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# Splenosis: a great mimicker of neoplastic disease

Yasmeen K. Tandon, Christopher P. Coppa, Andrei S. Purysko

Section of Abdominal Imaging, Imaging Institute, Cleveland Clinic, 9500 Euclid Ave., Cleveland, OH 44195, USA

## Abstract

Splenosis is a benign condition that can occur after splenic trauma or after surgery involving the spleen. These splenic implants are most often seen within the abdominal and pelvic cavities. On imaging, splenosis can be confused with multiple additional entities including metastatic disease, peritoneal carcinomatosis, peritoneal mesothelioma, abdominal lymphoma, renal cancer, hepatic adenomas, or endometriosis depending on its distribution. In all patients with history of splenic surgery or trauma, splenosis should be on the differential diagnosis of soft tissue nodules in the abdomen and pelvis, especially in the absence of systemic symptoms, to avoid unnecessary biopsy, chemotherapy, or surgery.

**Key words:** Splenosis—Spleen—Mimic—Trauma

Buchbinder and Lipkopf first used the term "splenosis" in 1939 to describe the heterotopic autotransplantation of splenic tissue [1]. It is a benign condition that can occur after splenic trauma with rupture (such as with stab wounds, gunshots, and car accidents) or after surgery involving the spleen. These splenic implants are most often seen within the abdominal and pelvic cavities and most commonly involve the parietal peritoneum, mesentery, greater omentum, serosal surface of the small and large bowel, and the diaphragmatic surface [2, 3], in a pattern resembling metastatic seeding of the peritoneum. However, splenic implants have also been described in more unusual places including within the liver, kidney, thorax, subcutaneous tissues, and in the occipital lobe of the brain [4].

Splenosis has been reported to occur in up to 67% of patients who have had splenic trauma. However, the true incidence of this condition is unknown as it is often an incidental finding on imaging or surgery [5]. On imaging, splenosis can be confused with multiple additional entities including metastatic disease, peritoneal carcinomatosis, peritoneal mesothelioma, abdominal lymphoma, renal cancer, hepatic adenomas, or endometriosis depending on its distribution [4]. The goal of this report is to raise the awareness of this entity to prevent unnecessary biopsies, surgery, or treatment.

## Case presentations

### *Case 1*

A 67-year-old man with history of nephrolithiasis presented with new onset left-sided flank pain and underwent computed tomography (CT) of the abdomen and pelvis without IV contrast to assess for urinary tract stones. CT demonstrated a 4-mm calculus in the left proximal ureter likely explaining the patient's symptoms. Additional findings included several soft tissue nodules in the left upper quadrant felt to represent splenules and a 5.2 × 2.9-cm circumscribed pelvic soft tissue mass between the bladder and rectum (Fig. 1). Magnetic resonance imaging (MRI) was recommended to further characterize the pelvic mass and demonstrated a solid, homogeneously enhancing mass in the rectovesical space (Fig. 2). Patient was referred to urology, and biopsy of the mass was recommended. However, additional review of the patient's past medical history revealed that he had a splenectomy at the age of 18 after suffering a car accident. This raised the possibility that the pelvic mass was due to splenosis and further workup with sulfur colloid study was recommended instead of biopsy. The sulfur colloid scan revealed several foci of activity in the left upper quadrant that correlated with presumed splenic tissue demonstrated on CT and focal pelvic uptake, that correlated with the solid mass demonstrated on CT and MRI, confirming the suspicion of ectopic splenic tissue (Fig. 3). No further workup, intervention, or followup was recommended.

