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THE COMMON FORMS OF MENINGITIS, AND THEIR RECOGNITION, WITH SPECIAL REFERENCE TO
SEROUS MENINGITIS.

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I do not know of a subject that is much more perplexing to a student than that of the different types of meningitis. The classification, never very simple, has undergone constant changes during the last half century, and such changes have been numerous even within the last years. The introduction of various kinds of serous meningitis and meningo-encephalitis, as well as of non-purulent encephalitis, and the peculiar manifestations of cerebral edema, have served to increase the complexity of the subject. The inflammations of the dura mater have also caused much discussion and given rise to much variety in definition and classification.

In one of the earliest and most conscientiously-made classifications of meningitis, that by Huguenin, published in Ziemssen's "Cyclopedia," and written nearly twenty-five years ago, fourteen different forms of cerebral meningitis were described. Grasset's work, which was published about the same time, and is a very masterly treatise of its kind, illustrates the different qualities of the French and German mind, for he describes only acute, chronic and tuberculous meningitis. The progress since Huguenin's time has been shown, on the one hand, by a gradual simplification of the classification, and on the other, by clinical and pathological studies which have added to the actual richness of the field, and obliged us to put two or three

new names in the list. Thus, Gowers, Oppenheim and Mills, although they drop out many of the terms used by Huguenin, still give us from ten to twelve types of meningitis.

There are classifications of diseases which must be elaborate, because we wish them complete, but in many cases this completeness is not necessary in practical medicine and destroys in the student the sense of proportion between what is vital and what is not important. At present we can find in literature: *A.* Pachymeningitis, external: (1) acute, and (2) chronic; internal: (3) hemorrhagic, (4) syphilitic, (5) purulent, and (6) serous. *B.* Leptomeningitis: (7) acute, and (8) chronic simple; (9) acute, and (10) chronic syphilitic; (11) acute and (12) chronic epidemic; (13) tubercular, (14) posterior basic. *C.* Serous meningitis: (15) acute ventricular, (16) acute general, (17) traumatic, (18) benign, (19) malignant, (20) chronic. This makes 20 different forms, without using the term "meningismus," or including acute cerebral edema or acute and chronic hydrocephalus.

The question arises, How many of the forms have actual clinical existence or importance? Without any special discussion we can, I think, agree that external pachymeningitis, (1) acute and (2) chronic, is only a surgical complication, and is probably never an independent malady. We can also drop purulent internal pachymeningitis (5), while serous internal pachymeningitis (6) is only a pathological curiosity. Acute syphilitic meningitis (9) is certainly most rare, if it ever exists, at least, using the word *acute* in the same way we apply it to other forms. Posterior basic meningitis (14) is probably a syphilitic or tubercular disease or a serous meningitis. Serous meningitis has three forms, as I shall try to show later. The malignant (18) and chronic (19) forms have a doubtful standing. We thus reduce the 19 types of meningitis to 11, or, dropping all temporal distinctions, to 9.

The forms of meningitis as seen in ordinary practice are shown by an analysis of 137 cases which I have collected from the records of Bellevue Hospital, the majority occurring in my service in the second and fourth medical divisions of the hospital during the past fifteen years. Among these, there were 46 with autopsical records.

FORMS OF MENINGITIS IN 137 CASES AT BELLEVUE HOSPITAL.

External pachymeningitis (from mastoid disease).....	2
Internal pachymeningitis (hemorrhagic and syphilitic)...	12
Fibrinopurulent leptomeningitis.....	52
Cerebrospinal leptomeningitis.....	15
Tuberculous leptomeningitis.....	14
Serous meningitis { traumatic	
{ alcoholic	15
{ infectious	
Chronic leptomeningitis.....	3
Unclassified forms.....	19
Spinal meningitis.....	5
Total	137

CASES WITH AUTOPSY.

