SEROUS MENINGITIS.

THESIS
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The subject of Sercus Meningitis as a distinct and separate disease is even to-day not quite clearly defined and the principal reason for this is that, owing to the relative scarcity of cases, the clinical picture of the disease has not been worked out by the Authorities to the same extent as other forms of Meningitis.

German and American authors give it some prominence in the literature, but in this country it is only mentioned in the most recent text books, chiefly in connection with typhoid fever, and its occurrence as a complication in middle ear disease is scarcely noted, although it is from such cases that we have some of the earliest reliable information on the subject.

That the condition is of rare occurrence, must be granted, but as the means of diagnosis before the year 1893 were extremely limited, it is probable that many cases before that time, and indeed for some years after, passed unnoticed, and that in the future we may find more cases published and more prominence given to the disease.

The disease is one of the greatest interest not only from its rarity, the extreme gravity of the symptoms and the difficulty of diagnosis, but
also from the satisfactory result of treatment. It was my good fortune to have charge of a case that shewed these above conditions to a very marked degree, and I have used it as a basis in the production of this thesis.

Although it is certain that by no single symptom can one definitely say that this is a case of Serous Meningitis and though the diagnosis can only be arrived at by a process of exclusion, yet by a careful perusal of the literature we must grant that Serous Meningitis as a clinical entity exists.

Robert Wyatt in 1768 was the first to describe dropsy of the brain and made observations in 20 cases in children all of which died and in 10 of which he made post mortem examinations. He found in all the cases collections of fluid in the ventricles and so can be named the pioneer in the discovery of tuberculous Meningitis. We may accept that Wyatt only found cases of Tuberculous Meningitis and of the common form accompanied by dilatation of the Ventricles. He is the father of Acute Hydrocephalus.

Quin found in 1790 that such cases as Wyatt described occurred also in Adults, and further that
Hydrocephalus Acutus was not only an increase of water in the Ventricles but also in the Membranes. In the latter, he found it took in the characters of an acute inflammatory condition and that the brain was dull and spotted. This no doubt refers to the fibrinous exudate on the surface of the Pia.

Barthez and Riltiet in 1844 described cases of dilatation of the Ventricles in which no signs of tubercle were found, though present in other members of the families. These they termed ideopathic non-tuberculous meningitis, but their findings were much scouted at the time.

Later Authors also describe cases of Acute dilatation of the ventricles, but the merit of giving us a clear clinical picture of the disease is due to Quincke by the publication in 1893 of his work on lumbar puncture. By experiments on animals he formed the plan of relieving pressure on the brain by puncturing the subarachnoid space at the level of the 3rd and 4th lumbar vertebrae.

The first cerebral case in which he used this means of treatment improved markedly after a large quantity of serous fluid under high pressure had been removed by the needle, and ultimately recovered.
from this result we may perhaps have some grounds
for believing that this was the first case of Serous
Meningitis cured by lumber puncture.

A new axiom was also clearly established, that
increase in the amount of Cerebro Spinal fluid
caused symptoms of pressure in the brain.

The result of this treatment was so gratifying
that it was tried in later cases with similar
symptoms, in all 14 cases, and these were published
by Quincke under the title "Ueber Meningitis
Serosa."

This then was the commencement of our modern
knowledge of the disease.

Before the introduction of lumber puncture
there had been no means of establishing a diagnosis
till the autopsy, and doubtless many cases of
recovery from so-called tuberculous Meningitis
and brain tumour published before this time were in
reality cases of Serous Meningitis.

Quincke emphasises the fact that the effusions
in cases of hydrocephalus are of less significance
even if of the same volume as in meningitis, for the
pressure which the brain suffers, not the amount
of fluid, is the important point. As in other
serous cavities the restoration of the equilibrium
by the outflow of the secretion is of decided importance. If the outlets become too narrow or too large, the absolute quantity of the fluid increases, and the pressure rises; the latter circumstance at first increases the outflow, the tracts widen, and compensation is brought about; but a certain increased internal pressure may also include the outlets, most readily in the cavity of the skull, where distention of the Ventricle presses the surface of the brain against the skull and the subarachnoid and subdural spaces, also the channels to the Pacchionian bodies are narrowed.

These are the conditions in which spinal puncture is of value by decreasing the pressure.

The outlet is cleared and equilibrium re-established.

Quincke also states that repeated punctures may be necessary before the condition returns to normal, and must be continued to avoid any permanent damage to the brain.

He draws an analogy to the condition of the lung in case of pleurisy with effusion, where aspiration is merely a therapeutic agent to avoid, among other things permanent injury to the lung involved.

(Grober cites a case where as many as 25
punctures had been performed at intervals of days.)

He finishes by saying that, while at the present time we can often determine the cause of an existing pressure on the brain, we can only guess at the nature and stage of the exudative process: hence the conditions being to a great extent unknown and varying, the benefits from lumber puncture in serous effusions also vary: in adults as in children the results of one puncture have been even more surprising than in pleural aspiration, and have suddenly changed the course of the disease.

Since Quincke's paper lumber puncture as a diagnostic and therapeutic agent has become widely known as a diagnostic agent especially, has proved of the greatest value - not only from the character of the fluid but from the progress of the case subsequent to the operation -

Quincke describes in all about 22 cases.

Among the earliest was that of a boy age 1½, who had previously been quite healthy. He became suddenly ill, crying out and vomiting. He became very dull and listless. There was slight fever. Symptoms of paralysis and stiffness of the neck were not marked. 3 lumber punctures were made and 15 cc. of serous fluid drawn off. After the
second puncture a double 6th nerve paralysis was noticed and a left sided facial paralysis.