*Correspondence to:* Yasmeen K. Tandon; *email:* tandony@ccf.org

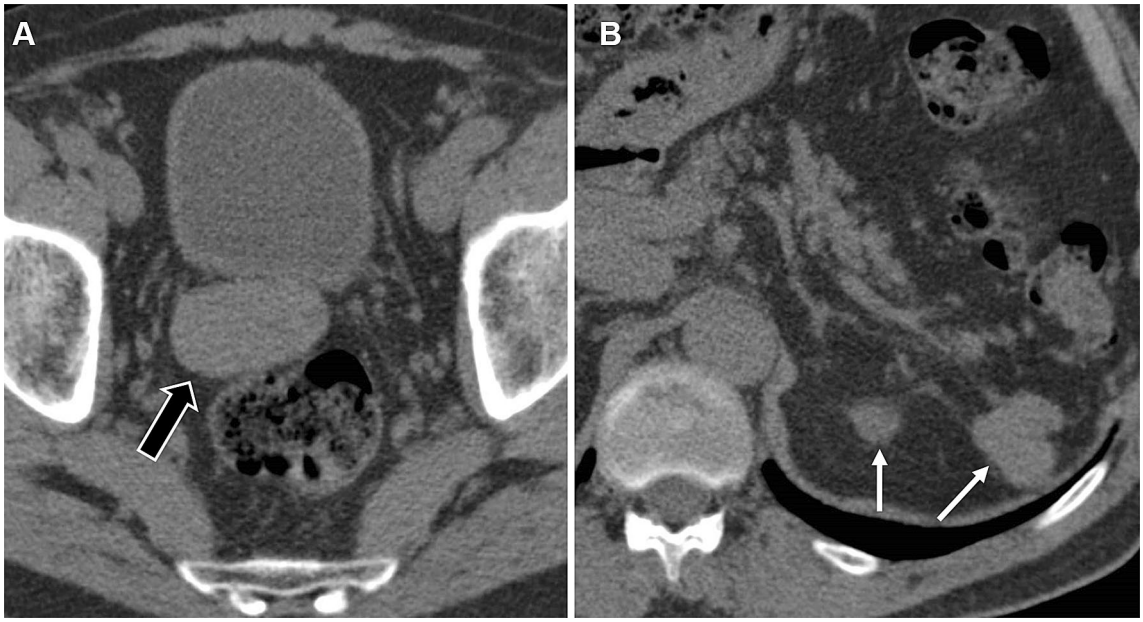


**Fig. 1.** Axial non-contrast CT images of the pelvis (**A**) and abdomen (**B**) demonstrate a soft tissue mass in the pelvis (arrow, **A**) and soft tissue nodules in the left splenic bed (arrows, **B**).

### *Case 2*

A 53-year-old man with history of prostate cancer underwent a staging prostate MRI examination, which showed a 3.5 × 2.1 cm lesion adjacent to the left seminal vesicle (Fig. 4). This lesion was stable in appearance compared to a CT performed several years earlier. This CT scan also demonstrated an absent spleen in the left subphrenic region and a crescent-shaped soft tissue structure measuring 4 × 2.4 cm between the descending colon and left kidney which was felt to represent splenic tissue (Fig. 5). Taking all of the findings into consideration, the pelvic mass adjacent to the seminal vesicle was most compatible with ectopic splenic tissue and not a malignancy. Patient underwent radical robotic prostatectomy and this diagnosis of splenosis was confirmed during surgery.

### *Case 3*

A 65-year-old man with remote history of splenectomy after a motor vehicle accident had a more recent history of renal cell carcinoma. Multiple hypervascular soft tissue nodules were scattered throughout the peritoneal cavity, including the left subphrenic region, peritoneal reflection adjacent to the seminal vesicles, perihepatic region, and in the right inguinal canal (Fig. 6). These nodules were present on the CT scan performed before nephrectomy three years prior, and although some were mildly larger, and the distribution of nodules could mimic peritoneal metastases, patient was presumed to have splenosis and continued surveillance rather than biopsy was recommended.

## Discussion

There are different forms of ectopic splenic tissue including splenosis, accessory spleens, wandering spleen, and polysplenism. Accessory spleens are congenital arising from the left side of the dorsal mesogastrium during embryogenesis and are found in 20% of the population. Splenosis on the other hand is an acquired condition after splenic rupture usually caused by trauma or surgery. Whereas an accessory spleen has normal splenic histology and a branch of splenic artery supplies it, splenic implants in splenosis have irregular architecture with a poorly formed capsule and no hilum. Additionally, the splenic artery does not supply the splenic implants in splenosis and it receives its blood supply from the surrounding tissue and vessels [2, 6]. Wandering spleen is a rare condition in which the spleen is located outside of its normal location secondary to laxity or maldevelopment of the supporting splenic ligaments. Polysplenia with situs ambiguous also known as bilateral left sidedness or left isomerism is a congenital syndrome more common in females which is associated with multiple highly variable visceral and cardiovascular anomalies. The number of spleens in polysplenia can range from two to six (with a dimeter of 1–6 cm) [7].

In splenosis, the mechanism of spread is hypothesized to be either direct seeding of damaged pulp seeds after splenic rupture onto adjacent surfaces or by hematological spread to distant organs such as the brain [2, 8].

