

explained in a paper by Mitchell (1938), who has shown that those fibres which accompany the left gastric artery are merely one part of what is in fact a very complex innervation, and that Knight's operation must inevitably fall short of a complete sympathetic denervation of the sphincter.

In view of the good results obtained in cases of megacolon by spinal anaesthesia alone it seemed to us obvious that the same method should be tried in mega-oesophagus. Accordingly, when in July, 1938, a very typical example of mega-oesophagus in a young man was referred to us for treatment, we asked Dr. Falkner Hill to administer a spinal anaesthesia which should include the first thoracic nerve, and so paralyse the whole of the sympathetic outflow from the spinal cord. This was done, and on the same evening his power of swallowing was completely restored, and he has not had the slightest difficulty with any type of food since the anaesthesia. Short notes of the case are as follows:

A male slipper worker aged 26 had suffered from dysphagia during two years. Difficulty was always present. At the best he could get down some solid food with the help of copious drinks, but often a whole meal was returned unaltered a few minutes after he had eaten. He had lost one and a quarter stone in weight, was very weak, and was unable to work. Routine clinical examination showed nothing abnormal. The radiological examination revealed an enormous oesophagus with a rounded cul-de-sac from which emerged a thread-like trickle of barium. Spinal anaesthesia, including level of T.I, was given on July 29, 1938. The relief of symptoms was immediate and complete. A barium swallow some six months afterwards showed that the bulk was passed direct into the stomach. The oesophagus was still large, but had been reduced to about a half of its former size. A portion of the barium was held up in the cul-de-sac. It will be noted that this finding is exactly similar to those in successful cases of megacolon, in which, although function is fully restored, the anatomical restoration is far from complete. The patient remains completely cured, and in July, 1939, he wrote: "My cure is maintained. I ate yesterday toast, cheese, potatoes, onions, and kippers. My weight has returned to 10 st. 4 lb., which is as much as I ever weighed."

#### Discussion

We offer no explanation of these results from the use of spinal anaesthesia alone, but think it worth while to record the facts which have emerged from this work. The temporary but complete knock-out administered to the sympathetic supply appears to have brought the two halves of the autonomic system once more into step.

Although mega-oesophagus may be of congenital origin, it is a fact that in later life the actual onset of symptoms is in some patients precipitated by a shock, and it may be that the further shock of the spinal anaesthetic corrects the imbalance. Mega-oesophagus is a rare condition, and it is unlikely that any one surgeon will meet with a number of cases large enough to permit an authoritative opinion on its treatment. We therefore publish this single instance in the hope that this simple treatment may be put on trial.

The ever-present handicap to the successful treatment of disease by interventions aimed at the sympathetic nervous system is the existence of secondary fibrotic changes in the affected organ. This fibrosis eventually converts the viscus into a fibrous bag and progressively destroys the normal neuromuscular mechanism, on the restoration of which the operation depends for its success. For this reason the method we describe, if it is to succeed at all, will be more hopefully tried in the earlier cases.

#### Summary

Seven cases of megacolon in children have been treated by spinal anaesthesia alone with excellent results.

A case of mega-oesophagus (cardiospasm) treated by spinal anaesthesia remains completely cured.

#### REFERENCES

- Knight, G. C. (1934). *Brit. J. Surg.*, **22**, 864.  
 Mitchell, G. A. G. (1938). *Ibid.*, **26**, 333.  
 Stabins, S. J., Morton, J. J., and Scott, W. J. Merle (1935). *Amer. J. Surg.*, **27**, 107.

## DIPHTHERIA PROPHYLAXIS

### A REVIEW OF THE ANTIGENS AND METHODS AVAILABLE

BY

J. TUDOR LEWIS, M.D., D.P.H.

(From the Health Department of the County Borough of Croydon)

Attention has been directed in earlier communications (Lewis, 1939a, 1939b) to the lack of uniformity in the current processes adopted in this country for controlling diphtheria by active immunization. A questionnaire issued by Dr. O. M. Holden, the medical officer of health for Croydon, to the medical officers of some 140 of the larger urban authorities revealed an astonishing miscellany of method, not confined to the organization of the schemes but extending to the antigens themselves. Quite clearly there is no consensus of opinion on the merits of the various preparations.

