MENINGOCOCCUS MENINGITIS AT CAMP LEE

RUSSELL L. HADEN, M.D. (DETROIT)

Lieutenant, M. C., U. S. Army

CAMP LEE, VA.

The epidemics of meningococcus meningitis occurring in a number of the army camps have afforded an unusual opportunity for the study of the disease. There have been numerous reports in the literature for the past year emphasizing various phases of the infection.

The disease had previously been studied so thoroughly and carefully by Flexner and his associates at the Rockefeller Institute that the experiences of most observers during the army epidemics have only confirmed previous findings. It seems that the one outstanding contribution to the study of the disease during the past two years is the conception of the infection as primarily a generalized one with a secondary localization in the meninges. For this view we are indebted largely to the work of Herrick¹ and his associates at Camp Jackson where many cases of meningitis have been studied. Workers at other camps have not been unanimous in accepting this view, but Herrick's work has been confirmed in other base hospitals, notably at Camp Beauregard by Landry and Hamley,² who subscribe fully to his views. Of course it had long been known that there was a type of the disease fulminating in character in which the infection was evidently generalized. But it had been held that the majority of cases were primarily a localized infection from the outset.

A necessary corollary of the conception of the disease as a generalized infection has been new ideas in regard to treatment. It has been shown that intravenous therapy influences markedly the course and outcome of the disease. This result is well illustrated in the Camp Jackson series of 265 cases. Of 137 patients receiving intraspinal treatment alone 34.3 per cent. died; in 128 cases with combined intraspinal and intravenous therapy the mortality was 14.8 per cent. The point is emphasized also that it is the severe cases in which the newer methods of treatment are most effectual. Mild cases of the disease respond readily to almost any treatment, even spinal drainage alone. It is for the severe cases that we have most needed improved methods of treatment.

Intravenous therapy also decreases the number of intraspinal treatments needed. It has seemed to us that the harm resulting from con-

1. Herrick, W. W.: Arch. Int. Med. **21**:541 (April) 1918; J. A. M. A. **71**:611. (Aug. 24) 1918.

2. Landry and Hamley: Am. J. Med. Sc. **157**:216 (Feb.) 1919.

tinued intraspinal treatments has not been emphasized enough. The majority of the bad effects of the disease are due to a myelitis in the caudal region and involvement of the nerve roots. This is the direct result of the local introduction of serum and needle traumatism, and is the explanation of the pain and stiffness of back and legs so often complained of. Rosanoff³ from the study of twenty-six convalescent cases has described what he considers a uniform postmeningitic syndrome. One can see that the most of the symptoms are directly dependent on changes in the spinal cord and nerve roots at the site of the local treatments.

At Camp Lee we have fortunately not had to deal with any large epidemic of meningitis, but cases have developed from time to time, usually in groups. From June 1, 1918, to June 1, 1919, thirty-one patients have been treated in the base hospital.

We have been interested in the analysis of the cases especially from the standpoint of the evidence they present for or against the disease being primarily a generalized infection, and also the results of treatment.

The cases have been quite generally distributed throughout the year and throughout the camp so the epidemic factor has played only a small part. The distribution by months has been as follows: June, 1918, one; July, 1918, one; September, 1918, four; October, 1918, eight; November, 1918, four; December, 1918, nine; January, 1919, three, and February, 1919, one. Every case came from a different company.

Twenty-one of the thirty-one patients, or 67.7 per cent., showed unmistakable evidence of a generalized infection before there were any signs of a localization in the meninges. Fourteen had petechiae, usually in large numbers; one had a macular rash; in thirteen records there is no mention of a rash, and in two cases it was absent. In six cases in which there was no rash the only symptoms for a period varying from seven to twenty-three days were the signs of a generalized infection, viz.: fever, general malaise, joint pains and enlarged spleen, usually with an upper respiratory tract infection of varying degree. The evidence of meningitis did not develop until late, and when lumbar puncture was done there was usually only a small number of cells in the spinal fluid. The meningitis as evidenced by the cellular reaction in the spinal fluid was only of a minor degree as compared with general infection. This type of case has been emphasized by Herrick in a recent paper.⁴ The following case illustrates the type as we have observed it here. The generalized infection overshadows the

3. Rosanoff, A. J.: *J. A. M. A.* **71**:1476 (Nov. 3) 1918.

4. Herrick, W. W.: *Arch. Int. Med.* **23**:409 (April) 1919.

local picture. Unfortunately, this patient was treated during the period in which only intraspinal and subcutaneous therapy was being used. The response to treatment was very slow.

