J. Hyg., Camb. (1962), **60**, 209
Printed in Great Britain

Effect of Naseptin cream prophylaxis on staphylococcal infection in adult surgical wards and infant nurseries

By E. JOAN STOKES* and SHELAGH E. MILNE†
University College Hospital, London

(*Received* 11 *November* 1961)

INTRODUCTION

The findings of Williams *et al.* (1959) that nasal carriers of *Staphylococcus aureus* in surgical wards are three times more likely than others to suffer staphylococcal wound infection has stimulated interest in nasal treatment as a prophylactic measure for the prevention of staphylococcal wound sepsis.

Evidence of its value in stopping an outbreak of staphylococcal infection in a maternity unit had already been presented by Gillespie, Simpson & Tozer (1958), but when the work described in this paper was begun no controlled trial had been made. It was therefore decided to try the effect of applying Naseptin cream (chlorhexidine hydrochloride 0·1%, Neomycin sulphate 0·5%) to the noses of surgical patients, and to test Gillespie's method under controlled non-epidemic conditions in infant nurseries. In order that the risk to controls and treated patients should be as nearly as possible equal, non-active cream and powder was applied to the controls.

ADULT WARD TRIALS

The trial was made in one male and one female general surgical ward. These wards were not surgically or administratively comparable; one being in sole charge of a Surgical Unit; the other having patients in the care of four different surgeons and their assistants. The risk of infection was not likely to be the same because in one ward no staphylococcal infection had occurred for several months, whereas in the other, two recent serious infections had occurred in patients treated by two different surgeons. Patients from both wards were operated upon in the same theatre suite assisted by the same theatre staff.

The difference in the two wards did not affect the trial because patients receiving prophylaxis were compared with controls in the same ward. For this reason, no regular check was made on carriers in the nursing staff because all patients in the same ward were equally exposed to the risk of infection from them. The trial continued for one year.

Methods

Nasal swabs were taken from all patients as soon as possible after admission. They were then given 'Nasal Cream' and instructed to apply it on the tip of the finger inside the anterior nares twice daily at temperature-taking time. Alternate patients received 'Naseptin' and the non-active 'Naseptin Cream Base', the

* Clinical Bacteriologist † Research Assistant

difference being indicated by colour known only to the Pharmacy staff. Patients who could not themselves apply the cream had it applied for them by the nursing staff using short sterile Q-tip swabs.

Although nasal swabs from actively treated patients were not always sterile, it was thought unwise to increase the number of daily applications because of the risk of increasing the spread of staphylococci from nasal carriers among the control group, from frequent handling of the nose.

All wound infections, including minor serous discharges, were investigated and a record was made of other staphylococcal infections. All patients were re-swabbed whenever they suffered a staphylococcal infection and immediately before discharge, unless they remained in the ward less than 2 days, or were unexpectedly discharged on a Sunday.

Results

During the investigation it became clear that penicillin-tetracycline resistant staphylococci, referred to hereafter as antibiotic resistant strains, caused most of the infections; they are therefore noted in the tables.

The results of nose swabs in Table 1 show that the number of carriers admitted to each ward was the same but the number of antibiotic resistant strain carriers was greater in the male ward. The number of patients becoming nasal carriers while in the ward was much greater in the male ward and this was due to the spread of resistant strains.

Table 1. *Effect of treatment on nasal carriage of* Staphyloccus aureus

Treatment	Total admissions*		Completed cases					
	Positive	Negative	Positive on admission	Negative on discharge	Positive on discharge	Negative on admission	Negative on discharge	Positive on discharge
			Female ward					
Naseptin	71	288	60 (4)	38	22 (3)	116	111	5 (0)
Control	70 (4)		47 (2)	12	35 (3)	103	87	16 (2)
			Male ward					
Naseptin	70 (9)	307	44 (6)	28	16 (3)	100	89	11 (9)
Control	71 (7)		47 (3)	13	34 (15)	99	75	24 (16)

Note. Antibiotic resistant strains are shown in parenthesis.

* Some patients were discharged without a second nose swab.

