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Bacteriological monitoring in penicillin treatment of streptococcal sore throat

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SUMMARY

Bacteriological monitoring of penicillin therapy in 30 children with streptococcal sore throats was performed by means of salivary and throat-swab culture, on the first, third, fifth and ninth days after therapy had started. Counts of beta-haemolytic streptococci per ml. of saliva were also performed.

Results showed that salivary culture and estimation of the numbers of beta-haemolytic streptococci in the saliva were much more sensitive indices of the effectiveness of penicillin treatment than throat-swab culture.

INTRODUCTION

Penicillin is universally accepted as being the best drug, in non-hypersensitive patients, for the treatment of streptococcal sore throat. Many investigators have recommended its use, including Hamburger & Lemon (1946), Denny, Wannamaker & Hahn (1953), Brumfitt & Slater (1957), Denny (1957), Breese & Disney (1958), Stillerman *et al.* (1960), Parker, Maxted & Fraser (1962) and Mitchell & Baber (1965).

Hitherto the criterion of successful penicillin therapy in streptococcal sore throat has been the production of a negative throat culture from the patients (Goerner, Massell & Jones, 1947). An element of chance is present in the use of swabs, however, and negative cultures may occur not necessarily because there are no organisms at the site of swabbing but perhaps because swabbing technique is faulty (Cruickshank, 1953; Ross, 1970) or because swabs which are detrimental to bacterial survival are used (Rubbo & Benjamin, 1951; Bartlett & Hughes, 1969). Ross (1971) reported, however, that a large number of isolations of beta-haemolytic streptococci, and in particular *Streptococcus pyogenes*, were obtained from cases of streptococcal sore throat when specimens of saliva were cultured. As it was felt that the use of the throat swab alone was a rather insensitive approach to the isolation of streptococci from the respiratory tract, it was decided to culture salivary specimens and perform salivary counts of beta-haemolytic streptococci in cases treated with penicillin, in order to ascertain whether or not a more accurate picture of the effect of penicillin therapy was produced by these procedures than by culture of throat swabs.

MATERIALS AND METHODS

Selection of children

Thirty-two children under the age of 15 years who presented with sore throats to family doctors in a group practice, and from whom beta-haemolytic streptococci were isolated, were investigated. These children were part of a group of 47 children who were investigated in studies on beta-haemolytic streptococci in the saliva (Ross, 1971). The doctors obtained specimens of saliva as well as throat swabs and completed a form for each child at the initial examination. At this time 30 of the children received 0·5–1 g. of oral penicillin daily, as recommended by the British National Formulary (1966) and the Monthly Index of Medical Specialities (1968). All daily doses were given orally in four equal amounts; the other children, usually those over 10 years of age, were prescribed 1·0 g. daily and the younger children 0·5 g. (see Table 2). Those who received 1·0 g. daily had a course of treatment of 7 days and those who were prescribed 0·5 g. daily had a course of 5, 6 or 7 days, depending on which of the doctors in the group prescribed the treatment. One of the two children who did not receive penicillin was prescribed 1·0 g. of erythromycin daily for 5 days and the other was given only analgesic.

Specimen collection

This is described in the previous paper (Ross, 1971). On the third, fifth and ninth days after the start of treatment the author visited the children's homes and obtained salivary specimens and throat swabs. At these visits a check was made on the number of tablets or amount of suspensions remaining, to ensure that the children had taken the treatment prescribed for them.

Laboratory methods

These are described in the previous paper (Ross, 1971).

RESULTS

Table 1 indicates the number and percentage of salivary and throat-swab cultures which were positive on the first, third, fifth and ninth days after the start of treatment. All salivary and throat-swab cultures were positive on the first day,

Table 1. *Growth of beta-haemolytic streptococci from the saliva and throats of 30 children with acute streptococcal sore throat, on the first, third, fifth and ninth days after penicillin therapy had commenced*

	Growth from saliva		Growth from throat	
	No.	%	No.	%
First day	30	100	30	100
Third day	21	70	10	33·3
Fifth day	7	23·3	1	3·3
Ninth day	4	13·3	1	3·3

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but thereafter the causal organisms were harvested much more often from the saliva.

In Table 2 the salivary counts of beta-haemolytic streptococci and the results of throat-swab culture from the 30 children on the various days of investigation can be seen. The highest initial count was $4{\cdot}4 \times 10^6$ per ml. and the lowest $6{\cdot}4 \times 10^5$ per ml. In most cases the numbers of beta-haemolytic streptococci isolated fell as treatment continued, but these organisms could still be cultured from the saliva of cases 8, 14, 15 and 27 on the ninth day. In the child who received erythromycin, salivary and throat cultures were negative by the fifth day, but the child who was

Table 2. *Salivary counts of beta-haemolytic streptococci (thousands/ml.), and growth from the throat swabs, of 30 children with acute streptococcal sore throat undergoing penicillin treatment*

