EPIDEMIC CEREBRO-SPINAL FEVER: ITS RECOGNITION AND TREATMENT.

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The following must be read in conjunction with our previous articles, and it must be borne in mind that we still insist on the protean nature of the disease and the necessity of diagnosing it on only a few symptoms. The disease rarely presents a classical picture. Further, we would again call attention to the three stages of the disease described by us. Our later observations have led us to associate more symptoms with Stage II than we originally thought belonged to it.

STAGE I.—CATARRHAL.

In a series of 170 cases the symptom which stands out predominant in its constancy is an initial naso-pharyngitis. Every patient has admitted to suffering from this, and this condition was present not only in the series of 170 cases definitely diagnosed as cerebro-spinal meningitis, from fluid obtained by lumbar puncture, but in every definite carrier. It is of the highest importance that this throat condition should be early recognized.

On looking at the throat the uvula is generally seen to be oedematous and flabby, with the venous radicles standing out distended and tortuous. The anterior pillars of the fauces are reddened and injected, as is also the posterior part of the soft palate and the posterior pharyngeal wall. The condition differs from the throat in scarlet fever in the colour being of a deeper hue, probably due to venous stasis.

In practice attention is called to the existence of an abnormal throat condition, by the huskiness of the voice and a complaint of dry cough.

The type of catarrh generally is a dry one. Any mucus secreted is viscid and tenacious, and difficult to dislodge. The nasal secretion is sometimes tinged with blood, as are also the crusts which are often present in the nose. There is sometimes a marked stuffing of the nostrils, but it is most unusual to see a free discharge. When the catarrh is at all marked the patient suffers from a good deal of prostration, more than one is accustomed to meet with in ordinary coryza, and the patient often lies up for a day or so. In the case of those who have been carriers for even, say, two or three weeks there is no apparent interference with health, but the throats are always noted to be congested as described. There is no early fouling of the tongue such as occurs in scarlet fever, and the state of the throat ought not to be confused with the condition found in that disease, inasmuch as it never presents the same "duty" aspect.

The pulse and temperature are not much affected, which serves to aid in eliminating the possibility of an attack of scarlet fever.

It is to be noted that in many cases the conjunctivae are also involved. There is redness and injection; an exudate may be seen and a bead of pus may collect at the inner canthus.

A swab taken from the throat of a patient in such a condition will almost invariably show the presence of a streptococcus. In our opinion, the primary invasion of the mucous membrane is by a streptococcus, which so prepares the way for the entrance of the more delicate meningococcus, and should the meningococcus settle on such a throat, the way for further advance is facilitated.

The importance of recognizing this first (catarrhal) stage of the disease in epidemic times cannot be too strongly

emphasized. While the patient himself may combat the disease well, he may be a constant source of danger to his immediate contacts. He may harbour the meningococcus for some time after the acute stage has passed, and the danger of his being a source of infection still remains.

The diagnosis cannot be confirmed without a bacteriological examination, and where the facilities exist this should invariably be undertaken.

STAGE II.—SEPTICAEMIC.

There is no sharp line of demarcation between Stages I and II. While the symptoms of Stage I persist, the symptoms of toxic absorption may be superadded in varying degrees. The usual symptoms are:

1. Headache almost invariably.
2. Pains in the back and limbs.
3. Feelings of chilliness and nausea; vomiting occurs in most cases, in very rare cases it may be the only symptom for a few days.
4. Sometimes mental depression, but in some exaltation.
5. Photophobia.
6. Deep-seated pains in the orbit and pain on moving the eyeballs.
7. The temperature is usually about 100° or 102° F.
8. The pulse is moderately accelerated.
9. The general nervous system in the early stages of the disease shows marked signs of irritation as indicated by the intolerance of light and sound. The skin is markedly hyperaesthetic. The patients complain bitterly of the slightest noises in the room. The hydrocephalic cry may be noted at this stage. All the reflexes are exaggerated. Ankle clonus is frequently met with and tetanic spasms have been described on an attempt being made to elicit certain reflexes. A further occasional occurrence at this stage is acute mania.
10. Rigidity of the neck and retraction of the head frequently occur early, and when present are of the greatest importance from a diagnostic point of view.
11. The skin is usually slightly flushed, and very sensitive to touch and cold, particularly the latter.
12. The *tache cérébrale*, which we originally thought appeared later, is present.

