Ventriculo-direct atrial shunts

A clinical evaluation

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✓ Ventriculoatrial shunts were performed on 10 patients by placing the cardiac tube directly into the right atrium via the auricular appendage at thoracotomy, and the long-term results after 3 to 6 years were analyzed. Complications included distractions of the upper part of the shunt, pleural cyst formation, pleural effusion, and phrenic nerve injury. The procedure is not recommended for the primary treatment of hydrocephalus, but is useful when simpler shunts are no longer possible or desirable.

KEY WORDS: hydrocephalus · ventriculoatrial shunt

W EINMAN AND PAUL 2 first reported ventriculoatrial shunting by thoracotomy and direct insertion of the atrial catheter into the heart in 1967. They cited the following advantages of this procedure: 1) the tube is placed directly into the center of the right auricle; 2) allowance can be made for growth by leaving a loop of the catheter within the pleural cavity; 3) there is no interference with venous return from the cranial cavity; 4) there is no possibility of either immediate or late jugular or caval thrombosis. Of their 42 patients, two died of postoperative pulmonary infections and a third developed pneumothorax. The longest follow-up was 2 years, and in that period only one patient needed a revision: an infant in whom the cardiac end pulled out of the heart, causing a hydrothorax.

Through the combined efforts of the Neurosurgical and Surgical Departments of the Children's Hospital Medical Center, Boston, we have treated 10 hydrocephalic patients with this operation; we have followed five of them for over 6 years and two for over 3 years, thus providing a more realistic long-term evaluation.

Operative Technique

Holter valves and tubing were used exclusively in our patients, but otherwise the operation did not differ significantly from that of Weinman and Paul. 2 A right lateral ventricular catheter was inserted through an inverted hockey-stick-shaped scalp incision and parietooccipital burr hole, and connected to a subcutaneous Holter valve. The atrial tubing was led subcutaneously down the neck into the chest through a stab wound in the anterior right second intercostal space. A right thoracotomy was performed through the fourth intercostal space and the pericardium incised over the right atrium anterior to the phrenic nerve. A large loop (6 to 8 in) of the tubing was positioned in the chest anterior to the lung and the end placed through two purse-string sutures in the appendage into the right atrium, so that the tip
Ventriculo-direct atrial shunts

### TABLE 1

<table>
<thead>
<tr>
<th>Original Shunt (Patient Age and Year)</th>
<th>Shunt Revision (Time after Original Insertion and Reason)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Head and Neck Portion</td>
</tr>
<tr>
<td>3 1/2 mos (1965)</td>
<td>16 mos (distraction)</td>
</tr>
<tr>
<td>5 mos (1965)</td>
<td>2 yrs (distraction)</td>
</tr>
<tr>
<td>7 mos (1967)</td>
<td>3 yrs (distraction)</td>
</tr>
<tr>
<td>2 1/2 yrs (1970)</td>
<td>none (functioning at 6 mos)</td>
</tr>
<tr>
<td>3 1/6 yrs (1965)</td>
<td>none (functioning at 6 yrs)</td>
</tr>
<tr>
<td>3 1/2 yrs (1965)</td>
<td>4 yrs (distraction)</td>
</tr>
<tr>
<td>6 yrs (1968)</td>
<td>none (functioning at 3 yrs)</td>
</tr>
<tr>
<td>8 yrs (1965)</td>
<td>5 yrs (distraction)</td>
</tr>
</tbody>
</table>

was midway between the superior and inferior vena cava. A chest tube was inserted at the closure, and antibiotics administered.

**Case Material**

The etiologies of hydrocephalus in these 10 cases included aqueductal stenosis, Arnold-Chiari malformation, medulloblastoma, vein of Galen aneurysm, communicating hydrocephalus, and congenital occlusion of the outlets of the fourth ventricle. Ages ranged from 3½ months to 15½ years. All but two patients had had one or more previous shunts, further revision of which had been considered undesirable or impossible.

**Results**

The only death was in a patient who succumbed within a year to a medulloblastoma. One patient required removal of the shunt because of a *Staphylococcus aureus* coagulase-negative infection, probably resulting from an earlier shunt infection that had been inadequately treated.

Table 1 summarizes the course of the remaining eight patients and suggests that revision might be required less often than expected in patients with ventriculoujugular shunts. Three shunts are functioning well without revision at ½, 2, and 5 years after operation. Five required revision because of disconnection and distraction of some portion of the shunt in the head or neck. The Holter valves currently used have a flange on the end of the valve connector which may decrease the incidence of this complication.

The atrial catheter has come out of the heart twice. One such complication occurred 5 years after operation and caused a large asymptomatic pleural cyst of cerebrospinal fluid (CSF), while the other occurred 3 years after operation and produced a pleural effusion of 500 cc of CSF. In neither case was there evidence of hemothorax. Reexploration of the chest revealed no evidence that an intrathoracic tube tract had formed around the tube, a phenomenon that might prevent uncoiling of the tube during growth.

One immediate postoperative revision was required because of occlusion of the cardiac catheter by the atrial purse-string suture. Reoperation resulted in injury of the phrenic nerve which caused marked atelectasis and pneumonia from which the patient eventually recovered. Phrenic nerve injuries might have contributed to the two deaths from postoperative infections in the series of Weinman and Paul.

In our series, one patient had an elective revision of the cardiac end 5½ years after the original operation at 5 months of age. Serial chest x-ray films showed uncoiling of the initially small intrathoracic loop of tubing. In other patients, uncoiling of the intrathoracic loop was not striking, nor was it recognized in the two patients in whom the cardiac tubing came out of the atrium.

All of the shunts which were revised are functioning well at present.

**Conclusions**

We do not recommend ventriculo-direct atrial shunts as the initial treatment of hy-
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drocephalus. However, our experience shows that they are practical and may be useful when simpler shunts have failed or are not advisable. Close clinical and x-ray monitoring of these patients is important. Complications thus far encountered include atelectasis and pneumonia due to injury to the phrenic nerve, CSF pleural effusion and cyst formation due to withdrawal of the tube from the heart, shunt infection, and relatively frequent distraction of the cephalic shunt components.

References


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