The boy recovered perfectly and the paralysis disappeared.

The favourable result of this case shewed that it was not a case of tuberculous meningitis, as only a serous inflammation could have recovered so quickly.

Goldscheider describes 2 cases of acute serous meningitis. One of those is that of a man of 30 previously healthy, who was seized with rigours, severe headaches, and stiffness of the neck. On lumber puncture a large amount of clear fluid was removed. The stiffness of the neck and the other symptoms disappeared immediately after the puncture showing that the pressure caused the symptoms.

Lenhartz, who did not at first accept Quincke's views on the subject, was converted by the following case and published by him.

A woman, 27 years of age, who had previously been quite healthy, was suddenly seized with violent headache, vomiting and faintness. She became dull and apathetic. The movements of the neck were restricted. The headaches and vomiting were intermittent. Finally she became comatose. Lumber puncture was then performed and 70 cc. of clear fluid under a
pressure of 320 mins of mercury came away.

Lumber puncture was resorted to, on the return of the headaches, on three subsequent occasions when smaller quantities of the same clear fluid were removed. Ultimately the patient recovered. The fluid was clear, quite sterile and contained albumen to the extent of $\frac{1}{2}$

Lenhartz noted in another case the disappearance of the neck stiffness after the puncture.

It was that of a child of 3 months. The symptoms of Meningitis had developed slowly, the reaction of the pupils was sluggish. Lumber puncture had to be performed 8 times and 25 to 40 cc. under high pressure taken away. The fluid had a specific gravity of 1006-9 and contained about $\frac{1}{2}$ of albumen.

A third case by the same author, where the chief symptoms were giddiness, headache and sluggish pupillary reaction, recovered after a single lumber puncture when 23cc. were removed at a pressure of 210 mins, the fluid being clear, sterile and having a specific gravity of 1007.

Another case was that of a chronic hydrocephalus with acute exacerbations.

It is as follows: - A woman age 25 who had been treated previously for hysero epilepsy suddenly
became unconscious with rigidity of the neck, while being examined. Lumber puncture was performed and immediately after she woke up and stated that a man had given her a blow on the head. The patient had lumber puncture performed in all 5 times and amounts of fluid ranging from 32 to 40 cc. removed. The specific gravity was 1006 and the amount of albumen $\frac{2}{3}$.

From the result it is more probable to suppose that this was a case of chronic hydrocephalus with acute exacerbations rather than of hystero epilepsy.

Fleischman reports a case of a man of 22, who suddenly began to suffer from headaches, sickness and vomiting. The pulse was slow, and the neck stiff. Double optic neuritis was present. After being punctured the patient recovered completely. 40 cc. of thin clear fluid, containing 3% of albumen and with a specific gravity of 1004 was taken away.

There was absolutely no pre-existing disease, but from the symptoms, the character of the fluid, and the quickness of the recovery, there can be little doubt that the case was one of serous meningitis.

The disease is more common in children and a
favourable issue usually follows.

Fleischman, however, reports a case of a child of 3 who died, notwithstanding repeated punctures. The post mortem examination shewed acute hydrocephalus and serous meningitis, and no further lesion.

Beck gives a similar case in a boy of 7, who shewed symptoms of rickets and who died with symptoms of intra-cranial pressure. On examination, the lateral ventricles were enormously distended with yellowish serum having a specific gravity of 1008 and containing 1.4% albumen. The bacteriological examination was negative.

Another case of his was that of a badly nourished, rickety child with an unusually large skull. The illness began with twitchings on both sides of the body. An incipient double optic neuritis was present. After pressure was relieved by lumbar puncture the child recovered.

In these two cases the bacteriological examination was negative, but in a third with somewhat similar symptoms, after death staphylococci and streptococci were found in the exudate.

One of Immerwol's cases is described as a case of acquired hydrocephalus following serous meningitis and is as follows:-- A child of 6.
months, who had previously been healthy, and had been born in a normal labour, suddenly sickened with feverishness, vomiting and constipation. These acute symptoms disappeared in two weeks. It was then noticed that the size of the head was increased and that the child had a right sided hemiplegia. The pupils reacted neither to light nor accommodation. Lumber puncture was performed on three occasions when 30, 60 & 18 cc. of fluid were removed. The fluid had a specific gravity of 1003 and contained 3% of albumen. Cultures in agar and blood serum, and innoculation gave negative results.

Furbringer tells us of three children who died with symptoms of meningitis.

In two of these cases the post mortem examinations shewed a serous meningitis, while in the third, after repeated examinations, Tubercle bacilli were discovered.

These are extremely instructive cases in shewing how very careful one has to be in diagnosing serous meningitis, and not to exclude the possibility of tubercle from a single examination of the fluid.

Again it must be remembered, that cases of Tuberculous meningitis do improve after lumber puncture.
and that from this temporary improvement may be mistaken for cases of serous meningitis.

It is a point worthy of note that in some of the cases mentioned above, the children suffered from rickets. That this is a predisposing cause of the disease is doubtful beyond the generally lowered state of vitality ensuing in rickets.

In some of these cases we have, either a sluggish pupil, or one in which the reaction is entirely absent.

This is common in the disease, but it is also noticed in other diseases causing increased intracranial pressure.

Briefly, we learn from these cases, that the disease comes on suddenly in some, gradually in others, that the almost universal symptoms are headache, vomiting, in the more chronic cases well marked optic neuritis, and some form of paralysis. Stiffness of the neck only occurs in some of the cases and is not an early symptom, nor is retraction of the head marked. That, unless relieved, the patient becomes comatose.

