Peritoneovenous shunting is an effective treatment for intractable ascites

P Sooriakumaran, H F McAndrew, E M Kiely, L Spitz, A Pierro

Aim and methods: A retrospective review was carried out of children undergoing peritoneovenous shunting for intractable ascites.

Results: 11 children, aged 3 months to 12 years (median 31 months) underwent peritoneovenous shunting over the past 17 years. The duration of ascites ranged from one month to 2.5 years (median two months). The primary pathology consisted of previous surgery in eight (three neuroblastoma, one renal carcinoma, one hepatoblastoma, one adrenal teratoma, one renal artery stenosis, and one diaphragmatic hernia), and cytomegalovirus hepatitis, lymphatic hypoplasia, and lymphohistiocytosis in one patient each. All patients had failed to respond to previous treatment including peritoneal drainage in six patients, diuretics in five, and parenteral nutrition in five. There were no intraoperative problems. Postoperative complications included pulmonary oedema in three patients, shunt occlusion in three, infection in two, and wound leakage in one. Ascites resolved after shunting in 10 patients. Five shunts were removed one to three years after insertion without recurrence of ascites. Three others are free of ascites with shunts in place for less than one year postoperatively. Three children died from their underlying disease: two after resolution of ascites (neuroblastoma) and one in whom the ascites failed to resolve (lymphohistiocytosis).

Conclusions: Peritoneovenous shunting is an effective treatment for symptomatic intractable ascites in children (10 of 11 successful cases in this series). Elective removal of the shunt after one year is recommended.
### DISCUSSION
The symptoms of ascites, which include anorexia, nausea, vomiting, pain, and respiratory embarrassment may be severe and disabling. Medical treatment of ascites with diuretics depletes the circulating volume in an attempt to draw fluid from the peritoneal cavity back into the circulation. Paracentesis removes the excess fluid from the peritoneal cavity providing good temporary relief but the fluid discarded is rich in electrolytes, protein, and white cells. Repeated paracentesis and diuretics may leave the patient hypovolaemic and nutritionally depleted.\(^6\)\(^-\)\(^8\) The aim of peritoneovenous shunting is to return the fluid to the circulation; it does not change the underlying disease process but rather improves the haemodynamic status.\(^9\) Successful resolution of ascites produces relief from nausea and vomiting and permits removal of dietary restrictions that promotes improved enteral intake, which combined with the recirculation of ascitic fluid leads to an overall improvement in the nutritional status of the patient. In common with adult series we noted a rapid improvement in the patients overall wellbeing after shunting.\(^9\)

The first description of the use of a prosthetic peritoneovenous shunt was by Smith in 1962 using a Spitz Holter valve.\(^10\) Although initially successful they tended to block, as shown in the one patient in our series in which it was used. In 1966 Hyde described his shunt designed specifically for the drainage of ascites, although he later admitted faults in the design that also led to a tendency to block.\(^11\) The success of the Leveen shunt presented in 1974 renewed interest in peritoneovenous shunting.\(^12\) In the discussion that followed Waddel described his experience with the Denver shunt published later in 1979 by Lund and Newkirk.\(^13\) The principle behind these shunts is that ascitic fluid flows down a pressure gradient from the peritoneal cavity to the venous circulation. A valve mechanism prevents back flow of blood if the venous pressure rises above the intra-abdominal pressure. The valve chamber in the Denver shunt lies in the subcutaneous tissue and can be manually compressed both to promote flow and to relieve blockage. Denver shunts are therefore less prone to blockage and thus have largely replaced other designs as the shunt of choice in the treatment of ascites.\(^14\)\(^-\)\(^16\) Patients with symptomatic ascites should be considered for shunting after failure of at least two weeks intensive medical treatment, with depletion of extracellular fluid volume without reduction of ascites or rapid reaccumulation after.\(^17\)\(^-\)\(^19\) Patients must be shown to be free from peritonitis before shunt insertion.\(^7\)\(^-\)\(^9\)\(^18\) Contraindications include loculation of ascites, free blood, and a protein content of greater than 45 g/l in the ascitic fluid, all of which prevent free flow and increase the risk of blockage. Congestive cardiac failure, severe cardiac disease, and renal failure all impair the handling of the increased plasma volume and are further contraindications. Coagulopathy, gastrointestinal bleeding, and hepatic encephalopathy are also contraindications as all worsen with shunting.\(^7\)\(^-\)\(^9\)\(^18\) Preoperative investigation must include microbiological and biochemical analysis of the peritoneal fluid, as well as basic blood tests including packed cell volume, coagulation profile, and liver function tests.

