Index for optimum ventricular catheter length

Technical note

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✓ The optimum length of a ventricular catheter to be placed in a particular patient may be difficult to determine when either intraoperative ultrasound is not available or considerable time has elapsed between the diagnostic computerized tomography scan and the operation. An index for estimating ventricular length based on the head circumference of the individual is described. This method was tested clinically and proved to be successful.

KEY WORDS • hydrocephalus • intracranial catheter • ventriculoperitoneal shunt

Since the early 1950's, valved shunt systems have provided effective management for tens of thousands of individuals with hydrocephalus. However, these shunts generate a series of problems that must be managed in addition to the original etiology of the hydrocephalus and the hydrocephalus itself. Malfunction at the proximal end of the device may be due to blockage of the ventricular catheter by the choroid plexus, intraventricular debris, or glial tissue growing into the lumen of the catheter. Another cause of ventricular catheter failure arises from the contraction of the shunted ventricle. The catheter may become embedded in the wall of the ventricle or pierce the wall and enter the white matter. These complications can be minimized by proper placement of the catheter so that the tip is located far enough anteriorly in the lateral ventricle beyond the anterior extent of the choroid plexus, but not too far. Ideally, the tip of the catheter should be 1.0 cm anterior to the foramen of Monro, in the frontal horn. The present study was undertaken to determine the distance of this anatomical point from the cranium.

Materials and Methods

During the last 9 years, 120 shunt procedures were carried out in our clinic, most of the implanted devices being ventriculoperitoneal shunts. For the placement of a right-sided shunt, the skin incision is made so that the burr hole is on the same direct line as the lateral ventricle. In the newborn infant, 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; in older patients, these values should be 4 cm and 3.5 cm, respectively.

Since it is known that the lateral ventricles are parallel to the planes of the computerized tomography (CT) scans, measurements were made on the CT scans of 35 hydrocephalic patients and 35 normal individuals with different shaped skulls to establish the real distance between the burr-hole site on the external table and the point 1.0 cm in front of the foramen of Monro. Correlation of these CT measurements with the head circumference, classified into three age groups, revealed a statistically significant ratio between these values and the head circumference (Fig. 1 and Table 1). When the head circumference is divided by a CT measurement, the optimum ventricular catheter length is obtained. Even when the results are rounded off to the next whole number, the values are significantly close to the actual measurements (p < 0.05); this is always 12 cm in adults unless there is macrocranium.

Results

Retrospectively, the calculation of optimum ventricular catheter length was tested on the 35 hydrocephalic patients and the results were compared with the catheter length already being used. It was observed that all patients who had undergone revision operations for proximal catheter occlusion did not have optimum
Ventricular catheter

Fig. 1. Correlation between the optimum ventricular catheter lengths and the head circumferences measured on 35 hydrocephalic and 35 healthy individuals in three age groups.

catheter lengths. In some cases, this was due to the considerable period of time that had passed between the diagnostic CT scan and the shunt operation because of other intervening medical problems. In other cases, especially those with greater ventricular indices, the shunted ventricle contracted and the catheter, which had previously worked without any problem, was longer than needed and pierced the wall of the frontal horn.

As a final step, this calculation was used prospectively in 15 patients, of whom three had major anomalies in ventricular shape and two had a single lateral ventricle. No problems were encountered and results obtained during the follow-up period of 1 year were excellent.

Discussion

This report details a method to determine the optimum length of a ventricular catheter, measured from the outer table of the cranium. This method operates well for different shaped skulls and ventricles and will be of use in institutions without intraoperative ultrasound facilities. Furthermore, if a patient’s sutures have closed, ultrasonic imaging is not possible unless a wind-

Table 1

<table>
<thead>
<tr>
<th>Patient Age</th>
<th>Ratio</th>
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<tbody>
<tr>
<td>&lt; 1 mo</td>
<td>5.0</td>
</tr>
<tr>
<td>1 mo–5 yrs</td>
<td>4.5</td>
</tr>
<tr>
<td>&gt; 5 yrs</td>
<td>4.0</td>
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* For convenience, the ratio is approximated.

dow is made in the skull sufficient to accommodate it. Also, if considerable time elapses between the operation and the diagnostic CT scan, measurements made on the CT scan will be inappropriate due to growth of the patient. In such cases, the calculation described here may be used and these complications can be avoided. Experience with this method is still limited but there does not appear to be any reason to expect more frequent malfunction of shunt systems prepared with this technique.

References


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