A rare, delayed complication of a ventriculogallbladder shunt

Case report and review of the literature

KOSTAS N. FOUNTAS, M.D., PH.D., MOZAFFAR A. KASSAM, M.D., AND ARTHUR A. GRIGORIAN, M.D., PH.D.

Department of Neurosurgery, Medical Center of Central Georgia, Mercer University, School of Medicine, Macon, Georgia

The use of the gallbladder as an alternative cerebrospinal fluid diversion site has been previously described in cases in which all other body cavities, such as the peritoneal cavity, right atrium, or pleural cavity, have been exhausted. Various ventriculogallbladder (VG) shunt complications have been described as well. In the present paper, the authors report on a rare, delayed VG shunt complication. A distal obstruction developed in a previously inserted VG shunt because of a large, radiolucent bile calculus. The presence of the VG shunt could be implicated in the pathogenetic mechanism of the bile calculus formation. The authors also review the pertinent literature.

KEY WORDS • cholelithiasis • complication • shunt obstruction • ventriculogallbladder shunt

Insertion of a ventriculoperitoneal shunt has remained the standard of treatment in the management of hydrocephalus. In cases in which the peritoneal cavity cannot serve as the insertion site of a ventricular shunt, other body cavities such as the right atrium, pleural cavity, stomach, ureters, fallopian tubes, gallbladder, or mastoid cells can be used to divert CSF. 2,5–7,10–12,15,17,21 In 1958, Smith and colleagues 19 suggested using the gallbladder as a receptor organ in a CSF shunt procedure and reported on a clinical series of 10 patients who had undergone VG shunt implantation for hydrocephalus. In that original study, they described early and late complications associated with this procedure. Since the initial description of this alternative surgical modality for hydrocephalus, there have been numerous reports regarding the occurrence of complications associated with VG shunts. 3,8,20,21

In the present report, we describe an unusual, late complication of a previously implanted VG shunt, and we review the pertinent literature.

CASE REPORT

History and Examination. This 51-year-old man was admitted to the emergency room with symptoms of severe nausea, emesis, and altered mental status. His symptoms started approximately 3 days before admission and had been progressively worsening. His medical history was remarkable for hydrocephalus with multiple shunt revisions, the most recent of which had been the insertion of a VG shunt 20 years previously at another hospital. Since that last insertion, the patient had been asymptomatic and had undergone no imaging or clinical follow up.

A physical examination on his arrival revealed extreme lethargy and response to noxious stimuli only (localized bilaterally). No focal neurological signs were elicited. His Glasgow Coma Scale score was 8 (2 + 4 + 2).

A head computed tomography scan and shunt radiographic series were emergently obtained and demonstrated significant dilation of the ventricular system and an intact VG shunt in an optimal position (Fig. 1). An external ventriculostomy was emergently performed, and the patient was admitted into the neurointensive care unit for observation and further treatment. The patient returned to his baseline neurological abilities a few hours after the insertion of the ventriculostomy (Glasgow Coma Scale Score 15), and he remained afebrile and asymptomatic for 72 hours. His CSF cultures grew no pathogens, and he was taken to the operating room for a shunt revision.

Operation. Under general endotracheal anesthesia, the previously inserted shunt was exposed at the cranial site to rule out a proximal obstruction. The proximal CSF flow was very vigorous; however, we noted the flow of a greenish mucinous material from the proximal end of the peripheral tube connected to the Rickham reservoir. Several

Abbreviations used in this paper: CSF = cerebrospinal fluid; VG = ventriculogallbladder.
unsuccessful attempts were made to unblock the obstructed distal end of the shunt, and thus open surgical exploration was chosen.

A standard right subcostal skin incision was made, and an enlarged gallbladder with dense pericholecystic adhesions was identified. A large bile calculus was palpated, and a standard cholecystectomy was performed (Fig. 2). All surgical wounds were closed and the patient was returned to the neurointensive care unit while the external ventricular CSF drain was maintained. After 72 hours, during which he had remained afebrile and his CSF cultures were negative, he was taken back to the operating room, where a right-sided ventriculopleural shunt was inserted with no difficulties.

**Postoperative Course.** The patient’s postoperative course remained uneventful, and he was finally discharged 3 days after the last procedure. He has remained asymptomatic since then (9 months), and he has been monitored on an outpatient basis.

**DISCUSSION**

It is widely accepted that ventriculo-peritoneal shunts represent the most common extracranial CSF diversion choice, given that the peritoneal cavity is the most efficient and reliable location for CSF absorption.\(^8,18\) Note, however, that a history of multiple revisions, a nonabsorbing peritoneum and/or pleural cavity,\(^9,21\) the presence of an abdominal pseudocyst,\(^11\) the development of lymphocele and chylous ascites due to superior vena cava thrombosis,\(^8\) the well-known association between ascites and shunting for optic chiasmal hypothalamic astrocytomas,\(^14\) and the usage of various abdominal sites for prolonged enteral alimentation in underweight hydrocephalic infants represent the major indications for the insertion of a VG shunt. Indeed, the gallbladder carries all the characteristics of an optimal CSF receptor organ: it is relatively sterile, provides the opportunity for resorption of CSF electrolytes and water, and has a remarkable concentrating capacity.\(^14,19\) In addition, the lytic action of the bile can potentially break down proteins in the CSF that impair absorption\(^14\) and can also prevent the formation of reactive fibrous tissue, which could plug and obstruct the distal end of the shunt.\(^19\) Furthermore, the hydrostatic pressure of the gallbladder maintains intracranial pressure at a suitable level, even 75 minutes postprandially, when cholecystic pressure reaches a maximum due to the active contraction of the gallbladder.\(^4,19\)

Despite these optimal characteristics, VG shunts have been associated with significant complications.\(^3,8,20,21\) In a relatively large clinical series of 25 children treated with a VG shunt for hydrocephalus, West and colleagues\(^21\) reported an overall infection rate of 24%. The most common complication in that study was shunt infection (six of 25 patients), whereas gallbladder atony occurred in two of 25 patients. Similarly, Ketoff and associates\(^8\) reported a 43.7% overall complication rate in a series of 16 patients with VG shunts; the infection rate was 31.3%. Likewise, in a series of eight patients, Stringel et al.\(^20\) reported a 37.5% complication rate. Bernstein and Hsueh\(^3\) described a fatal case involving VG shunt insertion for acute chemical ventriculitis from bile reflux. A case of bile reflux in a lumbar–gallbladder shunt has been reported by Barami et al.,\(^1\) although the outcome in that case was very good after revising the shunt. In contrast, Novelli and Reigel\(^13\) reported no complications in a series of six patients treated with VG shunt insertion. Mechanical obstruction of a VG shunt due to the development of a bile calculus has not been previously reported.

The pathogenetic mechanism of the cholelithiasis in the present case and the role of the gallbladder shunt in its formation are unclear. Authors of previous studies have demonstrated that biliary atony and a decreased biliary ejection fraction can lead to biliary stasis, which is a well-known predisposing factor for cholelithiasis.\(^23\) It has been previously demonstrated that gallbladder shunts can cause
gallbladder atony, which could consequently predispose to stasis and cholelithiasis. However, the formation of the bile calculus in the featured case could be an incidental event not related to the previously implanted shunt.

**CONCLUSIONS**

Early identification and prompt management of a delayed VG shunt–associated complication is imperative for the safe treatment of patients with VG shunt malfunctions. An awareness of such potential complications makes for an alert treating physician, whose exposure to such a shunt system might be very limited, and will allow him or her to maintain high suspicion for the development of delayed VG shunt–related complications.

**References**

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