

Staphylococcal resistance in general practice— a study of skin infection

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A HIGH incidence of penicillin resistance among hospital staphylococci is widely recognised, but some believe the same does not occur in general practice. This is not so. In the casualty department, that no-man's land between hospital and general practice, the incidence of penicillin-resistant staphylococci is recorded as 50 per cent (Price *et al.*, 1968) and 73 per cent (Rutherford *et al.*, 1970). In true general practice the incidence has been recorded as 23 per cent (Roodyn, 1954) and 25 per cent (Gould and Cruikshank, 1957), 45 per cent (Kay, 1962), 38 per cent (Harris and Wise, 1969) and 53 per cent (Harding and Knudsen, 1970). These figures alone suggest that treatment by penicillin is an unwise first choice, and this view was voiced ten years ago by Kay (1962) who cast doubt on the advisability of using penicillin for the treatment of staphylococcal infection in general practice.

However, penicillins which are inactive in the presence of penicillinase continue to be prescribed as a first choice, and this includes the ubiquitous ampicillin which is also ineffective against penicillin-resistant staphylococci. The situation has not been clarified by the result of the casualty study (Price *et al.*, 1968) in which both phenoxymethylpenicillin (Penicillin V) and phenethicillin ('Broxil') were shown to be as effective as lincomycin in the control of staphylococcal sepsis. The authors suggest that this finding may have been due to weak penicillinase formers among the 50 per cent resistant strains, or it may have been that antibiotics do not materially affect the natural course of superficial staphylococcal infection.

There is clearly some confusion about the choice of antibiotics in staphylococcal lesions. In addition, although Harris and Wise (1969) mentioned that some of their patients had recently been in hospital, studies in general practice have not clarified the significance, if any, of past admission to hospital.

It was considered worthwhile, therefore, to re-assess the incidence of resistant staphylococci in general practice; to try and correlate the findings with the clinical result of treatment, and to determine whether the incidence of resistance differed in patients who had previously been in hospital when compared with those who had not.

Skin infection was chosen as the medium of study, as it is here particularly that the option of initiating treatment against staphylococci lies with the general practitioner.

Method

The study was conducted in a Plymouth general practice during the three-year period July 1969 to June 1972, and included consecutive instances of bacterial skin infection occurring in all ages. Patients already on an antibiotic when first seen were also included and the fact noted. Otitis externa was excluded.

At the first visit the clinical diagnosis was recorded and a swab taken. In the absence of visible pus, a dry swab was taken from the surface of the lesion. An enquiry was made as to when the patient had last been a hospital inpatient, and in children under five, whether delivered in hospital or at home. Treatment depended upon the clinical diagnosis. When a systemic antibiotic was considered advisable, erythromycin

was used predominantly as a first choice. Each patient was seen subsequently for assessment of the clinical result.

Bacteriology

Swabs were placed immediately in Stuart's transport medium, and reached the Plymouth Public Health Laboratory within 24 hours where they were cultured aerobically on horse-blood agar and electrolyte-deficient medium. Staphylococci were tested for coagulase production, where necessary by the tube test, and beta-haemolytic streptococci were subdivided into Lancefield's groups.

Results

Skin infection occurred in 137 patients and 143 infections were seen; four patients presenting twice, and one patient thrice. The highest incidence occurred in children with a gradual decline throughout the remaining age groups. Males predominated (63 per cent) and the incidence of disease occurred fairly evenly throughout each of the three years. Four patients only were on an antibiotic when first seen.

Table 1 records clinical diagnosis correlated with bacteriological findings. Impetigo is shown to be the commonest lesion, and *Staphylococcus aureus* the most commonly found organism.

