

# Asymptomatic Bowel Perforation by Abandoned Ventriculoperitoneal Shunt

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## ABSTRACT

We report a case of an abandoned abdominal ventriculoperitoneal shunt that migrated into the gastric antrum, colonic hepatic flexure, and liver parenchyma, which was discovered incidentally on an abdominal CT obtained for renal stones. In regards to the migrated abandoned VP shunt, the patient was asymptomatic. Upon review of prior CT scans, these findings had progressed over approximately 7 years. We describe the case and discuss the clinical and radiologic findings, complications resulting from ventriculoperitoneal shunts, and possible approaches to their management.

## CASE REPORT

### CASE REPORT

A 28-year-old non-verbal man with a history of cerebral palsy, seizures, and complicated hydrocephalous requiring ventriculoperitoneal (VP) shunt placement status-post multiple revisions, received an outpatient abdominal and pelvic CT scan for urolithiasis following the discovery of stones in the patient's urine. The CT scan (Figure 1) demonstrated multiple bilateral obstructing renal stones. Incidentally, the CT also showed an abandoned abdominal VP shunt perforating the gastric antrum (Figure 2), the hepatic flexure of the colon (Figure 3) and the liver parenchyma (Figure 4). At the time of presentation the patient had no local or systemic symptoms related to the shunt.

Due to the patient's complicated past medical history, he had received serial CT imaging over a period of years, which upon review demonstrated progressive migration of the abandoned VP shunt into its current position. Chronologically, the catheter tip was first noted within the hepatic flexure of the colon approximately 5 years prior to presentation. Subsequently, a loop of the abandoned VP shunt is first found within the liver parenchyma approximately 3 years prior to presentation. Finally, a loop of the shunt is first noted within the gastric antrum at the time of presentation.

There does not appear to be a direct path taken by the abandoned VP shunt leading to its current position, but rather

a series of movements from various segments created the different perforations individually over a period of years. This can best be demonstrated by examining each perforation site individually on chronological CT exams. Beginning approximately 7 years prior to presentation, the catheter tip is located adjacent to the wall of the hepatic flexure of the colon, but outside its lumen (Figure 5a). On subsequent imaging obtained approximately 5 and 4 years prior to presentation (figure 5b-c), the tip migrates progressively further into the lumen of the colon. On the CT scan obtained approximately 5 years prior to presentation, the abandoned VP shunt is noted adjacent to, but outside, the liver. Subsequent imaging at approximately 3 years prior to presentation, a few months prior to presentation and at the time of presentation show that a single loop of the abandoned shunt has progressively migrated into the liver parenchyma (figure 6a-d). At approximately 4 years prior to presentation there is a loop of the abandoned VP shunt located adjacent to the gastric antrum, but not within the lumen. The CT scan obtained at the time of presentation is the first to show the shunt within the gastric lumen (Figure 7a and b).

While being treated for renal stones and hospital acquired pneumonia, neurosurgery and general surgery were consulted regarding the abandoned VP shunt migration and perforation. It was decided that based upon the patient's clinical condition and lack of symptoms related to the migrated abandoned VP shunt, that the patient could be managed conservatively and

followed clinically with serial imaging. The patient was later discharged in baseline condition without further management of the abandoned VP shunt.

Approximately 1 month following discharge, a CT scan for follow-up for nephrolithiasis showed that the free end of the shunt had once again changed position migrating from the hepatic flexure into the ascending colon (Figure 8).

## DISCUSSION

The ventriculoperitoneal (VP) shunt has been the preferred therapy for chronic hydrocephalus for more than 50 years [1]. A shunt is inserted into the enlarged non-draining ventricle, often with a valve to regulate the rate of drainage. This is then connected to a second shunt, which extends over the thorax subcutaneously before it is tunneled into the peritoneum. This procedure has shown decreased complications when compared to alternatives such as the ventriculoatrial shunt [1]. At times it may be necessary to perform a shunt revision in order to repair a non-draining shunt. In such instance it is common practice to leave the distal end of the malfunctioning VP shunt within the abdomen in order to simplify the procedure. These distal malfunctioning shunt segments are frequently referred to as abandoned, orphaned, redundant, or disconnected shunt catheters.

