enough, she declared that all her old symptoms had disappeared, that her health had been completely restored by the operation, and that she owed everything to my skill. This happy state of affairs continued for many months, then all her old symptoms returned, and for many years I was glad to go a long way round to escape an interview with her.

On many occasions I have undone adhesions in the abdomen, and seen cases operated on by others, for abdominal discomforts difficult to assign to any definite cause. Omitting those causing definite obstruction or associated with gross pathological change, I have never been able to satisfy myself that any benefit followed these operations, and patients are often worse after them. It is of interest in this connexion to note that Sir Arbutnot Lane, whose brilliant work has attracted the attention of the whole surgical world, has abandoned attempts to deal directly with adhesions because he has found these operations useless.

In conclusion, then, allow me again to offer a reason for my attempt to give an example of the type of post-graduate teaching that I consider ought to be offered in surgery.

The principles of surgery should be taught to students so thoroughly that they can never forget them. In the limited time at the disposal of practitioners they ought to be given as much information as possible, and their surgical teachers should give the results of their experiences in so practical a form as to serve as a safe guide to a diagnosis which suggests the need for surgical treatment.

Clinical Notes

ON

EPIDEMIC CEREBRO-SPINAL MENINGITIS:

WITH OBSERVATIONS ON TREATMENT.

BY

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At the present time cerebro-spinal meningitis is a disease of the greatest moment, because of its intense virulence and great rapidity of progression, and also because of its infectious nature.

An early diagnosis is of the greatest importance, for it gives better hope of recovery to the patient, and also lessens the danger of the spread of infection, as it enables immediate attention to be given to the disinfection of quarters and isolation of contacts—matters of vital urgency where moving troops are concerned.

Four cases of this disease having come under my care, some clinical notes, and some observations on treatment, may be useful to army medical officers and civilian practitioners, as cases of this form of meningitis have recently occurred both in the military and civil population, and in some instances a fatal termination has resulted, almost before diagnosis was made.

CASE I.

Trooper G. M., aged 19, was taken ill on February 12th, complaining of severe headache; he was admitted into the infectious hospital on February 15th. He was then very delirious at night and rambling all day, and complained of severe headache. Retraction of the head was well marked, and there was also some rigidity of arms and legs. Kernig's sign was very pronounced. Some pink spots were found scattered over his body, and some haemorrhagic blotches were present about the ankles and knees. *Tache meningitique* and pressure erythema were very well marked. The temperature on admission was 103°.

On February 16th 30 c.cm. of turbid cerebro-spinal fluid were withdrawn and 20 c.cm. of anti-meningococcic serum injected. On February 19th 64 c.cm. of turbid fluid were withdrawn; on examination the fluid was found to contain the *Diplococcus intracellularis*; 10 c.cm. of serum were injected.

On February 20th 48 c.cm. of clear fluid were withdrawn, and 15 c.cm. of serum injected. By this date the delirium had decreased, the headache had gone, and he was sleeping well, but his neck was still very rigid, and his head retracted. Kernig's sign was still very marked. On February 21st 64 c.cm. of clear

fluid were withdrawn and 15 c.cm. of serum injected. On February 22nd he had no headache and no pains, and his delirium had decreased, though still present at night. There was less rigidity of his neck and less general rigidity, but Kernig's sign was still well marked. Pressure erythema was also still very evident, but the subcuticular mottling was fading and there were only a few scattered pink spots on the back and buttocks. He never had any hyperaesthesia. On February 24th patient had slept well, and had had no delirium during the night; he looked better and there was more movement in his neck, but Kernig's sign was still very definite. On February 25th movement of his head was better, but as Kernig's sign was still well marked, 48 c.cm. of clear watery fluid were removed at pressure. No diplococci were found in this fluid; 15 c.cm. of serum were injected. On March 1st his general condition showed considerable improvement, but there was evidence of cardiac weakness; the pulse was soft, of low tension, and inclined to be intermittent, and the heart sounds were feeble and weak. This continued until March 4th, when 2½ minim doses of liquor strychninae were ordered every six hours. Since that date there has been steady improvement of the heart's action, and also an abatement of the remaining nervous symptoms; all rigidity of the neck has gone, Kernig's sign has disappeared, and the skin eruption and *tache meningitique* have subsided. The temperature has remained normal since February 27th, and on March 19th he was able to get up and walk about the ward.

Case I.—A, 20 c.cm. serum; B, 10 c.cm. serum; C, 15 c.cm. serum.

CASE II.

