

Imaging-Guided Management of a Bladder–Rectal Fistula after Gunshot Trauma: Implications of Delayed Imaging Phases in Trauma Decision-Making

Stefano Giusto Picchi¹, Augusto Minieri², Giulia Lassandro², Stefania Tamburrini¹,
Giulio Cocco³ and Antonio Corvino⁴ 

¹Department of Radiology, ASL Napoli 1 Centro, Naples, Italy

²Advanced Biomedical Sciences Department, “Federico II” University, Naples, Italy

³Department of Neuroscience, Imaging and Clinical Sciences, University “G. d’Annunzio,” Chieti, Italy

⁴Medical, Movement and Wellbeing Sciences Department, University of Naples “Parthenope,” Naples, Italy

Colo-vesical fistula is a condition characterized by an abnormal connection between the colon and the urinary bladder. Traumatic rectovesical fistulas (RVFs) are rare entities, most commonly resulting from penetrating trauma, including gunshot injuries. Symptoms shown by these patients are commonly pneumaturia and fecaluria, highly suggestive of a pathological communication between the bowel and the bladder. However, localization of the fistulous tract typically requires cross-sectional imaging. Herein, we report the case of a 29-year-old man admitted to our Emergency Department with a RVF resulting from a gunshot injury. Initial imaging studies were inconclusive, while the definitive diagnosis of traumatic RVF was established using abdominal computed tomography with an ultra-delayed acquisition performed 35 minutes after contrast administration. Clinical symptoms remain a key guide in the diagnostic process, and when standard imaging fails to identify the fistulous tract, ultra-delayed imaging acquisitions should be considered to facilitate timely surgical management and improve patient outcomes.

Keywords: *Soft-Tissue Fistula; Gunshot Injury; Trauma Management; Ultra-Delayed Acquisition; Contrast-Enhanced Computed Tomography (CECT)*

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INTRODUCTION

A fistula is defined as an abnormal tract establishing communication between two distinct organs or surfaces. Nomenclature is determined by the structures involved; thus, a pathological connection between the colon and the bladder is termed colo-vesical fistula (CVF) [1].

While most enterovesical fistulas are related to inflammatory or neoplastic conditions, traumatic rectovesical fistulas (RVFs) are rare and often associated

with high-energy injuries, including gunshot wounds and other penetrating trauma [2–4].

In the acute trauma setting, these lesions can be difficult to recognize, as initial clinical and imaging findings can be non-specific or masked by associated injuries. Persistent symptoms such as fecaluria or pneumaturia should raise suspicion of pathological communications between the bowel and the urinary tract [5,6].

Cross-sectional imaging plays a central role in both diagnosis and management of pelvic trauma. Conventional computed tomography (CT) protocols might be insufficient to identify evolving or low-flow fistulas. In selected cases, adapting imaging timing and acquisition phases might be critical to clarify the diagnosis and guide management decisions [2–6].

We report the case of a 29-year-old man presenting with a traumatic bladder–rectal fistula after gunshot injury, focusing on the role of a tailored imaging strategy with delayed acquisition phases in trauma decision-making.

This case report was prepared in accordance with the CARE guidelines.

Corresponding author:

Antonio Corvino, Medical, Movement and Wellbeing Sciences Department, University of Naples “Parthenope,” via Medina 40, I-80133 Naples, Italy.

Email: an.cor@hotmail.it

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CASE PRESENTATION

A 29-year-old man presented to the Emergency Department of our center (Ospedale Pellegrini, ASL Napoli 1, Naples, Italy) with a gunshot wound to the sacral region with no evidence of a bullet exit wound. His medical history was negative for previous pathologies.

On arrival, the patient was hemodynamically stable. His vital signs were: blood pressure 130/80 mmHg, heart rate 70 beats/min, respiratory rate 22 breaths/min, temperature 36.5°C, and oxygen saturation 98% on room air. Physical examination revealed a gunshot wound in the sacral region with no evidence of a bullet exit wound. The abdomen was treatable although painful on deep palpation in the pelvis and left groin region, and the patient showed no signs of neurological deficits in the lower limbs. After bladder catheterization, abundant hematuria was detected. Routine blood tests revealed normal hemoglobin (15 g/dL; range: 14–17 g/dL) and hematocrit (46%; range: 41–51%); all other blood values were also within normal limits.