CASE 1.—Patient aged 23 years, white, was admitted to the hospital Oct. 16, 1918. His family history was unimportant, and his personal history was negative, except that he had been treated in the base hospital from September 24 to October 4 for influenza and bronchopneumonia. He stated that he had begun to feel badly the night before admission, but had gone to work the next morning. He complained of headache, fever, chilliness, anorexia, pain in joints and backache. The general examination was negative, except that it was noted that he was nervous and irritable. His temperature was 103.2 F., pulse 120, and respiration 24. His temperature was normal for the next three days followed by an irregular temperature for forty-eight hours. October 26 he had a chill with a sharp rise in temperature, and October 29 there was again an unexplained fever of 103 F. Examination was negative, except for a palpable spleen. After several days of normal temperature he was discharged to quarters without satisfactory explanation for his symptoms. November 6 he had headache, general achiness, chilliness and slight vague abdominal symptoms and he was returned to the hospital with a diagnosis of acute rheumatic fever. His temperature was 100 F. The examination was negative, except for tenderness in the right iliac fossa. The next day he had headache and vomiting and twenty-four hours later there was slight neck rigidity, the white blood cells numbered 24,400 and the temperature was 103 F. The Brudzinski sign was negative and the Kernig was only suggestive on one side. Lumbar puncture showed cloudy fluid. The cell count of the fluid from the first puncture is not recorded, but the fluid on the following day showed only 1,018 cells per c.c. He was given 260 c.c. of antimeningococcus serum intraspinally and 475 c.c. subcutaneously. Thirteen lumbar punctures were made. He was sent to the Development Battalion for further hardening, Dec. 19, 1918.

The analysis of the results of treatment in our series is interesting. The cases are divided almost equally into two groups. In the first group, which covers the period from Sept. 15, 1918, to Dec. 7, 1918, intraspinal and subcutaneous treatments were used in twelve cases. Four patients received intraspinal treatment only. We discount entirely the value of the serum given subcutaneously. The mortality in this group was six deaths, or 37.5 per cent.

The second group comprises fifteen cases treated in June and July, 1918, and during the period from Dec. 7, 1918, to March 1, 1919. Eleven patients in this group received both intraspinal and intravenous therapy. Four cases of the mild type, one of which was transferred late in the course of the disease from another camp, were given only intraspinal treatment and recovered promptly. Only one patient of the fifteen died, a mortality of 6.6 per cent. This patient died within thirty-six hours after admission to the hospital.

I realize that no sweeping deductions can be drawn from such a small series, but one in daily contact with the patients could not but be impressed with the good resulting from the intravenous administration of serum. In the second group of cases the patients were on the

average much sicker than those in the first group, and a study of the clinical records convinces us that some of the patients receiving only intraspinal therapy could have been saved by serum given intravenously. In one case reported elsewhere I believe the intravenous injection of glucose was probably the factor determining the outcome of the infection. The value of glucose in reducing the brain volume has been emphasized elsewhere.⁵ We believe it is a valuable adjunct as a routine measure in meningitis.

The view is held by some, notably by Neal,⁶ that the only value of serum given intravenously is to destroy bacteria circulating in the blood stream. But there must be a passage of antibodies from the blood stream into the spinal fluid through the choroid plexus, and also into the tissues of the central nervous system. And it is really the tissues that are the seat of infection, and not the spinal fluid.

The following case is cited to show the evident effect of serum given intravenously on the affected tissues of the central nervous system and also presumably on the spinal fluid.

