

SOME ASPECTS OF SUPERFICIAL PYODERMA IN SINGAPORE

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SYNOPSIS

A study of 197 patients with superficial pyoderma showed that Group A streptococci and *Staphylococcus aureus* accounted for the majority of organisms isolated from skin lesions. Pyoderma was more common in children 0-14 years of age. Lesions were often noted on exposed body surfaces especially on the lower extremities. The Chinese had a lower incidence of pyoderma than Indians and Malays. Predominant T-pattern of 3/13/B3264, 4/24/26/28/29/46 and 5/12/27/44 were observed in skin streptococcal strains. Only 34% of patients with streptococci in skin lesions had anti-streptolysin O titre of 200 Todd units and more.

INTRODUCTION

Studies on superficial pyoderma had been carried out in various parts of the world (Dajani, A.S. et al, 1968, 1973; Allen, A.M. et al, 1971; Bassett, D.C.J., 1972; Nelson, K.E. et al, 1976). These studies indicated *Staphylococcus aureus* and group A beta-haemolytic streptococcus to be the predominant organisms isolated from superficial skin infections. In the past, several workers (Parker, M.T. et al, 1955; Barrow, G.I., 1955) had stressed the importance of *Staphylococcus aureus* in the pathogenesis of pyoderma. Recently however, more attention has been directed to the streptococci in these lesions because of the development of the important sequelae, acute glomerulonephritis. Indeed some of the largest epidemics of post-streptococcal glomerulonephritis have been known to follow streptococcal skin infections (Symonds, BER, 1960; Poon-King, T. et al, 1967; Potter, E.V. et al, 1968; Lasseh, E.E. et al, 1971).

This paper is a report on epidemiological and microbiological investigations carried out on patients with superficial pyoderma attending the outpatient clinic of Middle Road Hospital in Singapore.

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TABLE I—Number of Individuals with β -Streptococci and Staphylococcus Aureus in Skin Lesions

Age Group (In Years)	No. of Patients	Number of patients with skin lesions positive for:—			
		β -Streptococci		Staphylococcus aureus	
		No.	%	No.	%
< 5	93	52	55.9	77	82.8
5— 9	22	15	68.2	19	86.4
10—14	18	13	72.2	12	66.7
15—19	14	8	57.1	9	64.3
20 or >	50	22	44.0	32	64.0
Total	197	110	55.8	149	75.6

TABLE II—Location of Skin Lesions in Relation to Body Surfaces

Location of Lesions	No. of Lesions	% of Lesions
Head	62	18.8
Trunk	46	14
Upper Extremities	93	28.3
Lower Extremities	128	38.9
Total	329	100

MATERIAL AND METHODS

A total of 197 patients with superficial pyoderma was seen at the outpatient clinic of Middle Road Hospital over a one-year period from January to December 1973. Swabs were taken from throat, skin lesions and healthy skin over both wrists and knees of each patient. They were immediately inoculated on to blood agar plates containing 6% of defibrinated sheep red blood cells and despatched to the Bacteriology Section of the Department of Pathology for investigations.

At the laboratory, beta-haemolytic streptococci were isolated and group identification was carried out based on Lancefield's method (Lancefield, R.C., 1933). Extracts of group specific substance were prepared by hot formamide using Fuller's technique (Fuller, A.T., 1938). The grouping sera used were commercial rabbit hyperimmune sera.

T-typing of group A streptococci was done according to Griffith's method (Griffith, F., 1934) using also commercially available rabbit hyperimmune sera. Seventy strains of group A streptococci were sent to the WHO International Collaborating Centre for Reference and Research in Prague, Czechoslovakia for M-typing, using precipitation reactions (Swift, H.F., 1943).

Isolates of staphylococci from cultures were tested for coagulase production utilizing the tube test.

Blood was taken from 194 patients for estimations of anti-streptolysin O titre. Estimation was carried out by the spectrophotometric method based on modification of Liao's method (Liao, S.J., 1951).

RESULTS

The age structure of this series was as follows: 93 patients in the group of under 5 years, 22 in the 5-9 years age group, 18 in the 10-14 years age group and 50 in the age group of 20 years and above.

In all age groups, the incidence of beta-haemolytic streptococci found in skin lesions was 55.8% and *Staphylococcus aureus* 75.6%. Children aged 5-14 years had beta-haemolytic streptococcal isolation rate of 70%. The highest incidence rate of 72.2% was observed in children aged 10-14 years (Table I).

