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Bacterial Skin Infections at a Tertiary Dermatological Centre

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ABSTRACT

Background: Bacterial skin infections are common clinical problems encountered in most fields of clinical medicine. *Staphylococcus aureus* and group A *streptococci* are common invaders of eczematous, traumatised or immunocompromised skin. Advances in pharmacology have introduced a wide array of new antibiotics into the physician's armamentarium, but the rising incidence of bacterial resistance continues to be a problem. A retrospective study was carried out on 331 patients at the National Skin Centre, Singapore, to establish the causes of common primary and secondary pyodermas, as well as to determine the antibiotic sensitivities of the micro-organisms responsible.

Methods: A retrospective study of the medical records of 331 patients seen at the Centre for skin infections between October 1995 and May 1996 was done. Skin cultures and antibiotic sensitivity testing was carried out and the data analysed. Both primary pyodermas (impetigo, folliculitis, furuncles/carbuncles and cellulitis) and secondary pyodermas (infected ulcers and infected eczemas) were included. The results of bacterial isolation cultures and sensitivity of the organisms isolated to the commonly used antibiotics such as cloxacillin, penicillin, erythromycin and the tetracyclines were analysed.

Results: *Staphylococcus aureus* was the commonest organism isolated from both primary and secondary pyodermas, accounting for 67% and 46.7% of the organisms isolated, respectively. There was no significant difference in the racial representation in each of the various skin infections, but there was a significantly greater female representation in the infected ulcers. The secondary pyodermas had a significantly higher incidence of gram negative organisms causing infections, as well as culture results showing multiple bacterial pathogens. The methicillin resistant strains of *S. aureus* were commoner in the secondary pyodermas, and accounted for 4.2% of the total organisms isolated and 7% of the total strains of *S. aureus*. The *S. aureus* had a high rate of resistance (89.5%) to penicillin and ampicillin, but was very sensitive (93%) to cloxacillin, cephalexin and co-trimoxazole. The incidence of erythromycin resistance was 18.7%.

Conclusions: In patients with primary pyodermas, cloxacillin should be the first line antibiotic used, with erythromycin as a useful but less preferred alternative. The favoured combination of ampicillin and cloxacillin has little place in routine treatment of skin infections, except for cellulitis and infected eczemas. A cephalosporin can also be used in these conditions if single drug therapy is desired. The secondarily infected ulcers are difficult to treat and would probably require the use of combination therapy in view of frequent mixed infections.

Keywords: *staphylococcus aureus*, pyoderma, cloxacillin

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INTRODUCTION

Over the past three decades, the introduction of a variety of newer antibiotics has effected striking changes in the management of bacterial skin infections. With the availability of these drugs, the focus of attention is on the determination of the specific bacteria causing the problem so that the most appropriate antibiotics can be identified.

The purpose of this retrospective study was to analyse the aetiology of primary and secondary bacterial skin infections and the antibiotic sensitivities of the organisms isolated in patients with pyodermas attending our centre, a tertiary dermatological referral centre in Singapore. The findings will enable us to choose the most appropriate antibiotic to use in skin infections. We also hoped to identify the emergence of antibiotic resistance in the skin infections seen here.

MATERIALS AND METHODS

This is a retrospective study on patients attending our skin clinic between October 1995 and May 1996. Case records of patients with the following diagnoses were collated: (1) impetigo; (2) folliculitis; (3) furuncles/carbuncles; (4) cellulitis; (5) infected ulcers (all types), and (6) infected eczema (all types). The skin swab for culture and sensitivity test of these patients were collated and analysed. Patients' demographic data were also collated and analysed.

Culture specimens from skin lesions were collected by sterile swabs and sent to the Department of Pathology of the Singapore General Hospital. In patients with cellulitis, this was done

by aspirating the advancing edge of the lesions. On arrival at the microbiology laboratory, cultures were performed on blood and eosin methylene blue agar plates and in Robertson's cooked meat broth and incubated overnight at 35°C. The isolation and identification of recognised bacterial pathogens were done according to standard techniques. Antibiotic susceptibility tests were done by the agar diffusion method according to the National Committee for Clinical Laboratory Standards (1990 NCCLS Document M2-A4, volume 10, number 7)[1].

Statistical analysis was performed using Chi-square test and a p value of less than 0.05 was considered significant.

RESULTS

There were 331 patients with skin infections that had culture and sensitivity to antibiotics tests done during the study period.

Sex, age and racial distribution

There were 243 (73.4%) Chinese, 36 (10.9%) Malays, 32 (9.7%) Indians and 20 (6.0%) patients belonging to other races. There were 135 (40.8%) females and 196 (59.2 %) males. Their ages ranged from six months to 90 years (mean age 31.5 years). Of these patients, 137 (41.4%) were in the 10 to 30-year age range, while 42 (12.7%) were less than 10 years old, 83 (25.1%) were between 31 to 50 years-old and 69 (20.8%) were above 50 years of age.