Private H. H., aged 19, complained of feeling slightly unwell on February 14th. The following morning he reported sick, and complained of pains all over his body. As influenza was prevalent, he was treated with sodium salicylate, and kept in his billet. During the day he became much worse, severe headache, vomiting, and delirium supervening; the temperature rose to 102°. On further examination, some stiffness of the muscles of the neck, Kernig's sign, and *tache meningitique* were found to be present. The diagnosis of cerebro-spinal meningitis was made, and he was at once removed to the Isolation Hospital. The following morning the rigidity of his neck was more marked, and there was also retraction of his head, with hyperaesthesia of the calves, and a few pink spots on the upper part of his chest, left ankle, and neck.

Lumbar puncture was then performed; 30 c.cm. of turbid fluid were withdrawn and 28 c.cm. of antimeningococcic serum injected. The spinal fluid was found on examination to contain the *Diplococcus intracellularis*. The following day his condition had improved, the headache and delirium were less marked, and the temperature was below normal, but the retraction of the head and Kernig's sign still persisted. On February 19th another dose of antimeningococcic serum (15 c.cm.) was given after 48 c.cm. of clear fluid had been withdrawn. On February 20th 48 c.cm. of clear fluid were withdrawn and 15 c.cm. of serum injected. The same treatment was adopted on the following day, the same amount of fluid being withdrawn and the same quantity of serum injected. The delirium left him on the night of the 18th, and he slept well after this. A marked eruption of supraorbital herpes occurred on the right side on February 20th, and pressure erythema was very marked about the knees, ankles and hips. On February 22nd the erythema was still marked, but Kernig's sign had lessened, the head was less retracted, he had no headache, and no delirium, but some pink spots were still present on the left buttock. This improvement was maintained, but on February 24th he had an attack of urticaria all over his body.

The following day the temperature rose to 102°, and he complained of headache, but had no delirium. The rash was more marked on February 26th, and the temperature rose to 103° in the morning but steadily fell during the day. The other symptoms all improved until March 1st, when, as his temperature was on the upward grade, lumbar puncture was again made; 48 c.cm. of clear fluid at pressure were withdrawn and 15 c.cm. of serum were injected. On examination this fluid showed the *Diplococcus intracellularis* to be still present. On March 4th the patient had slept well, and had no delirium or headache, but the temperature at 10 a.m. was 102.6° and the urticaria, which had completely disappeared, recurred. There was no rigidity of the neck and Kernig's sign was only slightly marked. On March 8th Kernig's sign was more in evidence, and as his temperature had risen to over 102° with a rigor, 64 c.cm. of turbid fluid were removed and 15 c.cm. of serum injected. On March 9th patient was very restless and delirious during the night; lumbar puncture was again done and 64 c.cm. of turbid fluid withdrawn and 15 c.cm. of serum injected. On March 10th and 11th 64 c.cm. of turbid fluid were removed and 15 c.cm.

of serum injected on each occasion. On March 12th 72 c.cm. were removed and 15 c.cm. of serum again injected. As a result of this treatment the temperature came down to below

delirium during the night, and no headache after the second lumbar puncture; 48 c.cm. of only slightly blood-stained fluid were withdrawn, and 15 c.cm. of serum injected. Though

Case II.—C, 15 c.cm. serum; D, 28 c.cm. serum; E, 30 c.cm. serum.

normal for three days; he had no headache, no delirium, he slept well, there was no rigidity of the neck, and Kernig's sign had almost disappeared. At 6 a.m., however, on March 16th, his temperature ran up to 102°, delirium returned, with some stiffness of the neck, the erythematous rash was again present, together with marked *tache méningitique* and Kernig's sign, which had almost disappeared, was slightly more marked; 80 c.cm. of turbid fluid was therefore withdrawn and 15 c.cm. of serum injected.

CASE III.

Private A. H., aged 26, complained of feeling seedy on February 14th, there was no rigidity of the neck, and Kernig's sign had almost disappeared. At 6 a.m., however, on March 16th, his temperature ran up to 102°, delirium returned, with some stiffness of the neck, the erythematous rash was again present, together with marked *tache méningitique* and Kernig's sign, which had almost disappeared, was slightly more marked; 80 c.cm. of turbid fluid was therefore withdrawn and 15 c.cm. of serum injected.

Case III.—A, 20 c.cm. serum; C, 15 c.cm. serum; F, 27 c.cm. serum.

he had no delirium or headache, but some spots were still present on his back, Kernig's sign and *tache méningitique* were still well marked, and pressure erythema was present on the ankles and knees. On February 25th, as his temperature showed a tendency to rise, another lumbar puncture was made, and 48 c.cm. of clear fluid at pressure were withdrawn, which was found not to contain any organisms; 15 c.cm. of serum were injected. His temperature during the next few days subsided, he steadily progressed towards recovery, Kernig's sign gradually diminishing. On March 19th he was up in the ward.

CASE IV.