Common complications of non-abandoned (intact) VP shunts are well documented, and include shunt malfunction, infection, disconnection, migration and perforation [2]. While there have been multiple reports of non-abandoned ventriculoperitoneal shunt complications, reports of abandoned VP shunt complications are rare and the morbidity and mortality of such complications are unknown [8]. In one case reported by Thipphavong et al. the abandoned VP catheter passed spontaneously per anus following routine bowel preparation for colonoscopy and required no additional intervention beyond enteric antibiotic coverage. Another two cases similarly describe the passage per anus of an abandoned VP catheter in asymptomatic patients [17, 18].

In patients with intact (e.g. non-abandoned) VP shunts, bowel perforation is a rare but better documented complication, occurring in 0.1-0.7% of patients [3]. More than half of these bowel perforations occur in children under 10 years of age and have also been suggested to be more common in non-ambulatory patients such as in this case [4]. Sigmoid and transverse colon are the most frequent sites of perforation, followed by the stomach [2]. Many mechanisms for intact (e.g. non-abandoned) VP shunt migration have been suggested, including inadequate catheter length, failure to fix the shunt firmly to adjacent tissue, foreign body reaction, silicone allergy, formation of fibrous sheath and local pressure, use of spring-loaded shunts, use of both hard and soft tipped silicone shunts, inoculation of the shunt with bacteria during insertion, and use of trocar technique [2, 3, 5, 6, 7]. It is possible that abandoned VP shunts migrate via a similar mechanisms.

Although bowel perforation by an intact (non-abandoned) VP shunt is rare, mortality when this occurs is reported at approximately 15% [16]. Patient presentation is variable and nonspecific including abdominal pain with an elevated white blood count [8], diarrhea, and gastroenteritis [9]. More obvious signs such as meningitis with gram negative and anaerobic organisms [3, 10, 11] are also common due to enteric organisms ascending an intact shunt into the central nervous system. However in patients with abandoned shunts, meningitis is not a potential complication as the shunt is not in continuity with the cerebrospinal fluid. However, because a migrated abandoned catheter may still communicate between the bowel lumen and the peritoneum, there is a theoretical risk of peritonitis. In the clinically stable patient without contraindications, removal of the catheter by either colonoscopy or other surgical method has been pursued [2, 3, 4]. However, in the setting of multiple comorbidities and in the absence of signs or symptoms related to bowel perforation, an abandoned VP shunt may be managed conservatively as demonstrated in our case.

This is the first documented case of chronic asymptomatic multi-organ perforation by an abandoned VP shunt with radiographic evidence of chronologic progression. This suggests that the perforation can be a chronic process occurring over a period of years. While there is no risk of meningitis in patients with abandoned VP shunts, there is a theoretical risk of peritonitis, which must be weighed when deciding how best to treat such a patient. Radiologists must remain vigilant when reviewing studies of patients with VP shunts, as migration and perforation may be easily missed, especially when the patient's symptoms or imaging indication is not obviously related to shunt complications.

## TEACHING POINT

Abandoned ventriculoperitoneal shunt complications such as migration and perforation may be easily missed, especially when the imaging indication or patient's symptoms are not attributed to shunt complications. Clinical follow-up and serial imaging may be management options in asymptomatic patients with multiple comorbidities.

