TWO SCHOOL OUTBREAKS OF STREPTOCOCCAL THROAT INFECTION
THE EFFECT OF SULPHONAMIDE LOZENGES ON CARRIERS

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The main purpose of this paper is to report the failure of sulphonamides in the form of lozenges to clear up streptococcal carriers met with during the investigation of outbreaks of streptococcal infection at two residential schools, or to prevent contacts from becoming infected.

School X

This is a residential public school in Wiltshire containing about 200 girls aged 11 to 18, half of whom are housed, during the war, in a large country mansion (B) standing in its own grounds, and half on a country estate (C) about 7 miles away. The girls at C come over each day by motor-bus to B, where the teaching is carried out.

During the last few weeks of the Easter term, 1944, there was a small outbreak of sore throats in B and C; about 12 girls in all were affected. No rashes were observed, but during the holidays one of the girls, Joanna Br., peeled. About ten days after the end of the term one girl—Gillian Bo.—had a typical attack of scarlet fever, and another girl—Gillian Go.—had a sore throat. No bacteriological examinations were made. Joanna Br. returned to school at the beginning of the summer term (April 26), together with her sister, Penelope Br., who was never ill; Gillian Go. returned at the same time, but Gillian Bo. did not come back till May 28.

Six days after the beginning of the term a fresh outbreak of sore throats began, affecting C and later B. Between May 2 and July 14 there were 39 cases. The lesions were more those of a granular pharyngitis than of a follicular tonsillitis. The cases were mild, and none of the girls was seriously ill. On May 25 a girl who had been admitted to the sanatorium on May 8 and returned to school on May 16 was found to be peeling. Up till then no suspicion of scarlet fever had arisen, but on May 25, 26, and 27 three cases of sore throat accompanied by a rash occurred in succession, and it was decided to call in the Emergency Public Health Laboratory at Oxford. A visit was paid to the school on May 29 to take stock of the position and to determine the type of streptococcus responsible for the outbreak. Nose and throat swabs were taken from all girls who had suffered from sore throat in the Easter term, and from all cases and convalescents in the summer term. Two days later—May 31—the entire school, including girls and teaching and domestic staff, was swabbed. The result of these examinations was as follows:

The infecting type of streptococcus was Type 1.	
Number of Type 1 carriers among sick and convalescents during summer term	21 out of 33
Carrier rate	64%
Number of Type 1 carriers among normal contacts, including those ill during Easter term	19 out of 164
Carrier rate	11.6%
Number of Type 1 carriers among normal contacts, excluding those who were ill during Easter term	18 out of 156
Carrier rate	11.5%

Origin of Outbreak.—Without going into detail we may say that the summer-term outbreak appeared to be due to infection introduced by one of the girls who had suffered from sore throat or mild scarlet fever at the end of the Easter term or during the holidays. At the first swabbing, on May 29, two of these convalescents (Joanna Br. and Gillian Go.) were still carrying Type 1 streptococci. Joanna Br. had enlarged unhealthy tonsils, the removal of which in June was followed by disappearance of streptococci from her throat. Joanna, however, was housed at B, and was in a junior form, whereas the outbreak started at C among the sixth-form girls. It is improbable, therefore, that she was responsible, though she may possibly have infected her sister, Penelope Br., during the Easter holidays, and Penelope, who was in the sixth form at C, had served as a healthy carrier to introduce the infection. More suspicion attaches to Gillian Go., who was ill during the Easter

holidays and who, like Penelope, was in the sixth form and at C. Lack of information, however, on the distribution of streptococci at the beginning of the summer term prevents this conclusion from being more than speculative. Gillian Go. was later seen by an ear-nose-and-throat specialist, who advised removal of her tonsils and draining of her antra—with what effect we were unable to observe.

Treatment at School X

Cases in the sanatorium were given sulphonamide treatment—3 g. of sulphanimide for three days, followed by 1½ g. a day for one or two further days—and a chlorine gargle. As soon as it was apparent that an outbreak of sore throats was starting, all the girls in the school had their throats treated twice daily with a formol spray, and were given a permanganate gargle—later changed to Milton fluid. The failure of sulphonamide treatment to get rid of streptococci from the throat in these cases was shown by the fact that 9 out of 18 convalescents who were swabbed on May 29 were found to be still carrying Type 1 streptococci; and the failure of the local spray and gargle to protect the healthy contacts was shown by the occurrence of 15 fresh cases of sore throat or scarlet fever among girls who were undergoing this form of preventive treatment.

