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The bacteriology of tropical pyomyositis in Uganda

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Tropical pyomyositis is a condition which is clinically well defined (Ashken & Cotton, 1963; Cook, 1963). It consists essentially of large abscesses in voluntary muscles. They may be single or multiple and sometimes as much as a pint of pus may be evacuated from a single abscess. The condition has been reported from widely scattered parts of the tropical world including various parts of West Africa, East Africa, Malaya, Dutch East Indies, Pacific Islands, Brazil and the West Indies (Traquair, 1947). On the other hand, pyomyositis is very rare in temperate climates. Abram (1904) reported two cases from which streptococci were isolated, and Barrett & Gresham (1958) also reported four fatal cases from which group A streptococci were isolated. Adams, Denny-Brown & Pearson (1962), who have not seen a single case of suppuration in voluntary muscle, remark that 'the rarety of abscess formation in muscle even in the face of overwhelming septicaemia...indicates that muscle tissue does not provide a suitable medium for the growth of many bacteria'. This statement is certainly untrue for Africans in Uganda where the voluntary muscles are one of the commonest sites of suppuration due to pyogenic bacteria. However, cases have been described from temperate climates. Clark (1887), in England, reported a fatal case but no bacteriological examination of the pus was made. Ryle (1949) described a case without comment in his essay on staphylococcal fever and seven cases were reported from Sweden in 1924 (Holm, 1924). Cases have also been reported in Europeans resident in the tropics (Robin, 1961).

Various organisms have been isolated from the pus including a Pasteurella (Bouffard, 1920) and non-haemolytic streptococci (Robin, 1961). However, by far the most frequently reported organism has been the staphylococcus, usually *Staphylococcus aureus* but sometimes *Staph. albus*.

Fleming (1930) was the first to report a case from Uganda and *Staph. aureus* was isolated from this patient. But the disease certainly occurred long ago in Uganda for in the manuscript case notes of the Mengo Hospital, Kampala, for 1897 there is a case which can be confidently recognized as pyomyositis and in another case of the following year there is a drawing of some pus under the microscope illustrating the contained staphylococci. Cook (1963) reported a declining incidence of pyomyositis from 250 cases seen at Mulago Hospital, Kampala, in 1948 to 71 in 1961. Nevertheless, the disease is still very common. The present series of 79 cases was collected in about 9 months in 1964 and many cases have certainly been missed. The object of this paper is to present a detailed study of the bacteriology of these typical cases of tropical pyomyositis and to compare the phage-types and

antibiotic sensitivity pattern of the pyomyositis staphylococci with strains isolated from other lesions and from healthy nasal carriers.

It has been suggested that pyomyositis is associated with two specific infectious diseases: leptospirosis (Meyer-May & Vaucell, 1936) and syphilis (Manson-Bahr, 1960). Serum from some of the present patients has therefore been tested for evidence of leptospirosis and treponemal infection.

THE CLINICAL MATERIAL

The pyomyositis cases consisted of 79 patients. They were quite typical, the clinical history being usually one of pain and swelling of the affected part for 1 or 2 weeks. Any of the larger muscles may be affected, the calf, thigh, buttocks, and lumbar, subscapular and pectoral regions, as well as the arm have all been affected in the present series. Not infrequently several different sites were involved. At operation large abscesses were found deep to the deep fascia.

The strains of staphylococci isolated from other lesions for comparative purposes were an unselected collection of strains isolated in the clinical laboratory from hospital in-patients with a variety of infections such as osteomyelitis, wound infections, burns, skin and chest infections.

The nasal carrier strains were isolated from an unselected population of all ages and both sexes of Ugandans at school or attending dispensaries as out-patients. They had no connexion with the in-patient hospital environment. Table 1 shows sex and age distribution by decades of the pyomyositis patients where this information was available.

Table 1. *The distribution according to sex and age (decade) of fifty-three cases of pyomyositis*

	Decade							
	1st	2nd	3rd	4th	5th	6th	7th	Total
Male	8	10	4	8	4	1	1	36
Female	3	4	7	0	2	1	0	17

METHODS

Pus was collected at operation and plated out as soon as possible on human blood agar plates and incubated overnight at 37° C. both aerobically and anaerobically. A Gram-stained film of the pus was also examined microscopically.

