fluid from tetanus patients or serum from the normal controls. This method can be used as a useful test for the diagnosis of tetanus in doubtful cases: 3 to 5 c.cm. of blood serum from the suspected patient are injected into the peritoneal cavity of a guinea-pig; the animal shows spasms, jerky movements of the head and body after a preliminary stiffness if the serum comes from a case of tetanus. An earlier diagnosis is thus possible in doubtful cases. The antitoxin in the cerebro-spinal fluid therefore acts through absorption in the blood stream. Clinically it controls the spasms better and earlier. This observation is made so often that it cannot be dismissed lightly. It is possible that the absorption is slower and steadier, and the effect of the intravenous injection is thus maintained for a longer period. The rate of absorption of the antitoxin from the cerebro-spinal fluid into the blood stream and the amount of antitoxin present in the blood from day to day after this injection are well worth study.

Sedatives to Control Spasms

The control of spasms by the use of suitable sedatives is the other problem before workers. A large number of sedatives are being advocated. The patient is in a state of hyperexcitability. All kinds of external stimuli throw him into spasms. The majority of these patients have received paraldehyde per rectum for the control of spasms—4 drachms in 2 oz. of saline by the drop method four-hourly, varied according to the requirements of each individual case. The use of somnifaine by injection or avertin per rectum has been advocated. Several articles have appeared on the use of curarine, the alkaloid from curare, the arrow poison. This has a paralysing action on the neuro-muscular junctions. The dose has to be carefully regulated, as respiratory muscles are likely to be paralysed if a large dose is inadvertently given. Very efficient nursing is therefore necessary if this drug is to be used as a routine measure. The work of Abel *et al.* (1934, 1935) may be mentioned here. They have overhauled the older conception of the disease and consider that the toxin has a peripheral action on the neuro-muscular junctions in the muscles themselves. The descending order of the spasms, however, has not been sufficiently explained.

Summary and Conclusions

1. A further series of 438 cases of tetanus has been observed, with special reference to the use of antitoxin.

2. The combined method of administration of the antitoxin, intrathecally through the cisterna magna, intravenously, and intramuscularly, has continued to be used in this as in the previous series.

3. The total mortality of all consecutive cases, except the fifteen that were discharged by request, has been 50.6 per cent., and after excluding those that died within twenty-four hours of admission, 29.4 per cent. This compares somewhat unfavourably with the previous figures, but may probably be explained by the fact that several brands of sera have had to be used in the present group while only one brand was used for the previously published group.

4. The routine use of paraldehyde per rectum is recommended in all cases as the most suitable sedative for hospital patients.

5. The clinical fact that the intrathecal administration of serum through the cisterna magna along with the other routes controls the course of the disease better, estab-

lishes the need for further study of concentration of antitoxin in the blood serum after intrathecal injections.

I take the opportunity of thanking Lieut.-Colonel Vazifdar, I.M.S., for facilities with regard to the treatment of the patients, and my successive house-physicians, without whose co-operation this work could not have been carried out. I also thank Dr. Manohar and Dr. Nene for helping me with the guinea-pig experiments.

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TREATMENT OF MENINGITIS WITH MENINGOCOCCAL ANTITOXIN

BY

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Until recent years the only specific agent available for the treatment of meningococcal meningitis was anti-meningococcal serum, but lately there has been produced a meningococcal antitoxic serum,* with which a series of four cases was successfully treated at the Kingston and District Hospital during the last year.

This serum is the result of the work of Dr. N. S. Ferry, who, with his associates, investigated the properties of broth filtrates of the meningococcus (1931), and showed that specific extracellular toxins were produced with each of the four Gordon types of the meningococcus. Further, it was found that animals could be immunized with each of the toxins and true antitoxins produced which, when investigated in the case of the guinea-pig and monkey (1932, 1934), rabbit (1934), and finally the human being (1935), were shown to have a curative effect against live virulent meningococci, besides a neutralizing one on the specific soluble toxins. These effects were not only specific for the type of meningococcus against which the antitoxin was produced, but were apparent to a lesser extent for all types of meningococci.

Dr. H. L. Hoyne (1935), in an investigation of a series of eighty-five cases treated with antitoxin, showed that the mortality was 23.5 per cent. as against 45.9 per cent. for cases treated with anti-meningococcal serum. After eliminating those cases in which the patient died within 48 hours of admission to hospital, the mortality was 9.6 and 29.6 per cent. respectively. Dr. Hoyne noted that following the use of antitoxin there was a prompt response of the infection, and he favoured large doses of 60 to 100 c.cm. administered intravenously in order that the toxin should be rapidly neutralized. It was recommended that these quantities should be given diluted in twice the volume of normal saline or 10 per cent. glucose solution.

The four cases reported below, all children, were treated with Ferry's serum on these lines, and gratifying improvement appeared to follow its use. In two cases meningococci were found in the cerebro-spinal fluid, but in the other two no organism was identified. In each case there was a rapid improvement in the general condition of the child associated with a decrease in the number of leucocytes in the cerebro-spinal fluid. The antitoxin was given

* By Parke, Davis and Company.

undiluted intrathecally and intravenously in all four cases, two of which developed a well-marked serum reaction on the tenth day.

From the hospital records as far back as 1928 there appear to have been only six proven cases of meningococcal meningitis, of which five were treated with anti-meningococcal serum. All the cases ended fatally, the longest survival period being sixteen days. It is our impression that the use of antitoxin exerts a favourable influence on the prognosis of meningococcal meningitis, and that administration by the intravenous route is the most advantageous.