As soon as the distribution of the infecting organism was known from the swabbings on May 29 and 31, arrangements were made to segregate the heavy carriers in separate dormitories and class-rooms. All girls who developed sore throats were to be treated in the sanatorium for a few days, then kept segregated in special wards at B or C, and not allowed to return to school for 14 days after the beginning of their illness—and then only if they had ceased to be heavy carriers. These measures were put into practice, with apparent success, though it is quite impossible to say how far they were responsible for the results obtained. After June 5, when the heavy carriers were segregated, there was complete freedom for a month, after which three further cases of sore throat occurred—one on July 4 and two on July 14.

An attempt was made to clear up the heavy carriers by local sulphonamide treatment. By the kindness of Messrs. May and Baker Ltd. special lozenges were provided, each containing 1/2 gr. of sulphapyridine and 1/2 gr. of sulphathiazole. Roughly one-third of the carriers were given six of these tablets to suck daily for five days; one-third were kept on a formol throat spray and Milton gargle; and one-third were left untreated. The course of treatment lasted from June 12 to June 17, immediately after which the girls were swabbed. The results were as follows:

Treated with sulphonamide lozenges	8 out of 10 still carrying Type 1 streptococci
Treated with throat spray and gargle	7 " 12 " " " "
Untreated controls	4 " 6 " " " "

As the sulphonamide treatment appeared to be without effect, in spite of the fact that the strain was sensitive to sulphonamides, a second course of treatment was given, the number of lozenges being doubled (12 a day) and the treatment maintained for 7 days. Fresh carriers were added to replace those that had become negative. The second course of treatment lasted from June 21 to June 28. Swabs were taken on June 29, with the following results:

Treated with sulphonamide lozenges	10 out of 13 still carrying Type 1 streptococci
Treated with throat spray and gargle	5 " 12 " " " "
Untreated controls	3 " 6 " " " "

It seemed evident that neither the sulphonamide lozenges nor the local spray-and-gargle treatment was having any obvious effect on the persistence of streptococci in the throat, and all treatment was therefore stopped. The girls were liberated from segregation as they became negative or ceased to carry profusely.

One other point requires discussion. Special virtue has been claimed for local sulphonamide therapy to the throat in the form of either sprays or lozenges (Arnett *et al.*, 1943 ; Garson, 1943 ; Freis, 1944). We have had little experience of sprays, but the combined observations of Kidd (1944), of Hayden and Bigger (1945), and of ourselves seem to show that, so far as the prevention or cure of streptococcal infection is concerned, sulphonamides given in the form of lozenges in a total dose of 7 to 15 gr. (1/2 to 1 g.) a day have little or no effect. Puzzling over the reason for this failure, we were prompted by a suggestion of Dr. Calman, in our laboratory, to find out how closely the contents of a lozenge came into contact with the throat and posterior wall of the pharynx. For this purpose 22 of our laboratory staff sucked a pill containing 2 gr. of methylene blue for about 5 minutes, swallowing the saliva at intervals. Their throats were then carefully inspected in good daylight. The results were striking. Though the lips, tongue, mouth, hard palate, uvula, and anterior pillars of the fauces were stained deep blue, either no blue at all or, more frequently (16 out of 22 subjects), a slight coloration only.

could be detected on the tonsils—usually confined to a small area at the top in between the angle formed by the anterior and posterior pillars of the fauces. Except in two instances, in which there was a very faint streak on each side of the midline, no blue coloration at all could be detected on the posterior wall of the pharynx. Subsequently it was found that Arnett (1943) had carried out a similar experiment using chewing-gum impregnated with gentian violet or methylene blue, and, like us, had observed little or no staining of the tonsils or posterior pharynx if the subject chewed his gum in the upright posture; some staining, however, usually occurred if the recumbent position was adopted.

Thinking that our results might have been different if our subjects had not had healthy throats, we made observations on 6 patients in the isolation hospital who were suffering from measles or scarlet fever and whose tonsils were greatly enlarged. The pills were sucked in a semi-recumbent position, which, in view of Arnett's findings, may have affected the result. In one patient the whole of the medial surface of the tonsils was stained light green; in the remaining five the coloration was slight and was restricted to a small triangle at the top. In no instance was any coloration of the posterior pharyngeal wall seen.

These findings are in accordance with the observations of Bloomfield (1922), who concluded from an extensive series of experiments that there is a highly efficient mechanism, apparently dependent on suction currents, by which any bacteria introduced into the mouth are drawn directly backwards towards the oesophagus, avoiding the tonsils and posterior wall of the pharynx. It follows, therefore, that drugs given in the form of lozenges or chewing-gum can have little or no local effect on the throats of persons in the upright or sitting position unless they are sucked almost continuously throughout the day and night, as in MacGregor and Long's (1944) observations on penicillin pastilles. They are therefore unlikely to be of much value for prophylactic purposes in the ordinary healthy contact.

