DIPHTHERIA IMMUNIZATION IN A SCHOOL

BY

WILLIAM G. PATTERSON, M.D.ED., M.R.C.P.LOND.,
D.P.H.

MEDICAL OFFICER OF HEALTH FOR WEYBRIDGE

Vaccination against small-pox has the supreme merit that in almost 100 per cent. of cases it develops complete protection against small-pox in a period shorter than the incubation period of the disease. Schick immunization, unfortunately, requires for its development a period greatly in excess of the incubation period of diphtheria. Hence Schick immunization is of itself an imperfect means of eliminating an outbreak of diphtheria without further mortality or morbidity. Greatest stress is therefore correctly laid on the importance of Schick immunization as a prophylactic procedure prior to the appearance of diphtheria in a community. But the value of Schick immunization as a factor in the rapid stamping out of an actual outbreak of diphtheria should not be overlooked.

This communication about an outbreak of diphtheria with which I became concerned in February, 1933, may serve to emphasize the advisability of applying the Schick procedures without delay, in conjunction with other appropriate measures as outlined below, whenever diphtheria appears in a community not previously Schick-immunized. Incidentally, it lays stress on the peculiar virtue of Schick-prophylactic T.A.F. as an efficient immunizing agent characterized by great freedom from undesirable general or local secondary reactions.

The Ep'demic Described

The residential school in question had 310 boys, aged from 8 to 16 years. The physical condition of the boys was excellent, and they were extremely well cared for; but unusual facilities for droplet infection existed, owing to the close proximity of the beds in the very large dormitories; moreover, scarlet fever had been endemic in the school for some time. The stage was surely set for a considerable outbreak of diphtheria should the infection be introduced.

The first three cases of diphtheria were notified to me on the afternoon of February 5th, 1933, when N. M. and T. P. were admitted to Ottershaw Isolation Hospital under my care. The third patient, R. S., had died on February 3rd after a short illness; the diagnosis in his case was confirmed by a posthumous report concerning his throat swab, which had been taken just prior to his death. N. M. had a severe attack of faucial diphtheria, from which he made an uneventful recovery. T. P. had an extremely severe attack of diphtheria, from which he made an unexpected recovery.

A possible source of the infection was a fourth pupil, P. T., who, during the subsequent routine examinations, was discovered to have incipient paralysis of his soft palate; he subsequently developed complete paralysis of his soft palate and a severe degree of paresis of the legs; his paralytic complications kept him bed-ridden for several months. P. T., within a few days of his arrival home in London for the Christmas holidays, had developed a "sore throat." The only swab taken was negative for Klebs-Loeffler bacillus, and the diagnosis of diphtheria was not made. As this strong athletic boy was kept in bed at home for three weeks with a "sore throat" it is probable that his undoubted attack of diphtheria was severe from the onset.

Thus of the first four cases of diphtheria at this school one died, one almost died, one developed severe and long-lasting post-diphtheritic paralysis, and the fourth had quite a severe illness. It was obvious that the diphtheria which was presenting itself was of a virulent

nature. Dr. Cooke, the school medical officer, who was more than fully occupied with an epidemic of influenza in his private practice, kindly gave me a free hand to make my own arrangements at the school.

I visited the school on February 6th, and by the next morning had the following measures under way: (a) Schick-testing and immunization, (b) detection and control of carriers, and (c) institution of daily routine examination of pupils to ensure early detection of any new cases of diphtheria.

Institution of Schick-testing

On February 7th and 8th I Schick-tested 310 pupils and twenty-seven members of the staff. Since I proposed to use T.A.F. as the immunizing agent, and had therefore no apprehensions about undesirable secondary reactions, I did not perform any control test with heated toxin, nor did I carry out the Moloney test. This was in accordance with my usual practice, and anyone who agrees that 337 intradermal injections in two consecutive afternoons is a monotonous business may consider the simplification of the test procedure permitted by the subsequent use of T.A.F. as an additional valuable feature of T.A.F. One week after the test injection ninety-seven pupils and fourteen members of the staff were found to be Schick-positive, and were given the first intramuscular injection of 1 c.cm. T.A.F. The second injection of 1 c.cm. T.A.F. was given after a further interval of four weeks. No Schick-negative boy subsequently developed diphtheria.

