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## Lumbar Puncture of the Subarachnoid Space with Report of Cases

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LUMBAR puncture of the subarachnoid space was first performed by Quincke on man in 1891, and described by him shortly after, his object being at that time to relieve the pressure symptoms of hydrocephalus. The operation being more simple and much less dangerous, was intended to take the place of trephining or puncture through the fontanelle. As a therapeutic measure the operation has seemingly proved a failure, but Lichtheim, in 1893, published an article in which he called attention to its undoubted value as a diagnostic agent. If strict asepsis and antiseptics are observed there is practically no danger connected with the operation. In my cases I used an ordinary small-sized aspirating needle, sterilized, without the syringe being attached. It is necessary, of course, to be very careful in inserting the needle, as in several cases, by too free manipulation, the needles have been broken off and left sticking. When the needle strikes an obstruction it is always well to partially withdraw it before reinserting, and it may even be necessary to choose a new site. The needle is inserted in the adult between the third and fourth lumbar vertebræ, and in the child between the fourth and fifth. There is no danger of wounding the cord, for in the adult it only extends to the first lumbar vertebra, and in the child to the third. The danger of wounding the nerves is nil, as these are so tough that the needle readily glances off from them. In the child the needle may be inserted between the spinous processes in the median line as the processes are usually widely separated, but in the adult the puncture is made about a finger's breadth to the side of the spinous process, the needle being directed slightly upward and inward.

The depth of the insertion varies from 2 cm to 8 cm. The amount of



fluid withdrawn may vary from a few ccm to 100 ccm. The fluid may come away drop by drop, or with a spurt, thus indicating the condition of cerebral pressure. In my cases raising the head and shoulders caused the fluid to flow more rapidly. The patient should be placed in a position to give the greatest possible convexity to the spinal column, thus giving prominence to the spinous processes, which should be marked and counted several times, from above downward, to insure against any mistake in location. It is claimed that a line passing through the *cristae ilii* invariably passes through the body of the 4th lumbar vertebra. (Jacoby *N. Y. Med. Jour.* Dec. 28-95).

In the majority of cases an anesthetic is not necessary, but where there is much muscular rigidity, cutaneous hyperesthesia, or convulsions, it is much safer to have the patient anesthetized. The after-treatment of the site of puncture consists in covering the spot with iodoform-collodion.

What are the possible dangers attending the operation? Infection of the site of puncture may occur. The needle may by injudicious manipulation be broken. In three cases of cerebellar tumor reported, death followed the puncture in from 6 to 40 hours, but it seems to me manifestly unfair to take it for granted that the puncture was the cause of death, for cases of cerebellar tumor die when not punctured.

Wentworth reported his first case of lumbar puncture in the *Boston Medical and Surgical Journal* December '95, in which, after 5 or 6 ccm of fluid had been withdrawn most alarming symptoms occurred; the pulse rose to 250 beats per minute, (by stethoscope) the patient screamed and was restless, the extremities were cold, and the color bad. This condition passed away in about 30 minutes, and the patient made a good recovery in a few days.

As a therapeutic agent, the operation has seemingly not been attended by great success, although attempts have been made by Caille (*Archiv Pediatrics* August, '96) to medicate the parts directly affected in tubercular meningitis, through the lumbar puncture. Remembering the mysterious effect celiotomy has upon a tubercular peritonitis, we will wait anxiously the result of his experiments, hoping that the means are at hand by which we will be able to strike this dread disease, the diagnosis of which as Jacoby says is a death warrant, on its own soil, and in its own stronghold. It is also claimed that withdrawal of fluid through a lumbar puncture, relieves the extreme headache of brain tumor, although for a short time following the puncture the pain is more severe.

Jacoby (*N. Y. Med. Jour.* Jan. 4th, '96) reports two cases of spinal meningeal hemorrhage due to injury, followed by paralysis of the lower extremities, loss of control of the sphincters and so forth, in which puncture, permitting the escape of bloody fluid, was followed by complete recovery in one case, in the other case weakness of the peronei and extensors, and loss of knee-jerk remaining.

As a diagnostic agent, withdrawal of fluid from the subarachnoid space demands the attention of every diagnostician, for along this line it is no longer an experiment. Autopsies confirming diagnoses have been made sufficient in number to warrant its being placed in the front rank as an aid in the diagnosis of certain diseases of the brain, and possibly of the spinal cord. The only case of tubercular meningitis recorded, in which the diagnosis was made positively, terminating in recovery, is reported by Freyhan. In this case two punctures were made, a week apart, tubercle bacilli being found each time (Wolfstein *Archiv Pediatrics* Mar. '96). The search for tubercle bacilli is sometimes a tiresome procedure requiring plenty of patience and perseverance. In one case that I know of, 50 slides were examined before one bacillus was found. It is always well to clinch the diagnosis by animal inoculation and cultures.