Case series of splenosis have found that 93% of cases were secondary to trauma which required subsequent splenectomy, and that 70% of these patients suffered the traumatic injury as a teenager [9]. However, some pa-

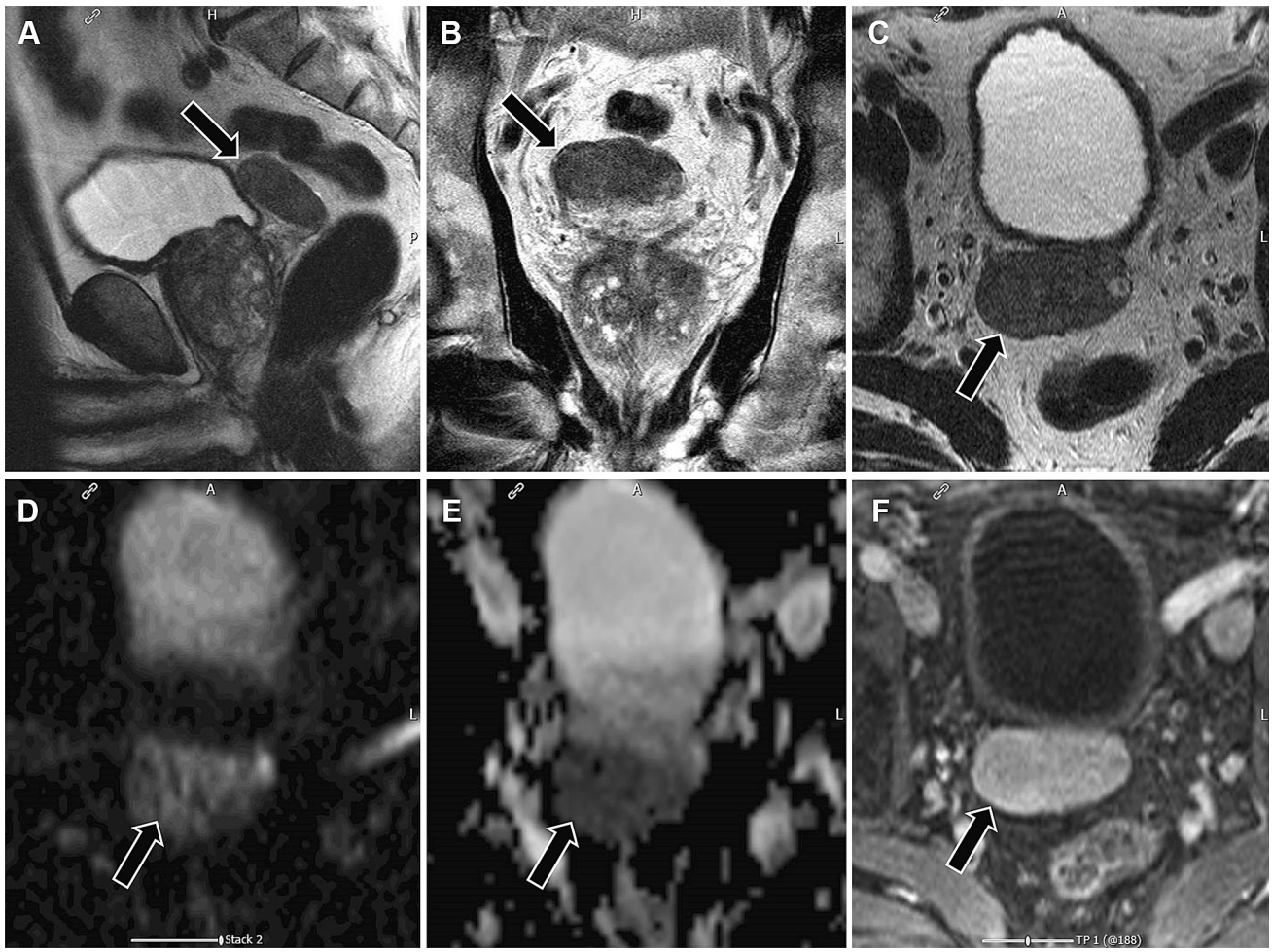


**Fig. 2.** Sagittal (**A**), coronal (**B**), and axial (**C**) T2-weighted images demonstrate a well-circumscribed lobular mass with intermediate to low signal intensity centered in the pelvic peritoneal reflection between the rectum and bladder (arrow, **A**–**C**). The mass has high signal intensity on diffusion-weighted image (arrow, **D**) and low signal intensity on apparent diffusion coefficient map (arrow, **E**). On axial fat-suppressed and contrast-enhanced T1-weighted image the mass demonstrated intense enhancement (arrow, **F**).

tients with history of splenic trauma and subsequent splenosis will still have a spleen in the left upper quadrant, since more conservative surgical or non-surgical management of splenic trauma has replaced splenectomy when possible in many centers. Also, in these types of patients, it is possible there may be no history of prior remote splenic trauma available, and the spleen may look relatively normal in a patient with splenosis.

