# Incisional Hernia Following Ventriculoperitoneal Shunt Positioning

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ABSTRACT

Incisional hernia represents a rare complication after ventriculoperitoneal shunt positioning due to failure of the fascial suture in the site of abdominal entrance of ventriculoperitoneal catheter. Clinical presentation can be extremely variable, according to patient's performance status, herniated material constitution (i.e. mesenteric fat, bowel loops or both) and complication occurrence (e.g. strangulation or intestinal obstruction). Early diagnosis is fundamental in order to surgically repair the defect and prevent further complications. We present the case of a paucisymptomatic incisional hernia following ventriculoperitoneal shunt positioning. Diagnosis was made by means of ultrasound and confirmed by means of computed tomography. The patient was successfully managed by means of surgical repositioning of herniated loop and re-suture.



## CASE REPORT

### CASE REPORT

A ventriculoperitoneal (VP) shunt was positioned in an 81 years old man because of normal pressure hydrocephalus. Four days after neurosurgery, after getting out of the bed, the man suffered from a stabbing pain in the mesogastrium. Clinical examination showed an 8 cm large soft swelling in the mesogastrium, in the site of the surgical suture. No alterations of skin color or temperature were appreciable. The patient had no other relevant signs or symptoms. No blood test alterations were present; in particular, CBC, CRP and electrolytes were normal. Because of patient's good clinical status, a watch and wait approach was applied. Four hours later, because of pain worsening and abdominal swelling persistence, an abdominal sonographic examination was requested.

B-mode sonographic scan of the abdomen, performed by means of a 5 MHz convex probe, excluded catheter dislocation by demonstrating catheter's tip in the left para-colic space. Some free fluid was appreciable between the small bowel loops, due to CSF output. Anyway, up to 3.5 cm dilated fluid-filled small bowel loops with abnormal peristaltic motion were appreciable in the upper-left abdominal quadrant (Figure 1). B-mode sonographic scan of the abdominal wall, performed by means of a 5 MHz convex probe and completed by means of a 14 MHz linear probe, demonstrated the regular course of the VP catheter within the abdominal subcutaneous fat tissue. Ventriculoperitoneal catheter appeared as a tubular hyperechoic 4-lined structure with an anechoic center (Figure 2). The swelling was due to a 60 x 26 x 35 mm large anechoic subcutaneous fluid collection delimited by up to 5 mm thick hyperechoic walls (Figures 3a-d). Some hyperechoic debris, without acoustic shadowing, was present inside the collection and a small amount of anechoic fluid was appreciable around it. Color-Doppler evaluation showed no flow signals within the collection's walls (Figure 3c). The catheter ran between the

fluid collection and the subcutaneous fat tissue, surrounded by a minimal amount of fluid (Figure 3d), before entering the abdominal cavity. The sonographic findings raised the suspicion of an intestinal occlusion secondary to small bowel loop incisional hernia.

Therefore, plain radiographs of the abdomen were performed in orthostasis by means of antero-posterior and lateral projections (Figures 4a-b). The radiographs showed multiple dilated small bowel loops, containing air-fluid levels, in the upper abdominal quadrants, confirming intestinal occlusion. The VP catheter tip was correctly allocated in the left flank. However, the catheter showed an abnormal loop before entering the abdominal cavity; in that site a round opacity was also appreciable.

Finally, a plain CT of the abdomen was performed in order to better define the anatomical relations between the catheter and the herniated loop. CT confirmed the diagnosis of bowel obstruction by showing multiple dilated small bowel loops containing air-fluid levels (Figures 5a-b). Loops' dilatation abruptly ceased proximally to a small bowel loop herniated in the subcutaneous tissue in the site of the previous surgical access (Figures 5a-b). The VP catheter was pushed forward by the loop, and run between the loop and the abdominal wall (Figures 5b-c).