In the great majority the symptoms disappear on lumbar puncture, if necessary repeated: that a large quantity of clear fluid of a low specific
gravity, and containing a somewhat large proportion of albumen is withdrawn. That the fluid is sterile: and that ultimately the patient recovers without any after consequences.

Before going further, I shall now proceed to give the case, the extreme interest of which with its satisfactory termination made me desirous of bringing into more prominent notice the subject of Serous Meningitis. Later, I shall contrast any differences there may be between it and some of the cases mentioned above, and shall also go systematically into the question of etiology etc.,

I intend to go rather fully into the case, the progress from day to day, as by shortening the description, the clinical picture is somewhat obscured.

A healthy well grown boy age 11 was admitted to the Royal Hospital for Sick Children in July 1905. The family history was as follows:

The father is alive and well.

The mother died suddenly a year or two ago from 'something in the brain'.

He has 4 brothers and 3 sisters all alive and well.
There is no history of Syphilis or tuberculosis.

His previous health had been good. He had had an attack of measles 5 years ago. The present illness dated back 3 years before the time of his admission.

He then began to suffer from frequent headaches, the pain being chiefly on the right side in the Frontal and Parietal regions. Occasionally he had fits of vomiting.

The headaches lasted sometimes for a week at a time.

About the same time the sight in the right eye began to fail.

He went to school up till March of the year of admission when it was found that working always brought on the headaches. His sight grew rapidly worse and he became unable to read.

He was admitted to Leith hospital in May and was treated there with Iodide of Potassium but without any improvement.

His sister says that lately when he sat up he has been inclined to fall to the right side.

He has never had any fits.

State in admission: - He was a well developed,
well nourished boy with a good colour.

His head was large, 21\(\frac{1}{2}\) inches in circumference.

There was no facial irritability.

Eyes: there was no nystagmus or ptosis. The pupils were equal, not contracted and reacted rather sluggishly to light.

The sight was much impaired, in the right he could only tell light from darkness, while in the left he could count fingers at a distance of about 18 inches.

The ophthalmoscopic examination showed double optic neuritis verging into atrophy.

The voice was a little hoarse but articulation was perfect.

He was a bright intelligent boy and answered questions promptly.

Sensation was unimpaired.

Organic reflexes: occasionally he had difficulty in starting to make water.

Skin reflexes: rather sluggish.

Tendon responses: --

The knee jerks were much exaggerated, equally on both sides, a tap causing clonic contractions.

Ankle and Patellar clonus present equally on both sides.
Baginski's sign present equally on both sides.

In the upper limb, supinator and extensor jerks were increased equally on both sides.

The muscles of the legs were somewhat spastic and there was a slight degree of Talipes Equinns from the contraction of the extensors.

He could not walk without assistance and dragged his toes. No inclination to fall to the right was noticed.

There was slight tremulousness of the hands but no marked inco-ordination.

There was no difficulty in swallowing and no weakness of the face muscles.

The limbs were rather blue and cold.

There was nothing worthy of note in any of the other systems.

The temperature was normal: the pulse 64 per minute, quite regular, rather feeble, and no increase in the tension.

This was the condition on July 3rd.

He was put on Potassium Jodide without any improvement.

At first he had some incontinence of bladder and rectum but this improved.

His condition gradually became worse, he had
frequent very severe headaches with vomiting.

The optic atrophy became more marked.

Co-ordination grew more impaired with intention tremors.

He was inclined to be very constipated.

On August 8th he was very sick. It was noticed that he had a very high tension pulse.

On August 9th he woke about 5 a.m. complaining of frontal headache, which gradually got worse, till at 6 a.m. he was screaming with pain and throwing himself about the bed.

Shortly after he became quiet and about 7 had a general convulsion lasting about 5 minutes - the head thrown back, teeth clenched, eyes staring, pupils dilated and limbs flexed and rigid - there was no twitchings.

He then became quite unconscious, with stertorous breathing, flushed bluish face, rigid limbs, and a full slow high tension pulse.

Lumbar puncture was performed and 40 cc. of fluid was withdrawn at very high pressure.

Immediately the pressure on the brain was relieved, the boy turned round and said he must have been asleep.

The fluid was clear, sterile and did not contain
any cells. Unfortunately, it was not examined chemically.

About 12 noon he again sank into an unconscious state with full slow pulse and stertorous breathing. He had 3 convulsions and several attacks of vomiting. The unconsciousness became deeper as the day went on and at 8 p.m. he was again lumber punctured and 26 cc. of the same clear fluid taken away, again at very high pressure.

His temperature at night was 100.2 and his pulse rapid and rather feeble.

Next day (Aug 10) he was more conscious - the bowels had acted freely with purgatives - his temperature was 101.2 and pulse 140.

About midday he again became unconscious; his face was rather blue and his pulse rapid and feeble. He recovered in about an hour but was very dull. He still complained of his head. There was no vomiting.

The temperature in the afternoon went up to 102.2.

The condition of the reflexes was the same but the left arm and leg were more rigid than the right.

There was no facial paralysis and no interference with the movements of the eyes.
On August 11th, he was much more conscious and was able to answer questions. The temperature however ranged from 102.6 in the morning to 100 at night, and the pulse from 176 to 150. The respirations were increased.

On August 12th he was found to have a pleural effusion on the left side, reaching to the base of the spine of the Scapula. Temperature came down to normal in the evening.

Stiffness of the neck and back were noticed. The effusion cleared off in about 10 days.

The boy remained in a very dull state, sleeping most of the time and rather irritable when roused. At times he complained of frontal headache.