Cerebrospinal leptomeningitis.....	5
Purulent cerebral leptomeningitis.....	18
Tuberculous leptomeningitis	7
Serous leptomeningitis.....	7
Pachymeningitis interna.....	9
Total	46

Leaving out the spinal cases there are, therefore, only five kinds of meningitis recognized in ordinary hospital practice. It will be seen also that the purulent, tubercular, cerebrospinal and serous are the principal forms, while pachymeningitis is practically only a chronic syphilitic manifestation. These hospital figures, I am sure, coincide in the main with the ordinary clinical experience of all of us, but I put them forth here to emphasize the importance of these forms and the relative insignificance of the other types.

Recognition of the Different Forms. Cerebral and Spinal Meningitis. In speaking of *meningitis* of the pia-arachnoid it is often unnecessary nowadays to use the term "cerebral" or "spinal." Practically all cases of acute cerebral meningitis are cases of cerebrospinal meningitis; on the other hand, acute spinal meningitis is a very rare disease. Indeed I have never seen a primary case and can find no record of one. We can almost, therefore, abandon the distinction between cerebral and spinal meningitis in ordinary clinical work. I have rarely failed

to find pus in the spinal canal if it is abundant on the cerebral membranes. Tubercles are also often found in the spinal canal if there is cerebral tubercular meningitis.

Pachymeningitis is a disorder which has received an extraordinarily rich vocabulary of qualifying terms. The distinction into external and internal types is a very academic one. Pus on the dura, or extradural abscess, is a more correct term for acute suppurations involving the outer surface of the dura. Here, mastoid inflammations and other forms of osteitis are really the disease, while the meningitis is simply an annex to it.

A non-surgical pachymeningitis is mostly an *internal* pachymeningitis, although naturally the whole membrane is more or less deeply affected. This form of inflammation is commonly syphilitic, and next to that, hemorrhagic. The hemorrhagic form is associated with disease of the blood and blood-vessels and is found practically only in scorbutic children, in insanity and alcoholism.

Leptomeningitis. The inflammations of the pia mater have also led to a luxuriant growth of types and names. There are very few writers who have not given a special classification of their own, so that meningitis vies with insanity in the disheartening multiplicity of its forms. Yet, practically, we know that at the bedside nearly all the forms of meningitis have pretty much the same symptoms, differing mainly in the rapidity or intensity of the process. The common forms, as I have shown, are the epidemic (cerebrospinal), fibrinopurulent and tuberculous.

Epidemic cerebrospinal meningitis can usually be readily recognized. The history of an epidemic, absence of trauma or previous infectious fever, the skin symptoms, the greater involvement of the base of the brain and cranial nerves suggest the nature of the trouble. The employment of lumbar puncture enables us to settle the diagnosis, if we find the *diplococcus intracellularis meningitidis* or *micrococcus lanceolatus*. There seem to be some epidemics due to the latter organism, and there is no way of distinguishing the two forms except by culture. In two cases in which the patients were tapped and examined under my observation the *diplococcus* was found.

Simple fibrinopurulent meningitis may be due to almost any pyogenic organism; usually it is a streptococcus infection. It is not rare, however, to find the pneumococcus. We do not know the distinctive clinical features of pneumococcus meningitis, though it seems to be a very fatal form.

Tuberculous meningitis. There is a form of inflammation which, it is quite agreed, has distinct features and about which no discussion is required, and that is, tuberculous meningitis. The presence of tuberculous infection elsewhere, the age of the patient, and the premonitory symptoms and lumbar puncture are usually quite sufficient to establish a diagnosis, which is often one of tuberculosis of the meninges rather than inflammation.

SEROUS MENINGITIS. There is a third type of cases, distinctly different, about which our knowledge is as yet much less complete, and they include that class known under the name of pseudo-meningitis or serous meningitis. The term meningismus has been applied to some of these cases and a simple mechanical cerebral edema is perhaps all that underlies some of them. The descriptions of this condition as given by Eichhorst, Quincke, and later by Boenninghaus and others, have caused a good deal of confusion. Quincke's original descriptions were based mainly upon 14 cases, and these were supplemented by reports of 12 more. Boenninghaus, in 1897, collected reports of 28 cases, in each of which the patient had either been operated upon or had died, so that the actual pathological condition was known. Other cases have been reported by Hanseman, Walton, Prince, Herter, Van Gieson, Niesser, Levy and Orchansky, a total of 39. Boenninghaus makes a division of his cases into the acute and the chronic, and the acute he again divides into the benign and the malignant types. Quincke also describes acute and chronic cases.