If a lumbar puncture be done at this stage the fluid is clear, and varies in quantity: it is always sterile. The protein content of such a fluid is always found to be increased, the sugar content is as a rule reduced, and there is present a pathological substance that promptly reduces potassium permanganate, giving a yellow coloration. Normal fluid remains pink with this test. The operation of lumbar puncture at this stage often relieves the headache temporarily, and may help to arrest the disease.

STAGE III.—MENINGEAL.

This stage is marked by the arrival of the meningococcus at its destination. Pus accumulates in the cerebro-spinal fluid, giving it varying degrees of turbidity. The general symptoms of nervous irritation give place to those of depression. Stupor tends to set in, and the patient ceases to complain of light and sounds. Headache still is frequently complained of. At this stage we have always found the pupils dilated. Strabismus, optic neuritis, and deafness may also be met with. Frequently there is incontinence of urine and faeces, but occasionally retention is met with. Priapism is often seen. The reflexes begin to disappear about this time. Kernig's and Macewen's sign can now be elicited. Head retraction is increased, and the patient may exhibit convulsive seizures. Herpes labialis is frequent, the mouth and tongue become very foul and dirty, in marked contrast with Stage I. The pulse is slow, the patient usually showing cyanosis due to respiratory failure, Cheyne-Stokes breathing being often observed. There is usually delirium, which may be either of the low muttering type or maniacal. The maniacal type is difficult to control, and not infrequently causes

death by exhaustion. The usual cause of death, however, is respiratory failure, but some cases died of coma.

In a certain number of cases, in which the natural resistance is low, the disease runs a fulminant course. The

Chart I.—A, Lumbar puncture; 30 c.cm. serum injected. B, Lumbar puncture; 75 c.cm. cerebro-spinal fluid withdrawn, and 30 c.cm. serum injected. C, Lumbar puncture. D, Lumbar puncture; 60 c.cm. cerebro-spinal fluid withdrawn, and 30 c.cm. serum injected. (Illustrating the effect of lumbar puncture frequently repeated.)

onset is extremely abrupt. After the first appearance of the headache death may follow in a few hours. In these cases the patient is always profoundly unconscious, and cannot be roused. There is no rigidity, no Kernig's sign, and the reflexes are absolutely lost, both deep and superficial. Even the conjunctival reflex is lost in a bad case. Instead of cyanosis and laboured breathing, there is paleness and collapse, shallow breathing, and a fast "thready" pulse of low tension. This type of case usually dies by cardiac failure. The cerebro-spinal fluid obtained in these cases is rarely turbid, but is under considerable pressure.

RASHES.

Rashes are not nearly so frequent as the popular appellation of the disease would indicate. This, of course, applies strictly to the present epidemic. About 10 per cent. of the cases have exhibited a rash, which may be erythematous, macular, morbilliform, petechial, or even purpuric. It is mostly in the severer cases and in the third stage that a rash occurs. The petechial and purpuric forms appear earlier than the macular or morbilliform. The two latter usually appear after serum treatment, about the time when a serum rash might generally be expected.

RELAPSES.

Early relapses may be met with in a fair percentage of cases, usually at about the end of a fortnight. The symptoms have generally been of a milder type than in the original attack, and have been characterized by a return of the headache and swinging temperature. The cerebro-spinal fluid again becomes turbid, and meningococci reappear in it.

A point of striking importance and magnitude is that a second attack of the disease may occur after apparent

Chart II.—A, Lumbar puncture; 30 c.cm. serum injected. D, Lumbar puncture; 60 c.cm. cerebro-spinal fluid withdrawn, and 30 c.cm. serum injected. (Illustrating the effect of lumbar puncture frequently repeated.)

complete recovery. This may happen two, three, or even four months after the patient has been pronounced well and discharged. These attacks may prove fatal. This naturally raises many points for consideration.

CHRONIC CASES.

In a certain percentage of cases the temperature falls, headache and all distressing symptoms disappear, but gradual wasting sets in. Nevertheless, in spite of the wasting the appetite remains good, although there is frequent vomiting. The patient during this process is apparently unconcerned. These cases usually die in about three to four months.