The patient was immediately brought to surgery. At surgery, after cutaneous sutures removal the herniated loop was recognizable within the subcutaneous fat, showing hypoperfusion but no signs of infarction. Therefore, the loop was simply pushed back into the abdominal cavity, followed by the VP catheter, and the surgical access was accurately re-sutured.

The patient showed no further complains and was discharged four days later.

## DISCUSSION

*Etiology & Demographics:*

Nowadays, ventriculoperitoneal (VP) shunt positioning is a routine intervention for hydrocephalus' symptomatic treatment. Despite the overall high experience, complications after VP shunt positioning represent a common event, with a prevalence of 35-53% (1, 2). VP shunt complications can be divided into two main categories: intracranial and intra-abdominal. Intra-abdominal complications are represented by seroma/hematoma, catheter infection, catheter malfunction due to blockage or disconnection, subcutaneous cerebrospinal fluid (CSF) collection due to catheter displacement or rupture, peritoneal pseudocyst and incisional hernia (3-6). The relative prevalence of these complications is extremely variable according to different series, but peritoneal pseudocyst and incisional hernia can be considered anecdotic.

*Clinical & Imaging findings:*

Clinical presentation of VP shunt complications is extremely variable, also because of the particular patient population, largely composed by children and elderly. For example, clinical presentation of incisional hernia may range from a completely asymptomatic swelling in the site of VP catheter abdominal entrance to bowel obstruction and ischemia. Radiological examinations are almost always required in case of VP shunt malfunction or complications in order to make a precise diagnosis and for treatment planning. Plain radiographs of skull, chest and abdomen represent the most frequently required imaging examinations. On these radiographs, the whole course of the catheter can be evaluated in order to identify ruptures, disconnections, kinking, knots and migrations (7, 8). Computed Tomography (CT) is the second most frequently required imaging examination. CT is useful for intracranial shunt extremity evaluation and for shunt-related abdominal complications diagnosis (6, 9-11). On the other hand, Magnetic Resonance (MR) imaging should be reserved to cases in which central nervous system infection is suspected. MRI is particularly indicated in children because of the lack or ionizing radiation (12). Finally, no indications are reported in the literature about the use of sonography (US) for the diagnosis of VP shunt complications. In our opinion, thanks to its reliability, wide availability and low cost, US represents the imaging modality of choice for evaluating the site of VP shunt abdominal entrance.

*Treatment & Prognosis:*

The correct identification and treatment of abdominal complications of VP shunt may represent a diagnostic challenge, both for the radiologist and for the clinicians, given the wide number of possible etiologies and the rarity of some of them. Surgery represents the treatment of choice in case of incisional hernia. The surgical procedure typically encompasses herniated material reduction and re-suture, but it may be more complex, including segmental intestinal resection, in case of bowel loop infarction secondary to strangulated hernia. Consequently, the prognosis is excellent in case of an uncomplicated hernia, but it worsens in case of intestinal ischemia.

*Differential Diagnosis:*

A swelling in the site of abdominal access of VP catheter may lead to some differential diagnoses:

- In the post-operative period, the most probable etiology is represented by blood or serous subcutaneous collections, which may be considered para-physiologic. Sonography is able to clearly identify a seroma / hematoma as an ill-defined, non-capsulated, hypo- or heterogeneously hyper-echoic subcutaneous collection. No flow signal should be observed at color-Doppler examination. No further imaging examinations are needed for this diagnosis.
- Although less probable, a subcutaneous cerebrospinal fluid collection caused by VP catheter peritoneal tip dislocation should be considered as a potential differential diagnosis. Even in this case sonography is able to recognize the pathology by showing the dislocated catheter tip within subcutaneous fat, surrounded by an anechoic non-capsulated fluid collection. Plain radiographs of the abdomen, with antero-posterior and lateral projections, can confirm the subcutaneous dislocation of the VP shunt tip and exclude catheter ruptures.
- VP catheter rupture in the site of its abdominal entrance with subsequent cerebrospinal fluid extravasation

should be considered very unlikely, if no complications or particular difficulties occurred during the surgical procedure. Also in this case, sonography shows an anechoic non-capsulated subcutaneous fluid collection just beneath the catheter, but it is not able to identify catheter rupture. Even plain radiographs of the abdomen might fail to directly demonstrate the break, but they can be extremely useful to definitely exclude VP shunt tip dislocation.

