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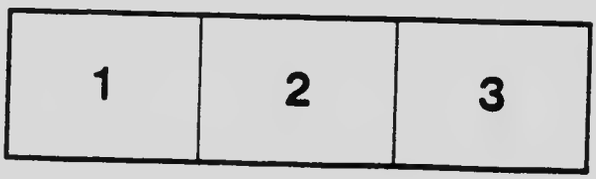

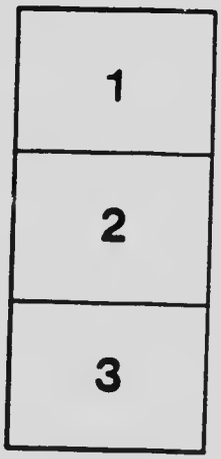

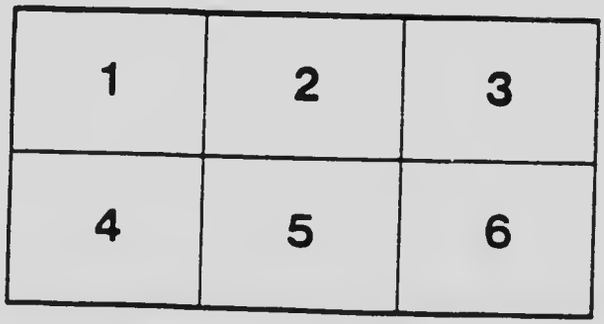

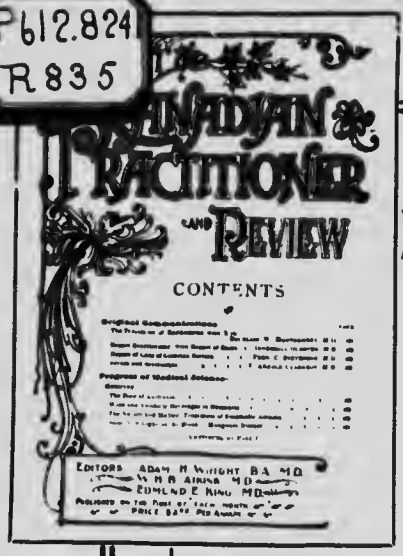
CANADIAN PRACTITIONER AND REVIEW

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The Clinical Estimation of the Pressure of the Cerebro-Spinal Fluid

By

R. D. RUDOLF, M.D.

THE CLINICAL ESTIMATION OF THE PRESSURE OF THE CEREBRO-SPINAL FLUID.*

By R. D. Rudolf, M.D.

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The method of lumbar puncture was introduced to the profession in 1890 by H. Quincke, of Kiel. Since that time it has been used a great deal, and is looked upon, according to Rothmann, of Berlin, as one of the most valuable contributions to our clinical armamentarium for the study and treatment of diseases of the nervous system.

Lumbar puncture is used for the obtaining of some of the cerebro-spinal fluid for chemical and microscopic examination, and also for the study of the elastic pressure that the fluid is exerting within the cranio-spinal cavity. It is with the latter part of the subject that we are here concerned.

The subarachnoid spaces of the brain and spinal form the only cavity that normally always contains any considerable quantity of fluid. This fluid is constantly exerting a positive pressure upon the surrounding and contained structures, and it was partly with the object of measuring this pressure that Quincke first advocated his method of lumbar puncture. Since 1890 he has again and again urged that this pressure should be measured as a routine method whenever lumbar puncture is considered necessary, but this is certainly not usually done, it being much commoner to find the pressure merely guessed at by noting how rapidly the fluid drops from the canula; or it may spurt. During the past winter we have been doing it a good deal in the Toronto General Hospital and find the results interesting and sometimes of value.

The apparatus we use is of the simplest, and consists of a long glass tube bent at a right angle near to one end. This end is connected by a flexible rubber tube with the canula, and upon the rubber tube is placed a clamp. The whole apparatus is sterilised, and then filled with sterilised normal saline solution, and by the use of the clamp this fluid is allowed to escape until there is about 120mm standing in the vertical arm of the glass tube. The object of thus filling the tube up to this mark

* Read at the meeting of the Ontario Medical Association.

with the saline solution is that we may estimate the pressure of the cerebro-spinal fluid without much of this escaping first from the spinal canal, as would be the case if it ran into an empty tube. I have not seen this method mentioned anywhere and it seems of value.

The method of lumbar puncture that we use is the ordinary one; the patient being upon his side with the head low, and the back as much bent as possible. The only anesthetic that we have employed has been ethyl chloride. The little operation seems to give some pain at times, but not to a great extent, and often no more than is caused by the administering of a hypodermic injection. We puncture in the third lumbar space, where one is well below the level of the spinal cord, and it seems easiest to reach the spinal canal by keeping to the middle line. As soon as the first drop of fluid escapes from the cannula showing that the subarachnoid space has been reached, the rubber tube is passed over the end of the cannula, and the cerebro-spinal fluid pressure is quickly registered. It is more convenient not to use any scale upon the vertical tube, but merely to mark the levels of the fluid with a glass marking pencil, and afterwards to measure the height at one's leisure.

In a normal individual the fluid pressure is about 100 mm. of water, but anything between 40 and 150 is, according to Quincke, within the limits of health.