Private H. B., aged 21, was taken ill on February 23rd complaining of pains and chilliness. When seen by the medical officer, Kernig's sign was well marked, and there was marked rigidity of the neck and of all extremities, together with well-marked retraction of the head, and his general condition was that of semi-coma, with a certain amount of rambling delirium. Pink spots were found scattered over his body. He was admitted to hospital, and lumbar puncture was performed; about 19 c.cm. of blood-stained, cloudy fluid were withdrawn, and 15 c.cm. of serum injected. On February 24th the general rigidity and Kernig's sign were less marked, but hyperaesthesia was present in the calves; he was quite sensible, though he had been somewhat delirious during the night; 20 c.cm. of blood-stained fluid were removed, and 15 c.cm. of serum injected. On February 25th the patient had improved. He had no

and this was found to be blood-stained and to contain a considerable quantity of albumin.

During the next few days some delirium and restlessness occurred at night, and, though the rigidity of the neck had disappeared by March 8th, Kernig's sign was more marked, and therefore

another lumbar puncture was made; 64 c.cm. of straw-coloured fluid, which showed no meningococci, were withdrawn, and 15 c.cm. of serum injected.

During this period, though the urine contained a considerable amount of albumin, and was always either smoky or blood-stained, his condition somewhat improved; but as some nocturnal delirium and severe headache, with persistent Kernig's sign, again developed, lumbar punctures were made on March 12th and 13th, when 60 c.cm. and 20 c.cm. of clear fluid were withdrawn and 15 c.cm. of serum injected on each occasion. Since that date his temperature has remained normal and his general condition has steadily improved. He sleeps well, and his Kernig's sign is diminishing. The renal condition has much improved, and all joints affected have recovered.

All these cases occurred in healthy, well-built, robust soldiers. None of the men were recruits. Case III had the shortest length of service—four months—and he is an athlete, and had never felt fagged by training. Cases III and IV could be traced to contact with a previous case of this infection, the incubation period being, as nearly as can be calculated, *eighteen to twenty-five days*. Case III also slept in the same corner of a billet immediately after it had been vacated by a man who later showed evidence of this disease.

Diagnosis.

As in all medical disorders, the diagnosis depends on the sum totals of the symptoms, and this in cerebro-spinal meningitis is clinched by lumbar puncture and the withdrawal of a turbid fluid, which is found to contain the *Diplococcus intracellularis*. In its earliest stages cerebro-spinal meningitis is sometimes simulated by cerebral influenza, especially (as is rarely the case) if the latter disease has stiffness of the neck. Such a case was recently admitted into the field ambulance, but on examination no Kernig's sign was present, there were no rashes, and no *tache méningitique*, and the soldier rapidly recovered with sodium salicylate.

Intense headache and delirium invariably occur, and rigidity of the neck with retraction of the head is very characteristic. Kernig's sign appears to be one of the most valuable indications of the disease; it is invariably

Case IV.—C, 15 c.cm. serum.

present, as far as my experience goes, and is one of the last symptoms to disappear as the patient recovers. Its disappearance is a good sign, its reappearance is an indication of a recrudescence of the disease.

Unfortunately the disease is very treacherous, and recrudescences or relapses are very liable to occur.

The rashes are very useful aids to diagnosis.

1. The pink spots are not unlike those of typhoid, but are not usually raised. They are more frequently found on the back and about the joints.

2. Pressure erythema is almost invariably present after the first few days, occurring on the part of the body exposed to pressure.

3. *Tache méningitique* is always present, usually well marked.

3A. Three of these cases had urticaria; Cases II and IV severely, and Case III only slightly.

4. Herpes occurred in Cases II and IV.

5. Haemorrhagic eruption occurred only in Case I. This is sometimes very evident.

Hyperaesthesia is sometimes very marked, at other times it is absent. In only two (Cases III and IV) was it present, and then only for a few days, and only well marked in Case IV.

Photophobia was also present in Cases III and IV, but only slightly for a short period.

The temperature in this disease is by no means constant; in fact, its irregularity is characteristic. A high temperature is generally found at the onset, but a fall is only a good sign if it remains below normal for several days.

The joint affection which occurred in Case IV is a fairly frequent complication of the disease, but the attack of nephritis which occurred in the same patient is an unusual one. Both these conditions are due to the diplococcus or its toxins.

Treatment.

As stated, these cases were treated by lumbar puncture together with injections of antimeningococcic serum. Previously I have had some cases recover with lumbar puncture alone, and I am confident that it is a most valuable aid to the patient's recovery. On this account on every occasion when a lumbar puncture has been performed as much fluid as possible has been withdrawn without applying suction, and even as much as 2 to 3 oz. has been withdrawn.