Types of pyodermas seen

Primary skin infections accounted for 179 (54%) of the cases, with the remaining 152 (46%) cases due to infected ulcers and eczema. Amongst the primary pyodermas, folliculitis was the commonest entity, accounting for 66 (36.9%) of the 179 cases. This was followed by furunculosis/carbuncles, with 57 cases (31.8%) and cellulitis and impetigo, with 9 (5.0%) and 8 (4.5%) cases respectively.

Frequency distribution of organisms isolated

Table I shows the frequency distribution of the pathogens isolated. Overall, the gram positive organisms predominated, with *Staphylococcus aureus (S. aureus)* accounting for 171 (60.4%) of the 283 organisms isolated. This included twelve isolates of the methicillin-resistant strains (MRSA), giving an overall prevalence of 4.2% for MRSA, or 7% of the total *S. aureus* population. The *Streptococci* (15.2%) were the second commonest organisms isolated. *Enterococci* (1.4%) were the other gram positive pathogens isolated. *Pseudomonas aeruginosa (Ps. aeruginosa)* were the commonest gram negative organisms isolated (8.5%), followed by *Klebsiella* (4.2%), *Proteus* (3.9%), *Escherichia coli* (2.5%), *Acinetobacter baumanii* (2.1%) and *Enterobacter* (1.8%).

Table II compares the organisms isolated in primary and secondary pyodermas. The higher prevalence of MRSA and *Ps. aeruginosa* in the secondary pyodermas was statistically significant ($p < 0.05$). The differences in the isolation rates of the other pathogens between primary and secondary pyodermas were not statistically significant.

Antibiotic sensitivity

Table III shows the antibiotic sensitivities of the three commonest organisms isolated. From the results, we noted that *S. aureus* had a high rate of resistance to penicillin and ampicillin (89.5%). It was highly sensitive to cloxacillin, cephalexin and cotrimoxazole. The overall sensitivity to erythromycin was 81.3%, and to tetracycline, 66.1%. The *Streptococci* showed complete sensitivity to penicillin, ampicillin and cephalexin, and 93% sensitivity to erythromycin. It had a low sensitivity to tetracycline (35%). *Ps. aeruginosa* was sensitive to cefoperazone (100%), piperacillin (89%), and gentamicin(89%). It was also sensitive to ciprofloxacin(92%), but only 12 of the 24 isolates of *Ps. aeruginosa* were tested to this antibiotic.

DISCUSSION

There have been few local reports on the aetiology of the common bacterial skin infections. A review was done on 127 cases of pyodermas in Singapore in 1987[2]. Our study updates the findings a decade later. In that review, *S. aureas* accounted for 71% of the primary pyodermas and 45% of the secondary pyodermas. These figures are similar to the results obtained in our present study (67% and 46.7% respectively). There was only one methicillin-resistant strain cultured amongst the 81 isolates of *S. aureus* then (1.2%). In contrast, our study shows that the proportion of MRSA is 7%, and this represents a significant increase. Although the rise in MRSA isolates in our patients is small compared to hospital data, the emergence of MRSA warrants further surveys. This emergence is probably due to the rise in antibiotic usage among the general public, and probably to the

Table I – Frequency distribution of organisms

Organism	Frequency	
	n	(%)
Gram positive	**218**	**(77)**
S. aureus	159	(56.2)
MRSA	12	(4.2)
Streptococcus	43	(15.2)
Enterococcus	4	(1.4)
Gram negative	**65**	**(23)**
Ps. aeruginosa	24	(8.5)
Klebsiella	12	(4.2)
Proteus spp	11	(3.9)
Acinetobacter baumanii	6	(2.1)
E. coli	7	(2.5)
Enterobacter	5	(1.8)

Table II – Comparison of organisms isolated in primary and secondary pyodermas

Organism	Primary pyoderma frequency		Secondary pyoderma frequency	
	(n)	(%)	(n)	(%)
S. aureus	88	(67)	71	(46.7)
MRSA*	1	(0.8)	11	(7.2)
Streptococcus	19	(14.5)	24	(15.8)
*Ps. aeruginosa**	2	(1.5)	22	(14.5)
Enterococcus	1	(0.8)	3	(2.0)
Proteus	3	(2.4)	8	(5.2)
Enterobacter	2	(1.5)	3	(2.0)
Acinetobacter baumanii	4	(3.2)	2	(1.4)
E.coli	3	(2.2)	4	(2.6)
Klebsiella	8	(6.1)	4	(2.6)
Total	131	(100)	152	(100)

Legend: * Statistical significance ($p < 0.05$) between primary and secondary pyoderma