- Incisional hernia is also very unlikely because of the small incision that is performed for VP shunt positioning. Sonography is a very reliable imaging modality for diagnosing it because of its ability to clearly depict the herniated material (i.e. intra-abdominal fat, bowel loops or a combination of these). Some free fluid may surround the herniated material. Peristaltic motions and flow signals within bowel walls at Color-Doppler examination may or may not be present, depending on the eventual presence of complications (i.e., like in our case, strangulation). Plain radiographs of the abdomen may be performed to confirm the correct VP catheter positioning, whereas CT is not indispensable for this diagnosis. However, CT may be requested by the surgeon in order to definitely confirm the sonographic diagnosis and highlight eventual further complications. Contrast material administration may be useful to evaluate bowel loop vitality. In any case, diagnostic workup should be as fast as possible in order to reduce the time to surgery.

## TEACHING POINT

Incisional hernia represents a rare complication of ventriculoperitoneal shunt positioning that can be diagnosed by means of Sonography.

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## FIGURES

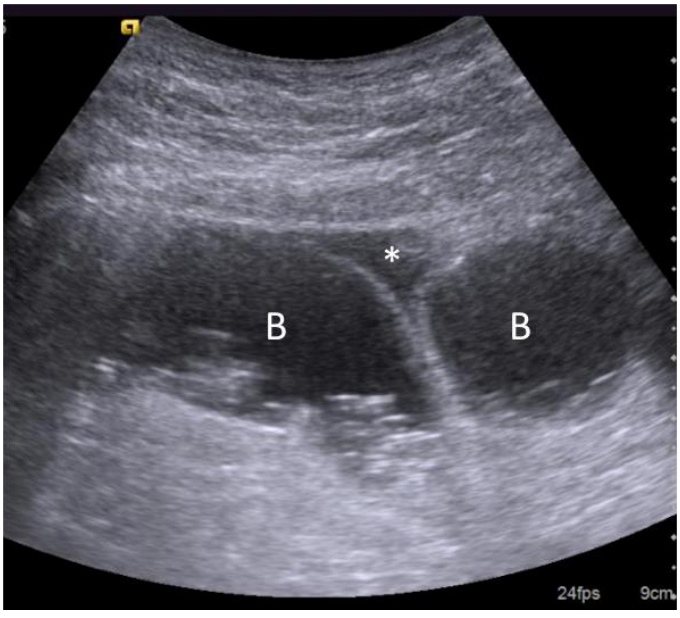


**Figure 1:** 81-year-old man with incisional hernia following ventriculoperitoneal shunt positioning. Technique: B-mode sonographic scan (5 MHz convex probe) of the upper left abdominal quadrant. - Findings: this image shows two dilated

(maximum axial diameter 3.5 cm) fluid-filled small bowel loops (B), containing declivous-lying hyperechoic debris representing feces, surrounded by some amount of free fluid (star). Abnormal peristaltic motion and pendulum-like movement of loops content was appreciable during the examination. These findings are typical for mechanical intestinal occlusion.


**Figure 2 (right):** 81-year-old man with incisional hernia following ventriculoperitoneal shunt positioning. Technique: B-mode sonographic scan (14 MHz linear probe) of the subcutaneous tissue of the anterior abdominal wall. - Findings: this image shows the normal appearance of a ventriculoperitoneal catheter caught along its longest axis with 4 echogenic parallel lines (arrows). The catheter is surrounded by hyperechoic subcutaneous abdominal fat.