The organisms isolated were identified by conventional methods. *Staph. aureus* was identified on the basis of typical colonial appearance, morphology and a positive slide coagulase test using citrated rabbit plasma. The staphylococci were phage-typed at the Staphylococcus Reference Laboratory, Colindale Avenue, London.

Antibiotic sensitivity was tested on 'Oxoid' Sensitivity agar using 'Oxoid' Multodiscs containing penicillin 1·5 units, streptomycin 10 μg., tetracycline 10 μg., chloramphenicol 10 μg., erythromycin 10 μg. and novobiocin 5 μg. Serum anti-α-lysin titres were measured using the method described by Lack & Towers (1962).

The Wassermann reaction (W.R.) and the Reiter protein complement fixation (R.P.C.F.) test were done in the standard way using a 1/5 dilution of patient's serum and 3 m.h.d. complement with incubation for 1 hr. at 37° C.

RESULTS

Table 2 shows the organisms isolated from the pus of the 79 cases of tropical pyomyositis. It will be seen that in most cases *Staph. aureus* was isolated in pure culture. Table 3 shows the distribution of the pyomyositis, hospital and carrier strains amongst the three main phage groups. The percentage of the total, in round figures, is shown in parentheses. The most striking observation is that 60 % of the pyomyositis strains belong to phage Group II as compared with 22 % for

Table 2. *Organisms isolated from the pus of seventy-nine cases of pyomyositis*

Organism	No. of cases
Staph. aureus	74
Staph. aureus + Group C Strep.	1
Group A Strep.	1
Strep. viridans	1
Non-haemolytic Strep.	2

Table 3. *The distribution of pyomyositis, other lesion and nasal carrier strains of* Staphylococcus aureus *between the three phage groups (percentages in parentheses)*

	Pyomyositis	Other lesions	Carrier
Group I	13 (18)	12 (24)	18 (20)
Group II	44 (60)	11 (22)	19 (21)
Group III	16 (21)	23 (46)	31 (35)
Untypable	1 (1)	4 (8)	21 (24)
Total	74	50	89

Table 4. *Comparison of the antibiotic resistance pattern of the pyomyositis, other lesion and carrier strains of* Staphylococcus aureus *(percentages in parentheses)*

Number of antibiotics to which resistant	Pyomyositis	Other lesions	Carrier
0	15 (20)	7 (14)	60 (67)
1	43 (58)	19 (38)	20 (23)
2	15 (20)	18 (36)	7 (8)
3	1 (2)	6 (12)	2 (2)

other lesions and 21 % for the carrier strains. Of the 44 Group II pyomyositis strains 32 had a single phage-typing pattern 3A/3B/3C/55/71 or did not differ from it by more than a single phage reaction, whereas this phage pattern accounted for only eight of the 50 strains from other lesions and nine of the 89 carrier strains. Table 4 shows the number of strains in each series which were either sensitive to all antibiotics tested or resistant to one, two or three antibiotics. Generally those

strains which were resistant to a single antibiotic were penicillin resistant; when resistant to two antibiotics to penicillin and streptomycin and when resistant to three antibiotics to penicillin, streptomycin, and tetracycline but occasionally a different pattern occurred. It will be seen that although the pyomyositis strains seldom showed multiple resistance they were penicillin resistant much more often than the carrier strains in the population from which they were presumably derived.

The results of the examination of serum samples from a number of patients for agglutinins to leptospira, for anti-staphylococcal alpha-lysin and for evidence of syphilis were as follows:

Leptospiral agglutinins. Eight serum samples were tested and all showed titres of 1/10 or less to both *L. icterohaemorrhagiae* and *L. canicola.* (These tests were kindly done by Dr P. Bradstreet of the Central Public Health Laboratory, Colindale Avenue London.)

Anti-staphylococcal alpha-lysin titres. Twenty serum samples were tested; 14 showed levels of 2 units per ml. or less, four showed 4 units per ml., one showed 6 units per ml. and one showed 16 units per ml.

Serological evidence of syphilis. Twenty serum samples were tested, three gave positive reactions with the W.R. and R.P.C.F. test. A further serum gave a positive W.R. but negative R.P.C.F. test. The remaining 16 sera were negative with both tests.

