AN INDEX FOR VENTRICULAR CATHETER LENGTH

İ. Semih KESKİL, M.D., Necdet ÇEVİKER, M.D., Kemali BAYKANER, M.D., Hızır ALP, M.D.,

Gazi University, School of Medicine, Department of Neurosurgery.

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-hole 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
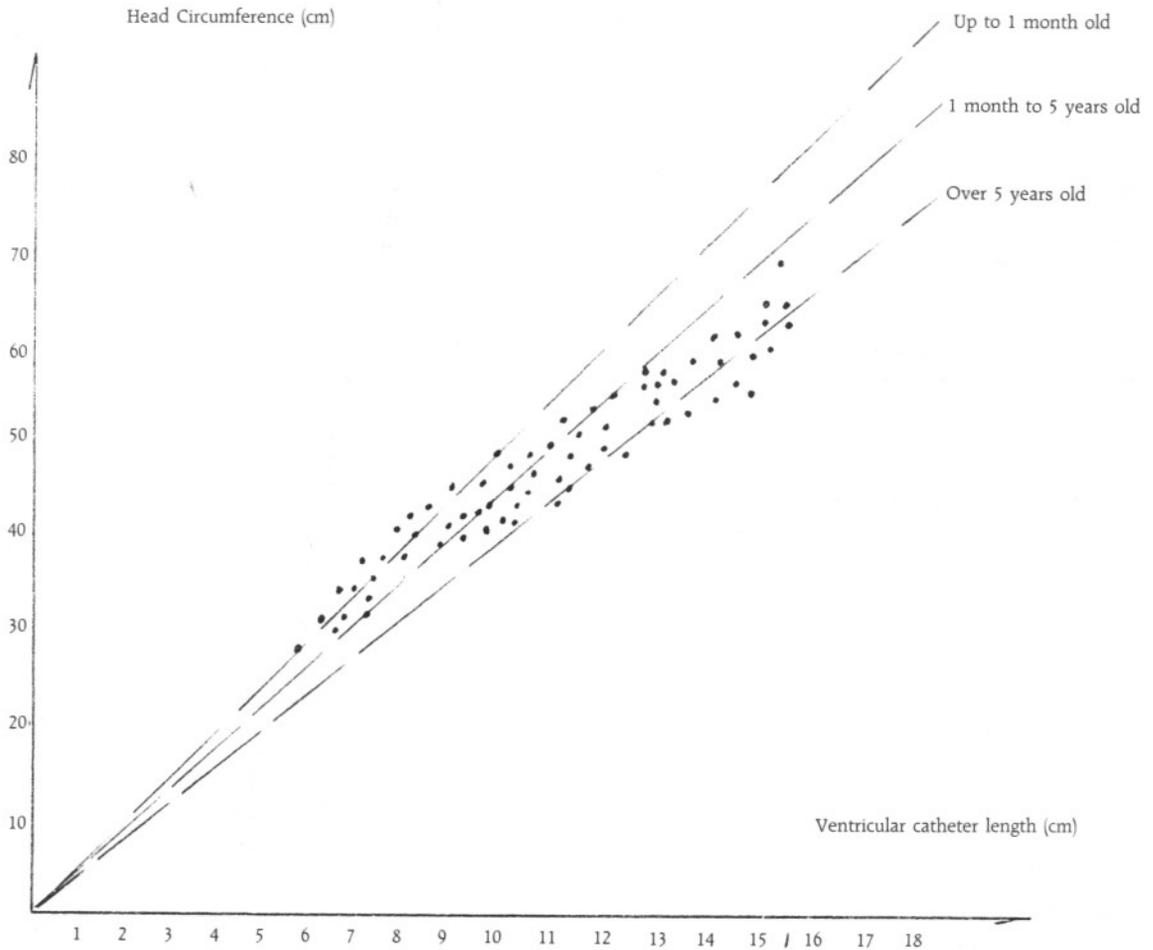— for children over 5 years of age 4

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 lenghts. The reason in some cases was the considerable time that had passed between the CT scan for diagnosis and the shunt operation beause 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

FIG I

Head Circumference (cm)

Up to 1 month old

1 month to 5 years old

Over 5 years old

Ventricular catheter length (cm)

This figure clearly shows the correlation between the optimum ventricular catheter lenght and the head circumference measured on 35 hydrocephalic and 35 healthy individuals.

tricular shape anomalies and 2 cases of univentricle and our results were also excellent in the follow-up period of 1 year.

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 hydocephalus 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

1. Becker DP. Nulsen FE: Control of hydrocephalus by valve-regulated venous shunts: Avoidance of complications in prolonged shunt maintenance. J Neurosurg 28:215-226, 1968.
2. Dennis M. Fitz Cr. Netley CT, et al: The intelligence of hydrocephalic children. Arch Neurol 38:607-615, 1981.
3. Epstein FJ. Fleischer AS. Hochwald GM, et al: Subtemporal craniectomy for recurrent shunt obstruction secondary to small ventricles. J Neurosurg 41:29-31, 1974
4. Fried A. Shapiro K: Subtle deterioration in shunted childhood hydrocephalus. A biomechanical and clinical profile. J Neurosurg 65:211-216, 1986
5. Hakim S: Hydraulic and mechanical mismatching of valve shunts used in the treatment of hydrocephalus. The need for a servo-valve shunt. Dev Med Child Neurol 15:646-653, 1973
6. Johnson DL. Fitz C. McCullogh DC, et al: Perimesencephalic cistern obliteration: A CT sign of life threatening shunt failure. J Neurosurg 64:386-389, 1986
7. Keucher TR. Mealey J: Long-term results after ventriculoatrial and ventriculoperitoneal shunting for infantile hydrocephalus. J Neurosurg 50:1979-1986, 1979
8. Noetzel MJ. Baker RP: Shunt fluid examinations: Risks and benefits in the evaluation of shunt malfunction and infection. J Neurosurg 61:328-332, 1984
9. Sacher P. Hirsig J. Bolthauser E: Limitations in the diagnosis of valvular dysfunction using the Rickham reservoir. Z Kinderchir 32:202-207, 1981

For Correspondence : Dr. İ. Semih KESKİL
Gazi University, School of Medicine
Department of Neurosurgery.
Gazi Hospital, Beşevler, Ankara, TURKEY.
Phone : 212 65 65/362, 363