TEMPERATURE.

In an average case of medium severity the temperature remains elevated for three to five days, with remissions of $\frac{1}{2}^{\circ}$ to 1° F., then falls to normal and remains so; but if lumbar puncture is not performed repeatedly during the period of elevated temperature, the fall of temperature is not maintained, and it again rises and develops a swinging character, which may persist for three or four weeks, and even then be followed by recovery, but in some cases even this treatment fails to prevent this unfavourable temperature. If lumbar puncture be performed when the temperature is swinging, the cerebro-spinal fluid is found to be under moderate pressure, but it is clear and usually sterile.

Hyperpyrexia.

Some cases die early with hyperpyrexia, the temperature rising, for example, to 103.8° F. in twelve hours from the onset, while others die with a normal or even a subnormal temperature.

SEQUELAE.

A notable feature of the recoveries in this epidemic is the absence of any serious sequelae. Occasionally complete deafness has occurred, and there were one or two cases in which the mental faculties were dulled.

PROGNOSIS.

If the disease is recognized in Stage I, and appropriate treatment carried out, recovery is invariable. It also may be reckoned upon in Stage II, but if Stage III supervenes the prognosis is much more grave, but by no means hopeless, provided suitable treatment is commenced early, and thereafter maintained as long as necessary.

TREATMENT.

Treatment will, of course, depend on the stage at which the disease is recognized.

Stage I.

We regard and treat these people as semi-invalids—for example, we exempt them from duty, provide them with invalid comforts, and place them under the most favourable condition for recovery. We find the most useful preparation for local treatment is a solution of potassium permanganate, 1 in 1,000, administered as a nasal and oral spray as advised by the Local Government Board. The importance of a generous diet must not be overlooked, and everything is done to allay their fears of a general infection. Light exercise, such as easy marches and light fatigues, serve to keep them sufficiently employed. They are allowed to play outdoor games. They are of course treated as infectious, and strictly segregated from the healthy community. Smoking is not encouraged, and frequent bacteriological examinations are made of their throats; it is only when two consecutive examinations have given negative results that a case is discharged.

Stages II and III.

The treatment of Stages II and III may most conveniently be considered together.

In performing the diagnostic lumbar puncture, it is well to administer a first dose of serum without waiting for the bacteriological report. Much valuable time is thus saved. It may be necessary to repeat this procedure daily or every forty-eight hours, being guided by the condition of the patient, until there is marked improvement in the condition. Under this treatment the disease is generally favourably affected. Consciousness is restored, headache is relieved or abated, and the general condition of the patient shows marked improvement. The fluid obtained by frequent lumbar puncture, followed by intrathecal injection of serum, becomes successively clearer, and, finally, it is sterile, and of normal pressure. This method of treatment should be persisted in until this end is attained. The serum almost invariably used has been that prepared by Mulford and Co., according to Flexner's directions.

We always remove as much fluid as will flow out spontaneously without suction; this may amount to 100 c.cm., and we always introduce a smaller quantity of serum than the amount of fluid removed. The usual dose is 30 c.cm.; if less fluid than 30 c.cm. has been removed, of course relatively less serum must be introduced.

The point we aim at is to make sure that the resultant will always be less than the initial pressure, and it is probable that part of the improvement is due to this point being always observed. (A curious fact is that the meningococcus grows vigorously on certain specific agglutinating serums.)

Autogenous Vaccines.

Some benefit may be obtained by this method used in conjunction with serum treatment. In chronic cases the results have not been encouraging. Further observations are in progress.

Medicinal Treatment.

Medicinal treatment can at best be only palliative. Numerous drugs have enjoyed a temporary reputation as curative agents in this disease, notably soamin and urotropin. We have tried these without observing any beneficial results, although urotropin has been pushed to the extent of producing haematuria. Soamin is particularly dangerous on account of its possibly deleterious effect on the optic nerve.

Sulphonal is very useful in the milder cases for its sedative action. In the severer cases morphine is indicated. For the slighter headaches in convalescence aspirin is very useful. We have found bromides of little use. Stimulants may be called for at any time in the disease. Brandy and digitalin can safely be used; strychnine is always contraindicated.