DISCUSSION

The character of staphylococcal strains from pyomyositis

The most interesting point in these observations is that 60% of the pyomyositis staphylococci belong to phage Group II and that 43% possess the single phage-typing pattern 3a/3b/3c/55/71 or do not differ from it by more than a single phage-pattern reaction. This is unusual in staphylococcal infections where, in general, all phage types are capable of causing the whole range of staphylococcal disease. The only previously described well-substantiated exceptions are: (1) that 70% of staphylococci from cases of impetigo are lysed by phage 71 only; and (2) that 83% of staphylococci from outbreaks of food-poisoning belong to phage Group III (Anderson & Williams, 1956; Williams, Rippon & Dowsett, 1953). There is, however, a tendency for some phage-types of staphylococci to be associated more with certain broad groups of infections than others. For example, Williams *et al.* (1953), in England, found that of 34 strains from fulminating, post-influenzal pneumonia 60% belonged to phage Group I but this was not true of other cases of staphylococcal pneumonia. Rountree (1953), in Australia, reported that of 59 strains from deep infections such as septicaemia, osteomyelitis and abscesses 44% belonged to phage Group II. This last observation is of special interest in the present connexion because although the phage patterns of this group are not stated nor the 'deep infections' characterized in detail it was noted that 20 out of 39 staphylococci from 'abscesses' belonged to phage Group II. We do not know the situation of these abscesses but they are distinguished from the group of boils and carbuncles. Parker (1958) also found a higher proportion of Group II strains in deep lesions as compared with superficial lesions. Williams & Jevons (1961)

showed that 31·3 % of staphylococcal infections arising outside hospital were caused by Group II strains, whereas Group II strains were responsible for only 11·1 % of infections acquired in hospital.

If all strains of staphylococci were similarly endowed with respect to pathogenicity one would expect the frequency of infecting types to be proportional to the frequency with which types were carried by the healthy population. This might be true in an uncomplicated situation consisting of cases of staphylococcal infection arising in an antibiotic-free environment. But since some strains are more capable of developing antibiotic resistance than others these strains have for a long time been selected to form 'hospital strains' and the same thing is true to a lesser extent outside hospitals. Of the 3a/3b/3c/55/71 strains causing pyomyositis 26 out of 32 were resistant to penicillin as compared with only two out of 10 carrier Group II strains and four out of 10 hospital Group II strains. It is true that many of the pyomyositis patients had been treated with penicillin before coming into hospital, but the onset of pyomyositis is rapid and it seems unlikely that the staphylococci could become resistant during the brief period of therapy. Moreover, of the other strains besides Group II strains isolated from pyomyositis only 14 out of 29 were penicillin resistant, despite the fact that they belonged to phage groups which acquire antibiotic resistance more rapidly. This suggests that staphylococci with the phage pattern 3a/3b/3c/55/71 and which are penicillin-resistant are most characteristic of pyomyositis.

Associated aetiological factors in pyomyositis

At one time or another a number of factors have been claimed to be associated with or to precipitate pyomyositis but none have been well substantiated. Burkitt (1947) investigated the possible association of pyomyositis with filariasis, ankylostomiasis, malaria and sickle-cell anaemia with negative results. Ashken & Cotton (1963) have suggested that subclinical scurvy and trauma may be predisposing causes. These factors have not been investigated in the present series.

Meyer-May & Vaucel (1936), working in Hanoi, found that 12 out of 54 cases of pyomyositis showed agglutinin titres of between 1/300 and 1/1000 against *Leptospira icterohaemorrhagiae*. Sera from the first eight patients in the present series were tested for leptospiral agglutinins and all found to be negative.

Manson-Bahr (1960) stated that 50 % of cases of pyomyositis have a positive Wassermann reaction and recommended anti-syphilitic therapy. The serum of 20 patients in the present series was tested and three were found to have both a positive W.R. and R.P.C.F. test and should therefore be regarded as having evidence of previous treponemal infection. A fourth patient with a positive W.R. but a negative R.P.C.F. test should probably be regarded as a false positive not indicating treponemal infection. A difficulty in associating any condition with treponemal infection in the tropics is that serological evidence of such infection may be found in a high proportion of the population. If reliance is placed on the W.R. alone positive reactions will be found not only due to true treponemal infections but also to false positive reactions due to such conditions as malaria. There are no published figures showing the incidence of serological evidence of syphilis in Uganda but a

comparison with a small number of sera recently tested suggests that three out of 20 positive is not in excess of the rate found in the general population.