Table III – Antibiotic sensitivity of the 3 common organisms isolated

Organsim	Antibiotic	Sensitive (n) (%)
		n = 171
S. aureus	Penicillin	18 (10.5)
	Ampicillin	18 (10.5)
	Cloxacillin	159 (93)
	Cephalexin	159 (93)
	Co-trimoxazole	159 (93)
	Erythromycin	139 (81.3)
	Tetracycline	113 (66.1)
	Clindamycin	171 (100)
		n = 43
Streptococcus	Penicillin	43 (100)
	Ampicillin	43 (100)
	Cephalexin	43 (100)
	Erythromycin	40 (93)
	Tetracycline	14 (35)
		n = 26
Ps. aeruginosa	Piperacillin	23 (89)
	Gentamicin	23 (89)
	Cefoperazone	26 (100)
	Ciprofloxacin	11/12 (92)

indiscriminate and inappropriate prescription of antibiotics. *S. aureus* is the predominant species in bacterial skin infections[3-5]. In patients with recurrent *staphylococcal* infections, it might be prudent to identify those with nasal *S. aureus* carriage and treat these patients appropriately.

In our study, *Streptococci* was the second commonest pathogen amongst the gram positive organisms. Among the gram negative organisms, *Ps. aeruginosa* was the commonest, followed by *Klebsiella* and then *Proteus*. We also determined that gram negative organisms were more likely to be isolated from the secondary pyodermas, and that this condition was significantly more likely to produce isolates of MRSA and *Ps. aeruginosa*.

S. aureus is highly sensitive to cloxacillin, cephalexin and co-trimoxazole, but close to one-fifth of isolates in this study (18.7%) were resistant to erythromycin. There have been recent concerns worldwide about the rise in erythromycin-resistant *S. aureas*. In one study in the United States, 26% of *S. aureus* isolated from a paediatric outpatient dermatology clinic were resistant to this antibiotic[6]. However, there was only one case of treatment failure amongst these 22 patients who were treated with erythromycin and subsequently found to have erythromycin-resistant *S. aureus*. Antibiotic resistance thus does not immediately imply treatment failure. We need prospective studies to determine the degree of treatment failure to erythromycin in this group of patients. It must however be stressed that erythromycin remains a useful alternative to patients allergic to the penicillin group of drugs.

From our results, we can conclude that antibiotics such as penicillin, ampicillin and tetracycline are not useful in the treatment of primary skin infections, where *S. aureus* is the most likely pathogen, except in cellulitis. Cloxacillin should be the drug of choice, with cephalexin and co-trimoxazole being equally effective. Erythromycin is a suitable alternative to the penicillin-sensitive patients. The main concern in using co-trimoxazole would be the higher risk of drug eruptions compared to cloxacillin or erythromycin[7], but it is interesting to note that the *S. aureus* isolates in our study were highly susceptible to this antibiotic, perhaps because it is not as often prescribed.

In cases of cellulitis, one might need to add coverage for *Streptococci* in the form of penicillin or ampicillin, or use cephalexin, co-trimoxazole or erythromycin which would cover both organisms. In patients with cellulitis/ecthymas, the cultures were done by aspirating the advancing edge of the lesions. This is a difficult means of obtaining cultures, and probably explains why this group had the highest proportion of sterile cultures. The prevalence of *S. aureus* amongst this group of patients is probably due to secondary contamination as *Streptoccus* is probably more likely to cause cellulitis[8].

The secondary pyodermas present a different picture. Infected eczemas have a high incidence of both *S. aureus* and *Streptococci* occurring together and thus should be treated with the same antibiotics as a patient with cellulitis. We recommend the use of cephalexin or erythromycin as the first line of treatment. The use of erythromycin as a single drug treatment for these two infections, however, should take into consideration the relatively high incidence of erythromycin resistance amongst *S. aureus*. The greater cost of the cephalosporins is a factor to consider in the use of cephalexin as a first line agent in the treatment of bacterial skin infections.

Patients with infected ulcers are probably the most difficult to treat, as many of them have mixed infections as well as a predominance of gram negative bacteria. From our analysis, gentamicin appears to be the best treatment for gram negative organisms, as it has coverage for *Ps. aeruginosa* as well as *Klebsiella* and the other gram negative organisms. Its main disadvantage is that it has to be given parenterally. We would thus recommend

that patients with infected ulcers have a swab culture done so that appropriate antibiotics can be prescribed. A good first line of treatment would be to use a combination of cloxacillin and gentamicin, or gentamicin and erythromycin. Gentamicin cream may be used instead of the parenteral form if the infection is mild and localised. The newer beta lactamase-resistant antibiotics which are said to have gram negative coverage, or the additional use of ciprofloxacin or a cephalosporin as effective agents against both the gram negative organisms as well as *S. aureus* and *Streptococci* would need to be considered. Although these drugs are more expensive, they have a definite role to play and should be included in sensitivity testing where appropriate.

In conclusion, this study has yielded some useful epidemiological data about pyodermas in Singapore. In our outpatient population, the trend of increasing antibiotic resistance needs to be monitored, and in future, larger prospective studies monitoring the outcomes of antibiotic treatment should be carried out.

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