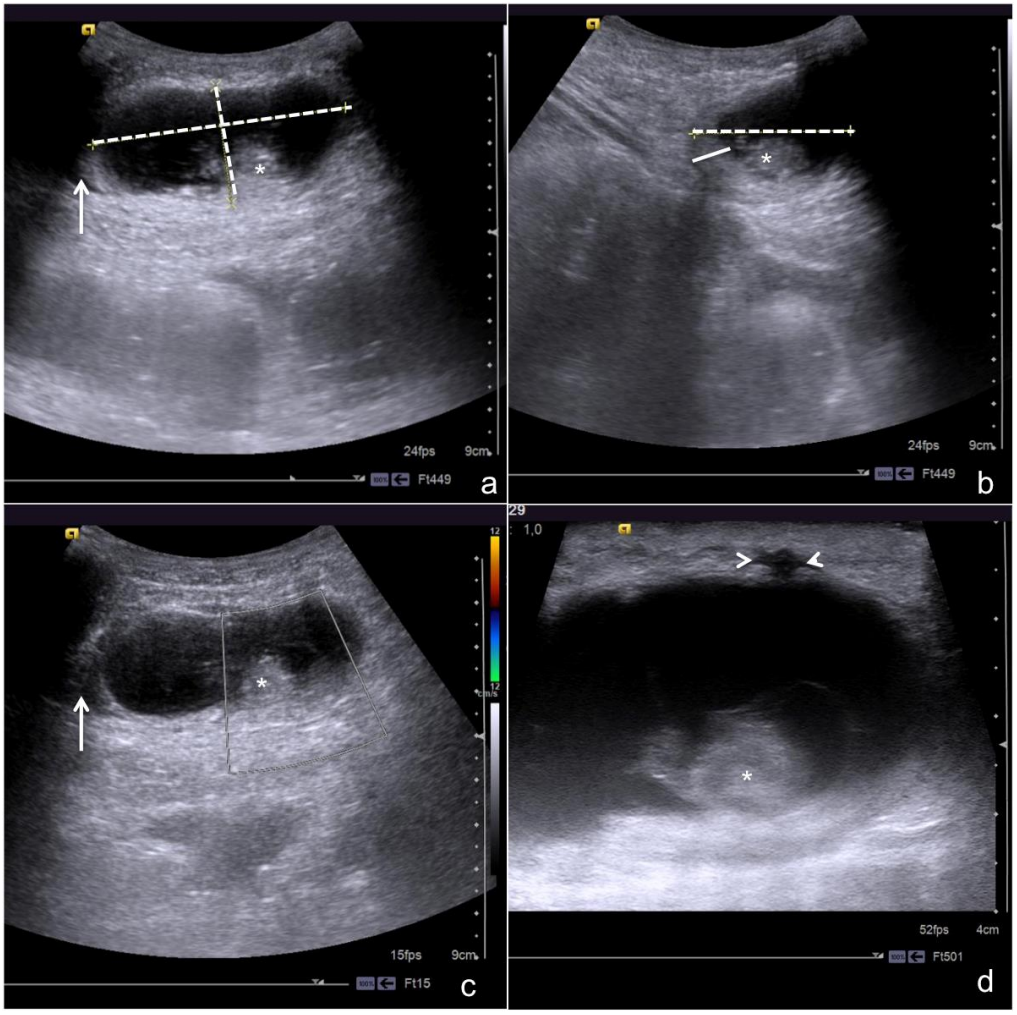


**Figure 3:** 81-year-old man with incisional hernia following ventriculoperitoneal shunt positioning. Technique: sonographic images obtained by means of a 5 MHz convex probe (figures a-c) and of a 14 MHz linear probe (figure d), in B-mode (figures a, b and d) and with color-Doppler (figure c), in the site of abdominal entrance of ventriculoperitoneal catheter. - Findings: a 60 x 26 x 35 mm large capsulated fluid collection (figures a and b, dotted lines), delimited by up to 5 mm thick walls (figure b, simple line), with no obvious flow at color-Doppler evaluation (figure c), representing a herniated small bowel loop, is clearly recognizable within the hyperechoic subcutaneous fatty tissue. Some hyperechoic debris (all figures, stars), representing bowel content, can be observed declivous within the collection. Moreover, a small amount of free fluid can be observed beneath the capsulated fluid collection (figures a and c, arrow). The ventriculoperitoneal catheter (figure d, arrowheads) runs between the collection and the subcutaneous fat.