On September 2nd he complained a good deal of his head. The pulse was full. He was again lumber punctured and 10 cc. of clear fluid at no great pressure was drawn off: the fluid was sterile but contained a few indefinite broken down corpuscles.

He remained in the same condition till September 8th when he had 2 general convulsions in the morning and was very sick.

Again on September 9th he had 3 convulsions, each lasting about a minute, and in the intervals was crying out with pain in the head. He was able to
take his food.

September 10th, the severe headache was relieved by the withdrawal of 10 cc. of clear fluid.

September 11th. Headache returned and he was found to have some cystitis.

September 12th. Voluntary movements of the legs impossible, he cannot raise his legs from the bed. There is no loss of muscular sense.

Co-ordination is very much impaired.

Control of the Sphincters is entirely gone.

The headache did not trouble him to any extent.

September 20th: he had another fit and was very drowsy and weak for a day or two.

September 24th. It was noticed that his anterior fontanelle was open, and bulging, and pulsation could be felt. The circumference of his head was then 22\(\frac{1}{2}\) inches, it having been 21\(\frac{1}{2}\) on admission. His speech was slurring.

September 28th, lumber puncture was again performed and 25 cc. of fluid taken away, unfortunately blood stained.

September 29th, he was very drowsy and weak, and the fontanelle was depressed. The limbs were very rigid and he could not move his arms to any extent.

October 2nd. He was very drowsy all day and 20.
his pulse very feeble. He was almost entirely paralised. Adductor spasm was noticed. October 5th he remained drowsy but had one slight convulsion. The circumference of the head was 22 1/4 inches.

October 8th. Lateral nystagmus and some deviation of the eyes to the right noted. Speech was difficult and slurring.

The rigidity and drowsiness continued up to October 20th, when he suddenly became very noisy and restless. This state continued till the beginning of November when he became quieter. In a week or so he rambled in his speech and smiled in an imbecile way.

From that time he gradually improved. The rigidity of the legs remained for some months and before he could get up, which he did in March, adhesions at the ankles had to be broken down. He remained in the Hospital till the following October, when he went to the Longmore Hospital. His gait was still spastic. The vision was slightly improved, as he could see someone standing in front of him, without of course being able to recognise them.

He improved still further at the Longmore 21.
and regained further the use of his limbs. He was discharged from that Institution in July 1907 and went to the Blind Asylum to learn basket making.

The cystitis cleared away very quickly under treatment.

There was no anaemia, and the percentage of the leucocytes remained unchanged.

I do not add any temperature charts, as except at the one period, the temperature remained quite normal.

Late in the disease the skull gave on percussion a peculiar boxy note.

This then was the case; and I shall now proceed to take up the study of the disease systematically, and shall refer to the case under the various headings. I shall also quote further some cases to emphasise points.

I. AETIOLOGY.

With regard to the frequency of Serous meningitis it is impossible to say anything, as the number of accurate observations is small, and many of the cases which recover have not been noted, or a doubtful diagnosis given.

One thing is certain: that it is a much more
frequent disease than we have, in the past, supposed and that, with the aid of the present improved means of diagnosis, a greater number of cases will, in the future, be published.

AGE.

As all other forms of Meningitis are more common in children we may take it that this variety also occurs more frequently in young people. Of the 28 cases published by Boenninghaus, 17 occurred in people under 20.

The factors in the causation of the disease: -

1. Ideopathic.

That Serous Meningitis is a disease which can arise without the presence of some organism has been disputed by many who have cited cases where the Baccillus Coli or the Pneumococcus have been found in apparently typical cases, but against this, we have the overwhelming number of cases, where, with the most careful and repeated bacteriological examination of the fluid obtained by lumber puncture, the result has been negative.

Quincke holds that ventricular Meningitis is not of bacteriological origin, and draws a parallel with the serous effusion found in joints in connection with disease in neighbouring bone. He goes so far
as to cite as similar the Blebs on the skin in cases of Herpes.

2. As a complication of middle ear disease.

This is one of the common causes, and is of the more interest owing to the misleading history which may be given. It is also from these cases complicating chronic middle ear disease, that we get some of the earlier reliable information on the subject.

Before the days of lumbar puncture, there was no means of finding out the condition of the cerebrospinal fluid save by opening the skull, and in many of these cases operation was decided on from a mistaken diagnosis of abscess or purulent meningitis, and the true character of the condition only shown by the presence of the clear fluid.

In connection with this disease especially, some authors hold that the serous Meningitis is only the first step in a purulent meningitis. That this is not so, will be admitted, and to strengthen the evidence against this theory I quote the following cases.

(1) Levi noted the case of a man age 35 who suffered from chronic suppuration of the right ear and some symptoms of Meningitis, giddiness, headache, stiffness of the joints and constipation.
The temperature was normal and the pulse rapid and irregular. An abscess formed behind the right ear which burst and thick pus came away. The brain symptoms continued, the pulse became slow and he had attacks of vomiting. The mastoid cells were found to be necrosed post mortem. Chronic Serous Meningitis of the Ventricles was found and a fresh, septic, basal meningitis of small extent, extending from the internal auditory meatus.

Levi holds the peculiar illness to be due to the chronic serous meningitis and that death was caused by the septic meningitis.

(2) Von Beck's case is of extreme interest. A boy, age 14, had for 7 years intermittent discharge from both ears. On January 22nd 1894 he had earache on the right side and headache, without fever but with vomiting.

On January 25th he became very drowsy.

He was admitted to hospital on the 26th! He was then dull and drowsy, but occasionally shrieking out and burying his face in the pillow. Exophthalmos was noted, more on the right than on the left side. He was hyperaesthetic over the whole body but there was no paralysis. Percussion on the right side of the head caused some pain.
There was no change in the Mastoid — No otorrhoea. The drum on the right side was covered with small old scars. Temperature 100°F Pulse 60.

