NASAL CARRIAGE IN STAPHYLOCOCCAL SKIN INFECTIONS

BY

L. G. TULLOCH, M.D.

Senior Registrar (Dermatology) Bristol Royal Hospital

The treatment of chronic staphylococcal infections of the skin is seldom rewarded by the satisfaction of a really permanent cure, even after the delivery of mighty broadsides from our armamentarium of modern antibiotics. The main reasons for this, I would suggest, are threefold:

(a) *Constitutional*.—In some individuals favourable conditions are provided for the growth of staphylococci by virtue, for example, of a hormonal imbalance (especially androgen excess) or a metabolic imbalance (with particular reference to the sugar and water content of the skin). One cannot hope to alter these factors permanently.

(b) *Immunity*.—Active immunization against *Staphylococcus pyogenes* is, on the whole, disappointing. Favourable results have, however, been reported with vaccines and with toxoid, especially with the latter (Barber and Forman, 1933; Dolman, 1935; Whitby, 1936; Bocage, Mercier and Pillet, 1947; and others). There is much need for research in this field, and there are reasons for hoping for improvements in the immunological attack, but detailed discussion of this is beyond the scope of this article.

(c) *Nasal Carriage*.—There is abundant evidence to suggest that staphylococci flourishing in the anterior nares provide the source of infection, and of reinfection after local treatment, in most staphylococcal skin diseases. The anterior nares have been demonstrated to harbour staphylococci in greater profusion than any other part of the body and in a very high percentage of the population. Nasal carriage of staphylococci was first demonstrated by Danbolt (1931), and since then many others have carried out investigations to determine the incidence in the general population. Miles, Williams, and Clayton-Cooper (1944), in a sample of a working-class population, obtained a mean carrier rate of 47.4%; and Williams (1946), taking a series of eight weekly swabs from each of a number of individuals, obtained an average carrier rate of 63% for any one week, and a total carrier rate over the eight weeks as high as 89%.

It will be obvious, therefore, that sterilization of the anterior nares must be a corollary to other methods of treatment if indeed the bacteria responsible do originate from the nasal flora. McFarlan (1938), however, has drawn attention to the fact that the frequency of the presence of staphylococci in the noses of healthy individuals makes it possible that their presence in the noses of patients with staphylococcal infections might merely be a reflection of the carrier rate in the community, and that, before attaching any significance to such findings, the identity of the types would have to be proved. Professor Robert Cruickshank (1953), in his Malcolm Morris Memorial Lecture (December, 1951), voiced his suspicion of the nose as the source of infection in staphylococcal impetigo and stressed the need for the determination by phage-typing of the source of the infecting organism.

Miles *et al.* (1944) took the first step in this direction by phage-typing the nasal and skin strains from 16 persons; in 15 of these the strains proved to be identical. Williams (1946) produced similar results: 31 out of the 36 double (nasal and skin) carriers had identical strains present in the nose and on the skin. This double carriage of identical organisms offers strong presumptive

evidence that the nose is the source of staphylococcal skin infections. All that remains to be done is to prove the identity of strains obtained from the nose and from actual skin infections in the same individual. Hobbs, Carruthers, and Gough (1947) provide further evidence by the serological typing of strains from the nose and from facial lesions in 19 patients, 17 of whom had staphylococci in the nose, in each case of the same serological type as in the lesion. The numbers involved in this investigation are small, but the results are striking enough to be worthy of note.

A search of the literature revealed no report of any investigations in which strains from the skin lesions and from the nose were compared by phage-typing. I therefore collected a total of 73 pairs of cultures from the noses and lesions of patients suffering from sycosis barbae, furunculosis, folliculitis, and infective eczematoid dermatitis; these were typed and the results obtained are tabulated below. Since completing this work an account has been published by Valentine and Hall-Smith (1952) of a similar series, totalling 25 cases, which closely approximates to the results obtained by myself. In 19 cases the strains were identical, and in five probably identical. Unfortunately, details of the phage types are not given.