The summary of Dr. Wentworth's paper on puncture of the subarachnoid space (*Archiv Pediatrics* Aug. '96) is so terse and to the point, that I will give it; 1. "The normal cerebrospinal fluid contains neither cells nor fibrin, and is perfectly clear.

2. In cases of meningitis, the cerebrospinal fluid is invariably cloudy when withdrawn. The degree of cloudiness is to some extent proportionate to the amount and character of the exudation in the meninges.

3. The cloudiness is caused by cells. The character of the cells differs with the variety of the meningitis. After withdrawal more or less of fibrin is formed in the fluid. The presence of these cells and fibrin is pathognomonic of inflammation in the meninges.

4. The cloudiness is oftentimes so slight that close inspection is necessary to detect it.

5. The operation is not difficult to perform on infants and young children. It is not dangerous if strict cleanliness is observed.

6. The differential diagnosis between the different kinds of meningitis can be made by microscopic examination of the sediment, by cultures taken from the fluid, and by inoculation experiments.

7. Inoculation experiments afford the surest way of determining tubercular meningitis. It is of value to distinguish between the different varieties in order to ascertain if tubercular meningitis is recovered from.

8. In normal cerebrospinal fluid a faint trace of albumin is present, about 1-50 of one percent or less, by quantitative analysis. In meningitis, the amount of albumin is increased, and has varied from 1-30 to 1-10 of one percent.

9. In one case, a diagnosis of general infection with *staphylococcus pyogenes aureus* was made from cultures taken from the cerebrospinal fluid."

Lichtheim has constantly found varying quantities of sugar, in cases of tumor of the brain, and seems to regard a considerable quantity of sugar in the cerebrospinal fluid, proving the patient is not a diabetic, as a circumstance which would lead one to suspect tumor of the brain. On tubercular meningitis examination of the blood will often throw considerable light, for in this disease, unaccompanied by suppuration, the number of leucocytes rarely exceeds 10,000, as has been demonstrated by V. Limbeck. If there be a slight increase in the number of leucocytes, it is usually of the small mononuclear variety known as lymphocytes. In cases of tubercular meningitis, the cloudiness of the cerebrospinal fluid was found to be caused by leucocytes, the lymphocytes preponderating. In cases of purulent meningitis the polynuclear neutrophiles were in the majority.

Case 1. A. M., male, age 40, of Scotch descent, and good family history, contracted syphilis five years ago. I saw the patient first June 2, when he was suffering with numerous syphilitic ulcers on both legs. These improved rapidly under treatment, until the middle of July, when they were entirely healed. About July 1 he commenced to complain of excruciating pains, limited to the right side of the head, always worse at night, which refused to yield to ordinary remedies. Iodid of potash was given to the limit of toleration. August 1 I was sent for by friends of the patient, and found him semi-stupid, complaining of pain in the head and nausea, but he had not vomited. His condition becoming worse, he was sent to the hospital. His pupils were sluggish, reacting to light slowly, temperature elevated, pulse fast and weak, both eyes showing choked disc. Owing to the temperature, pulse, pain worse at night, extreme restlessness of an automatic character, stupidity, and extreme pain localized in the right temporal region, a diagnosis of syphilitic meningitis was made, with a probable gummatous

growth in the region of the pain, at the same time conceding the possibility of tumor, which, owing to lack of focal symptoms, could not be localized.

On August 24, the patient having been without sleep or rest for four days, lumbar puncture was performed, and 25 ccm of fluid having an almost imperceptible cloudiness, were withdrawn; 12 ccm were given to Dr. Ohlmacher for bacteriologic examination. The fluid proved to be sterile, and cultures and animal inoculation gave negative results. The fluid that I retained showed fibrin shreds and some leucocytes, the majority being polynuclear. Fehlings solution gave an immediate test for sugar, throwing down a heavy red sediment. The bismuth test also gave positive results. There was 1-20 of one percent of albumin. Coverglass preparations failed to reveal the presence of any bacteria. There was no rise in pulse or temperature following the puncture. The patient almost immediately went off into a quiet sleep, the first for four days, and after awakening was much brighter than he had been for three weeks. This amelioration continued for about a week, when all his untoward symptoms returned. From September 2 on the patient failed rapidly, was stupid and had convulsions. On the evening of September 6, the second puncture was performed, and 35 ccm of cloudy fluid containing flakes were withdrawn.

The operation seemed to diminish the amount of restlessness, but beyond this no effect was noticed. The amount of sugar in the fluid was considerable. By the centrifuge the amount of albumin was one-fourth of one percent. The sediment showed fibrin and some polynuclear leucocytes. Coverslip preparations failed to show bacteria. The patient died on the morning of September 9.