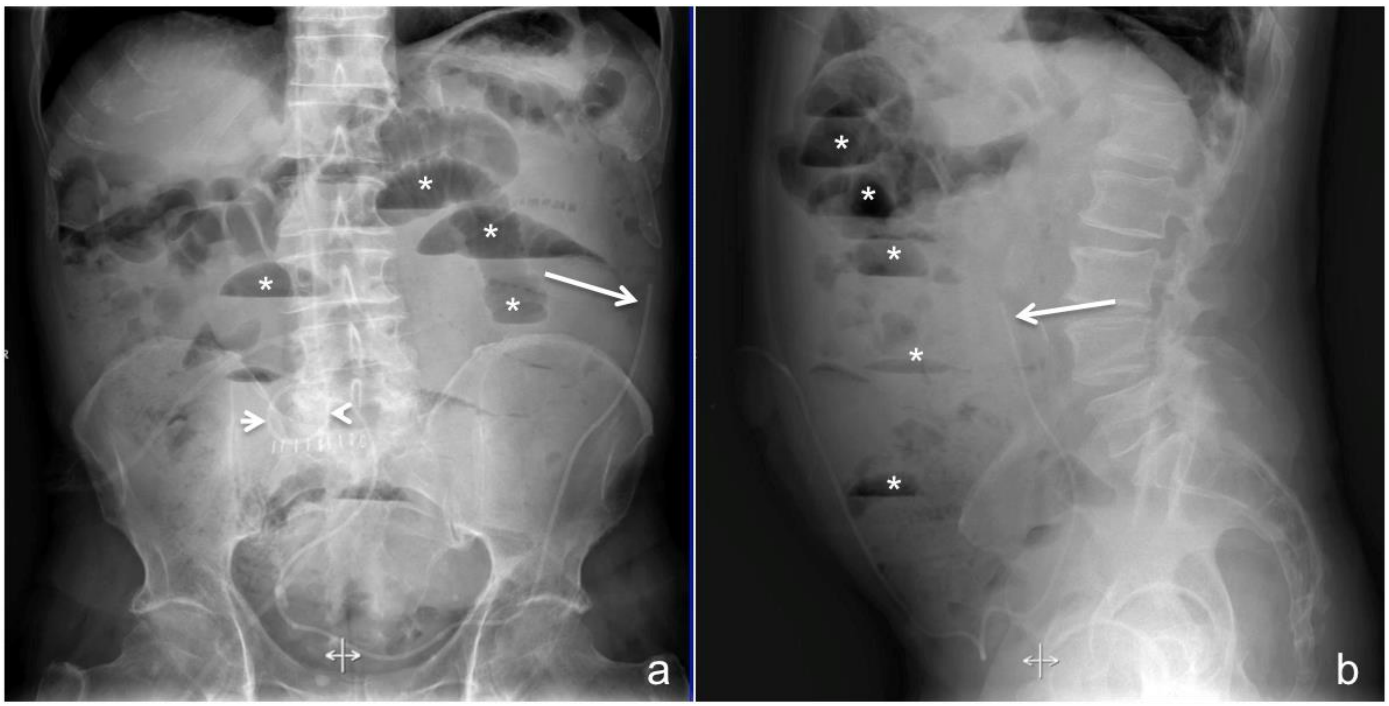


**Figure 4:** 81-year-old man with incisional hernia following ventriculoperitoneal shunt positioning. Technique: plain radiographs of the abdomen performed in orthostasis by means of antero-posterior (a) and lateral (b) projections. - Findings:
These images show multiple dilated small bowel loops, containing air-fluid levels (stars), as a consequence of mechanical intestinal occlusion. Neither intra-abdominal free air nor radiological signs of intestinal pneumatosis can be observed. Ventriculoperitoneal catheter tip is correctly located in the left flank (arrows), but the catheter itself performs an anomalous loop in the site of abdominal entrance (figure a, arrowheads).

