New lumboperitoneal shunt for communicating hydrocephalus

Technical note

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The authors describe a T-tube Silastic shunting device which has been used for lumboperitoneal shunting in 62 patients with communicating hydrocephalus during the past 3 years. In 38 patients it was inserted as a primary shunting procedure; 24 patients had the shunt inserted following problems secondary to arachnoiditis created by a polyethylene-type lumboperitoneal shunt. The shunt described here has not led to arachnoiditis when inserted as a primary shunting procedure. In 61% of patients no operative revisions of their shunt has been required to date, and 81% continue to do well on their T-tube type shunt.

KEY WORDS lumboperitoneal shunt • T-tube • arachnoiditis • communicating hydrocephalus • kyphoscoliosis • paraplegia • Silastic

The use of shunts from the lumbar subarachnoid space to the peritoneal cavity in cases of communicating hydrocephalus was first described by Ferguson in 1898. Cushing improved upon this technique and by 1908 had treated 12 patients with lumboperitoneal shunts with a silver cannula drilled from the subarachnoid space, through the vertebral body into the peritoneal cavity. Matson reported on the use of a polyethylene tube that ran from the lumbar subarachnoid space to the ureter in the treatment of hydrocephalus and later he began to run these tubes into the peritoneal cavity. Polyethylene lumboperitoneal shunts were in standard use in the treatment of communicating hydrocephalus in our institution during the years 1952 to 1973, when 285 patients with communicating hydrocephalus were treated in this fashion. Of this group, 96 patients are doing well with an IQ above 90, and still functioning on their lumboperitoneal shunts. A further 59 are also doing well with a normal IQ, but their shunt has been converted to either a ventriculo-
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peritoneal or ventriculoatrial shunt. Of the remainder, 82 are retarded, with IQ less than 90, and 48 died. Seventy-two patients have arachnoiditis resulting in lordosis, kyphoscoliosis, significant neurological deficit, and in five patients a frank paraplegia. In addition, because the shunt lacked a valve, five patients with secondary craniosynostosis have developed disproportion between brain size and head size; this has led to prolapse of their cerebellar tonsils necessitating a posterior fossa decompression. Infection occurred in only 13 patients with lumboperitoneal shunts and has been treated by removal of the infected shunt.

Because of the complications caused by the polyethylene shunt as demonstrated by our cases and referred to by Kushner, et al., we have now abandoned this type of tube. However, the concept of treating this form of hydrocephalus by a shunt from the lumbar subarachnoid space to the peritoneal cavity remained appealing in that 67.4% of our surviving patients have been left with a normally functioning brain.

Technique

During the past 3 years, we have used a T-shaped Silastic tube with a valve at the tip, for lumboperitoneal shunting (Fig. 1 left).* The bar of the T is inserted into the subarachnoid space in the mid or upper lumbar level. The distal end of the catheter is made of the same material as the Holter peritoneal catheter† and contains a valve at the tip, with a choice of a 30 or 60 mm opening pressure. The catheter is 65 cm long and because it cannot kink, allows for growth of the child. The bar of the T is 3 cm long, contains many pinpoint-size openings and is of such finer caliber than the rest of the tube, having an internal diameter of 1.0 mm and an outside diameter of 1.8 mm, whereas the peritoneal extension has an internal diameter of 1.2 mm and an external diameter of 2.5 mm.

The operation is carried out with the patient in the right lateral decubitus position with the left side of abdomen, flank, and back in the operative field. The incision is made in the upper lumbar level and a portion of the adjacent laminae are removed creating a keyhole opening between the remaining portions of the laminae. A 4-mm incision is made in the dura, the arachnoid is opened, and then, with a special instrument (Fig. 1 right) which holds the bar of the T so that the two ends are in apposition, the bar of the T is inserted through the slit in dura and arachnoid, into the subarachnoid space (Fig. 2). The dura is closed on either side of the tube. The abdominal portion of the tube is tunnelled deep to the paraspinal muscles, to an incision in the left lower quadrant of the abdomen and introduced into the peritoneal cavity (Fig. 3).