In the female ward, results of 'Naseptin' treatment were good. Patients receiving Naseptin were three times less likely than controls to gain *Staphylococcus aureus* during their stay in hospital, and nasal carriers receiving Naseptin were three times as likely to be negative on discharge. This however, indicates temporary efficiency of treatment only as it was not possible to repeat swabs in the absence of Naseptin. Some patients, negative on discharge, were positive again on re-admission, having received no treatment in the meantime.

In the male ward the effect was less striking, except in the case of antibiotic resistant strains, where the patients clearly benefited.

Table 2 shows the relation of nasal carriage to staphylococcal infection. Of the thirty-one infections, twenty-three occurred in the male ward, and eight in the female ward. Antibiotic resistant strains accounted for twenty-three of the infections, and in sixteen the patients also carried a resistant strain in the nose: six of these were treated patients, ten were controls. Bacteriophage typing, however, showed the relation of nasal carriage to wound infection to be less significant than it at first appears.

There were twenty wound infections, fifteen of them caused by resistant strains of which twelve occurred in the male ward.

Table 2. *Effect of prophylactic treatment of nasal mucosa of carriers and non-carriers on the development of staphylococcal infections in surgical wound or in other sites*

	Nasal carriers			Non-nasal carriers		
Treatment	No infection	Infection	No wound	No infection	Infection	No wound
Naseptin	93	8 (7)	3	203	4 (3)	9
Control	78	14 (10)	2	191	2 (0)	9
Totals	181	22	5	394	6	18

Note. Figures in parenthesis are antibiotic resistant strains.
In addition three patients were infected whose nose swabs on admission were negative but who were not swabbed on discharge

Table 3. *Bacteriophage typing of antibiotic resistant strains*

	A	B	C	D	E	Other	N.T.	Total
				Nasal strains				
Positive on admission	3	5	1	0	0	8	3	20
Gained in the ward	4	16	4	5	3	8	4	44
From infected patients	4	2	0	1	1	2	3	13
				Infection strains				
Wound	6	1	0	0	1	0	2	10
Other	2	0	0	0	0	1	0	3
Total	8	1	0	0	1	1	2	13

A, 80/81; B, 52/80/+; C, 53/77/+; D, 7/47/75/+; E, 47/53/75/77/+; Other, single strains of different types; N.T. non-typeable.

Bacteriophage typing

Thirteen paired resistant strains (nose and infection) were typed; six pairs were the same type, seven were different. Table 3 shows that there were two important strains, one (Strain B) spreading from nose to nose but causing little wound infection, and the other (Strain A) infecting wounds but rarely found in the nose. But when a patient carried Strain A in the nose, wound infection was likely. Of the three carriers of this strain admitted, the wounds of two became infected with the

same type; the third had no wound. Both the infected patients happened to be actively treated. One of them had a staphylococcal pneumonia and his wound became infected after this; the other had an operation for the plastic repair of his ear so that the wound was in close proximity to the carrier site. Of the four who acquired Strain A in the nose during their stay in the ward, two became infected with the same type, both controls, and two escaped infection—one a control and the other Naseptin treated. In the female ward, where no wound was infected with Strain A, only one patient carrying this strain was admitted, and she stayed for 1 night only.

Although the nursing staff were not regularly swabbed, 8 months after the onset of the trial, all staff in contact with in-patients were screened for penicillin-tetracycline resistant staphylococcal nose carriage. Of 855 nurses swabbed, thirty-seven were carriers, and only one of them had worked in the female ward; she was carrying Strain B in her nose. None of the medical, auxiliary or domestic staff were carriers, and only one student, who had been treated with tetracycline. It is therefore probable that the patients in the female ward were not significantly at risk from Strain A.

INFANT NURSERIES

The floor of the hospital investigated is divided into three wards, all served by the same nursing and medical staff, the wards having twelve, eleven and three beds respectively. The babies are in cots at the foot of the mother's bed for part of the day, but are in two nurseries of twelve and fourteen cots for most of the time.