I have made a study of acute serous meningitis following alcoholism, inanition, and the prolonged use of narcotics, and terminal stage of indulgence. In all I collected 24 cases in which autopsies were made, and in 12 microscopical examination was made of the cortex and blood-vessels. My paper was published after that of Boenninghaus, though the material was collected long before. In fact, the "wet brains" of alcoholics

give clinical pictures long known to hospital physicians and practically much like those in some of Quincke's acute cases. Still, it is the merit of Quincke to have shown that such conditions arise from various other causes than narcotic poisons and exhausted states.

According to my observation, one must probably recognize three conditions, all due to a more or less rapid serous effusion into the ventricles and subarachnoid space, and all causing symptoms like those of true meningitis. First, acute cerebral edema, usually following severe blows on the head, causing symptoms resembling meningitis, lasting two or three days, and generally disappearing with rapid restoration to health (traumatic serous meningitis). Second, the acute serous meningitis of alcoholism and allied states, called "wet brain," simulating closely meningitis, and lasting about ten days. Third, the serous meningitis described by Quincke, sometimes very acute, but sometimes subacute or recurrent and lasting three, four or more weeks. This form is still a somewhat vague one and its exact causes and pathology have yet to be worked out. It probably is oftenest due to some infection.

1. *Traumatic Serous Meningitis.* A very typical form of acute serous inflammatory effusion is seen as the result of severe injuries to the head. A person is thrown from a height or is injured in an accident and receives a severe blow upon the head, rendering him unconscious. He lies in a stupor for a day, then the neck begins to get stiff, the pupils contract, the temperature rises, the skin becomes hyperesthetic, and some rigidity of the limbs is seen, and there is constipation. He becomes a little more conscious and is slightly delirious; evidences of pain in the head are present, and the rigidity of the neck may be very excessive. There may be restlessness and twitching of the limbs. Perhaps vomiting occurs. All this looks very threatening, but within three or four days there is a change in all the symptoms; the temperature falls, the rigidity passes away, the mind gradually clears up and convalescence is established in a few days unless a pyogenic infection occurs, when a purulent meningitis develops. Both clinical observation and pathological examinations show that in these cases

there is an acute serous transudation which produces the clinical picture of meningitis.

2. *Alcoholic (and toxic) serous meningitis*, which is a sequel of profound alcoholic intoxication, and is seen occasionally in the exhaustion stage after the prolonged use of narcotic drugs, or following starvation, presents symptoms like the following: The patient may suffer at first from delirium tremens. This delirium passes away, leaving him irritable and restless, dull and irrational; or without any delirium he passes into this state as the result of a long debauch. In a few days a delirium of a mild character develops, with a slight fever of 101° or 102° F. He has but little headache or vomiting and convulsions do not occur. There is some rigidity of the neck, stiffness of the back and of the extremities, and some twitching of the muscles. The symptom of Koenig is sometimes, but not always present. The skin is hyperesthetic and the abdomen retracted. The tongue is coated and the bowels constipated. The pupils are contracted and conjunctivitis and even keratitis may develop. There is no optic neuritis. After five or six days of this excitement the patient becomes dull and passes into a semi-comatose state. The neck becomes still more rigid, as do the extremities, but it is a kind of voluntary rigidity, the patient resisting movement as though every motion hurt. The skin continues very sensitive and there is a disturbance in the vasomotor system, as shown in the *tache cérébrale*. The skin loses its elasticity when stretched and lies in flaccid folds ("putty skin"). Stools and urine may be passed involuntarily. The temperature ranges from 99° to 101-2° F. In the latter part of this stage there may be a sudden rise to 103° F. or more and the patient dies or begins to convalesce at about the end of the second week. In the last stage sterile serous fluid can be drawn in abundance by lumbar puncture.

