**ABSTRACT**

Ventriculoperitoneal shunt (VPS)-related abdominal pseudocyst (APC) is a rare cause of shunt malfunction. Variable VPS function due to APC has not been described before. A 21-year-old male with hydrocephalus and bilateral VPS presented with a right-sided shunt malfunction. After a routine abdominal ultrasound (US), that proved to be unremarkable, the patient had a clinical and radiological improvement followed by a relapse. An abdominal computed tomography scan subsequently showed an APC around the peritoneal catheter tip. Laparoscopic intervention on the APC cured the shunt malfunction. We believe that the APC emptied during the compression involved while performing the abdominal US. The pseudocyst collapse led to missing it on the abdominal US and explains the short-lived clinical and radiological improvement. We introduce the concept of APC-related variable VPS function, discuss the possible mechanisms by which the pseudocyst deflated, and make suggestions toward this diagnostic problem.

**Key Messages:** A collapsible abdominal pseudocyst could result in a variable ventriculoperitoneal shunt function. Starting the abdominal ultrasound examination over the location of the peritoneal catheter tip may overcome the collapse. Contrasted computed tomography is superior to ultrasound in diagnosing the pseudocyst.

**Keywords:** Pseudocyst, Collapse, Variable, Hydrocephalus.

**Abbreviations:**
- APC: Abdominal pseudocyst
- CSF: Cerebrospinal fluid
- CT: Computed tomography
- MRI: Magnetic resonance imaging
- US: Ultrasound
- VPS: Ventriculoperitoneal shunt
and make a recommendation for the investigation protocol in cases of a suspected pseudocyst.

CASE REPORT

A 21-year-old male developed tuberculous meningitis-related multiloculated hydrocephalus. Bilateral VPS were inserted with two consecutive right-sided proximal revisions within six months (Fig.1). The cerebrospinal fluid (CSF) obtained during surgeries did not grow any organism. A contrast-enhanced abdominal CT scan was performed immediately before the last revision and was within normal parameters (Fig.2).

The patient presented two months later with another episode of classic symptoms of VPS malfunction but no abdominal symptoms. An X-ray of the VPS course confirmed both shunts’ continuity and showed the tip of the right VPS in the right iliac fossa (Fig.3).

A brain MRI demonstrated evidence of right VPS malfunction (Fig.4A). An abdominal ultrasound was performed, given the recent proximal shunt revision, and yielded normal results. The patient, however, improved shortly after the ultrasound procedure. A follow-up brain MRI also demonstrated improved right-sided hydrocephalus (Fig.4B). The presenting symptoms, however, recurred within five days of in-hospital observation and a follow-up brain CT scan showed recurrence of the right-sided hydrocephalus (Fig.4C).

An abdominal contrast-enhanced CT scan was then performed and revealed a small APC in the right iliac fossa with the tip of the right peritoneal catheter barely inside it (Fig.5A-C). The pseudocyst was treated by laparoscopic resection of its walls and liberation of the involved convolutions of the ileum. The peritoneal catheter was repositioned in another abdominal quadrant. The content of the pseudocyst was the normal CSF. The cultures of CSF and pseudocyst tissue were negative, and the histopathological analysis showed inflammatory changes. Following surgery, the patient’s symptoms resolved and remained so at the last follow-up, six months later. A brain MRI obtained at six months visit showed no evidence of recurrent hydrocephalus (Fig.6).
DISCUSSION

The abdominal pseudocyst is a rare complication of VPS with an incidence of 1-4.5%. This case sheds light on some of the elusive aspects of the clinical entity of APC. A brief period of clinical and radiological improvement of VPS malfunction occurred after the abdominal ultrasound procedure. Shortly, clinical and radiological signs of VPS malfunction recurred, and a small VPS-related APC emerged on the abdominal CT scan.

The raised pressure within the APC interferes with optimal VPS function. The egress of CSF from the pseudocyst, to the low-pressure abdominal cavity, temporally normalizes the pressure and accordingly restores the shunt function. Our theory is that the APC emptied during the initial phase of the US examination owing to the pressure applied by the US probe. The pseudocyst...
Abdominal pseudocyst can form in a matter of weeks following VPS insertion and is a well-established cause of shunt malfunction. The possibility of pseudocyst collapse due to external pressure should be kept in mind, especially in its early formation phase. Starting the US examination over the area of the peritoneal catheter tip, as indicated by the plain radiographs, may minimize this risk. The fluctuation of the patient’s symptoms, especially the improvement following diagnostic maneuvers exerting abdominal pressure, should alert to the possibility of collapsible APC. A contrast-enhanced abdominal CT scan should be performed in cases where ultrasound fails to diagnose the APC despite high suspicion.

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MAA: Supervision, resources, writing, editing.
ZK: Conceptualization, writing, editing.
AA: Data curation, writing the original draft.