Abdominal ultrasound in the diagnosis of
cerebrospinal fluid pseudocysts complicating
ventriculoperitoneal shunts

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SUMMARY Pseudocysts filled with cerebrospinal fluid caused complications at the distal end of ventriculoperitoneal shunts in five children. Only one of these cysts was infected. The children presented with raised intracranial pressure or abdominal symptoms, or both. We report on the usefulness of abdominal ultrasound examination in the diagnosis and follow up of these patients and suggest that abdominal ultrasound should form part of the initial assessment of children with ventriculoperitoneal shunt dysfunction.

The widespread use of the ventriculoperitoneal route for cerebrospinal fluid shunting in hydrocephalic states has brought with it increasing awareness of possible complications of the distal end of the tubing such as migration or retraction of the distal catheter tip, perforation of a viscus, perforation of the anterior abdominal wall through the umbilicus, volvulus and other intestinal obstruction, peritonitis from the shunting of infected cerebrospinal fluid, and peritoneal fibrosis from the use of intraventricular chemotherapy. Cystic collections and free ascitic fluid have been reported occasionally as complications of the peritoneal end of the catheter. In only five patients have pseudocysts been suspected or diagnosed by the use of abdominal ultrasound.1-4

We report on a further five cases of abdominal pseudocysts complicating ventriculoperitoneal shunting, seen at the Royal Hospital for Sick Children, Edinburgh, and diagnosed by ultrasound. We show how ultrasound can be of use in both diagnosis and follow up.

Patients

Patient 1. This girl was born in 1967 with an upper thoracic myelomeningocele and a high level paraplegia. This was closed shortly after birth. She subsequently developed hydrocephalus and a Spitz-Holter ventriculoatrial shunt was inserted on day 7 of life. At 3½ years of age obstruction at the atrial end of the shunt occurred and the distal limb was rerouted into the peritoneum. At the age of 15 years she was admitted to hospital for investigation of chronic headache over the previous 10 months. Her valve felt ‘sluggish’ and a skull radiograph showed erosion of the posterior clinoids. A computed tomogram showed increased ventricular dimensions suggesting chronic, raised intracranial pressure from shunt malfunction. A well defined cystic lesion near the distal peritoneal shunt tubing in the right upper quadrant was seen on abdominal ultrasound (Fig. 1) and at operation a cyst containing some 30 ml of cerebrospinal fluid was found enclosed in thickened peritoneum. When the valve system was examined it was found that both the proximal and distal tube connections had become separated from the Spitz-Holter valve. Total replacement of the shunt was carried out using a Raimondi uniflow device and again using the peritoneal route. Eighteen months later she remains well with no symptoms of raised intracranial pressure or reaccumulation of her abdominal pseudocyst.

Patient 2. This girl was born at term, delivered by caesarean section because of fetal distress. At 1 month of age a Raimondi uniflow drainage system was inserted for a congenital hydrocephalus, using the ventriculoperitoneal route. Apart from a transient abdominal wound infection she remained well after the operation; there were no symptoms of raised intracranial pressure, her hydrocephalus was well controlled, and there was no evidence of over drainage.

She was admitted to hospital again at the age of 8 months with fever, vomiting, diarrhoea, and
abdominal distention caused by ileus. She responded to conservative management with intravenous fluids and antibiotics and was well within one week. Before discharge home both abdominal plain radiographs and abdominal ultrasound scans were normal.

Two weeks later she was again admitted to hospital with raised intracranial pressure. At clinical examination, intracranial pressure was 15 mm Hg and a mass was palpable in the right iliac fossa. Abdominal ultrasound examination showed a fluid collection around the distal end of the shunt and at laparotomy a pseudocyst was drained. Since the uniflow shunt was found to be working satisfactorily, the distal end was reinserted. Two years later she remains well without any clinical or ultrasonic evidence of reaccumulation of the cyst and her hydrocephalus has remained well controlled.

Patients 3. A girl born at 36 weeks' gestation was delivered by caesarean section because of maternal hypertension and falling oestriols. She weighed 1.7 kg at birth and suffered some symptomatic neonatal asphyxia with a grade II intraventricular haemorrhage. A communicating hydrocephalus subsequently developed for which a ventriculoperitoneal (Pudenz) shunt was inserted at 3 weeks of age.

At 11 months of age, after a two month history of non-specific symptoms, her shunt system was revised and a new Pudenz ventriculoperitoneal system was inserted. After the operation she remained irritable and intermittently feverish, with a neutrophil leucocytosis in peripheral blood. An infection screen which included examination and culture of cerebrospinal fluid, was negative on two occasions and her intraventricular pressure was also normal at 5 mm Hg. Empirical treatment with cloxacillin and gentamycin had no effect on the symptoms and eventually, three weeks after her total shunt revision, a multiloculated cystic collection at the distal...
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Fig. 3 Longitudinal ultrasound scan showing cystic collection (C). Foley balloon catheter (F) in bladder (B).

end of her shunt was identified by abdominal ultrasound.

Serosanguinous fluid (35 ml) was aspirated from the cyst; it contained pus cells and Gram positive cocci, which were subsequently identified as *Staphylococcus albus*. Metronidazole was added to her treatment. At laparotomy this fluid was drained from the multiloculated cyst surrounding the distal shunt tubing. The whole shunt system was removed, antibiotics were continued, and over the next 12 days the character of the ultrasonic appearance changed from one of low echogenicity to one of multiple fine echoes within the cystic area, suggesting organisation of this collection in the right subphrenic area (Fig. 2). When the infection had settled a Raimondi uniflow shunt was inserted, again using the ventriculoperitoneal route and two and a half years later she remains well with no evidence of cyst reaccumulation, infection, or raised intracranial pressure.