The routine postoperative use of diuretics has been recommended in adults, but we did not find this necessary in children without pre-existing cardiac disease and would recommend careful monitoring and use as clinically indicated.\(^4\)\(^7\)\(^9\)\(^11\) Daily pumping of the shunt chamber is recommended to promote flow and to detect, prevent, and relieve blockage.\(^7\)\(^-\)\(^9\) Postoperative weight and urine output should be monitored, with a lack of diuresis leading to suspicion of shunt failure. Packed cell volume, haemoglobin, coagulation, and electrolytes should be monitored, with the peak of maximum haemodilution occurring in the first 48 hours.\(^15\) The routine use of perioperative antibiotics is recommended by some authors.\(^17\)\(^7\)\(^9\)\(^15\) Although there are no reports of fatalities in children, tumour emboli, fluid overload, and disseminated intravascular coagulation have all resulted in deaths in adults.\(^4\)\(^-\)\(^9\)\(^15\) Discarding some ascitic fluid at operation can reduce the risk of fluid overload but the abdomen should not be drained completely, as patency of the shunt requires some flow.\(^4\)\(^7\)\(^9\)\(^15\) High central venous pressure will reduce flow, although pumping the chamber and abdominal compression may overcome this.\(^15\)\(^19\)

Infusion of ascitic fluid into the circulation dilutes the clotting elements, activates coagulation, and may cause disseminated intravascular coagulation.\(^4\) Although disseminated intravascular coagulation has not been reported in children undergoing peritoneovenous shunting, immediate ligation of the shunt would be recommended in such cases.\(^6\)

Blockage of the shunt should be suspected if there is reaccumulation of fluid. It may be relieved by pumping the chamber or percutaneous flushing. Shunt infection may

### Table 1  Clinical outcome

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Age (months)</th>
<th>Duration of ascites (months)</th>
<th>Medical treatment</th>
<th>Outcome of ascites</th>
<th>Complication</th>
<th>Shunt removed</th>
<th>Survival</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neuroblastoma</td>
<td>31</td>
<td>4</td>
<td>Diuretics</td>
<td>Resolved</td>
<td>Varix</td>
<td>Yes</td>
<td>A+W</td>
</tr>
<tr>
<td>Neuroblastoma</td>
<td>23</td>
<td>1</td>
<td>Drainage</td>
<td>Resolved</td>
<td>Blockage</td>
<td>No</td>
<td>Died</td>
</tr>
<tr>
<td>Neuroblastoma</td>
<td>78</td>
<td>1</td>
<td>Drainage</td>
<td>Resolved</td>
<td>None</td>
<td>No</td>
<td>Died</td>
</tr>
<tr>
<td>Hepatoblastoma</td>
<td>22</td>
<td>1</td>
<td>Diuretics</td>
<td>Resolved</td>
<td>Infection</td>
<td>Yes</td>
<td>A+W</td>
</tr>
<tr>
<td>Renal carcinoma</td>
<td>32</td>
<td>2</td>
<td>Drainage</td>
<td>2nd shunt</td>
<td>Leak</td>
<td>Yes</td>
<td>A+W</td>
</tr>
<tr>
<td>Adrenal teratoma</td>
<td>36</td>
<td>1.5</td>
<td>Drainage</td>
<td>Resolved</td>
<td>None</td>
<td>No</td>
<td>A+W</td>
</tr>
<tr>
<td>Renal artery</td>
<td>13</td>
<td>2</td>
<td>Diuretics</td>
<td>Resolved</td>
<td>None</td>
<td>No</td>
<td>A+W</td>
</tr>
<tr>
<td>Stenosis</td>
<td>19</td>
<td>2</td>
<td>Drainage</td>
<td>Resolved</td>
<td>None</td>
<td>Yes</td>
<td>A+W</td>
</tr>
<tr>
<td>Diaphragmatic hernia</td>
<td>3</td>
<td>1.5</td>
<td>Diuretics</td>
<td>Resolved</td>
<td>Pulmonary oedema</td>
<td>Yes</td>
<td>A+W</td>
</tr>
<tr>
<td>Lymphatic hypoplasia</td>
<td>146</td>
<td>30</td>
<td>Diuretics</td>
<td>Resolved</td>
<td>Pulmonary oedema</td>
<td>No</td>
<td>A+W</td>
</tr>
<tr>
<td>Lymphohistiocytosis</td>
<td>54</td>
<td>2</td>
<td>Diuretics</td>
<td>Persisted</td>
<td>Pulmonary oedema</td>
<td>No</td>
<td>Died</td>
</tr>
</tbody>
</table>

A+W, alive and well.
respond to intravenous antibiotics although removal may be necessary. Ascitic fluid leak from the abdominal wound has been reported. Careful closure of the wound and reducing the intra-abdominal pressure by drainage of the fluid should reduce this complication.

Elective removal of the shunt has not previously been described. A few patients have been described in whom ascites did not recur after removal or verigee blockage of the shunt. Ascites after retroperitoneal surgery was the underlying cause in eight of our 11 patients and is probably attributable to direct damage to lymphatic channels, which is recoverable. Also, the presence of a shunt carries the risk of infection, and we therefore recommend elective removal after one year.

In 10 of 11 patients in our series, ascites resolved leading to total symptomatic resolution with few complications. We have shown that peritoneovenous shunting in children is safe and successful and recommend the use of the Denver shunt early in the management of symptomatic ascites unresponsive to aggressive medical treatment.

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REFERENCES
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