The patient was transported to Radiology for an urgent abdominal contrast-enhanced CT (CECT). CECT scan was performed using a 64-slice CT scanner (Revolution EVO, GE, Boston, USA). Acquisition parameters were: rotation time 0.33 s, collimation 64 mm × 1 mm, slice thickness 1.0 mm, tube voltage 120 kVp, and tube current with automatic exposure modulation. Field of view included the area from above the diaphragm to the proximal portion of the thighs. Non-contrast, arterial, venous, and delayed phase were included in the emergency protocol. The intravenous contrast medium used was Iopromide 370 mg I/mL, 1.0–1.5 mL/kg, which was injected at 4.0 mL/s, followed by a 50 mL saline flush. A dedicated workstation was used for post-processing, obtaining multiplanar reconstructions, volume rendering 3D technique reconstructions, and maximum intensity projections. CECT

showed the bullet entry wound in the sacral region, resulting in a fracture of the first sacral metamer. The bullet's trajectory was postero-anterior, slanting from top to bottom through the pelvic cavity. The CECT revealed thickening of the perirectal adipose tissue and irregularity of the left wall of the rectum in the presence of perivisceral air (Figure 1a), suggesting a rectal laceration. The bladder appeared empty and catheterized, with irregularity of the left profile (Figure 1b), suggesting bladder laceration. The bullet was found on the posterior margin of the left rectus abdominis muscle.

The patient underwent urgent surgery laparotomy. Exploration of the abdominal cavity revealed an amount of blood in the pelvic cavity and the laceration of the left bladder wall. No obvious lesions were found in the rectum nor in the intestinal loops. A drainage tube was placed in the pelvic cavity.

On the fourth day after surgery, the patient presented with fecaluria, fever (37.8°C), and lower abdominal pain. The patient underwent retrograde cystography the following day, which did not reveal any extravascular spread of contrast medium.

The following day it was decided to perform a new CECT scan, which the radiologist (Picchi SG) supplemented with an ultra-delayed acquisition at approximately 35 min. The CECT showed the presence of a fistulous tract (thickness of 10 mm and extension of 35 mm) between the left posterior wall of the bladder and the left anterior wall of the rectum, with contextual gas coefficients. In the ultra-delayed acquisition phase, the fistulous tract and the rectum were filled with iodinated urine (Figure 2).

It was therefore decided to undertake conservative treatment with a urinary catheter and to perform a sigmoidoscopy on the patient.

In the following days, the patient's clinical condition improved, presenting as afebrile, without abdominal

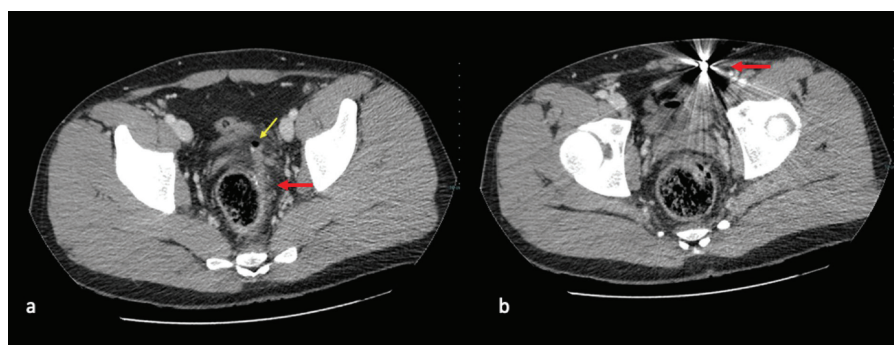


Figure 1 Contrast-enhanced computed tomography (CECT) images with portal phase of the axial plane. (a) CECT showed thickening of the perirectal adipose tissue (red arrow), irregularity of the left wall of the rectum, and the presence of perivisceral air (yellow arrow). (b) The bladder was empty and catheterized, with irregularity of the left lateral profile and thickening of the surrounding adipose tissue. The bullet was located on the posterior margin of the left rectus abdominis muscle, anterior to the bladder (red arrow).