Skin lesions were mostly multiple. Table II shows the distribution of skin lesions in relation to body surfaces. The part of the body with the highest frequency of skin lesions was the lower extremities (38.9%), followed by the upper extremities (28.3%), head (18.8%) and trunk (14%).

A total of 308 skin lesions was cultured. Distribution of the various organisms recovered from the lesions is shown in Table III. Beta-haemolytic streptococci coexisted with staphylococci in the majority of instances (51.7%). Streptococci were more commonly associated with *Staphylococcus aureus* (42.9%) than *Staphylococcus epidermidis* (8.8%). *Staphylococcus aureus* either alone or with streptococci were isolated from 75% of the cultures. Beta-haemolytic streptococci either

TABLE III—Organisms Isolated from 308 Skin Lesions

Organisms Isolated	Number of Cultures					
	Lower extremities	Upper extremities	Head	Trunk	Total	%
β -Strep only	10	9	2	2	23	7.5
Staph aureus only	30	25	25	21	99	32.2
Staph epidermidis only	6	4	5	4	19	6.2
β -Strep + Staph aureus	64	40	19	9	132	42.9
β -Strep + Staph epidermidis	14	8	4	1	27	8.8
Others/No. growth	2	4	2	0	8	2.6
Total	126	90	55	37	308	100

TABLE IV—B-Streptococci Isolated From Skin Lesions

Organism	No.	%
Gp A streptococci	162	89
Gp C streptococci	2	1.1
Gp G streptococci	18	9.9
Total	182	100

alone or with staphylococci were isolated from 59.1% of the total cultures.

Group A streptococci accounted for 89% of the 182 beta-haemolytic streptococcal isolates from skin lesions, with group G accounting for 9.9% and group C for the remaining 1.1% (Table IV).

Beta-haemolytic streptococci were found in the throats of 21 (19.1%) of the 110 patients with streptococcal skin lesions. Of the 28 patients with positive throat cultures for streptococci, 21 (75%) had streptococcal skin lesions and 8 were also found to be carrying streptococci on healthy skin (Table V). 89 (52.7%) of the 169 patients with negative throat culture for streptococci had streptococci in skin lesions and 43 (25.4%) carried streptococci on the healthy skin too.

The population of Singapore is comprised of 76.2% Chinese, 15% Malays, 7% Indians/Pakistanis and 1.8% others. The Chinese patients in our study group were found to have the lowest relative incidence of superficial pyoderma (0.80) followed by the Indians/Pakistanis (1.45) and the Malays (1.69). The relative incidence between streptococcal and staphylococcal pyoderma appeared to be the same.

From the data collected, there appeared to be two seasonal peaks in the number of skin lesion cases, one in January-February and the other in

June. The number of cases during these two periods were 2-3 times higher than seen in other months.

T-type patterns of group A streptococci isolated from skin lesions, healthy skin and throats are tabulated in Table VII. The three most common T-patterns found in skin lesions were T3/13/B3264 (28.4%), T4/24/26/28/29/46 (26.5%) and T5/11/12/27/44 (11.1%). Less frequently encountered T-patterns were T8/25/Imp19 and T14/49. T-patterns with a frequency of less than 5% were T1, T2, T6, T9 and T23. 8.6% of the strains were not T-typable. The serotype distributions of skin lesions and healthy skin isolates were similar. The serotyping patterns of throat isolates differed slightly in that T-pattern of T8/25/Imp19 was encountered more frequently than T5/11/12/27/44.

Of the 70 strains of group A streptococci subjected to precipitation reactions, 4 were found to belong to each M-type of M39 and M59; one belonged to each M-type of M37 and M41, and 3 belonged to each provisional M-types of M1 and M6 (Table VIII).

Blood samples were available from 194 patients at their initial visit for estimations of antistreptolysin O titre. Only 51 (26.2%) had a titre of 200 Todd units and more (Table IX). An analysis of sera from 109 patients with skin lesions positive for beta-haemolytic streptococci revealed that only 37 (34%) of them had ASO titres of 200 Todd units and more. Although the blood sampling was made at the first visit to the hospital, it was postulated that the pathological process had been in progress for several days and that streptolysin O should have already given sufficient antigenic stimuli.