On the 27th temperature was 98.4° and pulse 52.

The boy was comatose. The lateral sinus was opened, no pulsation was discovered, the Dura seemed normal. The ventricles were punctured and 26 cc. of clear fluid removed. After the operation the pulse rate was 86.

On the 28th the boy was better.

On February 2nd, the headache and vomiting returned — Pulse 44.

On February 5th, the Frontal, Temporal and occipital lobes were explored as an abscess was suspected but without result.

The ventricles were again punctured and 40 cc. of clean fluid removed.

On February 15th, again 40 cc. were removed from from the ventricles.

On March 18th the boy returned home cured.

Bramwell reports an interesting case which also ended in recovery.

It is that of a Girl age 20, who suffered from headache, and discharge from the left ear.
The urine contained blood and casts.

On admission the temperature was subnormal, and the pulse 72. She was collapsed, her gait was hesitating. Slight optic neuritis was present.

Soon after admission she had an epileptiform attack starting on the right side. An abscess in connection with the ear trouble was thought probable and the brain cavity opened on the left side and the temporo sphenoidal lobe punctured without result.

The lateral ventricles were then punctured and a considerable stream of clear fluid at high pressure came away.

After this the girl made a good recovery.

These cases are of further interest from the fact that lumber puncture was then unknown, and it was only from such operations that the existence of the excess of fluid could, in life, be discovered. Levi believed this complication to be rare, but Jansen insists that it is more common than we suppose, and that it must always be taken into consideration in the diagnosis of intra cranial complications of middle ear disease.
3. In connection with the acute infective diseases.

Among these we include pneumonia, influenza and Typhoid fever.

In many of the cases following pneumonia, however, the effusion does become purulent. Voisin found that though the effusion was purulent, yet cultures could not be obtained. He considers that it is due to Toxins in the circulating blood.

4. Alcoholism - acute or chronic.

As to there being a true meningitis in cases of alcoholism, there is some controversy.

Miles calls it a Pseudo meningitis and says that it consists of an oedematous state of the pia and brain substance.

In many of the cases of "wet brain" as it is called, which come to the autopsy, there is found a true purulent meningitis, but in these cases, he says, the infection has been superadded to the depraved state of the meninges, the result of Alcohol.

Lambert states that "wet brain" occurs in all forms of chronic alcoholism, but especially following acute and chronic delirium, and that it occurs...
with relatively equal frequency in men and women. There is no true inflammatory process, and the condition is called a meningitis from the excessive amount of fluid, but that it is a transudate and meningitis a misnomer. The most probable cause, he goes on to say, is that it is caused by a degeneration of the vessels, paralysis of the vasomotor control and the weakened condition of the heart.

Dana has described a case occurring in Delirium Tremens, where after removing a large quantity of clear fluid by Lumbar puncture the patient recovered.

5. Trauma.

Serous Meningitis is said sometimes to follow such injuries as a blow or fall on the head, and it may be so if the injury is sufficient to set up some irritation internally.

Boennigsmans is doubtful if this can be called a specific cause. What is more probable, however, is that the injury may set up an acute exacerbation of an already chronic disease.

6. Mental overstrain.

Quincke notes this as a cause, and notes a case which recovered under treatment with Calomel
It is also said to be due to exposure to cold and wet. One case has been published where it occurred with *Ascaris lumbricoides*, and Justin tells us of a case following Cerebro Spinal Meningitis, the symptoms being slow paralysis, headache, vomiting and optic neuritis. P.M. 150 cc. of clear fluid were found in the ventricles.

II. PATHOLOGY

The pathology of the disease is still very obscure. This can be explained by the comparatively few cases of the disease which end fatally, and which come to the postmortem table with a definite diagnosis of Serous Meningitis.

How can the increase of the fluid be explained?

1. The old idea was that it was merely an oedema of the brain with transudation into the ventricles. The difficulty was to find a cause for the oedema: this was given as a passive hyperaemia of the brain from excessive action of the heart; but there were no signs of oedema in other parts which would be affected, so this theory was put aside.

11. That it is an active hyperaemia with stasis, transudation, etc., is the more probable.
that it is due to some inflammatory action.

We have still to find the cause of the inflammatory action -

Quincke holds that the amount of irritation may at first be very slight, as from teething, neuralgia, or earache. This seems very feasible - there may be very slight hyperaemia, stasis and exudation of lymph - this upsets the delicately adjusted equilibrium in the series of ventricles, and more fluid continues to be poured out. There is no need for a marked migration of leucocytes, as the original cause was so slight.

This continues till the balance is restored by the removal of the superfluous fluid by lumbar puncture.

That it is an inflammatory exudate is shown by the fact that there is a higher percentage of albumen present than in normal lymph.

Some cases too can be explained by Quincke's analogy to the Serous effusion into joints in cases of osteomyelitis.

Boenninghaus describes an external and an internal form and states that it is impossible to have the latter without the former.

Again it must be remembered that a serous exud-
exudate may only be the first stage of a purulent one.

That the inflammation may be due to an organism must not be forgotten, though, with the aid of modern bacteriological methods it seems improbable.

The post-mortem appearances shew nothing beyond what we should expect. In the external form the dura is thickened and injected: the arachnoid is soft and covered with thick mucus. The exudate in the subarachnoid space is clear, opaque, or gelatinous. The veins on the surface of the brain are thickened and tortuous and there may be ecchymoses on the Pia. The sulci are partially obliterated.