Owing to pressure of work I did not retest the Schick-positives until October 31st—that is, almost eight months after their second injection of T.A.F.—when eighty-five of the ninety-seven original Schick-positive pupils were re-tested and with one exception found negative; the one exception gave a faint positive reaction. These results were in harmony with the clinical findings, as none of the original Schick-positives developed diphtheria after they had received two injections of T.A.F.

Detection and Control of Carriers

Dr. Ferguson, county medical officer of health for Surrey, kindly placed at my disposal the services of Miss Draper, the assistant superintendent of health visitors. She examined the noses and throats of all pupils in the school daily for about a fortnight, referring all suspicious cases to me. We discovered sixteen nasal carriers with rhinorrhoea and positive nasal swabs. Virulence tests were not carried out because they would have cost 15s. each, and in the circumstances I would not have modified my treatment of any reputed avirulent carrier.

Swabs were taken only from pupils with suspicious clinical signs. Wholesale swabbing appeared out of the question, as at 3s. per swab a nose-and-throat swab per pupil would have cost over £90; by careful daily clinical examination for a fortnight, combined with judicious swabbing for confirmatory purposes, we at any rate succeeded in detecting the carriers most likely to be the source of massive infection. My own impression is that careful repeated clinical examination outrivals routine bacteriological examination as a method of detecting dangerous diphtheria carriers in a community as much as careful clinical examination outrivals swab examination as a method of diagnosing the illness diphtheria. The sixteen nasal carriers, who were all Schick-negative, were segregated from the other pupils until the Schick-positives had received their course of immunizing injections. They were then released from isolation as soon as their rhinorrhoea had cleared up, no swabs being taken until then, and only one negative swab being required. The majority of the carriers were back at school within six weeks, though two were detained for three months.

The head master was informed that I did not guarantee, and indeed did not expect, that all of these sixteen boys had ceased to be carriers; it was considered that the risk of massive infection from them had, at any rate, been eliminated, and, moreover, that after all the Schick-positives had received a course of immunizing injections it might be advantageous to turn some carriers loose among them to encourage the development of complete herd immunity, even at the expense of an isolated case or two of mild clinical diphtheria.

A Daily Routine Examination

With the object of ensuring early detection of any new case of diphtheria a daily routine examination of all pupils was for the first fortnight included in Miss Draper's search for carriers. Thereafter the daily examination was carried out by the school nursing staff, and was limited to the Schick-positives, who were examined daily for another three months. Dr. Cooke or I was informed immediately of any clinical condition suggestive of diphtheria. In this way there were discovered three cases of faucial diphtheria, H. S., E. S., and A. P., whose illnesses commenced respectively on February 22nd, March 2nd, and March 12th, 1933. All three were Schick-positives who had received the first injection of 1 c.cm. Schick-prophylactic T.A.F. All three had comparatively mild attacks of diphtheria, and made very rapid recoveries. This may be contrasted with the course of the illness of the first four patients, of whom one died, one almost died, one developed severe and long-lasting post-diphtheritic paralysis, and the fourth had quite a severe illness.

While the comparative mildness of the diphtheria exhibited by H. S., E. S., and A. P. was probably due in large part to the relatively early administration of the anti-diphtheritic serum, by clinical impression was that their diphtheria was of a mild nature from the onset. If this clinical impression is correct, possible alternative explanations are that, as a result of the first injection of T.A.F., they had developed either a considerable degree of immunity or facility to develop it rapidly when required, or that, owing to the removal of the frankly clinical diphtheria carriers from the school community, they had received relatively small doses of the diphtheria organisms from missed carriers.