TABLE V—Isolation of Beta-Haemolytic Streptococci from Throat and Normal Skin in Skin Lesion Patients

Throat with β -Strep	No. of Individuals	Skin Lesion		Normal Skin	
		With β -Strep	Without β -Strep	With β -Strep	Without β -Strep
+	28	21	7	8	20
-	169	89	80	43	126

TABLE VI— β -Streptococci and Staphylococcus Aureus in Skin Lesions of Various Ethnic Groups

Ethnic Group	% of Ethnic* Group in Population	No. of patients with pyoderma examined	Relative Incidence	β -Streptococci		Staphylococcus aureus	
				No. of patients	Relative Incidence	No. of patients	Relative Incidence
Chinese	75.2	120	0.80	61	0.41	86	0.57
Malays	15	50	1.69	33	1.12	43	1.46
Indians/ Pakistanis	7	20	1.45	11	0.80	14	1.02
Others	1.8	7	1.98	5	1.41	6	1.69

* Based on 1970 Population Census in Singapore.

TABLE VII—T-Type Pattern of Group A Streptococci Isolated From Different Sites

T-Pattern	Skin Lesions		Normal Skin		Throat		Grand Total	
	No.	%	No.	%	No.	%	No.	%
1	1	0.6	2	4.5	0	0	3	1.3
2	5	3.1	0	0	0	0	5	2.2
3/13/B 3264	46	28.4	10	22.7	6	28.6	62	27.3
4/24/26/28/29/46	43	26.5	12	27.3	6	28.6	61	26.9
5/11/12/27/44	18	11.1	7	15.9	1	4.8	26	11.5
6	4	2.5	0	0	1	4.8	5	2.2
9	5	3.1	2	4.5	0	0	7	3.1
14/49	10	6.2	4	9.1	2	9.5	16	7.0
23	2	1.2	0	0	0	0	2	0.9
8/25/IMP 19	14	8.6	4	9.1	3	14.3	21	9.6
Untypable	14	8.6	3	6.8	2	9.5	19	8.4
Total	162	100	44	100	21	100	227	100

DISCUSSION

The results of this study, in agreement with several other investigators showed that beta-haemolytic streptococci and staphylococci were the predominant organisms recovered from skin lesions (Anthony, B.F. et al, 1967; Dajani, A.S. et al, 1968, 1973; Dillon, H.C., 1968; Allen, A.M. et al,

1971; Zawahry, M. E1. et al, 1972; Nelson, K.E. et al, 1976). Most of the beta-haemolytic streptococci belonged to Lancefield group A, the remaining few belonging to groups C and G. Streptococci and staphylococci coexist in the majority of instances and Staphylococcus aureus was more commonly isolated than Staphylococcus epidermidis.

TABLE VIII—M-Types of Group A Streptococci

M-Type	No. of Strain
59	4
41	1
39	4
37	1
Probable M-Type	No. of Strain
1	3
6	3

Although *Staphylococcus aureus* was considered to be the most important pathogen in pyoderma by some workers (Bigger, J.W. et al, 1943; Sheehan, H.L. et al, 1943; Barrow, G.I., 1965; Parker, M.T. et al, 1955 and Van Toorn, M.J., 1961), others believed that group A streptococci are the primary aetiological agents and that staphylococci are secondary invaders (Swift, H.F., 1952; Dillon, H.C. Jr., 1968 and Dajani, A.S. et al, 1973).

Studies done by Dajani, A.S. et al (1972, 1973) enabled them to make the following observations:—

1. Streptococci alone were more often recovered from early lesions than from crusted ones.
2. Early lesions are more often pure streptococci than pure staphylococci.
3. Streptococci last longer than staphylococci in mixed lesions; and
4. in serially cultured lesions, staphylococcal phage types change frequently, whereas the same streptococcal serotypes persist in the majority of instances.

These observations strongly suggest a primary role for the streptococcus in the pathogenesis of superficial pyoderma.

Different workers reported varying isolation rates of beta-haemolytic streptococci. Rates of 47% (Dajani, A.S. et al, 1968), 53% (Allen, A.M. et al, 1971) and 57.4% (Burnett, J.W., 1962) had been reported. Our isolation rate of 55.8% is therefore comparable to others.

Data obtained from the present study revealed that the part of the body with the highest frequency of skin lesions was the lower extremities followed by the upper extremities, head and trunk. This pattern of distribution of skin lesions in relation to body surfaces is similar to the findings of Dajani, A.S. et al (1973) and appears to be correspond to the degree of exposures to injury and subsequent infections. Living in a tropical country

like Singapore, the skin is more apt to be exposed and especially in children it is more likely to be traumatised whether as a result of insect bites or through mechanical trauma. The high percentage of children with skin lesions present in this study lends support to this observation. Moreover, children less than 5 years of age accounted for about half (47.2%) of the pyoderma cases studied.