**Patients 4 and 5.** A 6½ year old boy (patient 4) with hydrocephalus and a lumbar myelomeningocele developed a pseudocyst one month after his previous shunt revision, at which time he had been noted to have peritoneal adhesions. The distal end of his shunt was relocated in an area remote from the adhesions and 3 years later he remains asymptomatic.

A 14 year old girl (patient 5, Fig. 3) with hydrocephalus and a lumbar sacral myelomeningocele developed shunt blockage with symptomatic raised intracranial pressure four years after her previous shunt revision. A pseudocyst containing 30 ml of cerebrospinal fluid was drained and the distal end of her shunt was relocated. Six months later she remains well.

**Discussion**

Pseudocyst formation at the distal end of peritoneal shunts, first reported in 1954, remains an uncommon complication of this procedure. Before the advent of ultrasound examination of the abdomen and its use in this situation (first reported in 1978) many cases were only diagnosed at the time of laparotomy.

In our patients (Table), ultrasound gave accurate information about the size and situation of the cysts. Cysts had been suspected in two patients in whom abdominal masses were clinically palpable and also in patient 3 in whom intra-abdominal sepsis was suspected. While most previously reported cases have been of very large volume omental cysts, two of our patients had cysts of 30 cc and another of 60 cc volume.

The age range of our patients was wide (11 months to 15 years) and the aetiologies of the hydrocephalus were also different. No particular type of shunting device predisposed to pseudocyst formation as three different types of shunt system were used (Pudenz, three patients; Raimondi, one patient; and Spitz-Holter one patient).

It has been suggested that there may be a relation between cyst formation and abdominal procedures after the initial insertion of the shunt. In our

### Table Clinical features of patients with abdominal pseudocysts

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age at operation</th>
<th>Shunt type</th>
<th>Abdominal operations subsequent to initial shunt</th>
<th>Time since last revision/insertion of peritoneal shunt tubing</th>
<th>Cyst infected</th>
<th>Cyst single or multiloculated</th>
<th>Duration of symptoms</th>
<th>Intracranial pressure when cyst diagnosed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15 years</td>
<td>Spitz-Holter</td>
<td>0</td>
<td>11½ years</td>
<td>No</td>
<td>Single</td>
<td>10 months</td>
<td>Not done</td>
</tr>
<tr>
<td>2</td>
<td>11 months</td>
<td>Raimondi</td>
<td>0</td>
<td>10 months</td>
<td>No</td>
<td>Single</td>
<td>4 months</td>
<td>15 mm Hg</td>
</tr>
<tr>
<td>3</td>
<td>11 months</td>
<td>Pudenz</td>
<td>1</td>
<td>3 weeks</td>
<td>Yes**</td>
<td>Multiloculated</td>
<td>3 weeks</td>
<td>Normal</td>
</tr>
<tr>
<td>4</td>
<td>6½ years</td>
<td>Pudenz</td>
<td>5</td>
<td>4 weeks</td>
<td>No</td>
<td>Single</td>
<td>2 weeks</td>
<td>Normal</td>
</tr>
<tr>
<td>5</td>
<td>14 years</td>
<td>Pudenz</td>
<td>4</td>
<td>4 years</td>
<td>No</td>
<td>Single</td>
<td>4 weeks</td>
<td>15 mm Hg</td>
</tr>
</tbody>
</table>

*Staphylococcus albus*
series, patients 1 and 2 had had the original ventriculoperitoneal shunt operation only, while the remaining three patients had one, four, and five laparotomies subsequent to this.

Over half of the previously reported cases have occurred within one month and the remainder within 5 years of the previous shunt operation. We believe that our patient 1, who encountered this complication 11½ years after the previous shunt revision shows the longest recorded interval for the development of this complication.

Some authors have reported that the peritoneal site is unsuitable after the occurrence of pseudocysts because of further reaccumulation.6-8 This has not been our experience, however, with patients remaining well up to 3 years after shunt revision.

Intra-abdominal sepsis has been regarded as a main aetiological factor in this complication.6-8 It is easy to imagine this as causative in those cysts which are obviously infected and in those which occur a short time after operation, as in patient 3. It is probable that patient 4 was also infected as he had received antibiotics for two weeks before surgery. Other pointers towards the infective nature of the cyst may be the presence of a multiloculated cyst (present in only one proved case of infection in our series) and the suspicion of infection if multiple fine echoes are seen within the cyst on ultrasound. S albus was isolated in our infected patient; previous reports have implicated S albus, S aureus, and Escherichia coli.6-8

Although adhesions might also be expected to be prominent, this was only so in patient 4. In patient 2, a noticeably thickened area of peritoneum was noted at the site of the cyst.

All patients were symptomatic at the time of diagnosis, as has been the case in all other reports. The duration of symptoms in our series ranged from 3 weeks to 10 months.

Intracranial pressure was normal in the two patients who had abdominal symptoms only (patients 3 and 4); they had undergone a shunt revision three and four weeks earlier. In the remaining three patients neurological symptoms predominated and the intervals since their last shunt revision (11½ years, 10 months, and 4 years) were also longer. In two patients, one (patient 2) measured at lumbar puncture and the other (patient 5) via a ventriculostomy reservoir, intracranial pressure was mildly raised (15 mm Hg). In a third child (patient 1), skull radiographs and computed tomograms provided evidence of raised intracranial pressure.

In conclusion, we suggest that the possibility of cerebrospinal fluid pseudocysts should be considered in all patients with a ventriculoperitoneal shunt who show signs or symptoms of shunt blockage and infection, with or without abdominal symptoms and that in addition to clinical abdominal examination, routine abdominal ultrasound may provide a simple, non-invasive, and rapid diagnosis.

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References


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