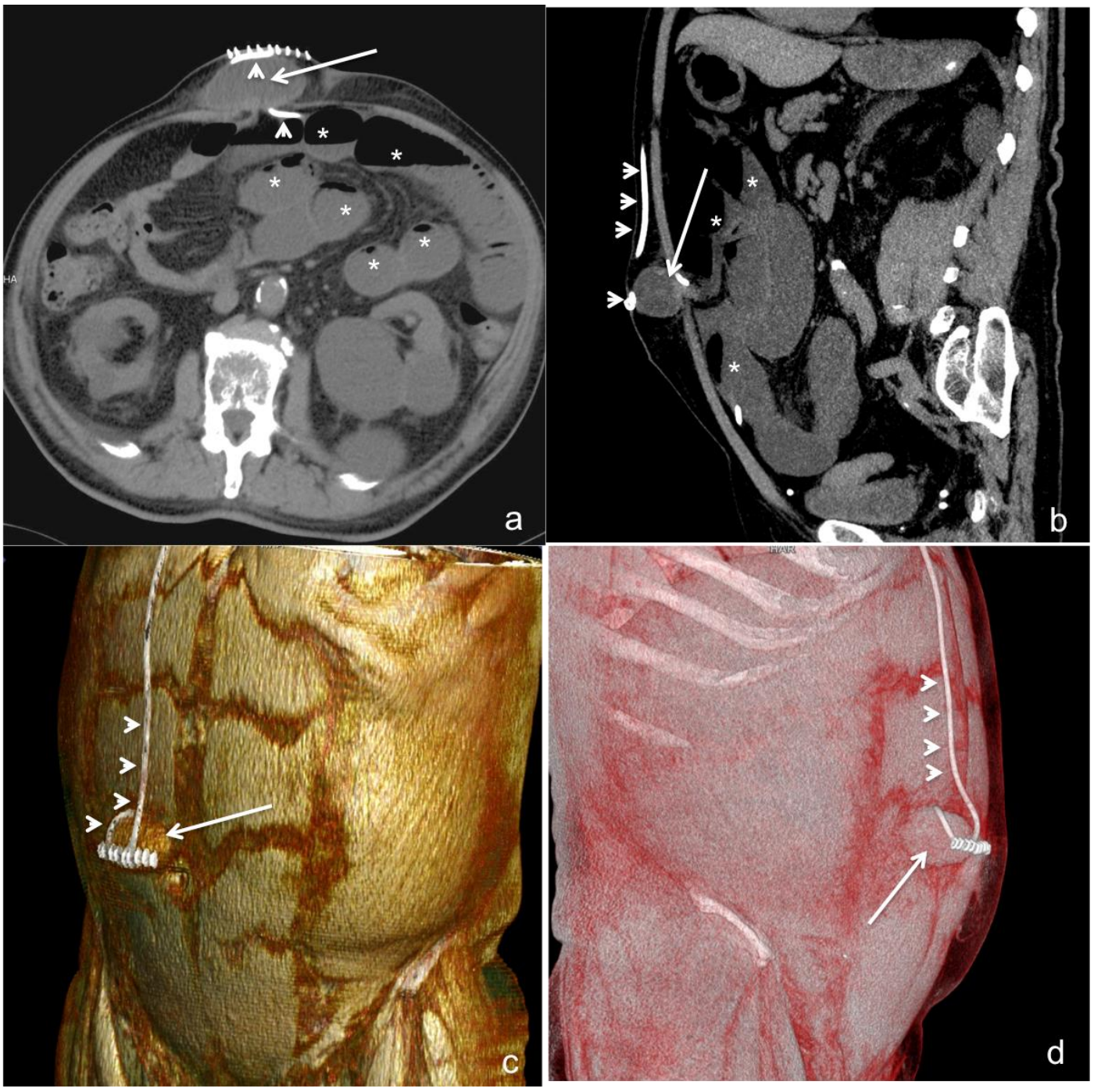


**Figure 5:** 81-year-old man with incisional hernia following ventriculoperitoneal shunt positioning. Technique: axial multiplanar reformation image (thickness 3 mm) (a), sagittal maximal intensity projection image (thickness 8 mm) (b) and volume rendering reconstructions (c,d) of a non-enhanced CT scan of the abdomen (Siemens Somatom Definition Flash, 120 kV, 110 reference mAs, Care Dose 4D). - Findings: axial and sagittal images (figures a and b) show multiple dilated small bowel loops containing air-fluid levels (stars) in the left abdominal quadrants, as a sign of intestinal occlusion. A capsulated fluid collection, representing a herniated small bowel loop, is clearly recognizable within the subcutaneous fat tissue of the anterior abdominal wall (all images, arrows), profoundly to the surgical suture. The Ventriculoperitoneal catheter (all images, arrowheads) runs around the herniated small bowel loop before entering the abdominal cavity.

| | |
|---|---|
| **Etiology** | Insufficiency of surgical sutures |
| **Incidence** | Unknown (extremely rare) |
| **Gender ratio** | M>F |
| **Age predilection** | Unknown |
| **Risk factors** | Unknown |
| **Treatment** | Surgical repair |
| **Prognosis** | Excellent if promptly treated in order to avoid possible complications |
| **Imaging findings** | Ultrasound: well-delimited fluid collection, usually surrounded by some free fluid, slightly displacing ventriculoperitoneal catheter. X-Ray: Normal position of ventriculoperitoneal shunt tip. Useful for excluding intestinal occlusion. CT: may demonstrate eventual complications like intestinal occlusion. |

**Table 1:** Summary table for incisional hernia after VP shunt positioning.

| | **Ultrasound** | **X-Ray** | **CT** |