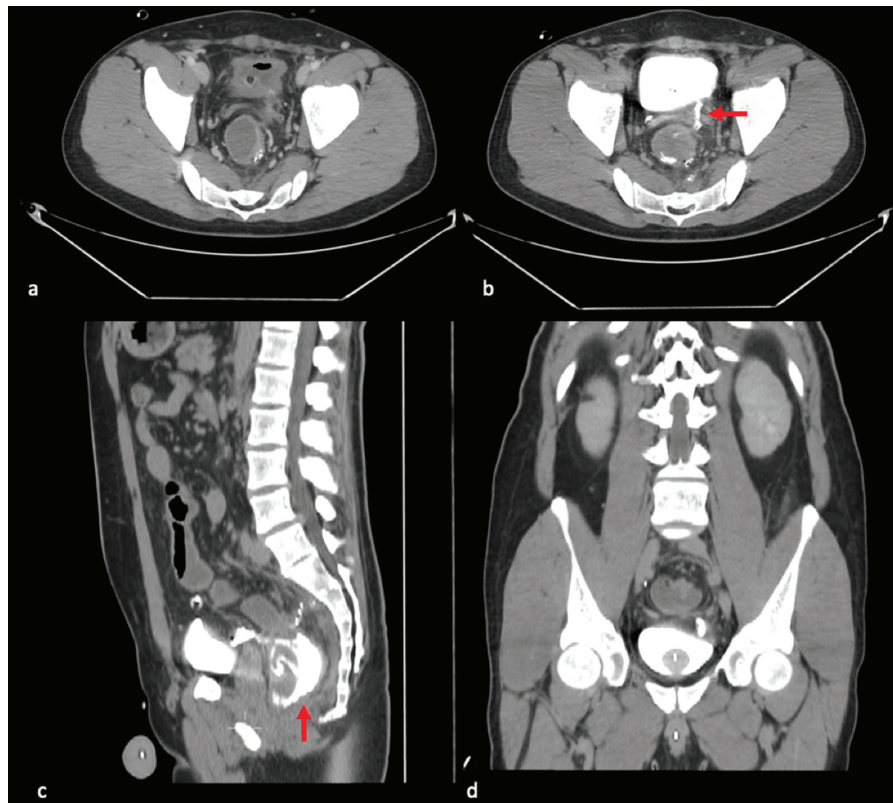


Figure 2 Contrast-enhanced computed tomography (CECT) images with portal phase of the axial plane. (a,b) Ultra-delayed phase, multiplanar. In the ultra-delayed acquisition phase at 35 minutes, the fistulous tract was filled with iodinated urine, also visible in the rectum lumen (red arrow). (c,d) CECT showed the presence of a fistulous tract (thickness: 10 mm and extension: 35 mm) between the left posterior wall of the bladder and the left anterior wall of the rectum (red arrow), with evidence of perivisceral air.

pain and without fecaluria, with clear urine in the catheter bag. A new cystography showed no extraluminal contrast leakage from the bladder. The patient was therefore discharged with instructions to keep the urinary catheter for another 15 days. At the last follow-up examination, the patient showed no signs of fecaluria or other clinical symptoms, and routine laboratory tests were normal.

Ethical Approval and Informed Consent

Ethical approval was not required as all data were anonymized. The patient signed an informed consent and endorsed the description of his clinical course for educational purposes.

DISCUSSION

CVF represents a clinically significant condition and a notable concern in surgical management. Most frequently the cause is diverticulitis, which accounts for over two-thirds of cases. Other etiologies include colorectal adenocarcinoma, Crohn's disease, prior pelvic

radiotherapy, and, less commonly, iatrogenic injuries from surgical procedures, abdominal trauma, or infections such as tuberculosis [1].

The typical age of onset for CVF is between 55 and 75 years. It occurs more commonly in males (male:female ratio 3:1), probably because of the anatomical barrier provided by the uterus and adnexal structures. In fact, usually when a CVF is diagnosed in a female patient, it often follows a hysterectomy [2,5].

Among malignant causes, colonic adenocarcinoma is the most frequently implicated in CVF formation. In these cases, direct tumor invasion into the bladder wall results in the establishment of an abnormal communication between the colon and the urinary tract.

In patients with Crohn's disease, the development of fistulas is a well-recognized complication due to chronic, transmural inflammation. Approximately 35% of individuals affected by Crohn's disease develop fistulous tracts but most commonly involving the small intestine (entero-enteric, entero-colonic, and entero-cutaneous fistulas). Less frequently, fistulas can extend to the bladder or the vagina, resulting in colo-vesical or colo-vaginal fistulas [1].

The classic symptoms suggestive of a CVF include pneumaturia, fecaluria, and recurrent urinary tract infections. In more severe cases, patients might present with hematuria, signs of peritonitis or an acute abdomen. However, the presentation is commonly variable, which can complicate and delay diagnosis [2].

In contrast to the more common inflammatory or neoplastic causes, this case presented involves a rare instance of a RVF resulting from a traumatic gunshot injury. In this report, we describe a traumatic RVF secondary to a gunshot wound. Initially, imaging did not clearly reveal the fistulous communication; however, the presence of fecaluria strongly raised clinical suspicion for RVF. Genitourinary tract injuries are frequently associated with rectal trauma. Bladder involvement is reported in approximately 30% of rectal trauma cases.

Accurate pre-operative assessment of the number, size, and location of the fistulous tract is essential for optimal surgical planning. A detailed physical examination remains a critical step in evaluating the perineal region and identifying the fistulous opening and surrounding tissue changes [7].

A multimodal imaging strategy is fundamental in diagnosing CVFs and RVFs. CECT, either with oral or rectal contrast, provides excellent visualization of the fistulous tract, while cystography adds further anatomical detail of the bladder involvement. Colonoscopy is also important to assess mucosal integrity, identify associated colonic pathologies, and rule out malignancy. In the literature, for abdomen X-ray a detection rate of 90–100% was reported [8]. Additional imaging, such as retrograde and voiding cystourethrography, can be useful to delineate the urinary tract anatomy. Elevated creatinine levels in discharged fluid might also help confirm urinary leakage. Nevertheless, intravenous pyelography and cystograms might fail to demonstrate associated genital tract anomalies [7].