The investigation here reported shows that staphylococci of phage Group II are more frequently found in cases of pyomyositis occurring in Uganda than would be expected from their incidence amongst healthy nasal carriers or other types of staphylococcal infection. Why this should be so is unknown but it is in line with the observations of Williams & Jevons (1961) that a higher proportion of Group II strains are found amongst staphylococcal infections arising outside hospital than amongst nasal carriers or staphylococcal infections arising in hospitals. As Dr M. T. Parker has suggested to me it may be that Group II strains are particularly well able to penetrate unbroken skin and cause infections. It would be of interest to know the phage-types of staphylococci found in pyomyositis in other parts of the world. However, factors other than a particular type of staphylococcus are clearly important in the aetiology of pyomyositis since many strains of staphylococci as well as other organisms can cause the disease. There may be some impairment of the patient's immune response, for 14 out of 20 of the present series showed a serum anti-alpha-lysin titre of less than 2 units per ml. on a single sample of serum taken about the time of operation. This may, however, be merely a reflexion of the fact that the disease up to operation is usually short. It was not possible to take serial blood samples.

The source of the infecting staphylococcus is not known. Although it has been claimed that there is sometimes a history of recent boils this does not seem to be usual. The carrier state of the patients before operation would be of considerable interest. It has been possible to test this in the present series in only three cases, in which nasal and perineal swabs showed no staphylococci. The preponderance of males amongst cases of pyomyositis which has been found in the present series may be of some significance, but might be due to a general difference in admission rate between the two sexes. More males than females are generally admitted to the New Mulago Hospital. However, all authors who have drawn their cases from the general population, rather than special groups such as soldiers, have noted this male preponderance, although Cook (1963) reported a narrowing of the sex difference from 5·5:1 between 1948 and 1955 to 2·7:1 between 1957 and 1961. If males are more susceptible than females it would seem likely that this is innate rather than environmental since the preponderance is found even in the first decade of life when environmental factors must be very similar for both sexes. Nor does it seem likely that trauma is a significant aetiological factor for it is doubtful if, in Uganda, males are subject to more trauma than females and the disease occurs in infants but a few months old.

A comparison of Uganda staphylococci with those from other parts of the world

I am not aware of any reports of the frequency of different phage-types in Uganda so that these results have some interest as showing, although the numbers are small, something of the distribution of different phage-types which can be compared with findings in other parts of the world, such as the data of Williams *et al.* and Parker from England and Rountree from Australia. Table 5 compares the

percentage of nasal carrier strains falling into three main phage groups. Table 6 compares 140 hospital strains tested by Williams *et al.* (1953), 76 strains from wounds and burns tested by Rountree (1953) and 78 strains from deep infections and 91 strains from superficial infections tested by Parker (1958) with the non-pyomyositis strains isolated in Uganda. The difference is not striking, particularly if one allows for the difference in the year in which the samples were collected and differences in availability of antibiotics in different countries which would be expected to favour the survival of Group III strains.

Table 5. *The distribution of nasal carrier strains of* Staphylococcus aureus *between the three phage groups in Uganda compared with England and Australia*

	Percentage of strains in		
	Group I	Group II	Group III
Williams *et al.* (1953)	24	14	19
Parker (1958)	34	22	15
Rountree (1953)	19	20	27
Uganda	20	21	34

Table 6. *The distribution of the non-pyomyositis hospital strains of* Staphylococcus aureus *between the three phage groups compared with strains isolated from lesions in England and Australia*

	Percentage of strains in		
	Group I	Group II	Group III
Williams *et al.*	14	4	56
Parker (deep)	33	36	13
Parker (superficial)	21	20	31
Rountree	20	21	24
Uganda	24	22	46

SUMMARY

1. The bacteriology of the pus from 79 cases of tropical pyomyositis has been studied. In 74 cases *Staphylococcus aureus* was isolated in pure culture.

2. Phage typing showed that 60 % of the pyomyositis strains belonged to phage Group II as compared with 22 % for miscellaneous hospital infections and 21 % for nasal carrier strains.

3. A high proportion of the Group II strains from pyomyositis were found to be penicillin resistant and it is thought that this is unlikely to be due to the use of penicillin therapeutically but is probably a natural characteristic of the strains.

4. Other suggested aetiological factors in pyomyositis such as leptospirosis and syphilis have been investigated but no association has been found.

5. The phage types of staphylococci found in Uganda have been compared with those reported from England and Australia and found not to be strikingly different.

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