a large acute hospital, C, all of which used a combination of topical barrier creams for the prevention and treatment of pressure sores (zinc and castor oil, Thovaline, Noratex, Keroderm and Kerodex 71 creams). Creams used in hospitals A and B were supplied in large 500 g stock pots, for use by several patients in the ward, whereas those used in hospital C were supplied in small tubes or pots for individual patient's use.

Nursing procedures for the application of topical medicaments differed between the three hospitals. A comparison was therefore made between contamination rates of *Ps. aeruginosa* and *Staph. aureus* in topical medicaments used in all three hospitals.

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METHODS AND MATERIALS

Examination of medicaments

All medicaments were examined before issue for absence of microbial contamination and after use in the wards. 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 overnight, aerobically, at 37 °C and then subcultured to cetrimide 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 patients

Skin sites on a number of patients were sampled for *Ps. aeruginosa* and *Staph. aureus*. In hospital A, swabs were taken from the nose, hand, axilla, elbow, umbilicus, perineum, buttock, heel and bedsore, if present. In hospital B, swabs were taken from the site of medicament application, the buttock area and less often from the heels and elbows. Patients in hospital C were not examined. Moistened swabs were incubated aerobically overnight at 37 °C in nutrient broth and then subcultured to cetrimide agar and mannitol salt agar.

Examination of environment

Environmental sites (baths and sinks) in the wards of hospital A were examined for *Ps. aeruginosa*. Moistened swabs were incubated aerobically overnight at 37 °C and then subcultured to cetrimide 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 Colindale, using a combination of serological and bacteriophage typing techniques. *Staph. aureus* was identified as a coagulase positive Gram-positive coccus. Strains were typed at Colindale, using a bacteriophage typing technique.

RESULTS

Hospital A

From a total of 163 pots of zinc and castor oil, Thovaline and Kerodex creams examined in three wards, 20 % were found to be contaminated with *Ps. aeruginosa* and 21 % with *Staph. aureus* (Table 1). A number of other organisms were also found, including *Klebsiella*, *Proteus*, *Enterococci* and *Pseudomonas* spp. Contamination rates in the creams varied from ward to ward (49 %, 36 % and 29 %) and this may have been due to differences in the handling of products. The zinc and castor oil and Thovaline creams were rather more often contaminated with *Staph. aureus* (25 %) than with *Ps. aeruginosa* (20 %). *Ps. aeruginosa* was isolated more frequently from Thovaline (32 %) than from zinc and castor oil cream (12 %). *Staph. aureus* was not isolated from any samples of Kerodex.

Table 1. *Contaminated medicaments in hospitals A, B and C*

	Hospital		
	A	B	C
No. medicaments examined	163	44	250
No. contaminated (%)	63 (39)	41 (93)	22 (9)
No. contaminated with *Ps. aeruginosa* (%)	32 (20)	11 (25)	0
No. contaminated with *Staph. aureus* (%)	34 (21)	26 (59)	0

Table 2. *Isolation of* Ps. aeruginosa *and* Staph. aureus *from patients in hospital A*

		Ps. aeruginosa		*Staph. aureus*	
Site	No. examined	No. positive	No. with medicament strain	No. positive	No. with medicament strain
Nose	28	3	NT	13	9
Hand	28	1	NT	15	13
Axilla	18	0	—	8	7
Elbow	28	1	1	16	12
Umbilicus	27	5	NT	12	10
Buttock	28	13	9	12	12
Bedsore	9	7	7	3	3
Perineum	18	9	NT	1	1
Heel	27	4	2	12	10
Total (%)	211	43 (20%)	19	92 (44%)	77

NT = Strains not typed.

Ps. aeruginosa was isolated from 43/211 (20%) skin sites examined in 28 patients in the three wards (22%, 18% and 22%). In Table 2 it can be seen that it was isolated less often from the nose, hands, axillae, elbows, umbilicus and heels of these patients (9%) than from the buttocks, perineum, and bedsores, if present (53%). *Ps. aeruginosa* was recovered from 7/9 bedsores and in all cases the strains were identical with those previously found in contaminated medicaments. Similarly, *Ps. aeruginosa* was isolated from 13/28 buttock areas and in 9 cases the strains were identical with medicament strains. Examination of environmental sites (sinks and baths) for *Ps. aeruginosa* showed that on one occasion only an identical strain was isolated from environment, medicament and patient in the same ward.

Staph. aureus was isolated from at least one skin site of all 28 patients examined, although the frequency of isolation varied between wards (28%, 62% and 42%). Evidently much cross-infection had occurred between medicaments and patients in the same ward; several strains were found in more than one ward. A correlation was noted between strains frequently isolated from barrier creams and those isolated from patients on several occasions. Of the 16 distinct strains (excluding

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non-typable strains) isolated from patients, seven were found more frequently than others. These seven strains were also isolated from 30 out of 34 contaminated medicaments. The commonest medicament strain (20 out of 34 pots) was also isolated from 15 of the 28 patients, usually from the site of application (buttocks, elbows, heels and hands), but occasionally from sites normally associated with carriage of *Staph. aureus*.

Hospital B

Of the 44 stock pots of zinc and castor oil, Thovaline and Noratex creams examined in 11 wards at hospital B, 41 had become contaminated within 3 weeks of use (93%). *Ps. aeruginosa* was isolated from a quarter of the pots examined (11 out of 44) and *Staph. aureus* was isolated from over half the samples (26 out of 44). On seven occasions both organisms were isolated from the same container. Sampling on several occasions showed that from a total of 418 examinations made, viable micro-organisms were recovered from 237 samples (57%). As at hospital A, *Staph. aureus* was isolated more frequently from zinc and castor oil cream (30%) than from other products (12%).