A review of the literature was made for the purpose of this paper, but it has been sacrificed to the present urgent pressure on editorial space. Some of the earlier workers in this field reported rather low rates of conversion to the Schick-negative condition after the use of various antigens, though little doubt can remain in one's mind that by the proper use of toxoid—T.A.M. or T.A.F.—highly satisfactory results can be obtained. Up to 1938 in this borough approximately 99 per cent. of children who had previously received three injections of T.A.M. or T.A.F. were found to be Schick-negative. Glenny and colleagues (1926, 1931a, 1931b) discovered the antigenic advantage resulting from the employment of alum with toxoid. For some time certain workers used these alum preparations in one dose—the so-called "one-shot" method—but in some series a disappointingly high percentage of the children were found to be Schick-positive when tested later. Chesney (1936), on the suggestion of Dr. R. A. O'Brien, used a first small dose to "detect" children who were unusually liable to troublesome reactions, followed four weeks later by 0.5 c.cm. In groups of 185 children in 1936 and 1,555 in 1938 and 1939 Chesney (1938, 1939) obtained a 99 per cent. Schick-negative rate four weeks after the second injection. A number of authors quote percentages from 97 to 100.

#### Results obtained in Croydon

It may help, at a time when large numbers of town children are being transported to rural and potentially susceptible districts, to give the results that have been obtained in the county borough of Croydon. With three fortnightly doses of 1 c.cm. of T.A.M., 2,163 children originally Schick-positive gave a conversion rate to Schick-negative of 99 per cent. A.P.T. was given to 1,039 children—760 originally Schick-positive and 279 not

Schick-tested. At first the earlier dose was 0.1 c.cm., but, since virtually no reactions were met with, this dose was increased to 0.25 c.cm., and the period between inoculations lengthened from two to four weeks; 99 per cent. of the children, tested eight to twelve weeks after the second injection, were Schick-negative.

One of the supposed disadvantages that have militated against a more general use of A.P.T. is its alleged tendency to cause severe reactions. In the present series the parent of each child was specifically asked what discomfort, if any, each injection had caused. "Discomfort" was accepted as a reaction if the child had himself complained without being questioned; or if he were obviously unwell within a day or so of the injection, there being no other explanation of his malady. In the accompanying table are given the reactions that were recorded. Thirty-five of these were mild and occurred after the first injection of 0.1 to 0.25 c.cm.; eight were severe, seven occurring after the first injection and one after the second injection.

Reactions after A.P.T.

Age Group	Total Cases	Total Reactions	Reactions %
1-5	402	4	0.99
5-8	334	11	3.3
8-10	154	9	5.8
10-14	192	19	9.9
1-14	1,082	43	3.9

Of the eight severe reactions one occurred in a child aged 5, three in children aged 8, three in children aged 9, and one in a child aged 14. There was a slight superficial fluctuation in one case, which, however, resolved without incision. The others consisted of extensive redness with brawny swelling extending over the whole of the back of the arm, with pain and tenderness, lasting in some cases for more than three weeks. Only one severe case occurred in 736 children under 8 years of age and seven in 346 children of 8 years or more, a percentage of 2. So far, therefore, as fear of reactions is concerned, it is safe to give 0.5 c.cm. as a first injection to children under 8 years; over 8 years, with two severe reactions per 100 children, it will be wise to limit the first dose to 0.25 c.cm.