Sometimes the signs are more marked at the apex, at others at the base. In the internal form the ventricles are greatly distended especially the lateral ventricles and contain a large quantity of fluid, usually clear but at times dark.

The brain surface is greatly compressed so that the outlines cannot be clearly distinguished. The Pia may be normal or shew hyperaemia.

III. SYMPTOMATOLOGY.

Owing to the multiplicity of causes it is not
to be wondered at that the cases shew a great variety of symptoms.

As seen from literature mentioned above, meningitis can be divided into (1) an acute and (2) a chronic form, the final condition being the same and the only difference being the rapidity of onset.

The cause is not apparently a factor in the rapidity of the production of symptoms.

As a whole there is very little that is characteristic of the disease and it is this which makes the diagnosis so difficult. All the symptoms can be caused equally by anything raising the intracranial pressure, in fact the symptoms are those of compression rather than of irritation.

Headache, giddiness, vomiting, convulsions are only expressions of brain trouble.

The stiffness of the neck noted in some cases is also due to the pressure, as is shown by its immediate disappearance when the pressure is removed. It is by no means a typical symptom of the disease. The temperature is usually normal or subnormal but in acute cases may be somewhat raised at the beginning; this is rather an important point.

The disease may commence with unconsciousness which may last several days and be followed by a
period of drowsiness from which the patient can with difficulty be aroused. At times the condition is similar to the "irritable stage" seen after concussion. It is more common to find the disease starting with headaches and 'cerebral' vomiting and in acute cases some portion of the skull may be sensitive to the touch. The patient gradually falls into a drowsy state. Motor inco-ordination and paralysis become marked.

Various forms of paralysis usually spastic in character, may be met with, in one case a general in another a hemiplegia, paralysis, in another a facial paralysis: again the only paralytic symptom may be a strabismus or a ptosis.

The pupils react sluggishly as a rule - but this again only follows the pressure. Optic neuritis is almost invariably present, which may unless pressure is relieved, merge in the later stages into atrophy. Convulsions occur and the patient finally pass into a state of coma and death ensues from compression.

Cole states that in cases occurring in Typhoid fever delirium is common.

Collins attaches importance to the state of the pupils and says that in the initial stages the
pupils are irregularly contracted while later they are extremely dilated.

We have to remember that in Serous Meningitis occurring in the acute diseases the symptoms of meningitis may be masked by those of the pre-existing disease.

The following picture is given by Lambert of Alcoholic Serous Meningitis. When the disease follows delirium tremens, the patient sinks in a few days into a semi-coma. The delirium becomes of a slow muttering type, but the patient retains sufficient consciousness to have delusions and hallucinations of sight and hearing. He is roused with difficulty, though he will still take food. The pulse is rapid, the temperature becomes normal or is slightly raised, but seldom over a degree. The pupils are usually diminished in size. The skin may be hyperaesthetic and pressure on the muscles of the arms, legs and over the abdomen may cause pain. In some the condition slowly develops and progresses for several days, in others the effusion increases rapidly and they sink into a more profound coma from which they cannot be roused, with spasticity of the limbs, incontinence and etc., and finally pass away in a state of coma or gradually.
recover.

In 709 cases of delirium in the New York Belle Vue Hospital, this condition developed in 108 instances: of these 37 recovered and 71 died - A mortality of 65.7%

We have then a disease, the symptoms of which point to an increase in the intra cranial pressure, the pressure in some cases occurring suddenly, in others slowly, and from no single symptom can one say definitely that this is a case of Serous Meningitis.

In the case described by me the symptoms were:

- headache, vomiting optic neuritis ending in atrophy,
- spastic paralysis, general rigidity, slow pulse,
- absence of fever, slight strabismus, drowsiness,
- convulsions and coma - all compression symptoms.

There is then no symptoms which will lead us to suspect the presence of Serous Meningitis beyond that of general intra-cranial pressure, and the sheet anchor of our diagnosis rests on one sign, one sign only, the great increase in the amount of the Cerebro Spinal fluid found by lumbar puncture.

IV. DIAGNOSIS.

The accurate diagnosis of Serous Meningitis can,
in the great majority of cases, only date from 1893 when Quincke introduced the method of lumbar puncture and any cases diagnosed before that time were those in which the skull had been opened in the course of an operation. Some of course were diagnosed on the post mortem table but even then the findings were not always clearly described. Many, no doubt, recovered without the condition even being diagnosed, while others were recorded as examples of recovery from tuberculous meningitis or cerebral tumour.

As Quincke's great discovery has only within the last few years been generally adopted as an aid to diagnosis, and as it is the only certain diagnostic point in the disease, it is small wonder that serous meningitis has not received more attention especially in this country.

We have the picture of a disease where the symptoms are those of increased intra cranial pressure, with optic neuritis leading, unless relieved, to atrophy: (It is a matter of much regret that in our case, lumbar puncture was not resorted to sooner, as in all probability the boy's sight might not have been permanently lost but by the time the diagnosis was established, optic atrophy was marked.) And "in children in whom the fontanelle
is not closed", the increase in the size of the head.

This was one of the most startling facts of the case and shews to what an enormous height the pressure inside the skull had risen, that the pressure could literally burst open the skull of a healthy well grown boy, almost 12 years of age, so that the fontanelle opened, bulged and showed pulsation. The circumference of the head too increasing almost an inch.

It is also remarkable that this opening of the fontanelle, which must, one would think, have taken place more or less suddenly, did not to any extent alleviate the symptoms, as four days after it was discovered, lumbar puncture had to be performed to relieve headache.