Autopsy on the head alone showed a thickening of the dura mater above, with some adhesions between dura and skull, particularly marked about the region where pain was so intense, and numerous points of adhesion between dura and brain. Section of the hardened brain showed a large tumor in each lobe of the cerebrum, springing from the lateral ventricles, and cavities in each lobe of the cerebellum, connected with each other but not with the fourth ventricle. This interesting case I hope to be able later to present to the society in detail.

Case 2. J. D., farmer, age 56, was injured in a runaway August 30. The pupils were sluggish. There were involuntary action of the bowels, stupor and delirium. The temperature was elevated, and the pulse fast. Through the kindness of Dr. C. B. Hummiston, I was permitted to make a

puncture, but could not obtain a single drop of fluid. The needle was withdrawn and inserted twice, going in about  $6\frac{1}{2}$  cm, and I am quite positive that I was in the subarachnoid space. The patient died in three days, and no autopsy was obtained.

Case 3. J. H., age 35, fell down a flight of stairs, striking on a stone flagging, sometime during the night of September 10, and was not found until four o'clock on the morning of September 11. I saw the patient at 10 A. M. September 11, for Dr. House, at which time he was semi-conscious, with a pulse of 130, temperature  $102.6^{\circ}$ ; the right arm and right side of the face were paralyzed, muscular movements in right leg were slow and weak, the tongue deviated to the right, the pupils were irregular and reacted sluggishly to light. The patient was continually making efforts to roll over to the right, and several times he succeeded in rolling himself out of bed. His condition being considered very serious, he was transferred to St. Clair Hospital, where a lumbar puncture was performed, and 10 ccm of bloody fluid withdrawn. This, after being allowed to stand six hours, showed a sediment composed of red blood corpuscles, great numbers of polynuclear leucocytes and considerable fibrin. There was a faint trace of sugar, and one percent of albumin.

Owing to the marked focal symptoms, the patient was trephined by Dr. House over the right arm-center. Upon removing the button of bone, the dura was found tense and bulging. Upon incision, about a teacupful of bloody fluid similar in appearance to that obtained by puncture gushed out. No clot was found. Following the withdrawal of the fluid the pulse became much slower, and the patient's condition seemed better, but this was only temporary, for in a short time the pulse was up to 160 beats per minute. The patient died on the afternoon of September 12. Autopsy showed bloody fluid in both ventricles, a clot in the left lobe of the cerebrum, interrupting some of the fibers of the internal capsule, and a clot about the size of a hickory nut in the anterior portion of the right lobe of the cerebellum. There was also a great quantity of bloody fluid between the dura and the brain. It seems quite probable that the clot in the cerebellum was the cause of the tendency to roll over.

Case 4. J. F., male, age 40, was injured September 14, by colliding with a wagon, and falling on his head. The patient was unconscious, with contracted pupils, stertorous breathing, a pulse of 120, and temperature of

101°. Through the kindness of Dr. J. E. Cook I was permitted to make puncture, drawing off 20 ccm of dark bloody fluid. On being allowed to stand six hours, the red corpuscles were thrown down, leaving the supernatant fluid distinctly cloudy. Microscopic examination of the sediment obtained by the centrifuge showed great numbers of red cells losing their hemoglobin, also numerous polynuclear neutrophiles, and some fibrin. Purdy's method showed 10 percent of albumin; the fluid also showed a trace of sugar.

The patient died September 17, and the postmortem examination was made 12 hours afterwards. The dura was so tightly adherent to the skull-cap, that in lifting, force sufficient to tear the dura was required. The dura was adherent to the brain an inch on either side of the longitudinal sinus throughout its entire extent; these adhesions were all recent. A clot about the size of a hand was found between the dura and the brain, on the left side, occupying the anterior and middle fossae. The under surface of the anterior lobe was considerably softened, and a deep fissure in the same locality seemed to warrant the belief that there was laceration of brain substance. The left lateral sinus was ruptured, and this seemed to be the source of most of the hemorrhage. The right lateral ventricle contained a large softened clot. There was no fracture of any portion of the skull.

Therapeutically, the result of the puncture in the last two cases was negative; in the first case, however, it seemed to me that the amount of benefit derived from the operation warranted its performance. In the first case it was possible to bar out tubercular meningitis and purulent meningitis. The large amount of sugar in the fluid made me feel certain that a growth of some kind would be found, in connection with any other condition that might be present. In cases 3 and 4 I felt sure of the presence of bloody fluid in the ventricles, and owing to the dark bloody fluid in case 4, an intraventricular clot was suspected. However, one puncture in a case of this kind is not sufficient to warrant a positive diagnosis of bloody fluid in the ventricles, for the possibility of wounding a vessel while making the puncture must always be taken into consideration.