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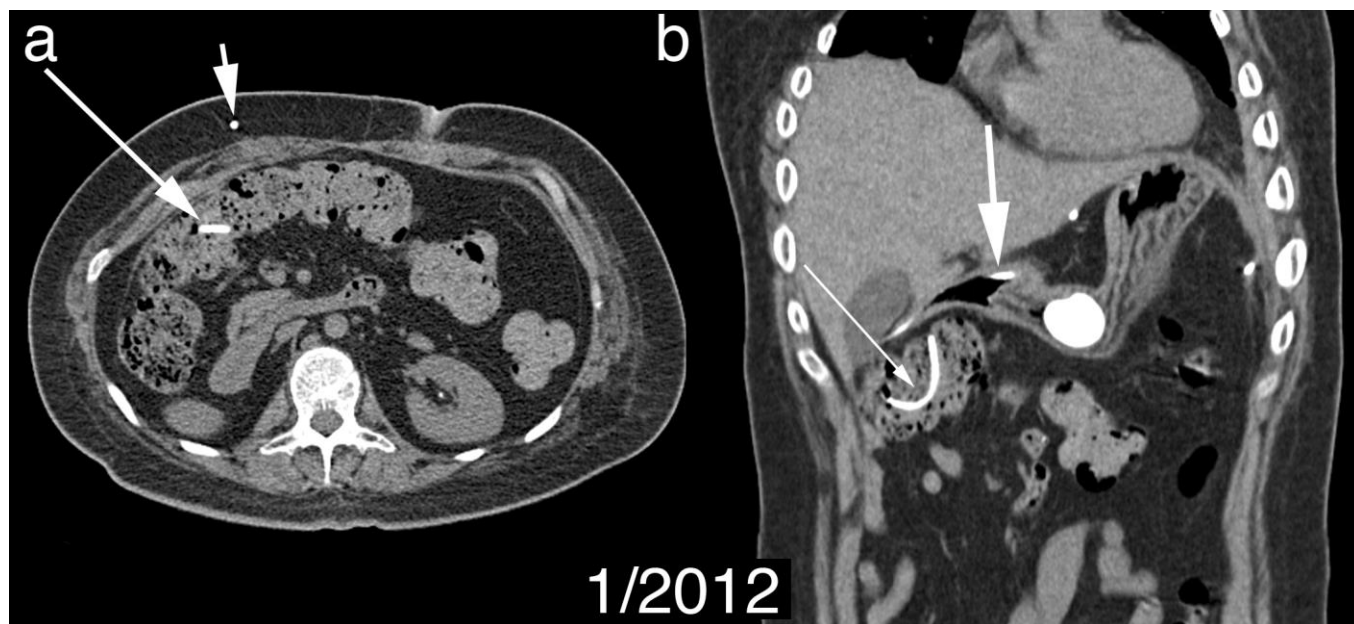
## FIGURES