TABLE 1

CORRELATION BETWEEN CLINICAL DIAGNOSIS AND BACTERIOLOGICAL FINDINGS, WITH SWABBING TECHNIQUE

Swabbing technique			Clinical diagnosis and total incidence	Number of isolations of micro-organism								
				<i>Staphylococcus aureus</i>	<i>Staphylococcus aureus</i> & <i>B-haemolytic streptococcus</i>	<i>Staphylococcus aureus</i> & <i>E.coli</i>	<i>B-haemolytic streptococcus</i>	<i>E.coli</i>	<i>Staphylococcus albus</i>	<i>Staphylococcus albus</i> & <i>Monilia</i>	<i>Pasteurella septica</i>	NO GROWTH
<i>Pus swab</i>	<i>Surface swab</i>	<i>No record</i>										
24	39	-	Impetigo (63)	30	16	1	13	1	-	-	-	2
24	8	1	Abscess (33)	28	-	-	-	-	2	-	-	3
4	7	-	Erysipelas (11)	8	2	-	1	-	-	-	-	-
5	6	-	Furunculosis (11)	5	-	-	1	-	1	-	-	4
4	3	-	Acute paronychia (7)	3	-	-	2	-	-	-	-	2
1	-	-	Cellulitis (1)	1	-	-	-	-	-	-	-	-
1	-	-	Carbuncle (1)	-	-	-	-	1	-	-	-	-
1	-	-	Web infection (1)	1	-	-	-	-	-	-	-	-
1	-	-	Sycosis barbi (1)	-	-	-	-	-	-	1	-	-
7	6	1	Miscellaneous (14)	4	2	-	1	-	2	-	1	4
72	69	2	TOTALS (143)	80	20	1	18	2	5	1	1	15

Impetigo and impetigenous lesions occurred predominantly in three sites; widespread, on the face, and on the lower limbs. Underlying lesions were apparent in 16; abrasions (ten), eczema (three), herpes simplex (one), scabies (one), and flea bites (one). Abscesses including a solitary boil, and furunculosis were widely distributed without a predominant site. The lesions described as miscellaneous were neither classical

infections, nor recognisable as abscess nor impetigo, and included infected bites, burns and lacerations.

Erysipelas requires special mention, as the lesions seen were atypical, predominantly staphylococcal, and seemingly undescribed in current texts and articles. While classical streptococcal erysipelas starts as a red plaque with a distinct edge, commonly on the face, and may be associated with constitutional upset, the lesions seen were smaller, in variable sites, less violent and without constitutional upset, yet possessing a distinct rapidly growing pustular edge. Response to an oral antibiotic was swift.

Bacteriology

Bacteriological data (table 1) were obtained by a swab of pus in 72 instances and by a swab of the dry surface in 69. It was unrecorded in two. While 14 of the 15 instances of no growth on culture followed surface swabbing, this technique is shown to be an effective method of obtaining bacteriological information (table 1) and also yields a similar spectrum of micro-organisms (table 2). If the 'no-growth' groups are excluded, there is no statistically significant difference in the distribution of micro-organisms detected by the pus and surface swabs.

TABLE 2

COMPARISON OF PUS SWAB WITH DRY SURFACE SWAB, AS A MEANS OF ISOLATING MICRO-ORGANISMS FROM SKIN INFECTIONS. IF THE 'NO GROWTH' GROUPS ARE EXCLUDED, THERE IS NO STATISTICALLY SIGNIFICANT DIFFERENCE IN THE DISTRIBUTION OF MICRO-ORGANISMS DETECTED BY THE PUS AND SURFACE SWABS.

<i>Total incidence of micro-organisms</i>	<i>Number of isolations detected by swab of pus</i>	<i>Number of isolations detected by surface swab</i>	<i>No record</i>
<i>Staphylococcus aureus</i> (80)	46	34	—
<i>Staphylococcus aureus</i> & <i>B-haemolytic streptococcus</i> (20)	10	10	—
<i>Staphylococcus aureus</i> & <i>E.coli</i> (1)	1	—	—
<i>B-haemolytic streptococcus</i> (18)	9	9	—
<i>E.coli</i> (2)	1	1	—
<i>Staphylococcus albus</i> (5)	2	1	2
<i>Staphylococcus albus</i> & <i>Monilia</i> (1)	1	—	—
<i>Pasteurella septica</i> (1)	1	—	—
<i>NO GROWTH</i> (15)	1	14	—
TOTALS (143)	72	69	2

Staphylococcal infection

Coagulase positive *Staphylococcus aureus* was isolated from 101 separate instances of infection. In 80, the organism occurred alone; in 20, mixed with beta-haemolytic streptococcus, and in one with a coliform. Sensitivity patterns are shown in table 3; 70 per cent were resistant to penicillin, 12 per cent resistant to tetracycline, and one per cent resistant to erythromycin. This latter single instance occurred in a patient who had never been in hospital. An incidence of penicillin resistance occurred throughout the diagnostic spectrum, being highest in impetigo.

Significance of past admission to hospital

Of the 101 staphylococcal infections, 60 patients had previously been in hospital, and the information was not obtained in three. The remaining 38 patients had never been in hospital and comprised 25 penicillin resistant infections (66 per cent).