#### Discussion

The results obtained by some workers with T.A.M. and T.A.F. have varied widely, and those following the use of "one-shot" A.P.T. have been so diverse as to make this method clearly untenable. All the reports of the use of two injections of A.P.T. are in accord with a consistently high Schick-negative rate. The fears of reactions after A.P.T. seem to have been ill founded, as the table clearly shows. No doubt in the early days high proportions of reactions were registered, but the manufacturers are now able to produce a very refined product, so that it may soon be justifiable to consider whether larger dosage should not be employed. These well-documented facts should go a long way towards giving A.P.T. by two injections a more accredited place in immunization schemes. This method is now employed in a little over 40 per cent. of schemes investigated (Lewis, 1939b); there is no reason why the other 60 per cent. should not have equal confidence in its efficiency.

#### Summary

In Croydon 2,163 children originally Schick-positive gave a conversion rate to Schick-negative of 98.9 per cent. when tested three months after three injections of T.A.M.

A group of 760 children originally Schick-positive and 279 not previously tested were given two injections of A.P.T.—mostly 0.25 c.cm. followed by 0.5 c.cm. four weeks later. The former group gave a conversion rate to the Schick-negative condition of 99.2 per cent.; the latter group 98.9 per cent. No significant difference was found in different groups aged from 1 to 14. The number of reactions was small and no serious trouble occurred. This method of preventing diphtheria merits a greater popularity than it at present enjoys.

I wish to record my thanks to Dr. O. M. Holden and Dr. D. D. Payne, medical officer of health and deputy medical officer of health respectively of Croydon, for help in the preparation of this paper; and to the former for permission to publish it.

#### REFERENCES

- Chesney, G. (1936). *British Medical Journal*, 1, 208.  
 — (1938). *Lancet*, 2, 587.  
 — (1939). *Med. Off.*, 61, 127.  
 Glenny, A. T., Pope, C. G., Waddington, H., and Wallace, U. (1926). *J. Path. Bact.*, 29, 31.  
 — and Barr, M. (1931a). *Ibid.*, 34, 131.  
 — Buttle, G. A. H., and Stevens, M. F. (1931b). *Ibid.*, 34, 267.  
 Lewis, J. T. (1939a). *Med. Off.*, 61, 187, 197.  
 — (1939b). *Ibid.*, 62, 127.

## Clinical Memoranda

### Fractured Femur due to Muscular Violence in a Case of Epilepsy Treated by Epanutin

This case is of particular interest from two points of view. First, although fracture of the femur as the result of the muscular violence of a cardiazol or triazol convulsion is now a recognized entity, an extensive search of the literature failed to reveal such an occurrence due to the muscular violence of an epileptic fit. Secondly, in view of the present vogue for the use of epanutin in the treatment of epilepsy the possibility that this fracture may be a complication of its administration is worthy of note.

#### CASE HISTORY

A man aged 37 was admitted to Cane Hill Mental Hospital on June 17, 1938, suffering from "insanity with epilepsy." He was subject to many fits, the majority of which were nocturnal. From the time of his admission until March, 1939, he was given 1 grain of sodium luminal thrice daily. During this period he had bouts of confusion both before and after fits. He was querulous, quarrelsome, and bad-tempered, and at times impulsively aggressive to the patients or nursing staff.

On March 9, 1939, he was given epanutin. A complete transference was effected, so that his sole medication was one capsule of epanutin thrice daily. On this his temperamental condition began to improve, but he still had many fits. On April 11 the dosage of epanutin was increased by a further capsule, given at 9 p.m. This produced a complete cessation of fits. From that day till the end of June (ten weeks in all) the patient had no fit. Unfortunately about six weeks after complete freedom from fits he started getting confused, and this gradually became worse. It remained continuously present and eventually necessitated bed treatment. As the patient had remained in this state for four weeks, on June 23 his epanutin was reduced to three capsules a day, with the idea of bringing on a fit.

On July 5 he had one fit during the day and one at night. He next had a fit on July 26 at night and another on the following night. The night nurse witnessed the latter fit and found the patient under the bedclothes, with these tucked in and in a normal position, so that there was no question of his having fallen. He recovered from his fit in the normal