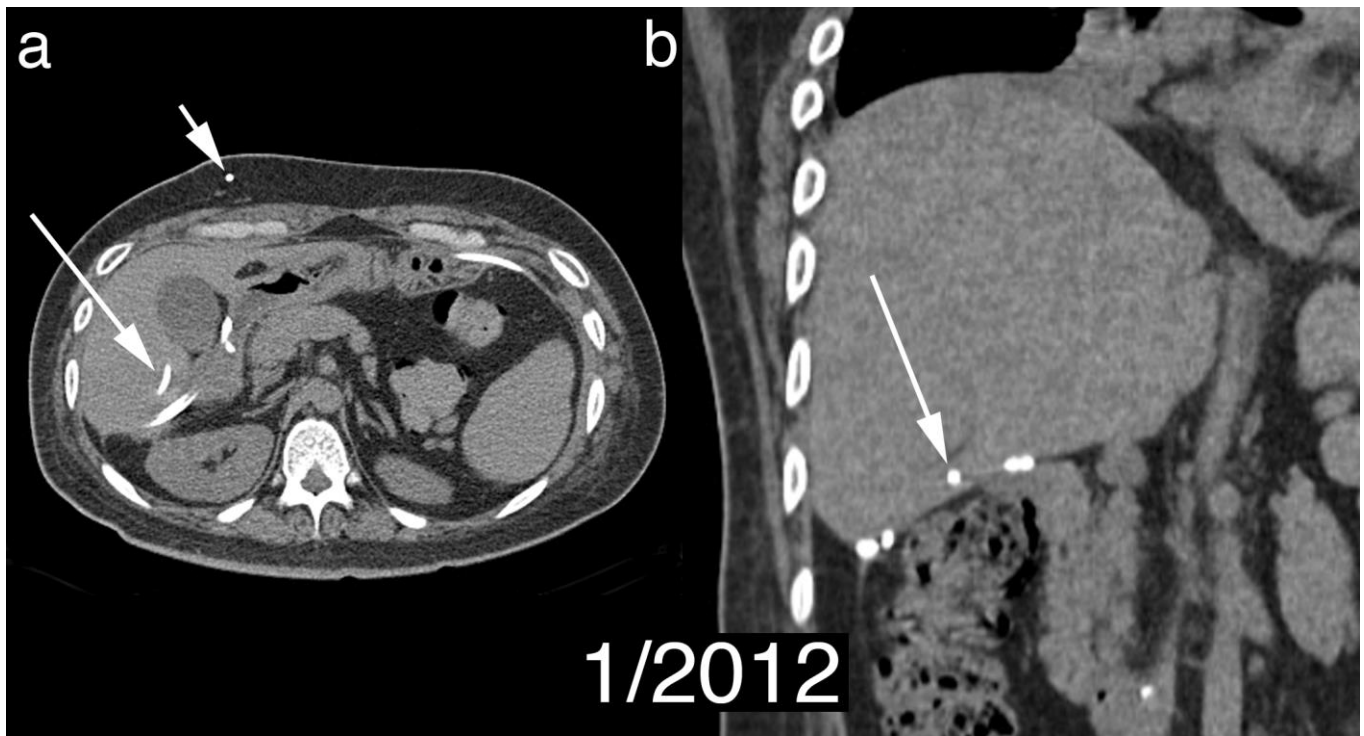
**Figure 1.** Diagnosis: Abandoned VP shunt migration. 28-year-old male with a history of cerebral palsy, hydrocephalus, and 2 prior VP shunt placements presents with urolithiasis. Frontal scout radiograph (Siemens 64 slice, protocol: 35 mAs, 120 kVp) obtained at patient presentation demonstrates an abandoned VP shunt extending horizontally from right to left in the upper abdomen (long arrows). An additional non-abandoned VP shunt is partially visualized projecting vertically across the right upper and lower abdomen (short arrows). An additional abandoned VP shunt is partially visualized projecting vertically over the right upper abdomen (arrowhead). A percutaneous gastrostomy tube projects over the midabdomen.



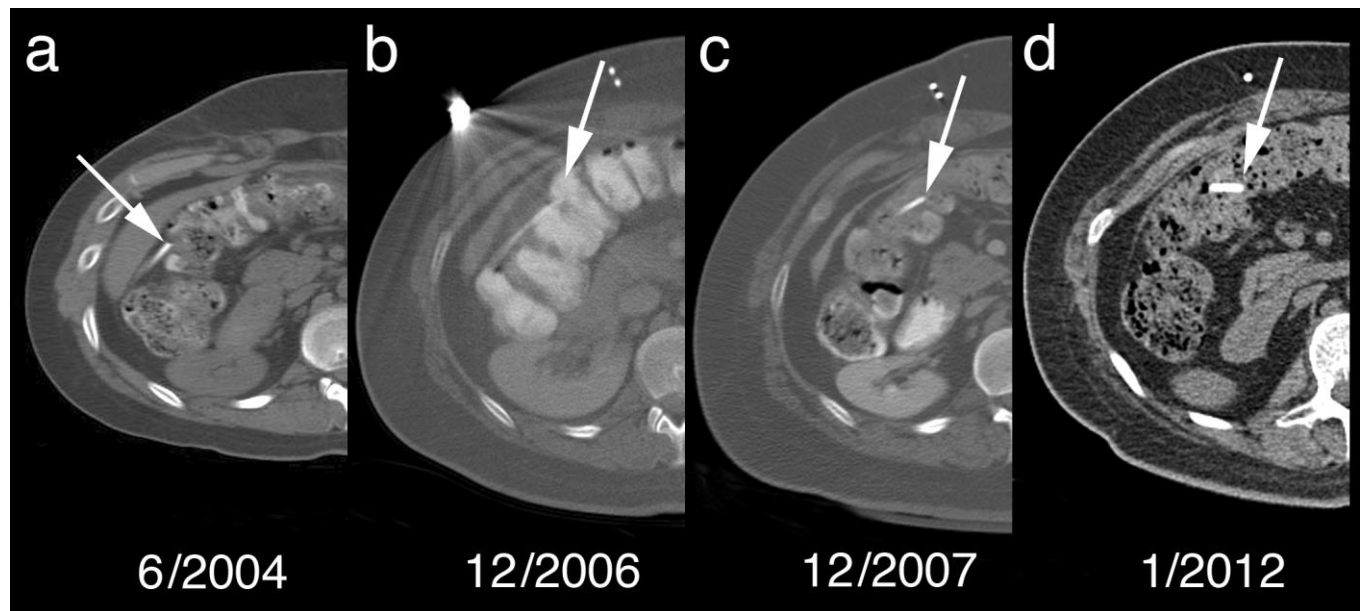
**Figure 2.** Diagnosis: Abandoned VP shunt migration. 28-year-old male with a history of cerebral palsy, hydrocephalus, and 2 prior VP shunt placements presents with urolithiasis. Non-contrast CT (Siemens 64 slice, protocol: 200 mAs, 120 kVp) a) axial (5 mm) and b) sagittal reformatted (2 mm) images of the abdomen obtained at patient presentation shows the abandoned VP shunt perforating the gastric antrum (long arrows). A portion of the non-abandoned VP shunt is seen on the axial image in the anterior subcutaneous tissues of the right upper abdomen (short arrow).