Method

In one nursery, Naseptin cream was applied twice daily to the babies' noses by the nursing staff, using short sterile cotton wool swabs and in addition Sterzac powder (0·33 % hexachlorophane) was used as a dusting powder every time the clothing or napkin was changed. In the other nursery, which served as the control, the cream and powder base *without* active ingredients were applied. All preparations were colour labelled, so that the staff using them did not know which was active. The investigation continued for 6 months, and after 3 months the preparations were reversed, so that the ward previously receiving active preparations now acted as the control.

Since all babies were equally at risk from the nursing staff, no regular check was made of nasal carriers among them. Before starting work on the maternity wards, however, all nurses had noses and throats swabbed; those found to carry *Streptococcus pyogenes* or tetracycline resistant *Staph. aureus* were excluded from theatre, delivery rooms, and nurseries.

Patients normally remained in the ward 8–10 days. Immediately before discharge, swabs were taken from the noses of the mothers and the babies and from the umbilical stumps of the babies. The mother was given a pre-paid post card and told to post it if she, or any member of her family, suffered from spots, boils, abscesses or sticky eye, and to post it in any case after 8 weeks. When cards were received before 8 weeks, patients were visited and the lesion and nose were swabbed.

Results

The nasal carrier rate (Table 4) of the mothers on discharge from hospital was what one would expect in any group of healthy, untreated adults. The Naseptin treated babies showed a much lower rate than the controls, but this merely indicated effective application as they had recently received Naseptin when swabbed. The difference was much less marked in the umbilical carrier rate. This may be partly due to the method of cord treatment (Huntingford, Welch, Glass & Wetherly-Mein, (1961), which was ligature with thread and treatment twice daily by the nurses with sterile surgical spirit until it separated; no dressing was applied.

Table 4. *Effect of treatment on carrier rate of* Staphylococcus aureus

Carriers	Total	Active (%)	Control (%)
Mother's nose	277	30	35
Baby's nose	278	6	51
Baby's umbilicus	278	37	51

Active treatment for nasal carriers = Naseptin cream, for umbilical carriers—Sterzac powder. Controls received inactive cream or powder.

Table 5. *Effect of treatment on infection rate*

	Active (Naseptin) treatment	Control (inactive nasal cream)
Total pairs swabbed	132	145
Total cards returned	70	80
Infections reported		
Hospital	4	13
Home	12	20
Total incidents reported	16	33
Staph. aureus infections	5 (4 families)	26 (23 families)
Culture of lesion sterile	1	0
Other infection	9	3
Not obtained	2	7
Total infections	17	36

The number of infections reported in the control group was more than twice that in the treated group (Table 5). *Staph. aureus* caused thirty-one of the fifty-three infections, and the rate for the controls was more than four times that for those receiving active treatment. Non-staphylococcal infection was higher in the treated group, but all these were very mild infections, mainly transient sticky eyes.

The majority of *Staph. aureus* infections were mild, but in the control group, two breast abscesses and two paronychiae in mothers needed surgery; three mothers had styes, and five babies paronychiae. In the treated group, there was only one serious lesion, a paronychia in a mother, probably staphylococcal but sterile on swabbing after penicillin treatment; one other mother had styes.

Bacteriophage typing

Bacteriophage typing of antibiotic resistant strains, presumed to be of hospital origin, revealed that among strains from infections in fifteen families there were eight different types. Typing paired strains (from nose and lesion) showed that all, of eleven pairs, were the same type in lesion and carrier site.

DISCUSSION

From the results reported here it is clear that Naseptin cream is effective in reducing the risk of becoming a nasal carrier of *Staph. aureus* while in hospital.

In maternity wards, where the original carrier rate is very low, all the babies being non-carriers originally, and where a high proportion of infections is caused by the patient's nasal strain, Naseptin prophylaxis can be expected to reduce the staphylococcal infection rate, and this has been shown to be so.