Phage-Typing

The cultures used in this investigation were obtained from a consecutive series of patients seen by me at the Manchester and Salford Hospital for Diseases of the Skin. No system of selection or rejection was employed.

Two swabs were taken from each patient—one from the anterior nares, and one from the boil, pustule, bulla, or under the crust in the eczematoid lesions. Cultures were made from these on blood-agar plates and incubated overnight at 37° C. In most cases well-pigmented aureus colonies of *Staph. pyogenes* were grown, although in a few cases coagulase-negative strains were found. Almost invariably the strains isolated from the nose and from the lesion in the same patient presented an identical appearance in colony, size, colour, and the amount of haemolysis produced. Subcultures were made in nutrient agar, and these were kept for typing.

In the earlier stages of this investigation I grew the phages from filtrates and propagating strains kindly supplied by the Public Health Laboratory Service. Later, when facilities were not available for propagation, the Central Public Health Laboratory was good enough to undertake the typing of the remaining strains to complete my series. The typing was carried out with the method described by Wilson and Atkinson* (1945). The results are tabulated below. All the strains listed were coagulase-positive.

Results

The key to the symbols used is as follows: The phage numbers represent phages producing confluent lysis. + represents additional minor reactions. NT indicates that the strain is not typable. W indicates weak reaction.

Sycosis Barbae.—Thirty cases were investigated. In seven of these neither strain was typable. In the remaining 23 the results were as shown in Table I.

Furunculosis and Folliculitis.—Thirty-three cases were investigated. In nine of these neither strain was typable. In the remaining 24 the results were as shown in Table II.

Infective Eczematoid Dermatitis.—Ten cases were investigated. In two of these neither strain was typable. In the remaining eight the results were as shown in Table III.

Of the 73 pairs of strains examined, 18 pairs were not typable, in 4 only one strain was typable, and in 51 both strains were typable. In 45 (88.2%) of these 51 pairs both strains were identical. In the various types of infection the

TABLE I

Case No.	Staphylococcal Phage Types	
	Nose	Skin Lesions
1 ..	6, 47, 54	6, 47, 54
2 ..	7+	7+
3 ..	54+	54+
4 ..	6, 47, 54+	6, 47, 54+
5 ..	54	54
6 ..	7, 47c, 54+	7, 47c, 54+
7 ..	7, 54+	7, 54+
8 ..	47+	47+
9 ..	7, 47, 54+	7, 47, 54+
10 ..	7, 42b, 42e, 54+	7, 42b, 42e, 54+
11 ..	7+	3b, 3c+
12 ..	52a+	52a+
13 ..	52a+	52a+
14 ..	52a	52a
15 ..	52a	52a
16 ..	3b, 3c	3b, 3c
17 ..	42e	42e
18 ..	42e	42e
19 ..	53, 31	53, 31
20 ..	31+	31+
21 ..	51+	51+
22 ..	6, 47, 54+	NT
23 ..	47, 54	NT

TABLE II

Case No.	Staphylococcal Phage Types	
	Nose	Skin Lesions
1 ..	7, 47, 54+	7, 47, 54+
2 ..	47, 54+	47, 54+
3 ..	6, 47+	6, 47+
4 ..	7, 47, 54	52a
5 ..	47, 54+	47, 54+
6 ..	7+	7+
7 ..	47, 53, 54+	47, 53, 54+
8 ..	31, 54	31, 54
9 ..	52a	52a
10 ..	3b, 51+	3b, 51+
11 ..	3b, 3c, 31+	3b, 3c, 31+
12 ..	3c+	3c+
13 ..	3b, 3c+	3b, 3c+
14 ..	3b, 3c, 31, 52a	3b, 3c, 31, 52a
15 ..	3c+	3c+
16 ..	51	51
17 ..	51+	51+
18 ..	42e	42e
19 ..	42e	42e
20 ..	31, 44	47+
21 ..	31, 53+	44+
22 ..	53+	52, 53W, 55a
23 ..	3b+	NT
24 ..	6, 47, 54	NT

