AN INDEX FOR VENTRICULAR CATHETER LENGTH

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SUMMARY:
While placing a ventricular catheter, the optimum length may be difficult to determine when intra-operative ultrasound is not available or some time has passed between the CT of diagnosis and the operation. An index based on the head circumference of the individual is described. Our method was also tested on patients and proved successful.

KEY WORDS:
Hydrocephalus, shunt systems

INTRODUCTION
Shunt systems are widely used throughout the world for the treatment of hydrocephalus, but with a high rate of complications. Proximal revisions are more common in peritoneal systems while distal revisions are more common in vascular systems (7). Since shunt systems are used more and more now, the present study was undertaken to overcome the ventricular catheter problems encountered in the follow-up period of these problems.

MATERIAL AND METHOD
In the last 9 years, 120 shunt procedures have been carried out in our clinic, mostly ventriculoperitoneal (V-P) shunts. For the placement of a right sided shunt, first of all, the skin incision is made so that the burr-hole is in direct line with the lateral ventricle. The burr hole site should be at a point 2.5 cm superior to the inion and 2.5 cm lateral to the occipital midline for the newborn infant. These values should be 4 and 3.5 cm for the other patients. If the cerebral mantle is thin, the catheter should be inserted directly into the ventricle; if the mantle is thick, the catheter is inserted through a ventricular cannula. As soon as the ventricle is entered, the cannula is removed and the catheter is advanced.

Since it is known that lateral ventricles are parallel to the planes of the CT scan, we have made measurements on the CT scans of both hydrocephalic (number 35) and normal (number 35) individuals to find out the real distance between the burr-hol e site as described above and the point 1.0 cm in front of the foramen of Monro. Comparing these values by the age of the patient, the head circumference and the ventricular index, a statistically significant regression coefficient is found between head circumference and these values (Fig. 1). For convenience, the coefficient is approximated and found to be:
- for infants up to 1 months old .................. 5
- for children over 1 months old up to 5 years ......................................................... 4.5
- for children over 5 years of age .......... 4

When we divide the head circumference by these values, we get the optimum ventricular catheter length. Even when the results are approximated up or down to the nearest counting number, the values are significantly close to the real measurements (p<0.05). This length is 12 cm in grownups when there is no macrocranium.

RESULTS
Retrospectively, we tried this calculation on our patients still being followed up (number 35) and compared it with the catheter length already used. We observed that all patients who had undergone revision operations for proximal catheter occlusion either because of choroid plexus enmeshment or being embedded in the frontal white matter did not have optimum catheter lengths. The reason in some cases was the considerable time that had passed between the CT scan for diagnosis and the shunt operation because of medical problems that had to be solved. In some other cases, especially those with greater ventricular indices, the shunted ventricle contracted and the catheter length which was formerly optimum and had worked without any problem became longer than needed and pierced the wall of the frontal horn. There were also cases in which the catheter length was not correctly chosen pre-operatively.

As the last step, we used this calculation in 15 patients and did not encounter any of the problems described. There were even 3 cases with major ven
This figure clearly shows the correlation between the optimum ventricular catheter length and the head circumference measured on 35 hydrocephalic and 35 healthy individuals.

DISCUSSION

Valved shunt systems have, since the early 1950’s, provided effective management of tens of thousands of individuals with hydrocephalus. But shunt systems generate a series of problems which must be managed as well as the original aetiology of the hydrocephalus and the hydrocephalus itself (4). These problems include malfunction of the various components of the shunt system (6, 8, 9).

Malfunction at the proximal end of the shunt may be due to disconnection with separation of the ventricular catheter from the rest of the shunt system. This complication has become less frequent in recent years as a result of technical advancements in shunt systems.

A second cause of malfunction at the ventricular end is blockage of the ventricular catheter by the choroid plexus, intraventricular debris and glial tissue growing into the lumen of the ventricular catheter.
This complication can be minimized by lumen of the ventricular catheter. This complication can be minimized by proper placement of the ventricular catheter; the tip of the catheter should be placed sufficiently far anteriorly in the lateral ventricle so that it is beyond the anterior extent of the choroid plexus. Ideally, the tip of the ventricular catheter, therefore, should be anterior to the foramen of Monro (1). It is believed that obstruction can be virtually eliminated by the use of a flanged catheter (5), but in fact no ventricular catheter design will prevent it from enmeshment in the choroid plexus, since the choroid plexus tends to migrate toward the perforations of the catheter whereever it is placed.

A third cause of ventricular catheter failure arises from contraction of the shunted ventricle. Close contact of the ventricular wall with the catheter favours occlusion of the catheter. The catheter may also become embedded in the wall of the ventricle or pierce the wall and enter the white-matter. Fortunately not all cases of overdrained small ventricles are followed by ventricular catheter obstruction. Other factors like foreign body reaction and infection may be of some importance in the development of this complication. The use of a high-pressure valve in the system may be of very significant benefit. Epstein et al. have described the procedure of subtemporal craniectomy for recurrent shunt obstruction due to small ventricles (3).

RESULTS

This report details a method to obtain the optimum length of the ventricular catheter. The calculation we have described is optimum for ventricular catheter length and is measured from the outer table of the cranium. Our method will be of use in institutions without intraoperative ultrasound facilities. Furthermore, if the sutures have closed, ultrasonic imaging will not be possible unless a sufficient window is made in the skull to permit it. Also, if a considerable time passes between the operation and the CT scan for diagnosis, measurements made on the CT scan will cause problems due to the growth. In such cases, this method can be used and the two latter complications can be avoided.

Experience with this method is still limited, but there does not appear to be any reason to expect frequent malfunction.

REFERENCES


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