TABLE 3
ANTIBIOTIC SENSITIVITY IN THE 101 INFECTIONS FROM
WHICH A COAGULASE POSITIVE *Staphylococcus aureus* WAS ISOLATED

Antibiotic	Number of isolations of <i>Staph. aureus</i> tested	Sensitive	Resistant
Penicillin	101	31	70
Tetracycline	101	89	12
Erythromycin	101	100	1
Chloramphenicol	100	100	0
Novobiocin	99	99	0
Fusidic acid	76	76	0
Cloxacillin	72	72	0
Methicillin	72	72	0
Clindamycin	57	57	0
Lincomycin	10	10	0

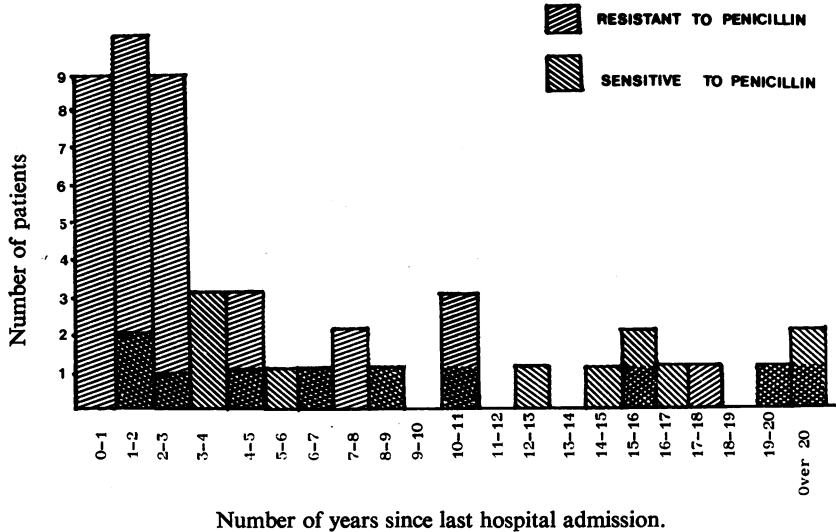


Figure 1
Instances of staphylococcal infection in those patients who had previously been in hospital.

The penicillin resistance rates of the 60 previously in hospital are shown in histogram form (figure 1). The impression that a direct relationship exists between previous hospital admission and subsequent penicillin resistant infection is suggested by noting that the number of penicillin resistant infections is raised only in those recently in hospital. The penicillin sensitive infections are distributed evenly irrespective of when the last hospital admission occurred. Further, the penicillin resistant rate (90 per cent) of those in hospital within the last three years was significantly higher ($p < 0.01$) than the rates of those in hospital more than three years ago (48 per cent) and those never in hospital (66 per cent). There was no significant difference between the rates of these latter two groups ($p < 0.2$).

The apparent high incidence of penicillin resistant infection in those recently in hospital could have been an artefact due to an excess of children in that group, for a small child cannot have been in hospital very long ago. However, an age analysis

excludes this. There were 22 children under five in the whole series and staphylococcal infection occurred in 16. These 16 comprised seven previously in hospital subsequent to delivery, five with hospital delivery only representing previous hospitalisation, and three never in hospital and delivered at home. The information was unrecorded in one. The five children above, delivered in hospital, were all under the age of three when seen. This figure of 12 for past hospitalisation, comprising 11 penicillin resistant infections, reflects rather than is responsible for the overall high resistance rate among those in hospital within the last three years.

Tetracycline-resistant staphylococci

The 12 instances were unremarkable, occurring in impetigo (eight), abscess (one), erysipelas (two), and furunculosis (one). Three had never been in hospital and five had, within the last three years.

TABLE 4
ANTIBIOTIC SENSITIVITY IN THE 38 INSTANCES OF INFECTION FROM WHICH
A BETA-HAEMOLYTIC STREPTOCOCCUS WAS ISOLATED

<i>Antibiotic</i>	<i>Number of isolations of B-haemolytic streptococci tested</i>	<i>Sensitive</i>	<i>Resistant</i>
Penicillin	38	38	0
Tetracycline	38	31	7
Erythromycin	38	38	0
Chloramphenicol	38	38	0
Cephaloridine	28	28	0
Streptomycin	37	0	37

Streptococcal infection

The 38 instances (table 1) were all Lancefield group A, and sensitivity patterns (table 4) show seven (16 per cent) to be tetracycline resistant. These seven instances occurred in impetigo (three), erysipelas (two), acute paronychia (one), and infected laceration (one). Acute nephritis as a late sequel did not occur.