Case I

A girl, aged 13, developed generalized headache and persistent pain in the neck which was becoming gradually worse, and was admitted to hospital on the eighth day. She then presented a typical picture of meningitis, with very marked head retraction. The temperature was 104° F. and the pulse 100. The cerebro-spinal fluid was under greatly increased pressure and milky in appearance, containing 2,990 cells per c.mm., all of which were neutrophil; and from a later specimen meningococci were obtained. Daily lumbar puncture was performed under light ether anaesthesia, as it was found that this gave a rather better flow of cerebro-spinal fluid; moreover, the child preferred it to local anaesthesia. Antitoxin was given, 30 c.cm. intrathecally on the first day, and 90 c.cm. on the sixth day, followed by 110 c.cm. on the next three days. The cerebro-spinal fluid was normal by the thirtieth day, the child having made a complete recovery.

Case II

A boy, aged 14, had been ill for one day prior to admission with rapidly developing headache, abdominal pain, and delirium. His general condition was very bad: temperature 96° F., pulse rate 62, delirious, and with well-marked head retraction. The spinal fluid was under greatly increased pressure, very milky in appearance, and contained 100,000 leucocytes per c.mm., while a stained film showed many organisms morphologically identical with meningococci. Failure to culture these organisms was thought to be due to the fact that the laboratory was some distance away. Repeated spinal puncture was performed under ether anaesthesia, and a total of 134 c.cm. of antitoxin was given intrathecally and 163 c.cm. intravenously during the first sixteen days. The number of cells in the cerebro-spinal fluid gradually fell in association with an improvement in the boy's general condition, and on the twelfth day there were 95 per c.mm., all lymphocytes, while the fluid was normal on the twenty-fifth day. The patient made an uninterrupted recovery and there were no sequelae.

Case III

A girl, aged 10, had been unwell for three days before admission with severe headache, vomiting, and general pains in the back and limbs. Her condition was very poor: the temperature was 102.4°, the pulse rate 110, and she was very irritable, with some head retraction and pronounced neck rigidity. Kernig's and Brudzinski's signs were strongly positive. The spinal fluid was under increased pressure and milky in appearance, and contained 7,000 leucocytes per c.mm. No organism was ever identified. Repeated spinal puncture was performed under ether anaesthesia, and large doses of antitoxin given intravenously: 90 c.cm. on the first day, 60 c.cm. on the second, and 30 c.cm. on the fourth. From the third to the ninth day a total of 85 c.cm. was given intrathecally. The child became afebrile by the seventh day, and the cell count in the cerebro-spinal fluid slowly fell to normal by the twenty-seventh day. There were no sequelae and recovery was complete.

Case IV

A girl, aged 13, was suddenly taken ill with severe occipital headache and increasing unconsciousness, vomiting, and involuntary movements of the limbs. She was admitted twenty-

four hours later, when her temperature was 97.4° and pulse rate 80. She was unconscious; jaw spasm was present and neck rigidity was marked. The limbs were flaccid, Kernig's sign was positive, and there was a slight strabismus. Lumbar puncture revealed a very turbid white fluid under a pressure greater than 300 mm. of cerebro-spinal fluid, which showed a count of 9,120 cells per c.mm., all polymorphonuclears. No organism could be identified. A dose of 80 c.cm. antitoxin was given intravenously, and lumbar puncture performed under ether anaesthesia each day. On the second day in hospital the patient slowly returned to consciousness, and her temperature rose irregularly to 103.2°. Antitoxin was given intravenously and intrathecally for the first thirteen days, the amounts totalling 405 c.cm. and 200 c.cm. respectively. By the middle of the third week she was afebrile, and the spinal fluid showed a normal cell count by the thirty-second day. The strabismus disappeared slowly, and by the seventh week she appeared to have made a complete recovery.

I wish to record my thanks to the late Dr. P. Vernon Davies, medical superintendent of the Kingston and District Hospital, for permission to publish notes of these cases, and to Dr. E. C. Warner, consulting physician to the hospital, for valuable advice and criticism.

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A NOTE ON THE EXAMINATION OF TUBERCULOSIS HOME CONTACTS

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It is no longer disputed that there is a greater incidence of tuberculous disease in contacts of persons suffering from pulmonary tuberculosis than in the general population. This is admitted independently of any views that may be held on the mechanism by which the disease develops in the contacts: whether it is primary infection or reinfection (endogenous or exogenous), or whether it is due to superinfection or to lowered resistance associated with poor economic circumstances in the family of a tuberculous adult. But much difference of opinion still exists on the extent of this increase in incidence in contacts as a whole and in contacts at various ages. Nor is the significance of latent tuberculous lesions as yet fully appreciated.

The subject of contact examination came up for discussion recently at the annual conference of the National Association for the Prevention of Tuberculosis (1936). It was then stressed by some speakers that active pulmonary tuberculosis in children was uncommon, although it was stated, with insufficient emphasis, that latent lung lesions and active foci in other organs occurred in an appreciable number of children in addition. One speaker pointed out that the supervision of all contacts was not a practical proposition at present. Basing himself on an index of 2.5 (according to the 1931 census the average size of the London family was 3.46 persons), and assuming that it was necessary to follow up a contact for five years, he calculated that this would mean in London the supervision of about 65,000 people. Arguing on the relative infrequency of active pulmonary tuberculosis in children, he urged that instead of paying increasing attention to child