General Treatment.

Good nursing is absolutely essential if success is to be obtained. The toilet of the mouth and eyes is very necessary. Special attention must be paid to the prevention of bed-sores; incontinence of urine and faeces make this condition difficult to avoid. In cases of retention of urine the use of the catheter must not be neglected. Particular attention to the bowels is necessary, and calomel (gr. 3-5) is found best for preventing constipation.

The patient should be kept in an airy, quiet room, with the light subdued. Disinfection of the excreta should always be carried out.

Dietetic Treatment.

In the acute stages a milk diet only is advisable, but a noticeable feature is the ability of the patient to resume a normal diet at an early stage. Occasional vomiting or a swinging temperature does not contraindicate a generous diet, if the patient is already convalescing or progressing favourably in other respects. In the later convalescence the diet should be liberal and the patient should be kept as much as possible in the fresh air.

Lumbar Puncture.

A general anaesthetic may be necessary for excitable patients, or those showing much rigidity of the lumbar

muscles. No ill effects have been noted from its use. The site of puncture is between the fourth and fifth lumbar vertebrae in the middle line. We arrive at this point by drawing a horizontal line between the highest points of the iliac crests. A 3-in. exploring needle with a stylet is employed. This is inserted a short distance centrally below this line and directed forwards and slightly upwards until the resistance of the interspinous ligament is felt. The next resistance encountered is that of the posterior common ligament; the point of the needle is then slightly withdrawn and the stylet removed, when fluid should at once appear, but if it does not come, the stylet should again be passed and the needle rotated. The usual antiseptic precautions should, of course, be observed. The serum is gently introduced by gravity through a short rubber tube from a glass funnel held about a foot above the patient. On no account must a serum syringe be used to force it in. The puncture is sealed by collodion.

The recovery-rate in the series of 170 cases is 75 per cent.

EIGHT CASES OF EPIDEMIC CEREBRO-SPINAL MENINGITIS IN INFANTS.

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THE eight cases here recorded were seen and treated within three weeks; all presented similar symptoms, and all proved fatal, notwithstanding different lines of treatment. Seven of the cases were between the age of 6 months and 1 year, while one was 2 years of age. All came from Manchester and the surrounding districts, but no connexion could be traced between any of them, and there appeared to be no relation to soldiers who had been outside the district.

In each case the onset was fairly sudden, often starting with vomiting, and all presented the same symptoms. Marked head retraction was a prominent feature in every case, and the anterior fontanelle was very tense. Drowsiness was also present, and the infants would lie in their cots taking no notice of anything except when awakened to have their feeds, which they took well. Squint and blindness were invariable, especially towards the end. The bowels acted regularly, in contrast to the constipation found in tuberculous meningitis.

The other symptoms included slight fever, irregular pulse, Kernig's sign, and increased reflexes; towards the end twitching of the limbs and convulsions were common. The lumbar fluid was examined in each case by Dr. A. H. Miller, pathologist to the hospital, who reported the presence of a meningococcus found inside the leucocytes, and giving the cultural properties of the *Diplococcus intracellularis* of Weichselbaum.

Treatment did not appear to help very much. Repeated lumbar punctures were done, even twice a day, according to the tenseness of the anterior fontanelle; the object of doing this was to draw off the infected fluid, which was under pressure, with the hope that as fresh cerebro-spinal fluid was formed the organisms would be diminished. After a few days, however, it became impossible to withdraw any cerebro-spinal fluid, which appeared to dry up, although the anterior fontanelle kept tense and bulging. It thus appeared as if there was no communication of the fluid in the skull with that in the spinal column.

The first four cases were also treated with soamin, which has proved so successful abroad in cerebro-spinal meningitis of adults. An injection of soamin, gr. iii, dissolved in sterile water, was given intramuscularly for three days; then, after an interval of two days, three more injections were given daily. As the result in these cases was not successful, the next four cases were treated with antimeningococcus serum injected into the spinal canal after the withdrawal of cerebro-spinal fluid. An injection of 10 c.cm. of serum was given daily for three days and repeated for a similar period after an interval of two days. These latter cases were unsatisfactory as those treated with soamin. To all of them also urotropin was given by the mouth during the whole time they were under treatment.