THE IMMUNOLOGY OF SCARLET FEVER : AN UNUSUAL CASE

BY

W. R. F. COLLIS, M.D., M.R.C.P., D.P.H.,
Assistant Pathologist & Research Fellow,

and

A. G. WATKINS, M.B., B.Sc., M.R.C.P.

(From the Hospital for Sick Children, Great Ormond Street, London.)

The summary of the records of the single case discussed in this paper is as follows :—

A boy aged two years and two months was admitted to Dr. Thursfield's ward in the Hospital for Sick Children, Great Ormond Street, on May 12th, 1930, with signs of a right-sided empyema following 'influenza' nine weeks previously. A portion of a rib was resected eight days later (May 20th) with subsequent improvement in the general condition. On culture the pus yielded a pure growth of pneumococci, and a vaccine was given subsequently.

On May 23rd, three days after the resection, the child developed a rash of the scarlatiniform type on the chest, abdomen, and inner aspect of the limbs. The rash was accompanied by no change in the general condition, nor was there fever, vomiting, or sore throat. It faded within 24 hours and showed no subsequent peeling. A Schultz-Charlton reaction and a Dick test were done at this time. Owing to the rapid fading of the rash the Schultz-Charlton was indefinite, but the Dick test was definitely negative. The boy, so far as could be ascertained, had not been exposed to any known source of scarlet fever.

On June 7th an irregular swinging temperature commenced, and was attributed to pocketing of the empyema.

On June 18th an exploration of the chest was made under anaesthesia, but nothing further was determined. On June 16th, twenty four days after the rash, the urine was found to contain albumin, blood, pus and casts. The blood urea was 88 mgrm. per 100 c.cm. With the onset of vomiting the child became rapidly worse, and died on June 26th. On June 17th a second Dick test had proved negative.

Two other cases of scarlet fever appeared in the ward about this time, one on June 1st, the other June 20th.

AUTOPSY. At post-mortem examination a general septicæmic condition was present as exemplified by an enlarged spleen with prominent Malpighian corpuscles, a fatty liver, etc. The right-sided empyema cavity showed no recent collection of pus, and the rib resected was in a healthy condition. The serous cavities showed some inflammation and a little pus was found on the visceral peritoneum. The kidneys were swollen and oedematous, and showed macroscopically and microscopically a state of typical acute nephritis.

BACTERIOLOGY. Cultures were taken from the heart's blood, spleen, pericardial and peritoneal fluids. From each of these a hæmolytic streptococcus was grown. It was found in pure culture in the heart's blood and spleen.

This micro-organism was classified for us at the Ministry of Health's Bacteriological Laboratory, Dudley House, and shown to belong to Type II scarlatinal streptococcus as classified by Dr. Griffith¹. Of this organism he says :—' Analysis of clinical data in a series of 100 cases shows clearly that a fairly severe form of scarlatina with greater tendency to complications is often caused by infection with Type II scarlatinal streptococcus; Type II has so far been found only in association with scarlet fever.'

Discussion.

We are publishing this case because it demonstrates an important point in the immunology of scarlet fever which is not generally accepted in this country. To quote Pearson and Wyllie² :—' Generally speaking a positive Dick reaction indicates susceptibility to scarlet fever, and a negative reaction, immunity.'

Although the above case showed only a transient rash and none of the graver toxic symptoms of the scarlet fever syndrome, yet the patient succumbed to the specific hæmolytic streptococcus which is now generally accepted as the cause of that disease. The Dick test was negative at a time when under ordinary circumstances one would have expected it to be positive.

It would appear, then, that the immunology of the disease is not so simple as the above quotation warrants, and that there are two immunological states to be considered in scarlet fever :—one the specific toxic state producing the usual exanthem : the other, those septic phenomena resulting directly from infection with the specific streptococcus, namely, pharyngitis, adenitis, otitis, septicæmia, etc.

Parish and Okell³ have noted in animal experiments that the presence of antitoxin in the patient's blood does not prevent the subsequent development of a fatal septicæmia with the specific organism. This is well borne out by the fact that in severe cases of scarlet fever whereas an early administration of antitoxin will often cause the toxæmic symptoms to subside dramatically, it has no preventive effect on the later septic complications.

Cooke⁴ does not hold the belief commonly expressed in this country that scarlet fever can be explained simply as a toxin-antitoxin reaction. This writer in numerous experiments has shown that 90 per cent. of infants (under six months of age) are insensitive to the Dick ' toxin ' (i.e., are Dick-negative) although only a small number have inherited any antitoxin from the maternal circulation. This state may be called the first or pre-sensitive stage. Later as these children are exposed to streptococcal infections they become hypersensitive to the Dick toxin (i.e., become Dick-positive), this being the second or hypersensitive stage. Older children and adults whether they have had clinical scarlet fever or not, usually develop sufficient antitoxin in their blood to abolish or mask this hyper sensitive state, and once again are Dick-negative, thus reaching the third or post-sensitive stage.

On this hypothesis, the syndrome of scarlet fever (the rash, vomiting, fever, etc.), is a hypersensitive response on the part of the patient to the specific toxin of the scarlatinal type of hæmolytic streptococcus, rather than a general

reaction to an infection with the organism itself. It is thus possible for the patient to be severely infected with the specific organism of the disease without showing any of the typical symptoms of the scarlet fever syndrome. This may occur in either the pre- or post-sensitive states.

In our present case the facts that the child was over two years old and gave a negative Dick reaction suggest that he had already reached the third or post-sensitive state, and that his serum contained enough antitoxin to neutralize the injected Dick test 'toxin' and prevent all the specific clinical symptoms of scarlatina except the transient rash. The presence of this antitoxin, however, did not prevent the multiplication of the specific streptococcus in his blood, or his subsequent death from septicaemia complicated by acute nephritis.

Conclusion.

The above case affords additional evidence in support of the view that scarlet fever is not a simple toxin-antitoxin phenomenon, and that the Dick test should be regarded merely as an indication of the presence of antitoxin in the patient's serum and not as a guide to the general immunity of the patient to the specific streptococcus of the disease.

Our thanks are due to Dr. Thursfield for allowing us to publish this case, and to Dr. Griffith for classifying the micro-organism.

REFERENCES.

1. Griffith, F., *J. Hyg.*, Camb., 1927, XXVI, 336.
2. Pearson, W. J. & Wyllie, W. G., *Recent advances in Dis. of Child.*, Lond., 1928, 500.
3. Parish, H. J. & Okell, C. C., *J. Path. & Bact.*, Edinb., 1927, XXX, 521.
4. Cooke, J. V., *J. Allergy*, St. Louis, 1929, I, 22; *Am. J. Dis. Child.*, Chicago, 1927, XXIV, 969; 1928, XXXV, 762, 772, 781, 784, 974, 983, 991.