Response to treatment

The prime object in recording response to treatment was not an evaluation of different treatment methods, but rather to show whether *in-vitro* sensitivity patterns corresponded with the result of antibiotic use in treatment.

Conventional treatment methods were used, alone or in combination, including kaolin poultice, magnesium sulphate dressing, drainage, 'Phisohex', local antibiotic ointment and oral systemic antibiotic. 'Phisohex' was not used in infants. Surgical incision was rarely necessary.

Generally, response to treatment was good, and it was possible in the 63 instances treated by a systematic antibiotic alone, and in which a culture was also obtained, to show a positive correlation between *in-vitro* sensitivity pattern and the response to the antibiotic employed. Fifty-nine infections responded rapidly and in all the responsible organism was sensitive to the antibiotic employed. Four infections failed to respond and in each the responsible organism was resistant to the antibiotic used.

Discussion

Gould and Cruickshank (1957) found that *Staphylococcus aureus* was rarely isolated from the intact surface covering lesions. The results in this study are the reverse, and Kay (1963) also comments on the greatly increased contamination of skin around lesions. While it might be argued that the surface swabs were monitoring a skin carrier

state, the wide spectrum of micro-organisms isolated and the statistical assessment tend to implicate the lesion itself as the source.

It was the impression in this study that antibiotic use was beneficial in the treatment of staphylococcal lesions. This is contrary to the finding by Rutherford *et al.* (1970) who in a trial in a casualty department found cloxacillin of no significant benefit in enhancing healing-time among patients also treated by surgical incision.

It is conceivable that the type of lesion seen in general practice could benefit from an antibiotic. The lesions, as in this study, are generally seen earlier, and although they may eventually discharge a little pus spontaneously, can be localised and probably undergo partial resolution with antibiotic use. That cloxacillin in the above trial was of no value may be due to nothing more obscure than the lateness of the lesions studied.

One may now reconsider the findings of Price *et al.* (1968) mentioned in the introduction. Although their staphylococcal lesions in casualty were apparently not so advanced as those described above, it is possible that the similar response to the two penicillins and lincomycin is explained by the suggestion that *all three* antibiotics were ineffective. Perhaps a casualty department is not the right place in which to assess the value of antibiotics in staphylococcal sepsis unless it can be ascertained that lesions reaching there are early—as early as normally seen in general practice.

In the present study, the recorded incidence of resistant organisms, coupled with the positive correlation between bacterial sensitivity and results of treatment suggest that patients in general practice presenting with skin infection or any suspected staphylococcal lesion, are best treated with an antibiotic other than penicillin or tetracycline; the term 'penicillin' including ampicillin and those penicillins inactive in the presence of penicillinase. Suitable antibiotics would be those listed in the sensitivity tables, such as erythromycin and cloxacillin, or cephaloridine.

Hospital admission within the previous three years was shown to be associated with a very high incidence of penicillin resistance among staphylococcal infections occurring in general practice. It seems reasonable to infer that this phenomenon is explained by a carrier state of 'hospital' staphylococci conferred upon the patient while in hospital. It appears that this presumed carrier state tends to die out after three years. It is tempting to speculate whether this high incidence group corresponds to that group of nasal carriers (Kay, 1963) in which there occurred both the production of septic lesions and a high incidence of penicillin resistance. Further elucidation is outside the scope of this study owing to the absence of concomitant nasal swabs. None the less, with reference to the treatment of the individual patient, it is suggested that those hospitalised within the last three years and presenting with a staphylococcal lesion are particularly likely to benefit from measures aimed at elimination of both nasal and skin carriage.

A final comment is worthwhile on the prevalence of staphylococci as the aetiological agent in skin infections. A predominance of staphylococci in impetigo is also recorded by Parker *et al.* (1955) and El Zawahry *et al.* (1972).

Summary

In a study of 143 consecutive skin infections in general practice, 70 per cent of 101 staphylococcal infections were penicillin-resistant. The impression was gained that antibiotic use was beneficial in staphylococcal lesions, and evidence is presented suggesting a choice other than penicillin, ampicillin or tetracycline. Hospital admission within the previous three years was shown to be associated with a high incidence of penicillin resistance among staphylococcal infections occurring in general practice, and it is suggested that this group of patients particularly, might benefit from treatment of the

carrier state. A staphylococcal variant of erysipelas is described and comment made on the prevalence of staphylococci in skin infection.

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