CASE 2.—Patient, white, aged 36 years, was admitted to the hospital May 31, 1918, with an evident cerebrospinal meningitis. There was a profuse crop of petechiae and he was very ill. The second day he had an arthritis affecting the left wrist. He at first improved under intraspinal treatment. June 4 he became worse, the spinal fluid was more cloudy and meningococci reappeared. Intravenous injection was attempted but stopped after only a few c.c. had been given because he did not react well. He again became worse on the ninth but then improved and became afebrile. June 27 he began to have fever, headache and vomiting and lumbar puncture showed turbid fluid. After three intraspinal treatments his temperature returned to normal. July 6 he began to have an irregular rise in temperature. He complained of headache but there was no stiffness of the neck or vomiting. On attempting intraspinal treatment again it was found that the spinal fluid had become so thick that it would not run out. Only a few drops could be obtained at each puncture even by aspiration. The introduction of serum had to be abandoned. Meningococci were present in the fluid obtained July 16. Up to this time 440 c.c. of serum had been given in twenty-eight punctures. At this time intraspinal treatment was given up and 435 c.c. of serum given over a course of six days in seven intravenous injections. After each injection there was a reaction with chill and fever. His temperature remained normal after the last treatment. He had a partial paraplegia evidently from caudal and nerve root involvement subsequent to the many intraspinal treatments and was deaf. He was transferred to a general hospital, Oct. 20, 1918, for further convalescence.

The infection in this case which seemed to be localized in the central nervous system was cured by serum given intravenously. A similar case is reported by Camac.⁷

5. Haden, R. L.: To be published in J. A. M. A.

6. Neal, Josephine B.: J. A. M. A. **72**:1785 (June 14) 1919.

7. Camac, C. N. B., and Bowman, Karl M.: Arch. Int. Med. **23**:17 (Jan.) 1919.

I believe that there is a tendency to overemphasize the danger of the intravenous administration of serum. This is certainly not to be undertaken inadvisably, but in competent hands should be perfectly safe. We have used routinely 100 c.c. at each injection, giving it at intervals of twelve hours for the first three to five doses. The intraspinal treatments have been given twice daily. One of the most fundamental points in the serum therapy is to give it in large doses, the optimum being 100 c.c.

I have been very much impressed by local ill effects of intraspinal therapy. In every case in this series in which a large number of punctures were employed there has been evidence of a caudal myelitis and nerve root injury leaving what bid fair to be permanent residuals. In no case in which intravenous therapy was instituted early has this occurred because much fewer intraspinal treatments were necessary. It has been common to have develop also in those patients receiving many treatments by spinal puncture delirium, increased rigidity, headache and fever for a period of several days. This usually came on well after the period of serum sickness. Dopter⁸ ascribes the condition to the mechanical and toxic effects of the reaction leading to the formation of precipitin in the spinal fluid.

The complications in the recovered cases have been as follows: Panophthalmitis, one case; deafness and partial paraplegia, one case; paralysis of sixth cranial nerve and of musculospiral nerve, one case; arthritis (excluding serum arthritis), three cases, and arthritis and paralysis of sixth cranial nerve, one case.

I cannot emphasize too strongly that each case of meningitis must be studied by itself, and all the factors in the case taken into consideration before the plan of treatment is determined. While I believe that every case of meningitis is primarily a blood stream infection when the case is first seen by the clinician, there may be only the evidence of a meningeal localization. If the infection is a mild one it should respond readily to intraspinal therapy. All cases seen early, all with signs of an existing blood stream infection, and all severe cases should have the benefit of serum given intravenously.

SUMMARY

Thirty-one cases of meningococcus meningitis have been studied at Camp Lee during the past year.

Twenty-one, or 67.7 per cent., showed unmistakable evidence of a generalized infection before there was a localization in the meninges.

The mortality of the entire series was 22.6 per cent.

8. Dopter: Quoted J. A. M. A. **71**:35 (July 6) 1918.

During the period of intraspinous treatment alone and combined intraspinous and intrasubcutaneous treatment the mortality was 37.5 per cent.; during the period in which intraspinous and intravenous therapy was employed the mortality was 6.6 per cent.

CONCLUSIONS

Meningococcus meningitis, in probably every case, is primarily a generalized infection with subsequent meningeal localization.

The use of immune serum intravenously marks a great advance in the treatment of the disease.

Prolonged intraspinal treatment is very apt to result in permanent ill effects from the involvement of the cauda equina and nerve roots.

Intravenous treatment decreases the number of intraspinal treatments necessary, thus minimizing the harmful effects of local treatment.

One case is reported in which an active localized infection in the meninges recovered under intravenous therapy alone.

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