		Day of treatment							
		First		Third		Fifth		Ninth	
Case no.	Treatment class*	Salivary count (10^3/ml.)	TS†	Salivary count (10^3/ml.)	TS†	Salivary count (10^3/ml.)	TS†	Salivary count (10^3/ml.)	TS†
1	A	1040	+	72	+	–	–	–	–
2	B	920	+	48	–	–	–	–	–
3	B	1560	+	36	–	–	–	–	–
4	D	880	+	8	–	–	–	–	–
5	D	1480	+	–	–	–	–	–	–
6	A	1200	+	240	–	–	–	–	–
7	A	2400	+	–	–	–	–	–	–
8	B	1280	+	12	+	8	–	8	–
9	B	960	+	4	+	–	–	–	–
10	B	720	+	48	–	–	–	–	–
11	B	640	+	–	–	–	–	–	–
12	B	920	+	–	–	–	–	–	–
13	B	800	+	64	–	–	–	–	–
14	B	3200	+	2400	+	260	+	160	+
15	A	2400	+	1300	–	300	–	24	–
16	D	2000	+	–	–	–	–	–	–
17	B	900	+	–	–	–	–	–	–
18	B	840	+	104	+	–	–	–	–
19	B	2200	+	760	+	128	–	–	–
20	C	1040	+	440	+	164	–	–	–
21	C	840	+	–	–	–	–	–	–
22	A	1000	+	84	–	–	–	–	–
23	C	1600	+	220	–	–	–	–	–
24	A	1800	+	92	–	–	–	–	–
25	B	2600	+	–	–	–	–	–	–
26	B	4400	+	–	–	–	–	–	–
27	B	1240	+	360	+	76	–	8	–
28	B	2360	+	600	+	–	–	–	–
29	A	1480	+	496	–	–	–	–	–
30	A	3720	+	256	+	44	–	–	–

* The penicillin treatment classes are as follows: A, 1·0 g. daily for 7 days; B, 0·5 g. daily for 7 days; C, 0·5 g. daily for 6 days; D, 0·5 g. daily for 5 days.

† TS = throat-swab result.

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prescribed analgesic produced positive throat and salivary cultures on the ninth day.

On the first day of examination, when growth was obtained from all specimens of saliva and all throat swabs, the beta-haemolytic streptococci isolated from the saliva and those from the throat of each child were grouped and in every case the organisms from the saliva and the throat belonged to the same group. Twenty-eight of the 30 pairs of beta-haemolytic streptococci were group A and the other two pairs (cases 11 and 21) were group G. Each pair of *Strep. pyogenes* had similar T-agglutination patterns. The organisms isolated from the throat and saliva of each child were similar not only at the first but also at each subsequent isolation.

DISCUSSION

It was surprising to find that as many as four children who had been prescribed penicillin still retained *Strep. pyogenes*, of the serotype originally isolated from the throat, in the saliva on the ninth day. The counts were not high however (see Table 2). The doses of penicillin which were prescribed for these children were those recommended by the manufacturers of the proprietary preparations and also by the British National Formulary (1966) and the Monthly Index of Medical Specialities (1968). In such antibiotic literature, although daily dose schedules are well documented the duration of treatment is not, although in the British National Formulary (1966) it is stated that in most cases penicillin treatment should not be continued for more than 7 days. The impression is given in much of the literature that the main factor in the control of therapy is clinical response. In the present series, although all the children had recovered clinically from their throat infection by the fifth day, 23 % still retained the infecting organism. It is clear that at times clinical and bacteriological response may be quite unrelated, but the aim of treatment for streptococcal sore throat should be eradication of the streptococci.

The two sampling techniques produced conflicting results; those obtained from throat-swab culture indicated a greater degree of treatment success than those from salivary culture. The treatment failure rate was in the region of 13 % using salivary culture as an indicator of therapeutic efficacy, but only in the region of 3 % using conventional throat-swab culture. It was surprising to record such a large number of children with high counts of beta-haemolytic streptococci even after 5 days' treatment. There is no doubt that by using the results of throat-swab culture rather than those of salivary culture a far more optimistic picture of the efficiency of the therapeutic measure was obtained.

Cases 8, 14, 15 and 27 still retained *Strep. pyogenes* in the saliva on the ninth day; the counts per ml. in cases 8, 15 and 27 were very low, but this was not so in case 14, who had a count of $1{\cdot}6 \times 10^5$ per ml. These treatment 'failures' may have been due to failures in absorption of penicillin or simply to the children not taking the prescribed treatment; although at each home visit checks were made on the amount of penicillin remaining, it does not necessarily mean that the penicillin was actually ingested. The most likely explanation, however, is that the duration of treatment was too short; in oral penicillin therapy a 10-day course is necessary if

eradication or near-eradication of the organisms is to be achieved (Wannamaker *et al.* 1953).

Four of the 30 children, cases 5, 12, 21 and 26, had had their tonsils removed, and it is interesting to note that the organisms were completely eradicated from each of these children by the third day, even from the child who produced the highest initial count of the series, $4{\cdot}4 \times 10^6$ per ml. It may be that these children with tonsils present are more obstinate from the point of view of treatment, the beta-haemolytic streptococci presumably obtaining protection from the antibiotic by lodging in tonsillar crypts, which may also contain protective cellular debris. As the streptococci from the sore throat can be isolated from the saliva, however, this protection is presumably only partial.

Growth was never produced from throat-swab culture and not from culture of saliva, but in many cases growth was obtained from culture of saliva but not from throat-swab culture. Culture of a specimen of saliva has been recommended for the isolation of beta-haemolytic streptococci from the upper respiratory tract (Ross, 1971), and it can be seen that to perform viable counts of beta-haemolytic streptococci in the saliva of cases of streptococcal sore throat can be a useful guide in assessing the efficacy of penicillin, or indeed any antibiotic, therapy; these results also show that the throat swab alone is less sensitive, and may produce erroneous results. It should not be used as a sole agent in the bacteriological monitoring of penicillin therapy for streptococcal sore throat.

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