Ultrasound can aid early detection of CVFs in selected cases. Sometimes the fistulous tract is directly visualized; however, this imaging approach has its limits. It is useful to the point that applying abdominal compression during a transabdominal scan can enhance visualization by revealing an echogenic “beak sign,” which connects the peristaltic bowel loop to the urinary bladder. Additionally, anorectal or transrectal ultrasound can help identify deeper or more complex fistulous tracts [9].

Although conventional radiography is not routinely diagnostic, an upright abdominal X-ray might incidentally reveal an air–fluid level within the bladder, raising a strong suspicion for an underlying enterovesical fistula (EVF) [9]. Barium enemas (BE) have a limited role in diagnosing EVFs because of their low sensitivity (almost 30%) [10]. The procedure starts with the introduction of a barium-based contrast agent into the rectum via a

small tube, followed by X-ray imaging in multiple positions to visualize the colon and rectum. A double-contrast enema, which includes air, might enhance image detail. With this imaging technique, the Bourne test may be performed to increase the diagnostic yield of BE. The test consists of radiographic evaluation of a centrifuged first urine sample obtained immediately after a non-diagnostic BE [11].

CT is the gold standard for EVF diagnosis, with a diagnostic accuracy of 90–100%. It not only detects fistulae but also provides detailed information about surrounding anatomical structures. CT should be performed after oral contrast but before intravenous contrast, allowing detection of diluted oral contrast in the bladder. Key CT findings suggestive of EVF include intravesical air (if there is not recent urologic procedures in anamnesis), oral contrast in the bladder, colonic diverticula, thickening of the adjacent bladder and bowel walls, and rectovesical masses or adhesions between pelvic organs. The detection of intravesical air is regarded as a pathognomonic finding and significantly increases the diagnostic accuracy [9,12]. So, to avoid false positives, CT should be performed before any transurethral manipulation, which can introduce iatrogenic bladder air [13]. CT also serves as a valuable pre-operative roadmap for surgeons and offers guidance for diagnostic and therapeutic interventional procedures [14]. Multidetector CT cystography is now considered the modality of choice for detecting and classifying traumatic bladder injuries. The procedure begins with the bladder emptying using a Foley catheter (with the patient in the supine position on the CT scanner table). After, through this catheter, a diluted contrast medium at least 300 mL is introduced into the bladder (pressure injection or manual squeezing of the contrast bag is discouraged to avoid worsening any existing bladder injury). Once the bladder is adequately distended, a volumetric pelvic CT scan is performed. Especially when a neoplastic or inflammatory process is suspected, intravenous contrast must also be administered [12].

Although CT is highly effective in detecting features suggestive of CVF, the actual fistulous tract is only occasionally visualized. Usually, only magnetic resonance imaging (MRI) can detect and describe the fistulous tract because it offers superior soft tissue contrast and multiplanar imaging capability, making it a useful adjunct in cases where CT findings are inconclusive. The appearance of a fistula on MRI depends on its content (fluid, air, or both), which affects signal characteristics. MRI is the modality of choice for local staging of pelvic malignancies because of its superior soft-tissue contrast and multiplanar imaging capabilities. Within the comparative limitations of different imaging modalities, our findings are consistent with the MRI results previously reported, such as the thickening of the perirectal adipose tissue [15,16].

CONCLUSION

Although uncommon, gunshot injuries can result in lacerations to both the bowel wall and the bladder, potentially leading to the formation of RVF. In trauma patients with suggestive clinical signs, a high degree of suspicion should be maintained. Clinical symptoms remain a key guide in the diagnostic process, and when standard imaging fails to identify the fistulous tract, ultra-delayed imaging acquisitions should be considered to detect the fistula and expedite and optimize surgical planning and consequently improve patient outcomes.

Ethics Statement

- (1) All the authors mentioned in the manuscript have agreed to authorship, read and approved the manuscript, and given consent for submission and subsequent publication of the manuscript.
- (2) The authors declare that they have read and abided by the JEVTM statement of ethical standards including rules of informed consent and ethical committee approval as stated in the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest

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Author Contributions

All the authors made a substantial contribution to the manuscript and participated sufficiently in submission to take public responsibility for its content. Publication was seen and approved by all authors and by the responsible authorities where the work was carried out.

Data availability

The data supporting the findings of this study are not publicly available due to privacy and ethical restrictions. The datasets are securely stored by the first author (S.G. Picchi) and are available from the first author upon reasonable request.

Declaration of the Use of Generative AI and AI-assisted technologies in the writing process

The authors declare that no generative AI or AI-assisted technologies were used in the writing, editing, or preparation of this manuscript. After using this tool/service,

the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

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