In adult surgical wards the situation is much more complex, and although in this trial there is no doubt that those treated were less likely to become carriers, there was no marked effect on wound infection. One explanation may be that, as babies are small, the distance is never great between carrier site and lesion. Mothers suffer mainly from breast abscesses and paronychiae; the sites of these infections are in close contact with the baby. In adult surgical patients, the distance between nose and wound is usually very much greater, and the nature of the wound will sometimes make it more liable to extraneous infection than the obstetric 'wounds', umbilicus and placental site. The number of surgical wound infections directly due to nasal carriage is therefore likely to be comparatively small, and will only be demonstrable when other factors are eliminated.

The difference in results between the two surgical wards shows the need to assess carefully the risk of infection when attributing good results to prophylactic methods. The low infection rate in the female ward might be attributed to different surgical treatment, but these patients were not at risk from the wound-infecting Strain A, and if infections due to it are discounted, the figures are equivalent for the two wards. It can therefore be argued that the higher rate in the male ward was due to the presence of the more virulent strain.

The comparatively poor effect of treatment on nasal carriage in the male ward can be explained in a variety of ways. Social habits between men and women in hospital differ, the men being more active and anxious to help the nurses, while the women take the opportunity to rest, and this leads to greater physical contact between male patients. The men's noses, being larger, have a greater area of mucuous membrane to be protected. In these wards, too, ward administration may have affected the results, for the female ward was run by the Unit, and it was therefore easier to introduce a new technique than in the male ward which served four different surgeons. Moreover, there were three different sisters in charge of the male ward during the year, whereas the female ward sister was unchanged throughout the trial.

It may be of interest to record that neomycin-resistant strains of *Staph. aureus* were not encountered.

RECOMMENDATIONS

We would recommend that until some more effective way can be found of eliminating staphylococci from maternity units, Naseptin cream should be applied routinely to the babies' noses twice daily. In surgical wards it should be applied four times daily to patients at special risk as part of their prophylactic treatment. Patients likely to need treatment are those who have been in hospital for a week or more before operation, especially if they are being treated, or have been treated, with antibiotics while in hospital, because they are likely to be carriers of resistant, and possibly highly infective, staphylococci. All of our patients carrying antibiotic resistant strains on admission had recently been treated in hospital; the four carrying Strain A had recently been in medical wards. Surgical patients with wounds who are receiving antibiotics should also, in our view, receive prophylactic Naseptin.

SUMMARY

A controlled trial of Naseptin cream, as an anti-staphylococcal prophylactic, made in two adult wards, showed the cream to be effective in reducing nasal carriage, including antibiotic resistant strains. There was no marked effect on wound infection.

A controlled trial of Naseptin cream and Sterzac powder prophylactically in maternity nurseries was found to be effective in reducing nasal carriage and infection.

These findings are discussed, and recommendations on the use of Naseptin cream as a prophylactic are made.

Our thanks are due to the nursing staff, especially to the ward sisters, without whose help these trials could not have been made; to Prof. W. C. W. Nixon and Dr R. E. Bonham-Carter, to Prof. R. S. Pilcher, Mr D. R. Davies, Mr D. N. Matthews, Miss D. Nightingale, and Mr G. L. Bunton, for permission to treat their patients. Also to Dr K. Green of Imperial Chemical Industries, Ltd., for supplying Naseptin and the non-active base, and to the Hospital Pharmacy staff for colour labelling, and for making the non-active powder. Finally, to Dr M. T. Parker for the bacteriophage typing, and to Prof. Wilson Smith and Prof. G. Belyavin for their interest and advice.

The work was financed from U.C.H. Special Funds, Cowburn legacy for microbiological research.

REFERENCES

Gillespie, W. A., Simpson, K. & Tozer, Rosemary C. (1958). *Lancet*, ii, 1075;

Huntingford, P. J., Welch, G., Glass, Ursula & Wetherly-Mein, G. (1961). *J. Obstet. Gynaec., Brit. Comm.*, **68**, 179.

Williams, R. E. O., Jevons, M. Patricia, Shooter, R. A., Hunter, C. J. W., Girling, J. A., Griffiths, J. D. & Taylor, G. W. (1959). *Brit. med. J.* ii, 658.