That the bone had been somewhat thinned by the pressure before the actual burst occurred, I have no doubt, and this explains the peculiar boxgy note heard on percussion later on in the disease.

The cause of the pressure can only be diagnosed by the escape of a very large quantity of clear sterile fluid under high pressure. In the case under my charge, the pressure was not measured in mille metres of Mercury, but it was so great that when the needle was first introduced, and the finger
pressed against the end of the needle to prevent escape of the fluid, the pulsations of the brain could be felt very forcibly transmitted through the fluid; the fluid came away through the rather fine needle in a strong jet which could be best likened to the tapping of a tense hydrocele with a small trocar. The fluid had not quite ceased to flow when the boy woke up, turned round and said he thought he must have been asleep, the needle was then withdrawn. This shews how quickly the reduction of the pressure removes the compression.

The symptoms of compression, not the amount of the fluid, are the important points. The amount of the fluid varies according to the age of the patient and the rapidity of onset.

McCrae states the amount to be from 20 to 60 cc. In our case the total amount was 111 cc. and of this 66 cc. was drawn off within 24 hours. Larger than this is the 150 cc. mentioned above as having been found in the ventricles after death.

The fluid is as a rule quite clear, but may be slightly opaque. It contains only a few broken down corpuscles.

The specific gravity is low 1003-1009. It contains a somewhat high percentage of albumen.
Lastly, what absolutely distinguishes it from other forms of meningitis, it is sterile.

It is a point worthy of note, that in cases of pneumonia and Typhoid fever we may at one time get a serous meningitis, probably due to the toxins, while at another, we may have, with the same symptoms and same naked eye characters of the fluid, a meningitis, in the fluid from which, the organisms are obtained almost in pure culture. Cole found this is four of his series of eight cases occurring in Typhoid fever. We must, however, remember that in many cases, especially of pneumonia, the meningitis becomes a purulent one. It must also be remembered that in the early stages we may have both varieties - external and internal - of Serous meningitis present, but that the increased pressure within the ventricles gradually presses the expanded brain substance against the skull and obliterates the space.

The crux of the matter lies in the differential diagnosis and the four diseases from which Serous Meningitis has to be distinguished are

1. Tuberculous Meningitis.
2. Purulent Meningitis.
3. Abscess of the brain.
4. Tumour of the brain.
It may have been noticed that all along I have avoided mentioning Cerebro spinal meningitis, nor do I think it necessary to give it here more than a passing reference.

Cerebro spinal meningitis occurs in epidemics, though Sporadic cases are met with and the symptoms are more those of irritation with fever and early convulsions: finally the presence of the diplococcus intracellularis, readily found in the fluid, makes the diagnosis clear.

1. From Tuberculous Meningitis it is extremely difficult to make a diagnosis for it may require many repeated examinations of the Cerebro Spinal fluid before the Tubercle bacilli are found and one might readily fall into the error of too easily taking it for granted that the case was one of serous meningitis when the first examination proved negative. All the more so as some cases of tuberculous meningitis do improve after lumbar puncture. The diagnosis may have to be deferred for weeks, and Quincke's only other diagnostic point (beyond the fluid) 'the course of the disease' may become the only peg on which to hang our diagnosis. Most authors admit of the generally fatal issue of tuberculous meningitis
though at times the diagnosis may be doubted and the hopes of the patients friends revived by a startling temporary improvement in the condition. The writers on Serous Meningitis on the other hand are all agreed on the curability of the disease and the rapid improvement after lumbar puncture.

The diagnosis may be aided by the presence of tubercular disease elsewhere, as in the lungs etc., but the following case of Fleischman's, diagnosed as tuberculous meningitis shews how deceptive this may be :-

A woman age 24 who had greatly enlarged glands in the neck, suddenly began to have attacks of vomiting and wandering, the right side of the skull was painful. Range of vision was impaired and there was a commencing double optic neuritis. On lumbar puncture 25 cc. of fluid came away. Examination for tubercle bacilli proved negative. It contained 1% albumen and had a specific gravity of 1007.

In four weeks the patient was entirely well.

In this case the first of Quincke's two diagnostic points 'the large quantity of clear fluid' did not aid the diagnosis to any great extent but the second 'the course of the disease' proved the case.
Finally as an aid to the diagnosis we have the Calmette reaction, but of this I can say nothing and the future only will shew.

2. From purulent meningitis.

Here we have the fallacy, stated by some authors and true, no doubt, in some cases, that serous meningitis is only the first stage of a purulent meningitis. That this is not so, I think is already proved.

As in some cases of Serous Meningitis we have fever, especially in cases occurring in the acute fevers and when we remember that the symptoms are only those of intra-cranial pressure, so we may have a serous effusion giving a clinical picture of a purulent one.

The diagnosis here can only be made perfectly clear and the purulent meningitis at once excluded by the aid of the needle.

Quincke states that the rigidity and fever are more marked in purulent meningitis and Miles holds that the onset in purulent meningitis is more sudden and the course of the disease more rapid! He also adds that choked disc occurs more frequently in serous meningitis.
3. From abscess of the brain.

These are extremely interesting cases and, as I have said above, it is from them that we have the earliest notice of serous meningitis. In diagnosing between Cerebral abscess and serous meningitis we have always to bear in mind the fact that the two may be present coincidently and that we may have the remarkable phenomenon of the production of pus due to staphylococci and the like in the substance of the brain while at the same time clear sterile fluid is being poured out into the ventricles.

This is a good example of Quincke's analogy to the clear effusion in joints in disease of neighbouring bone.

The fluid in the ventricles is not due to infection from the organism and is probable due to irritation from their toxins.