TABLE III

Case No.	Staphylococcal Phage Types	
	Nose	Skin Lesions
1 ..	7+	7+
2 ..	54	54
3 ..	54	54
4 ..	31, 47	31, 47
5 ..	31+	31+
6 ..	3c+	3c+
7 ..	3c	6, 47+
8 ..	3b, 3c+	3b, 3c+

results were: (a) sycosis barbae, 20 (95.2%) out of the 21 typable pairs were identical; (b) furunculosis and folliculitis, 18 (81.8%) out of the 22 typable pairs were identical; (c) infective eczematoid dermatitis, 7 (87.5%) out of the 8 typable pairs were identical.

The two commonest groups of phage types encountered in the series were the 6/7/47/54 group and the 3b/3c group, which between them account for two-thirds of the total where typing was possible (46% and 20% respectively). Noteworthy also is the relatively small number of 3b/3c group in the sycosis series, and the absence of the 52a group in the infective eczematoid dermatitis series. Comparison with phage types found in other areas, such as those reported from St. Thomas's Hospital by Elwood (1951), suggests that there may be a geographical variation in the incidence of different phage types.

Discussion

These figures provide the final link in the chain of evidence proving the identity of the strains of staphylococci isolated from a skin infection and from the anterior nares of the same patient. It would therefore seem that the nose is the primary source of infecting organisms in most cases of chronic staphylococcal dermatoses. Moreover, these findings would suggest that local treatment alone, although temporarily successful, unless accompanied by an

attack on the nasal flora, is likely to be followed by a relapse of the infection. There are various methods by which sterilization of the anterior nares may be attempted. One which I have found useful for this purpose is the tyrothricin solution described by MacKee *et al.* (1946). Their formula is:

Sodium mixed alkyl sulphonate	..	1.0%
Tyrothricin	..	0.1%
Propylene glycol	..	10.0%
Distilled water	..	88.9%

This vehicle was found to increase the penetration of the tyrothricin. Alternatively, an aqueous solution of penicillin (1,000 units per ml.) is very effective, and, in spite of the risk of sensitization usually attached to the topical use of penicillin, I have yet to see it occur following the use in this way of an aqueous solution. These solutions are best administered with an atomizer, but, as this may not always be convenient, a suitable cream containing 0.1% tyrothricin or 1% aureomycin may be used. Tyrothricin is especially suitable for this purpose, as it is never administered parenterally; the risk of producing resistant strains may therefore be ignored.

Summary

A brief account is given of the relevant studies in staphylococcal carriage.

A report is made of an investigation establishing, by phage-typing, the identity of strains of staphylococci carried in the anterior nares and those isolated from infections of the skin.

The importance of adequate sterilization of the anterior nares in the treatment of staphylococcal skin infections is stressed, and methods of doing this are suggested.

I am indebted to the consultants of the Manchester and Salford Hospital for Diseases of the Skin for permission to investigate these cases; also to Professor H. B. Maitland, of the department of bacteriology, Manchester University, for the provision of laboratory facilities and for his encouragement and help. I wish to thank Dr. R. E. O. Williams, of the Central Public Health Laboratory, for undertaking the typing of the latter part of my series of staphylococcal strains. Part of the material in this article was incorporated in a thesis for the degree of M.D. (Aberdeen).

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The Ceylon Ministry of Health has asked the World Health Organization for the services of five international experts to establish in Colombo a third nurses' training school. The nursing team asked for consists of a principal for the school, a nursing arts instructor, a public health educator, a paediatrician, and a nurse. The Ministry has suggested that the contract of the W.H.O.'s staff working now in the nurses' training school in Kandy should be extended when it expires next year and that they should be transferred to Colombo. Other requests made to W.H.O. for new projects in 1956 include a consultant in preventive mental health for the mental health services and an epidemiologist for the Angoda fever hospital. These requests, which were put before the recent meeting of the Regional Committee for South-east Asia, were presented by Dr. D. L. J. KAHAWITA, director of Ceylon's health services.