In the early summer of 1914 I had a lad of 19 in my wards at the Liverpool Stanley Hospital suffering from cerebro-spinal meningitis. He progressed most satisfactorily for about five weeks under the treatment of lumbar puncture alone; indeed, so well did he progress that, though the advisability of giving serum was considered, it was decided that it was unnecessary. Suddenly, however, a recrudescence occurred, his temperature rapidly rose, he became comatose, and died in a few hours. Having this case fixed in view, the treatment in these four cases has been that of lumbar puncture *plus* antimeningococcic serum, and the result has been eminently satisfactory. There is no doubt that the serum has been beneficial in its effects; the symptoms abated more rapidly and constantly. In nearly all instances the puncture has been made under local anaesthesia (ethyl chloride spray), and the injection given by an ordinary serum syringe, the serum being injected very gradually. It has been noticeable that patients invariably complain of pains in the legs if the injection is hastened. There is occasionally some numbness in the legs after injection, but this passes off in about half an hour.

The pulse throughout the injection was always good, and the necessity of taking blood pressure was never evident. At the first injection 20 to 30 c.cm. of serum are generally given, and daily doses of 15 to 20 c.cm. for the following three or four days. After an interval of about three days another injection is given, and further injections at intervals if the cerebro-spinal fluid still shows the diplococcus, and Kernig's sign still remains marked, or the temperature still shows a tendency to spiking. Daily injections appear necessary so long as the cerebro-spinal fluid remains turbid; and even when the fluid becomes clear and shows no diplococci, persistent Kernig and irregularity of temperature are, in my opinion, indications for further injections at intervals.

The importance of prophylaxis cannot be over-estimated. In all cases, disinfection of billets, and the isolation of

contacts, and the treatment of their naso-pharynx by an antiseptic spray, was rigorously carried out. Naso-pharyngeal swabs were taken and examined for the diplococcus in all contacts, and isolation of contacts was persisted in for twenty-two days, and it is gratifying to report that no case of the infection has been reported from these four cases.

Since this paper was prepared for press Case II had a further recrudescence, and died on April 2nd; the other cases are convalescent.

FURTHER REMARKS ON THE MIXED TYPHOID + PARATYPHOID A + PARATYPHOID B VACCINE.

BY

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So many inquiries have recently reached me concerning the mixed typhoid + paratyphoid A + paratyphoid B vaccine—especially on its preparation—that a further note on the subject will perhaps be found useful.

First of all, as regards the amount of immunization induced, the technical method of preparation of typhoid vaccines is—within limits, of course—not, in my experience, of paramount importance: vaccines killed by heat or by various chemicals may be used; or live attenuated vaccines, sensitized vaccines, etc., with almost equally satisfactory results. The important point is that, whatever the method of preparation, the antienteric vaccine should not be a simple typhoid vaccine, but should contain the three species of germs—typhoid, paratyphoid A, and paratyphoid B.

The simplest and most practical types of the mixed typhoid-paratyphoid vaccine, are, according to my researches, the following two:

1. Dead mixed vaccine, with germs killed by heat.
2. Dead mixed vaccine, with germs killed by carbolic acid.

I have described in detail the technique of preparing them in previous papers,¹ but it may be here again briefly summarized.

Mixed Vaccine (Heated).

This is a mixture of the three vaccines—typhoid, paratyphoid A, and paratyphoid B—each of which is prepared according to the technique used by Wright and Leishman in the preparation of their simple typhoid vaccine.

1. Prepare broth cultures of *B. typhosus*, broth cultures of *B. paratyphosus* A, and broth cultures of *B. paratyphosus* B, from recent agar cultures, inoculating two normal loopfuls per tube, into tubes containing 10 c.cm. of broth.

2. Incubate at 37° C. for eighteen hours.

3. *Standardization*.—Count the number of bacilli by using a Thomas-Zeiss blood counter, and, by dilution, bring the number down to approximately 1,000 millions per cubic centimetre.

4. If the germs are very motile they are immobilized, as done by Leishman, by adding a trace of formalin. Keep the standardized cultures at 53° C. for an hour in a water bath. Leishman has shown that 53° C. is the minimal thermal death point for typhoid bacteria, and that the lower the temperature at which the germs are killed the greater is the immunizing power of the vaccine.

5. Mix in the following proportions:

Typhoid	...	...	...	2 parts
Paratyphoid A	...	...	...	1 part
Paratyphoid B	...	...	...	1 "

To this mixture, when cooled, add 0.25 per cent. lysol, and shake thoroughly. Twelve hours later inoculate some agar slopes to test for sterility. The mixed vaccine will contain per cubic centimetre:

Typhoid	...	...	...	500 million
Paratyphoid A	...	...	...	250 "
Paratyphoid B	...	...	...	250 "

Of this vaccine 0.5 to 0.6 c.cm. is inoculated subcutaneously in the arm the first time, and the second time,