There are three fluctuations of a normal character noticed in the column of fluid: (a) One synchronous with the heart beat, (b) one synchronous with the respiration, the pressure falling with inspiration and rising with expiration, (c) a slower variation of a somewhat rhythmical character occurring about every ten to thirty seconds, and causing a variation in the height of the column of from 10 to 30 mm. The exact nature of this fluctuation is not clear. Further, any straining or excitement at once sends the pressure up, and Nawratski and Arndt found the column to rise to 800 mm. during an epileptic fit in a case where it had previously been normal. If the patient's head be passively raised, and much more so if he be raised to a sitting posture, the pressure will rise very much. This rise is of course of hydrostatic nature. Theoretically the difference here should be about 600 mms., that being about the average height of the top of the cranial above the point of lumbar puncture, but, owing to the fact that the skull is a closed and rigid cavity, this amount of change does not occur. Kronig found that about 40 per cent. of the total height regis-

tered, and we found that it varied between 154 and 334, and the average (in 9 cases) was 256.7, which is 42.8 per cent. of the average 600 mms..

The fluctuations in the pressure due to the respiration and pulse are, according to Henneberg, only *transmitted* to the lower dorsal space, and hence when they are absent this absence is a valuable distinguishing point between myelitis and compression myelitis.

Without going into the very complicated question of what keeps up the normal pressure of the cerebro-spinal fluid, one may say that it depends upon the relation between secretion and absorption, and also upon the amount of solid contents. For example if a large cerebral abscess rapidly form, this would tend to increase the total pressure within the cranio-spinal cavity. Compensation will be attempted here by either increased absorption or decreased secretion or both, but such compensation is often insufficient, and we have a pathologically raised pressure within the cavity of the skull and spine.

The communication between the subarachnoid spaces in the skull and the spine is normally so free that any increased pressure is soon equally distributed, and can hence be measured in the lumbar region. If, however, as sometimes happens, the communication between the two cavities is mechanically interfered with there may exist within the cranium a high pressure while within the spinal cavity this may be low, and in such a case lumbar measurements are of no avail. If, however the fontanelles be open and are bulging, showing an increased intra-cranial pressure, and yet the pressure in the lumbar region be low, then we could argue that there must be some mechanical obstruction about the foramen magnum due perhaps to meningeal thickening or some other structural cause.

Under pathological conditions the pressure of the cerebro-spinal fluid frequently rises. These conditions always, according to Quincke, within the cranium, as it is that the chief secretion and chief absorption both take place. The conditions which may give rise to increased pressure may come under the three headings of (a) proliferation of tissue which decreases space, such as tumors, etc., (b) purulent or serous exudates either within or without the brain, (c) effusions of blood either into the brain or between the membranes.

Frequently in diseased conditions the pressure reaches

500 is high, 700 extremely high, but 1,000 has been recorded. As elsewhere in the body, a rapid rise will produce more acute symptoms than a gradual accumulation of a much greater extent. The nervous structures are able to accommodate themselves to an increased pressure if only given time.

There is apparently no relation between the pressure of the cerebro-spinal fluid and the blood pressure. In one of our cases, one of cerebral abscess following middle ear disease, the cerebro-spinal fluid pressure was 230, and yet the systolic blood pressure was only 90 mm. of mercury. On the other hand the blood pressure may be high, and yet the cerebro-spinal fluid pressure not raised as in a case recently observed in which there were periodical attacks of cerebral compression accompanying a cerebral tumor not of the base. During one of these attacks the cerebro-spinal fluid dropped rather slowly from the cannula, showing that there was probably no marked increase in the pressure of the fluid, and yet the systolic pressure was well over 200 mm. This case was observed before we had begun to actually measure the pressure, which deprives the observation of much of its value.

When in various diseased conditions, especially in meningitis, when it is considered advisable to draw off some of the cerebro-spinal fluid the actual measurement of the pressure is of great importance.

The drainage can then be done via the glass gauge, and we can accurately know when the pressure has fallen to normal and hence the drainage should cease. Suppose, for example, that the pressure be found to be 500 mm. we could allow the fluid to escape until the pressure fell to 150, and then stop. To reduce it to below the normal suddenly would probably incur the risk of producing hemorrhage into the central nervous system from the removal of the support to the surface of the brain and spinal cord.

Occasionally it is found that the pressure falls very rapidly when only a very small quantity of the cerebro-spinal fluid has left the spinal canal. Quincke explains this by saying that a more or less complete obstruction about the foramen magnum, due to the abnormal brain being forced down as the pressure in the spinal canal is removed, has taken place. It is very urgent in such a case to at once stop the drainage. In one of our cases something of this sort happened. He was a man, aged 10, who was admitted unconscious, and apparently uremic. The urine contained albumin, and many casts. The

leucocytes numbered 19,200. He had frequent fits, and Babinski's sign was present. The cerebro-spinal fluid pressure was only 54 mm., but fluctuated freely with respiration and the heart beat, and was easily raised by raising the head, all this proving that the communication between the cranium and spinal cavity was free. A few drops of the fluid were allowed to escape, and the pressure quickly fell to 40 mm., and stayed there. Post mortem examination in this case showed thrombosis of the lateral sinuses.

The only complication that we have had after lumbar puncture has been considerable headache, often lasting for a day or two. On the other hand it may not be amiss to mention that in functional nervous cases the psycho-therapeutic effect has been marked.

In this preliminary communication one would close by urging that in every case where lumbar puncture is considered advisable for diagnostic purposes the pressure of the fluid should be measured. Further, it seems most necessary that where the pressure is high and the fluid is being drained off to give relief, this withdrawing should be done *via* the measuring tube in order that we may the better know what we are doing, and when to stop.