Summary and Conclusions

In this residential school of 310 pupils, with exceptional opportunity for droplet infection in the somewhat crowded dormitories, and a synchronous prevalence of scarlet fever, a threatened epidemic of virulent diphtheria was stamped out within five weeks without further fatality and with very little further morbidity. Three agents were used to secure this result: (a) Schick-testing and immunization, (b) detection and temporary isolation of carriers, and (c) routine daily examination of pupils for new cases over a period of three and a half months.

All three agents played a vital and separate part in securing the good results obtained. The Schick-immunizing agent employed was T.A.F.—two 1 c.cm. injections being given at four weeks' interval. No general or local secondary reactions of any magnitude were observed. From the administrative point of view it should be emphasized that the great virtue of T.A.F. as an immunizing agent is that it seldom causes any undesirable secondary reaction. A diphtheria-immunizing agent capable of producing immunity with one injection and with greater rapidity than T.A.F. is greatly to be desired; but unless such an agent compares favourably with T.A.F. in respect of secondary reactions it should not replace it for general use. We do want a diphtheria-immunizing agent comparable with small-pox vaccination for certainty and

speed, but not at the expense of comparison with vaccination for severity of general and local reaction.

The experience outlined above suggests that Schick-testing and T.A.F. immunization, combined with detection and temporary isolation of carriers and adequate precautions to ensure early detection of new cases of diphtheria, will suffice to stamp out quickly a threatened epidemic of virulent diphtheria without further mortality, with little further diphtheria morbidity, and with no appreciable undesirable secondary reactions, in any community where the necessary administrative procedures can be carried out efficiently. If T.A.F. can do so much it should not be too readily discarded for "one-shot" diphtheria-immunizing agents until, as already stated, one is secured which compares favourably with T.A.F. in regard to absence of undesirable secondary reactions.

UNDULANT FEVER AND CONTAGIOUS ABORTION IN NORTHUMBERLAND

BY

A. I. MESSER, M.A., M.B., CH.B., D.P.H.
BACTERIOLOGIST, NORTHUMBERLAND COUNTY COUNCIL

The results of the examination of a first series of Widal sera for agglutinins to *Br. abortus* were recorded in a previous note (Messer, 1932). The investigation has been continued, and in the past three years sera from 425 patients have been examined. In sixteen (3.7 per cent.) of these a diagnosis of undulant fever was considered justified on serological and clinical grounds, the serum titres being as follows:

1 in 125	...	...	2 cases	1 in 1,500	...	...	5 cases
1 in 250	...	...	1 case	1 in 2,000	...	...	2 cases
1 in 1,000	...	...	2 cases	1 in 3,000	...	...	2 cases

In the remaining two cases complete agglutination occurred in a serum dilution of 1 in 250, but the end-titre was not ascertained; fifty of the sera agglutinated *R. typhosus* and eighty-nine *B. paratyphosus* B in significant titres. The bacterial suspensions used were those supplied by the Oxford Standards Laboratory and the minimum "reduced titre" observed among the sixteen cases of *abortus* infection was 62.5.

Some discussion has centred round the significance of the agglutination reaction in the diagnosis of undulant fever. The consensus of opinion, however, with which the experience here recorded agrees, is that the test has much the same value and limitations as the Widal reaction in enteric infection. Both tests require to be interpreted in the light of what is known of the distribution of antibodies in the population at large, and having regard particularly to the occurrence of agglutinins resulting, in the case of enteric infection, from preventive inoculation, and, in the case of undulant fever, from the latent infections which are especially liable to occur in certain occupational groups. The difficulties thus arising are, however, simplified to some extent by the fact that a majority of active *Brucella* infections are accompanied by antibodies reacting in high dilution—1 in 1,000 or more—and such titres may usually be accepted as diagnostic. Equivocal results can frequently be elucidated by means of repetition of the test at intervals.

Clinical Features

Clinically, the cases that have been met with may be roughly divided into two groups. The first consists of six cases of a more or less mild—even ambulant—type in which the chief symptoms were headache, fatigue, loss of appetite, weakness, and sweating, especially at night.