The whole picture resembles closely one of ordinary purulent meningitis except that there is less headache, the onset is slower, the delirium is less acute, there is less fever, no optic neuritis, and less general constitutional disturbance. The fluid drawn by lumbar puncture is found to be clear and free from albumin or any microbes, and there is, of course, no pus.¹

¹ The symptoms of this condition are given in detail in an article entitled "Acute Serous Meningitis," *Medical Record*, 1898.

3. *The Serous Meningitis of Quincke and Boenninghaus.*²

This disease is an acquired acute hydrocephalus. It occurs oftenest in children. Sometimes it runs a short course, ending in recovery (benign type), and sometimes it is rapidly fatal (malign type), and again it may become chronic (chronic acquired hydrocephalus), or the patient may get well and the disease recur (recurrent serous meningitis).

The acute form occurs in children under the age of five years in nearly half the cases, and under 30 years in three-quarters of the cases (Boenninghaus). It affects the sexes about alike. The cause is some form of infective fever in about half the cases; trauma is rarely a cause. Otitis media and sepsis are occasional factors. Bacteriological tests of the cerebro-spinal fluid so far have been negative.

The disease begins with the usual symptoms of cerebral irritation: headache, delirium, followed by stupor and coma. General convulsions are frequent; rigidity of the neck and limbs, and twitchings are also present. Fever is sometimes present (one-third of the cases), but is not characteristic, neither is the pulse. Headache, however, convulsions, eye palsies and fever are not always present and it is not often possible to distinguish the disease except by its ultimate favorable course and by lumbar puncture. Even the latter procedure is not certain, because there may be some pus in the brain and none in the cord. In general, therefore, one can only say that if a young child develops symptoms of a meningitis, in the course of the exanthemata or rheumatism, or after an injury, or with an otitis, if these symptoms run a favorable course and if on puncturing the cord only a serous fluid which does not contain albumin and is sterile to culture tests, the case is probably one of acute serous meningitis. If the attack recurs, or if the child continues ill and gradually develops hydrocephalus, it may be considered a chronic serous meningitis.

The chronic form sometimes takes on the symptoms of cerebral tumor. Optic neuritis and atrophy, headache, vomiting, vertigo, convulsions, cranial nerve palsies—all may be

² Eichhorst, *Zeitsch. f. klin. Med.*, 1891, Bd. 19; Quincke, *Verhandl. der Kongl. f. inter. Med.*, 1891; *Sammlung. klin. Vorträge.*, No. 67, 1893, and *Berlin. klin. Wochens.*, 1895, No. 41; Boenninghaus, "Ueber Meningitis serosa," Wiesbaden, 1897.

present. There may even be weakness and pains in the extremities. The chief distinguishing points are the remissions and intermissions, the increase in the size of the skull, showing hydrocephalus, and the absence of distinct localizing symptoms.

Diagnosis by Lumbar Puncture. It may be of interest here to describe the method of performing lumbar puncture. The operation is a simple one and is entirely safe if the operator is careful to perform it aseptically and not draw off more than two ounces of fluid at a time. The back of the patient and the operator's hands should be made sterile. The needle should be boiled for ten minutes. The patient should lie on the right side with knees drawn up and the uppermost shoulder so depressed as to present the spinal column to the operator. This position permits the operator to thrust the needle directly forward rather than from side to side. An antitoxin-needle, 4 cm. in length, with a diameter of 1 mm., is well adapted for infants and young children. A longer needle is necessary for adults and children more than ten years of age. The puncture is generally made between the second and third lumbar vertebræ. The thumb of the left hand is pressed between the spinous processes and the point of the needle is entered about 1 cm. to the right of the median line and on a level with the thumb nail, and directed slightly upward and inward toward the median line. At a depth of 3 or 4 cm. in children and 7 or 8 cm. in adults the needle enters the subarachnoid space and the fluid flows usually by drops but often, in alcoholic meningitis, in a spurt. It is allowed to drop into an absolutely clean test-tube, which previously has been sterilized by dry heat to 150° C. and stopped with cotton without running down the sides. From 5 to 15 cubic centimeters of fluid is a sufficient quantity for examination.