CISTERN PUNCTURE IN CHILDREN.

A SERIES OF ONE HUNDRED AND TWENTY-SEVEN PUNCTURES IN THIRTY-THREE CHILDREN, AGES VARYING FROM SEVEN MONTHS TO TWELVE YEARS.*

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DURING the past few months, through the kindness of Dr Charles M'Neil, Senior Physician to the Royal Edinburgh Hospital for Sick Children, I have been able to investigate in a certain number of cases the possibilities of cistern puncture in children. It is not my object here to discuss fully the uses of cistern puncture, but only to take up the aspects which presented themselves to me in this series of cases. The 33 cases investigated comprised—

10 with tuberculous meningitis,
4 with meningococcus meningitis,
3 with pneumococcus meningitis,
1 with streptococcus meningitis,
15 in which exploratory puncture was done for diagnosis, and where no meningitis was found.

This means of obtaining fluid from the subarachnoid space has been used clinically only for the past seven or eight years. Three American observers, Ayer, Wegeforth, and Essick,¹ in 1919, after a series of successful experiments, described the very simple technique, and from the results which they obtained, were convinced of the possibilities of the method. In 1923 Ayer² gave a report on nearly 2000 punctures done on 450 patients. This series of cases was noted over a period of five years. In several other papers also, Ayer³ has strongly advocated this procedure.

Anatomy.—The cistern lies immediately in front of the occipito-atlantoid membrane, which is reached in children at a depth of 1.5 to 4 cm. from the surface. Anterior to, and immediately in contact with, this membrane lie the dura mater and arachnoid. Between these and the posterior aspect of

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the medulla, at the level of the foramen magnum, the sub-arachnoid space is widened out to form the cisterna magna. The depth varies in children from 1 to 3 cm.

Technique.—1. Preparation of the Surface.—The skin surface is prepared as for any surgical operation. Shaving as a rule is necessary; then application of spirit or methylated ether to clean the surface; and finally iodine, 2½ per cent., is applied.

2. Position of the Patient.—The patient is placed in the right lateral position, with the neck supported by a small pillow to preserve the alignment of the vertebral column. The head is placed at the edge of the bed, and is slightly flexed forwards. Care has to be taken to prevent any sudden movement on the part of the child, who is held firmly by an assistant.

3. Anaesthesia.—In this series of cases, general anaesthesia was only used once, and then in the case of a sturdy and restless boy of ten years. As a rule in children who were definitely ill no local anaesthesia was necessary. In most cases over eight years of age where exploratory puncture only was performed, local anaesthesia with 1 per cent. novocain was used, a weal the size of a threepenny-bit being raised just above the tip of the axis vertebra.

4. Procedure.—The thumb or forefinger of the left hand is placed on the tip of the second or axis vertebra, the first bony prominence felt below the occiput. The needle is then inserted just above the guiding finger, and pushed guardedly upwards and forwards in line with the external auditory meatus and the tip of the glabellum, till the dura is pierced. If the cistern is entered at this angle, there is usually a depth of from 2.5 to 3 cm. between the dura over the occipito-atlantoid membrane and the medulla. This has been demonstrated satisfactorily in frozen sections of the parts. With the needle less oblique in position, the distance between the walls of the cistern becomes progressively less; therefore it is good practice to aim a little higher than the auditory meatus, and if the needle strikes the occiput, to depress just enough to pass the dura at its uppermost attachment to the foramen magnum. It is advisable to withdraw the stilette immediately the point of the needle is felt to be gripped by the tense occipito-atlantoid membrane. The flow of fluid shows one that the cistern has been reached, and it is unnecessary to push the needle further.
5. Needle.—In children a needle with a smaller calibre than the adult needle is used. The length is also less, varying from 4 to 7 cm., according to the age of the child. As in lumbar puncture needles, a stilette is made to fit the needle perfectly.

The Safety of Cistern Puncture.—Puncture of the cisterna magna is potentially a dangerous procedure. Nevertheless, the advantage of having at times a method of approach to the cerebral meninges without operation, is so great as to outweigh any potential danger. In Ayer’s series of 450 patients, no death was known to have occurred directly or indirectly from puncture. In the present series of 33 children, no harmful sequelæ such as headache, pain in the face, dizziness, or nystagmus were noticed. These phenomena have been noticed far more often in adults. Nowadays, as a matter of routine scopolamine and morphine are administered in adults prior to cistern puncture. This was never found to be necessary in children. None of the children complained of pain either at the time of the puncture or later. It is obvious also that

![Diagram of Cistern Puncture](image)

FIG. 1.—Diagram of Cistern Puncture.

a. Cisterna magna.  
b. Occipito-atlantoid membrane.  
c. 2nd or axis vertebra.  
d. Cerebellum.  
e. Fourth ventricle.  
f. External auditory meatus.  
g. Medulla oblongata.
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adults have a greater apprehension of the operation than children. The fact that a needle is being inserted into their head naturally has a psychological effect which in children is

![](image)

Fig. 2.—X-ray of the head with needle in the cisterna magna. The forefinger is pressing on the spine of the axis vertebra, and the needle is lying between the first vertebra and the basi-occiput, about 1 cm. beyond the occipito-atlantoid membrane, in the cistern.