Studies carried out at the Red Lake Indian Reservation revealed that a primary factor in the development of pyoderma was previous acquisition of streptococci on the normal skin (Dudding, B.A. et al, 1968). Ferrieri, P. et al (1972) confirmed the above finding with observations at more frequent intervals made on children, initiated in many cases some weeks or months before the appearance of skin lesions. They found that in 94% of instances, the streptococcal strain was recovered from normal skin of an individual before it appeared in the respiratory tract and in 75% of instances, lesions harbouring this specific strain developed before the strain appeared in the upper respiratory tract. Results obtained in this survey support the above view that the streptococci colonizing healthy skin and/or causing skin lesions do not originate from the throat.

In spite of the fact that our study group was comprised of 120 Chinese, 50 Malays and 20 Indians, yet the incidence of superficial pyoderma was lowest in the Chinese and highest in the Malays. Whether or not this difference reflects a different socio-economic standard among the ethnic groups has yet to be confirmed.

Although there appeared to be two seasonal peaks in the number of skin lesion cases, no conclusive evidence can be drawn on the seasonal variation mainly because of the small number of cases studied.

Parker, M.T. et al (1955) and Barrow, G.I. (1955) described the association of limited serotypes of streptococci with superficial skin infections. The majority of their strains belonged to one of three T-antigen complexes of 3/13/B3264, 5/12/27/44 and 8/25/Imp19. T-agglutination patterns similar to Parker et al had also been reported by Dillon, H.C. (1967) and Nelson, K.E. (1976). Dajani, A.S. et al (1968) however found that most of their group A streptococcal isolates from cases of superficial pyoderma agglutinated with T-pattern 8/25/Imp 19 (40%) with no impressive prevalence among the other types found. The three T-patterns of 3/13/B3264, 4/24/24/28/29/46 and 5/12/27/44 together accounted for 66% of our streptococcal isolates from skin lesions. In addition the serotyping

TABLE IX—ASO Titre in Todd Units

Age Group (years)	< 200					200—400					> 400					
	No. of Patients	With Strep Lesions		Without Strep Lesions		No. of Patients	With Strep Lesions		Without Strep Lesions		No. of Patients	With Strep Lesions		Without Strep Lesions		Not Done
		No.	%	No.	%		No.	%	No.	%		No.	%	No.	%	
<5	72	35	48.6	37	51.4	14	11	78.6	3	21.4	6	6	100	0	10	1
5 - 9	13	9	69.2	4	30.7	6	4	66.7	2	33.3	2	1	50	1	50	1
10 - 14	11	7	63.6	4	36.4	3	3	100	0	0	4	3	75	1	25	0
15 - 19	7	3	42.9	4	57.1	5	3	60	2	40	2	2	100	0	0	0
20 or >	40	18	45	22	55	9	4	44.4	5	55.6	0	0	0	0	0	1
Total	143	72	50.3	71	49.7	37	25	67.6	12	32.4	14	12	85.7	2	14.3	3

patterns of normal skin isolates mirrored those found in skin lesions.

Most workers found a relatively low percentage of skin strains of group A streptococci to be M-typable (Dajani, A.S. et al, 1968; Allen, A.M. et al, 1971; Nelson, K.E. et al, 1976). Our streptococcal isolates were no exception in that the majority (77.1%) could not be serotyped with the reference M antisera currently available. Of the six streptococcal M serotypes found in this study, only M-type 59 had been reported to have been isolated from patients with pyoderma and acute glomerulonephritis. In fact, it had been known to account for a number of cases of nephritis in Alabama, but had not been reported to have been associated with epidemic outbreak of nephritis (Dillon, H.C. et al, 1974).

The low percentage of our patients having anti-streptolysin O titres of more than 200 Todd units confirmed the results of earlier studies that the ASO response is poor after streptococcal skin infection (Kaplan, E.L. et al, 1970; Bisno, A.L. et al, 1973). This phenomenon could be related to suppression of streptolysin O by cholesterol or other skin lipids (Kaplan, E.L. et al, 1973). On the other hand, certain streptococcal antibodies like anti-deoxyribonuclease B regularly respond with increased titres following streptococcal pyoderma (Kaplan, E.L. et al, 1970; Bisno, A.L. et al, 1973).

There is thus a need for an alternative serological test like antideoxyribonuclease B for studying serological responses to streptococcal skin infections.

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