Skin sites, mostly the buttock area, were examined in 102 patients in the 11 wards. *Ps. aeruginosa* was isolated from 14/191 sites (7%) and on seven occasions the strains concerned were the same as strains previously isolated from medicaments. *Staph. aureus* was isolated from 60/191 skin sites (31%) and on 16 occasions the strains were shown to be similar to medicament strains.

Hospital C

Two hundred and fifty tubes and small pots of Keroderm ointment, Kerodex 71 and zinc and castor oil creams from six wards at hospital C were examined for microbial contamination. Viable micro-organisms were recovered from 22 medicaments (9%). *Staph. aureus* and *Ps. aeruginosa* were not found in any products and patients in these wards were therefore not examined.

Introduction of tubed medicaments at hospitals A and B

The results from hospital C indicated that medicaments packed in small containers were less likely to become contaminated during use by individual patients than those packed in large containers and used on several patients. Medicaments in hospitals A and B were therefore packed for a trial period in small metal tubes and supplied to each patient. To exclude any special handling of the tubes during use, the nurses were not informed of the study but were requested to save the tubes after using three quarters of their contents.

Three hundred and fifty tubes of zinc and castor oil and Thovaline creams were examined after use in the wards of hospital A. *Ps. aeruginosa* was isolated from four tubes only (1%), showing a marked reduction in contamination rates compared with pots previously used in these wards (20%). All isolates were found in the Thovaline ointment. A similar reduction in contamination rates by *Staph. aureus* was not, however, shown for medicaments packed in tubes (26% compared with a former value of 25%) and there appeared to be no significant difference between Thovaline and zinc and castor oil creams (24% and 26% respectively).

Following the introduction of tubed medicaments at hospital B, similar results were found to those in hospital A. Of the 102 tubes of zinc and castor oil cream, Thovaline and Noratex creams examined, *Ps. aeruginosa* was isolated from two tubes (2%), showing a marked reduction in the contamination rate compared with previous studies of stock pots (25%). Similarly, the isolation of *Staph. aureus* was shown to be reduced from 52% to 17%.

Method of application of medicament

Nursing staff at hospitals A and B had been observed to remove the barrier creams from containers with their bare hands. The medicament was then applied directly to the patient, repeating this procedure several times during treatment. On a number of occasions nurses were seen to proceed to the next patient without washing their hands. In contrast at hospital C, the nursing staff took considerable time and care in treating pressure sores. Medicaments were first transferred to patients using disposable spatulas, and then rubbed in by hand using plastic disposable gloves. This difference in nursing procedures probably accounted for the absence of *Ps. aeruginosa* and *Staph. aureus* in medicaments at hospital C.

Nursing staff at hospital A were therefore requested to change procedures and to use spatulas for the application of medicaments, taking a new spatula for each patient. Contamination rates for medicaments packed in tubes and applied by this technique were then assessed. A further 255 tubes were examined at hospital A and of these, one (0·4%) was found to be contaminated with *Ps. aeruginosa* and 13 (5%) with *Staph. aureus*.

DISCUSSION

Patients who develop, or who are liable to develop, pressure sores during their stay in hospital are frequently treated with unpreserved zinc-based barrier creams. Appreciable quantities of cream may be applied two to three times daily to extensive areas of skin on the back, buttocks and, less often, to the heels and elbows. In the long-stay geriatric wards of two hospitals in this study, barrier creams were packed in large stock-pots to be used on several patients during 'back rounds'. In some wards it was observed that stock pots remained in use for several days until empty. These frequently became contaminated during use with *Ps. aeruginosa* and *Staph. aureus*, with colony counts ranging between 10^2–10^6 organisms/g and 10^2–10^4 organisms/g respectively.

The inadvertent application of contaminated topical medicaments to patients thus provided a means of seeding the skin with large numbers of bacteria which may not have been part of the normal flora. *Ps. aeruginosa*, like other gram-negative organisms, is not generally found on normal skin, although it may appear as a transient organism in moist areas (Lowbury, 1969; Grogan, 1966). The establishment of this organism on the skin is, however, affected by the presence of tissue damage (Lowbury & Fox, 1954; Harris & Gray, 1974). Results from the present study appear to support this in that most of the bedsores were infected with *Ps. aeruginosa*; in turn this may have been responsible for a high recovery rate of *Ps. aeruginosa* from adjacent skin sites associated with application of medicament, such as the buttock area.

Unlike gram-negative bacteria, *Staph. aureus* is part of the normal flora of the skin and is commonly isolated from carriage sites in the anterior nares, umbilicus and perineum. It has been shown that strains of *Staph. aureus* isolated from the anterior nares, the main depot, closely resemble strains isolated from other skin sites (Williams *et al.* 1959). In the case of sepsis, however, there is conflicting information as to whether the strains are derived from self-infection or cross-infection (Williams *et al.* 1959; Bassett *et al.* 1963). In the present study it would seem that both occurred and were responsible for the high isolation rate from skin sites. Common strains were isolated both from medicaments and carriage sites; more often, however, common strains were isolated from medicaments and site of application; sometimes all three were involved.

Regardless of the mechanism whereby medicaments become contaminated in use, their continued use on other patients in the ward presents a potential cross-infection hazard. In view of this, it is suggested that medicaments used in the treatment of patients with pressure sores should, firstly, be made under controlled environmental conditions and supplied free of microbial contamination and, secondly, should be packed in small containers for individual patient's use. Guidance should be given to nursing staff on the correct method of applying medicaments.

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