The size of the tube has allowed insertion without difficulty in children of all ages and sizes. We have used it in a 2 kg newborn baby and a 60 kg 14-year-old child.

* T-shaped Silastic tube with valve manufactured by Extracorporeal Medical Specialties, Inc., King of Prussia, Pennsylvania.
† Holter peritoneal catheter (Salmon design) Model No. B-910, made by Extracorporeal Medical Specialties, Inc., King of Prussia, Pennsylvania.

Fig. 1. Left: T-tube lumboperitoneal shunt. Right: Bayonet forcep with cup-like tips, and locking mechanism in handle, for grasping T-tube.

Fig. 2. Operative technique for insertion of T-tube lumboperitoneal shunt. A = Location of insertion. B = Insertion of the T-tube. C = Position of T-tube in place in the subarachnoid space.
This T-tube type of shunt has been inserted as a primary lumboperitoneal shunting procedure in 38 patients, 25 of whom have not required revision of their shunt to date. Three patients had their shunts replaced by ventricular-type shunts shortly after the T-tube was inserted because of poor subarachnoid flow. One patient had a shunt scan done 4 months after the shunt insertion, which demonstrated adequate shunt function, but a subsequent meningitis due to contamination at the time of the scan led to conversion of the shunt to a ventriculoperitoneal shunt. One patient has had six revisions in 27 months; however, he had one of our early prototypes of the T-tube which consisted of a proximal Silastic T-tube and a distal catheter of a spring type, which came apart several times. The new type of T-tube was finally inserted. One patient had three revisions, one of which was due to a technical error in which too short a tube was placed into the peritoneal cavity. It quickly withdrew and a longer extension was required. Two patients have required two revisions each; and five patients, one revision each; all of these have been carried out by simply flushing the tubing through a small incision in the flank (Fig. 4).

Twenty-four patients had a T-tube shunt inserted after problems secondary to arachnoiditis were created by a former polyethylene-type lumboperitoneal shunt. As a result of their arachnoiditis all of these patients had had many operative revisions, one as many as 12 times. After insertion of the T-tube, 13 have required no further operative procedures. One patient has required three operative irrigations of his shunt and three patients have each had one operative irrigation. In seven patients severe arachnoiditis interfered with subarachnoid CSF flow sufficiently to make conversion to a ventricular-type shunt mandatory. Before the use of these T-tubes, all patients with arachnoiditis would, no doubt, have been converted to a ventricular type of shunt. It is of interest that the 17 patients with arachnoiditis who are functioning on T-tubes have had improvement in the signs and symptoms of their arachnoiditis once their hydrocephalus came under proper control (Fig. 5).

Out of a total group of 62 patients with T-tube type shunts, 38 have required no further operative procedure. Twelve shunts have been
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results of this shunting device, but we feel that it has many advantages over the polyethylene tube and hope that because of its length and method of design, it will allow for long term effective control of communicating hydrocephalus.

**TABLE 1**

Comparison of results in patients treated primarily and secondarily with T-tube lumboperitoneal shunt

<table>
<thead>
<tr>
<th>Primary Procedure</th>
<th>Secondary Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>number of patients</td>
<td>38</td>
</tr>
<tr>
<td>converted to VP or VA shunt</td>
<td>24</td>
</tr>
<tr>
<td>revision (irrigation)</td>
<td>4</td>
</tr>
<tr>
<td>progressive arachnoiditis</td>
<td>9</td>
</tr>
<tr>
<td>no further surgery</td>
<td>26</td>
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<tr>
<td></td>
<td>24</td>
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<td></td>
<td>13</td>
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</tbody>
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revised; seven only once; two twice; two, three times; and one, six times. Twelve have been converted to a ventricular type shunt and eight patients in this group had problems with arachnoiditis prior to insertion of the T-tube (Fig. 6 and Table 1).

We realize that this is a relatively short period of time to truly assess the long term

**References**

2. Ferguson AH: Intraperitoneal diversion of the cerebrospinal fluid in cases of hydrocephalus. NY State J Med 67:902, 1898

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