Thanks are due to Dr Edmund Price, Radiologist, Chalmers Hospital, Edinburgh, for valuable help in taking this photograph.

absent. From experience, however, it has been found that the direct sequelæ of cistern puncture are less common than after lumbar puncture.

What Ayer calls “bloody tap,” that is to say, where blood
is obtained instead of fluid, is apt to be looked upon as dangerous. He found that it was much commoner to get blood by lumbar puncture, and in his large number of cistern punctures only drew blood on a few occasions. In the present series, blood was obtained on three occasions, at a depth seemingly short of the cistern. In each case when puncture was repeated at a later date, cerebro-spinal fluid was obtained. This blood was probably from the suboccipital veins (extradural), and was not a contra-indication to deeper puncture.

Failure to obtain fluid in adults has been the experience of most clinicians, as a rule in thick-necked patients where it was considered unwise to persist to unaccustomed depths. Only once in children was no fluid obtained, in a case of purulent streptococcus meningitis, where at post-mortem it was found that the cistern was filled with semi-solid pus, too thick to come through the needle.

That repeated puncture may be safely made is the experience of all observers. Ayer had a case in which he did twenty-six. In one case of tuberculous meningitis that lived for three weeks after admission to the Children's Hospital, ten punctures were done.

Contra-indications. — Any intracranial condition which would cause the cistern to be partially occluded or obliterated is, of course, a direct contra-indication. Cerebral tumour is therefore an important contra-indication. Occasionally, in very advanced meningitis, where the patient is in a moribund condition, a certain degree of softening of the cerebral tissues brings the vital structures in the floor of the fourth ventricle into the line of puncture, and so cistern puncture is not to be advised. In most of these cases treatment is of no avail. The contra-indications therefore in children are comparatively few, and the operation is to be strongly advised whenever necessary.

Indications for Cistern Puncture. — I. Diagnosis. — The examination of the cerebro-spinal fluid from the lumbar region is usually sufficient to establish a diagnosis in most cases of meningitis. In tuberculous meningitis, the organism is not commonly found by this method. Ayer and Solomon have shown that the fluid obtained by cistern puncture usually contains more organisms and more cells than that by lumbar puncture. In the 10 cases of tuberculous meningitis in this series, tubercle bacilli were found in the lumbar fluid in only 4, and then at a late stage of the illness. In the cisternal fluid
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tubercle bacilli were demonstrated in every case;—in 5 cases after centrifuging the fluid for twenty minutes; in the other 5, after incubating the fluid for twenty-four hours. One case may serve to illustrate.

W. F., aged 3$\frac{5}{12}$.—Admitted with history of being out of sorts for a week. Slight vomiting, rather constipated, off food. Very cross, restless, and irritable. No fever, no cough, no pain anywhere. The day before admission the mother thought patient rather more sleepy than usual, and not quite so restless.

On examination—Looks rather tired, but not acutely ill. Very cross and irritable. No fever. Pulse 100. Resp. 28. Slight drowsiness, but no coma. Lungs and abdomen healthy. Kernig and Babinski negative. No squint or tache cérébrale. Reflexes and optic discs normal. Lumbar puncture showed increased pressure and albumin with the nitric acid test. Increase of lymphocytes, but no tubercle bacilli. Cistern puncture was done an hour or two later, and tubercle bacilli were found immediately.

The patient lived for twenty-two days after admission, and developed the characteristic clinical signs of tuberculous meningitis. Repeated search for tubercle bacilli in the lumbar fluid failed to show any. At post-mortem the diagnosis was confirmed.

From these data it may be concluded that as a means of early diagnosis of tuberculous meningitis, cistern puncture is preferable to lumbar puncture.

2. Treatment.—It is obvious from the anatomical situation of the cisterna magna that it has a strategic position as the centre of distribution of the cerebro-spinal fluid to both cerebral arachnoid and spinal arachnoid spaces. In 1912 this conception was grasped by Haynes and Kopetzky, who devised an operation for drainage of the meninges at this point. A few unsuccessful trials owing to faulty technique caused their efforts to fall into undeserved disrepute. Again in 1917, Anton and Schmieden tried the same procedure, and Schmieden and Scheele in 1921 used it to drain infected meninges, with marked success. Ayer has used it as a means of drainage and introduction of serum successfully for several years. Mitchell and Reilly report cure in a child of four months with acute meningococcus meningitis, having introduced serum by this method. Peet also records a case of the same disease in a girl of eight years, where cure was brought about by the combined use of ventricular, cisternal, and lumbar puncture, both for drainage and introduction of serum. Alternate injection of
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serum by lumbar and cisternal routes has been used by these clinicians. It has been shown that the possibility of block of the arachnoid space by adhesions is lessened by this alternation.