Summary and Conclusions

An outbreak of scarlet fever due to *Str. pyogenes* Type 11 in a residential preparatory school for boys, and an outbreak of sore throat accompanied by cases of scarlet fever due to Type 1 in a residential public school for girls, are briefly described.

Treatment of healthy and of convalescent carriers with 6 to 12 lozenges a day for 5 to 7 days, each lozenge containing 1/2 gr. of sulphapyridine and 1/2 gr. of sulphathiazole, had no apparent effect, as compared with control carriers receiving either a formol spray and hypochlorite gargle or no treatment at all, in clearing the infecting type of streptococcus from the throat.

Prophylactic treatment of healthy non-infected contacts with 6 lozenges a day had no apparent effect in preventing streptococcal infection of the throat.

Observations made on persons sucking methylene-blue tablets showed that only a fraction of the dye was deposited on the tonsils and none on the posterior pharyngeal wall; and it is therefore concluded that neither for the prophylaxis nor for the cure of streptococcal infection of the throat are lozenges containing sulphonamide drugs likely to be of value in practice.

It is maintained not that prophylactic sulphonamide treatment of streptococcal infections is useless but that further carefully controlled investigations should be carried out before this method, which is now being extensively used in the American Forces, is applied to the civilian or Service personnel of this country.

Our thanks are due to the medical officer of the girls' school, and to the head master of the boys' school, for their help in enabling us to carry out these investigations; and to Dr. Nora Archer, superintendent of the City Isolation Hospital, Oxford, for allowing us to make observations on patients with enlarged tonsils.

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SURGERY AND ANAESTHESIA OF WAR WOUNDS OF THE ABDOMEN

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This paper includes a report of a series of missile wounds of the abdomen treated in the forward areas during the present campaign in Europe. In 200 consecutive battle casualties the abdomen was explored in 56 cases, so that a little over a quarter of the work of the forward surgeon is likely to be concerned with this type of injury. No selection whatsoever has been exercised in the choice of patient, and with one exception every case seen in the pre-operative ward and diagnosed as an intra-abdominal lesion has been operated upon. This one patient was so severely injured that in spite of suitable resuscitative measures he collapsed after the administration of 0.1 g. of pentothal, and it was considered useless to continue. Every patient is now given his chance, because it has been found that what may well be considered a hopeless case sometimes confounds such an opinion.

The mortality rate in this series is therefore a fair representation of that occurring among all patients with abdominal injuries who arrive at the forward surgical centre working within a few miles of the fighting-line. There is probably a small additional mortality at the base hospitals, due to subsequent complications, but when evacuated down the line after anything up to three weeks the patients have been in good condition.

All save one of our cases have been operated on under pentothal anaesthesia alone, the exception receiving in addition a spinal analgesic. For the success of this somewhat exacting type of work under difficult circumstances the choice of the anaesthetist is equally as important as the choice of the surgeon. The forward anaesthetist should be the most skilled and experienced available, for the type of case with which he has to deal is the most difficult of all to anaesthetize. In view of forthcoming campaigns in other parts of the globe, no apology is necessary in pleading that wherever a forward surgeon is sent he should be accompanied by a high-grade anaesthetist if his work is to be a success and not marred by anaesthetic mortality.

Diagnosis

The diagnosis of the straightforward abdominal case is easy; that of the dubious one extremely difficult—so much so that some cases will always provide such an element of doubt that an occasional negative laparotomy will be undertaken. The reduction of this number to a minimum is, however, of paramount importance, because, as so many of these cases have other and severe lesions, such a laparotomy lessens their chances of recovery. Especially is this so in chest injuries, which may closely simulate an intra-abdominal lesion. Let it be said that there is no one symptom or sign that is always present, no one single observation upon which reliance can always be placed, and a diagnosis must be made by a summation of the points in favour and the points against.

A high proportion of cases in which a hollow viscus is injured give a history of early vomiting, repeated at intervals. This is not like the vomiting of a severely shocked patient, which occurs often after the administration of the traditional cup of hot sweet tea, which few of them can assimilate, or during the period of their recovery from the shock. This vomiting in those injured in the abdomen occurs when shock is absent and when nothing has been taken by the mouth.

The site of the wound should be located, and any injury to the anterior or lateral abdominal wall must be considered to be perforating until proved otherwise. If evidence from other signs and symptoms is not conclusive, all such wounds must be explored and followed to the end of their course before deciding that the peritoneum is not perforated. It is quite useless to