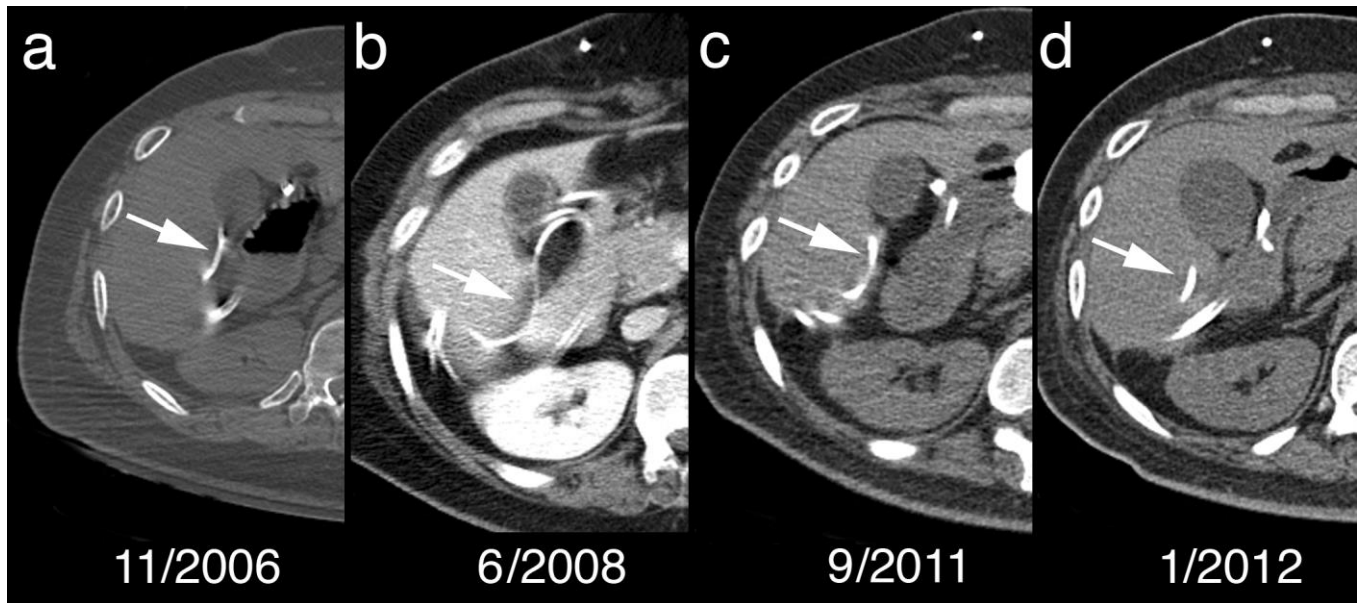
**Figure 3.** Diagnosis: Abandoned VP shunt migration. 28-year-old male with a history of cerebral palsy, hydrocephalus, and 2 prior VP shunt placements presents with urolithiasis. Non-contrast CT (Siemens 64 slice, protocol: 200 mAs, 120 kVp) a) axial (5 mm) and b) coronal reformatted (2 mm) images of the abdomen obtained at patient presentation show the abandoned VP shunt perforating and terminating in the hepatic flexure of the colon (long arrow). The abandoned VP shunt is again seen perforating the gastric antrum (thick arrow) on the coronal image. The non-abandoned VP shunt is seen on the axial image in the anterior subcutaneous tissues of the right upper abdomen (short arrow).