|---|---|---|---|
| **Incisional hernia** | Well-delimited fluid collection, usually surrounded by some free fluid, slightly displacing ventriculoperitoneal catheter. | Normal position of ventriculoperitoneal shunt tip. Useful for excluding intestinal occlusion. | May demonstrate eventual complications like intestinal occlusion. |
| **Hematoma/ seroma** | Ill-defined fluid collection, variable from anechoic to hyperechoic, surrounding ventriculoperitoneal catheter. | Normal position of ventriculoperitoneal shunt tip. | Ill-defined fluid collection showing variable density; may become capsulated. |
| **VP catheter dislocation** | Ill-defined anechoic fluid collection surrounding the displaced ventriculoperitoneal catheter tip. | Ventriculoperitoneal shunt tip dislocated in the subcutaneous tissues. | Clearly displays ventriculoperitoneal catheter tip position. |
| **VP catheter rupture** | Ill-defined anechoic fluid collection surrounding ventriculoperitoneal catheter. Catheter breakage may be directly recognized only in case of complete rupture. | Normal position of ventriculoperitoneal shunt tip. Catheter breakage may be recognized only in case of complete rupture. | May highlight small ventriculoperitoneal catheter ruptures. |

**Table 2:** Differential diagnosis table of swelling in the site of VP shunt abdominal entrance.





## ABBREVIATIONS

CBC = Complete Blood Count
CRP = C-Reactive Protein
CSF = Cerebrospinal fluid
CT = Computed Tomography
MR = Magnetic Resonance
VP = Ventriculoperitoneal


## KEYWORDS

Ventriculoperitoneal shunt; incisional hernia; shunt dislocation; Ultrasonography; US; Sonography; CT; X-ray; abdomen; hydrocephalus



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