The cases noted above (part 1) shew well the great difficulty in the diagnosis, and again before giving a final decision after lumbar puncture we must allow a little time to elapse and note if there is improvement, in case that in addition to the meningitis, an abscess may be present.

A case occurred under my charge which was very instructive. A boy was admitted with symptoms
resembling tuberculous meningitis. He had had a chronic discharge from the right ear. The temperature remained high and he had some rigidity of the limbs. He had 3 convulsions in rapid succession. It was decided that it was a case of cerebral abscess due to the ear disease and the boy was accordingly operated on. There was some exudation in the mastoid cells and on opening through the Tegmen, the Dura bulged slightly. There was no sign of inflammation on the surface of the brain. The Temporo Sphenoidal lobe was probed in all directions without result. The boy was put back to bed and shortly after the dressings were found to be saturated with clear fluid. This occurred frequently in the 2 days following when the boy was removed home and died some 10 days later.

That this was a case of serous meningitis seems not improbable.

4. From tumour of the brain.

This perhaps is the hardest diagnosis to make, the similarity of the symptoms with chronic serous meningitis being very marked. Also the tumour growth may cause increase of pressure in the cerebro spinal fluid and indeed may cause, from irritation, an
actual increase in the amount of the fluid. Our case was admitted with a provisional diagnosis of Cerebellar tumour.

The four main symptoms of tumour - Headache, vomiting, optic neuritis and paralysis were all present.

In the hospital the boy showed no symptoms in favour of the tumour being in the cerebellum: it was then thought it might be a Pontine tumour but the absence of any facial paralysis or any paralysis of the external muscles of the eye (till very late in the disease) negatived this.

Quincke asserts that the headache in tumour is remittent while in serous meningitis it is continuous, but this was not the finding in this case, as the boy had days when he did not suffer from headache: he also states that the optic neuritis is more marked in tumour but here it had proceeded into Atrophy.

Some cases are still more difficult to diagnose when in addition to the main symptoms of tumour, there are others added; as in one by Anmaske, where in addition there was 6th nerve paralysis and right sided facial paralysis: yet post mortem, great dilitation of the ventricles, only was found.

Finally to show how difficult an accurate diag-
diagnosis is I shall repeat the following from Oppenheim who diagnosed (in most cases with a colleague) the following:–

1. Two cases of Tumour of the Pons.
2. A cysticercus in the floor of the 4th ventricle.
3. Two cases of Tumour near the fissure of Rolando.
5. A central softening in the 1st Frontal convolution.
6. A cerebellar tumour.

All these turned out to be cases of serous meningitis. He ends up by saying that among the diseases which even to-day are very difficult to diagnose from cerebral tumour, serous meningitis stands facile princeps.

V. PROGNOSIS.

Now that lumbar puncture is so universally in use the prognosis in cases of serous meningitis is quite good, and ultimate recovery without any bad after effect is the rule, rather than the exception.

Had the boy under our charge had lumbar puncture performed earlier in the disease, there is little
reason to doubt that his sight would have been saved.

Recovery may take place within days, or the condition become more chronic and require repeated tappings.

Dana states that the stiffness of the neck is a useful prognostic:—that if the patient has not a stiff neck he will recover, but that when it is present, he will die.

This is rather sweeping and is not borne out by the cases mentioned above.

VI. TREATMENT.

The main therapeutic agent we possess is that of judicious lumbar puncture.

This acts in the first place by relieving the pressure. In addition it may bring about some change in the condition in the ventricles, and perhaps may remove some irritating products in the fluid.

In acute cases only one puncture may be required but in the more chronic repeated punctures may be necessary before the normal conditions are restored.

In some indeed as many as 25 punctures have been made at intervals of days, with ultimate recovery.

In infants when the fontanelle is open, and when from the minuteness of the part, the spinal canal is difficult to find, the possibility of tapping
the lateral ventricles through the fontanelle must not be forgotten.

The needle is introduced as far from the middle line as possible to avoid injury to the Longitudinal Sinus and pushed downwards, inwards and slightly backwards.

Among medicinal agents in the treatment of this disease Quincke recommends the administration of Mercury either internally or as inunctions carried to the point of slight mercurialism.

Collins has found salicylate of Sodium in doses of 10 to 20 grns. to be useful, but the value of drugs in the treatment is somewhat problematical.

To sum up briefly,

Serous Meningitis is a disease which may occur spontaneously or in connection with some infective disease in the system. It is due to some irritation whether by Toxines or other cause. It is characterised by the effusion into the ventricles of a large quantity of clear sterile fluid, which may come on suddenly or more slowly, so that we recognise an acute and a chronic form.

It must also be noticed that at first we may have effusion into the subarachnoid space, which
is gradually forced out by the expansion of the brain substance so that an external and an internal variety has been described. The symptoms are mainly those due to an increase in the intracranial pressure and are rather those of compression than of irritation, with paralysis usually spastic, without fever, and without as a rule, any localising symptoms; unless relieved the condition passes into coma and death.

The diagnosis can only be definitively made by the withdrawal by means of the needle of a large quantity of clear sterile cerebro spinal fluid at high pressure.

The treatment consists in removing the excess of the fluid by lumbar puncture to be repeated, if necessary, whenever there are signs of an increase in the intracranial pressure. But that under this treatment the prospect of recovery is good.

Finally, in one particular, my case is deficient, and that is in the pathological report: nor do I regret it.

By Quincke's great discovery this boy, after being for months unable to move a hand or foot, after enduring the most intense agony, after being
prepared and indeed anxious to die in order to be relieved of the pain, has been restored to perfect health (save for his sight) and is now leading a useful and contented life.
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