**Figure 4.** Diagnosis: Abandoned VP shunt migration. 28-year-old male with a history of cerebral palsy, hydrocephalus, and 2 prior VP shunt placements presents with urolithiasis. Non-contrast CT (Siemens 64 slice, protocol: 200 mAs, 120 kVp) a) axial (5 mm) and b) coronal reformatted (2 mm) images of the abdomen obtained at patient presentation show the abandoned VP shunt perforating the right posterior hepatic lobe (long arrow). The non-abandoned VP shunt is seen on the axial image in the anterior subcutaneous tissues of the right upper abdomen (short arrow).



**Figure 5.** Diagnosis: Abandoned VP shunt migration. 28-year-old male with a history of cerebral palsy, hydrocephalus, and 2 prior VP shunt placements. a) Axial non-contrast CT of the abdomen obtained 7 years prior to presentation (GE Lightspeed 16 slice, protocol: 399 mAs, 120 kVp, 5 mm) shows the abandoned VP shunt tip adjacent to the wall of the hepatic flexure of the colon. b) On the axial contrast-enhanced CT of the abdomen obtained 5 years prior show (Siemens 64 slice, protocol: 321 mAs, 120 kVp, 4 mm, 125 mL of Optiray 350) the tip of the VP shunt just inside the wall of the colon. c) On the axial contrast-enhanced CT of the abdomen obtained 4 years prior show (GE 64 slice, protocol: 195 mAs, 120 kVp, 5 mm, 125 mL of Optiray 350) the tip of the VP shunt is seen further inside the lumen of the colon. d) On the non-contrast CT (Siemens 64 slice, protocol: 200 mAs, 120 kVp, 5 mm) obtained at presentation show the VP shunt is seen centered within the lumen of the colon.



**Figure 6.** Diagnosis: Abandoned VP shunt migration. 28-year-old male with a history of cerebral palsy, hydrocephalus, and 2 prior VP shunt placements. a) Axial non-contrast CT of the abdomen obtained 5 years prior to presentation (GE 64 slice, protocol: 499 mAs, 120 kVp, 1.25 mm) shows a segment of the abandoned VP shunt adjacent to, but outside the liver parenchyma (arrow). On the axial CT images from b) 3 years prior (Phillips brilliance 64 slice, protocol: 125 mAs, 120 kVp, 5 mm, 125 mL of Optiray 350), c) 4 years prior (Phillips brilliance 64 slice, protocol: 263 mAs, 120 kVp, 2.5 mm), and d) at presentation (Siemens 64 slice, protocol: 200 mAs, 120 kVp, 5 mm) the same segment of the abandoned VP shunt is shown progressively migrating further into the parenchyma of the right posterior hepatic lobe (arrows). While a few of the other visualized segments of the abandoned VP shunt seen on these images appear within the liver, this appearance was due to volume averaging artifact and were determined to be located outside the liver on serial axial and reformatted images.



**Figure 7.** Diagnosis: Abandoned VP shunt migration. 28-year-old male with a history of cerebral palsy, hydrocephalus, and 2 prior VP shunt placements. a) The axial contrast-enhanced CT of the abdomen from 4 years prior (GE 64 slice, protocol: 499 mAs, 120 kVp, 3.75 mm, 125 mL of Optiray 350) shows the abandoned VP shunt (long arrow) located adjacent but outside the gastric antrum. b) The axial non-contrast CT of the abdomen obtained at presentation (Siemens 64 slice, protocol: 200 mAs, 120 kVp, 5 mm) shows the abandoned VP shunt located within the gastric antrum. The non-abandoned VP shunt is seen on the axial images in the anterior subcutaneous tissues of the right upper abdomen (short arrow). Note that the abandoned VP shunt is not intrahepatic in these images; this was determined to be due to volume averaging artifact.