Introduction of serum by this route was tried in 3 cases of acute meningococcus meningitis during the past month or two. Two were very advanced on admission, and serum with drainage was of no avail; both died in a few days. The other case recovered. The following are the main points in the history:—

J. G., aged 7/12.—Admitted 29.4.26. Sudden onset of vomiting and diarrhoea, with marked drowsiness, four days before admission.

On examination—Looks ill. Very pale and weak. Marked drowsiness. No irritability. Slight head retraction, with definite cervical rigidity. Reflexes normal. Discs normal. Temperature, 102.4°. Pulse, 130. Respirations, 38. Lumbar fluid showed turbidity, increased pressure, and large numbers of meningococci.

30.4.26.—L. P., 50 c.c. withdrawn; 10 c.c. serum injected.

3.5.26.—Still very ill. High temperature. Very drowsy. Head retraction more marked.

4.5.26.—L. P., 40 c.c.; 10 c.c. serum.

6.5.26.—Cistern puncture, 45 c.c. withdrawn; 10 c.c. serum.

8.5.26.—L. P., 60 c.c.; 10 c.c. serum. Fluid not so turbid. Meningococci still numerous. General condition slightly improved.

10.5.26.—Cistern puncture, 50 c.c.; 10 c.c. serum. Fluid less turbid. Temperature still about 102°. Still slight improvement.

14.5.26.—Serum rash, slight.

20.5.26.—Rash gone. Good general improvement. Still slight temperature. Fluid rather more turbid.

23.5.26.—L. P., 50 c.c.; 10 c.c. serum.

25.5.26.—Cistern puncture, 45 c.c.; 10 c.c. serum.

29.5.26.—Splendid improvement. Smiled to-day. Fluid almost clear. Very few organisms.

2.6.26.—L. P., 20 c.c. Clear. No organisms. Temperature has been normal for seven days now. No neck rigidity or head retraction. Doing well.

9.6.26.—Discharged. Fluid normal. General condition very good.

21.7.26.—Reported. Still doing well. Gained 4 lbs. in weight since discharge. C. S. F. normal.

In 2 cases of meningitis, one tuberculous, the other pneumococcal, both in children with open anterior fontanelle, triple
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puncture as described by Purves Stewart was used. 20 c.c. Ringer's solution was injected into the ventricles, about 30 c.c. cerebro-spinal fluid having been removed, and drained off from the cistern; later 20 c.c. Ringer's was injected into the cistern and drained off by lumbar puncture; a third time the same amount of Ringer's was injected into the ventricles, this time being withdrawn at the lumbar region. In the case of tuberculous meningitis, life was undoubtedly prolonged, the patient regaining semi-consciousness several hours after. Within twelve hours, however, he relapsed into the previous coma. The case of pneumococcus meningitis was too far advanced for treatment to be of much avail. Cistern-lumbar irrigation with Ringer's has been used by Selling in 2 cases, by Eagleton in 3, and by Ayer in 7 cases. All the operators testify to the simplicity of the procedure, and to the excellent drainage afforded.

3. When Lumbar Puncture is Unsuccessful or Impossible.—Not uncommonly in children one has great difficulty in obtaining fluid by lumbar puncture. The canal in the lumbar region often is narrow, and as one does not so easily have the feel of being inside, as in adults, the result is that one goes too far in, so failing to get fluid. In acute purulent meningitis with adhesions in the spinal arachnoid space, one fails to obtain fluid by lumbar puncture. We had several cases in the hospital where repeated lumbar puncture was unsuccessful for the above reasons. In each case fluid was easily obtained by cistern puncture.

It is obvious, too, that in cases of children with bony deformities of the thoracic or lumbar vertebrae, cistern puncture would be preferable to lumbar puncture.

Conclusions.—1. Cistern puncture is an easy and safe method of removing cerebro-spinal fluid from children.

2. Repeated puncture is safe, and anaesthesia is rarely necessary.

3. The contra-indications are: (1) Very advanced meningitis where the patient is in a moribund condition, and where puncture might injure vital structures displaced by disease. (2) In cerebral tumour, or any other disease of the brain causing occlusion of the cistern.

4. Indications: (1) Treatment of acute meningitis, especially meningococcus meningitis, by serum therapy, by irrigation, and
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by simple drainage. (2) As a means of diagnosis, especially in tuberculous meningitis. (3) When lumbar puncture is unsuccessful or impossible.

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