**Figure 8 (left).** Diagnosis: Abandoned VP shunt migration. 28-year-old male with a history of cerebral palsy, hydrocephalus, and 2 prior VP shunt placements. Axial image from a non-contrast CT abdomen (GE Lightspeed 16 slice, protocol: 125 mAs, 120 kVp, 3.75 mm) obtained 1 month after shows that the distal end of the abandoned VP shunt within the colon has moved from the hepatic flexure into the ascending colon.

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<b>Etiology</b>	While the true mechanism of viscera perforation by VP shunt has yet to be elucidated, it likely involves a chronic process of erosion over time. <i>The mechanism is likely the same whether the VP shunt is abandoned or intact.</i>
<b>Incidence</b>	While the incidence in abandoned VP shunts is unknown, <i>in intact (non-abandoned) VP shunts</i> it is stated to range from 0.1-0.7% of patients
<b>Gender Ratio</b>	It is unknown if there is a gender predilection
<b>Age Predilection</b>	There appears to be a predilection for pediatric patients in the case of non-abandoned VP shunts, with half of all cases occurring in patients under the age of 10. [4]
<b>Risk Factors</b>	Risk factors are likely similar for abandoned as well as <i>intact (non-abandoned) VP shunts</i> and include nonambulatory patients, inadequate catheter length, failure to fix the shunt firmly to adjacent tissue, foreign body reaction, silicon allergy, formation of fibrous sheath and local pressure, use of spring-loaded shunts, hard and soft tipped silicone shunts, inoculation of the shunt with bacteria during insertion, and use of trocar technique [2, 3, 5, 6, 7]
<b>Treatment</b>	Laparotomy, laparoscopy, peranal extraction, and watchful waiting
<b>Prognosis</b>	Mortality is unknown for migrated abandoned VP shunts, but is approximately 15% for intact (non-abandoned) VP shunts that perforate bowel. [16]
<b>Findings on Imaging</b>	On radiography, the shunt catheter projects over the lateral abdomen and/or thorax, but discontinuous with portions of the catheter projecting over the skull (or no portion of the catheter projects over skull). On CT, the shunt catheter presents usually along the lateral abdomen and/or thorax, but discontinuous with the CNS system.

**Table 1:** Summary table for abandoned VP shunt migration

Differential	Computed Tomography	X-ray
Abandoned VP shunt	Shunt catheter present usually along the lateral abdomen and/or thorax, but discontinuous with the CNS system.	Shunt catheter projects over the lateral abdomen and/or thorax, but discontinuous with portions of the catheter projecting over the skull (or no portion of the catheter projects over skull).
<i>Intact (e.g. Non-abandoned) VP shunt</i>	Shunt catheter within the lateral abdomen and/or thorax is continuous with the CNS system.	Shunt catheter projects over the lateral abdomen and/or thorax and is continuous with portions of the catheter projecting over the skull.
Nasogastric tube	Tube within neck and thorax follows alimentary tract, along esophagus into the stomach.	Tube projects midline over expected location of the esophagus, extending from the nares and terminating over the left upper abdomen in the expected location of the stomach.
Gastrostomy tube	Tube present in left upper abdomen and extends through the skin into the gastric lumen, often with an insufflated balloon within the gastric lumen to secure it in place.	Tube projects in central to left upper abdomen in the expected location of the stomach, often with a radiopaque insufflated balloon projecting in the same location.

**Table 2:** Differential table for CT and x-ray findings of abandoned ventriculoperitoneal shunt migration

**ABBREVIATIONS**

CT - Computed Tomography  
 VP - Ventriculoperitoneal

**KEYWORDS**

Ventriculoperitoneal shunt; abandoned; orphaned; disconnected; migrate; migration; perforation; bowel; colon; intestine; liver; stomach; asymptomatic

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