Splenosis is more commonly detected in males, which may be due to the higher incidence of trauma in young men. Less commonly, spontaneous non-traumatic rupture of the spleen can occur in newborn infants due to severe hemolytic disease and secondary to infectious mononucleosis in older children and teenagers [9].

Patients with splenosis are typically asymptomatic and the condition is detected incidentally by imaging. Splenosis requires no surgical resection in most patients. In fact, it has been theorized that these splenic implants may actually exert a protective immune response in asplenic patients, although this effect is limited [10]. In rare cases, depending on the location, it has been reported that splenosis may lead to vague recurrent testicular or abdominal pain, GI bleeding, or intestinal obstruction secondary to adhesion [3, 5].

Splenic implants in splenosis can be solitary or multiple (upwards of 400 nodules) and usually remain small in size ($< 3$ cm) because they do not have their own blood supply [5, 11]. Imaging can define the shape, location, number, and size of these nodules. On computed tomography (CT), these nodules can be rounded, oval, sessile, or pedunculated and have density and enhancement characteristics similar to the spleen. On

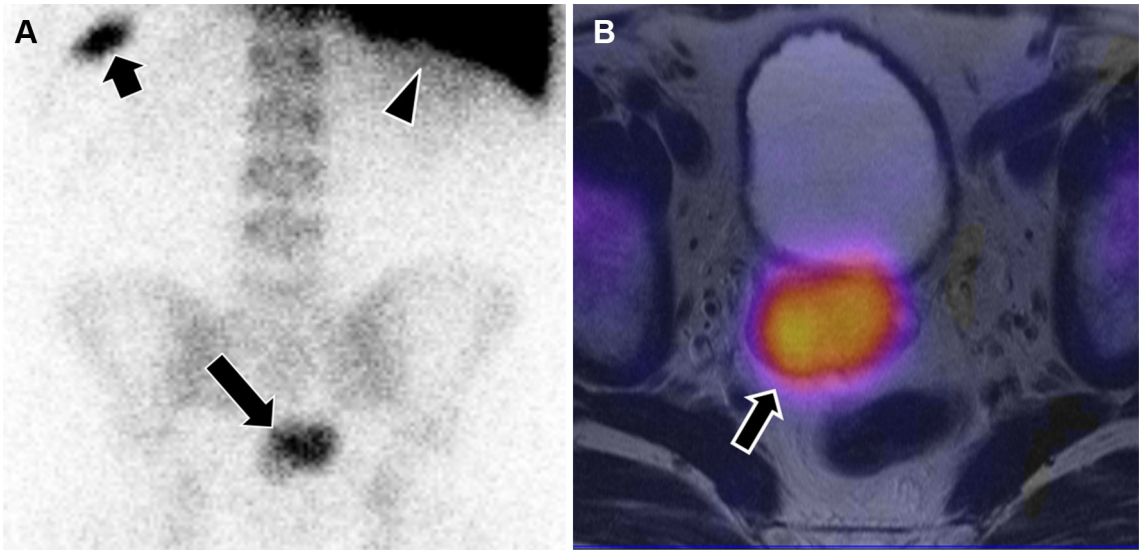


**Fig. 3.** Frontal projection of Tc-99 m sulfur colloid study demonstrates normal expected uptake of tracer within the liver (arrow head, **A**). There is also increased uptake of the tracer in the left upper quadrant (short arrow, **A**) and pelvis (long arrow, **A**). Fused single-photon emission computed tomography image obtained during the Tc-99 m sulfur colloid study and the T2-weighted images from the previously obtained MRI of the pelvis show precise correlation between the trace uptake and the pelvic mass (arrow, **B**), confirming the diagnosis of ectopic splenic tissue.

MRI, they demonstrate intermediate to low signal intensity on T1-weighted images, intermediate to high signal intensity on T2-weighted images, and restricted diffusion, with signal characteristics and an enhancement pattern of normal splenic tissue [4, 9].

Recent reports also describe using Ferumoxide-enhanced MRI in detecting splenosis. Ferumoxides are superparamagnetic iron oxides that are removed from the circulation by the reticuloendothelial system [12], and accumulate in ectopic splenic tissue.

On ultrasound (US), they appear as solid round or oval-shaped masses with homogeneous hypoechoic echotexture [4].

While the diagnosis of splenosis is often made using CT, conventional MRI, and US, sometimes ectopic spleen cannot be differentiated from malignant conditions. If a diagnostic dilemma persists after traditional imaging, non-invasive nuclear scintigraphic studies become the imaging modalities of choice [13]. A Tc-99m sulfur colloid test is a nuclear study which localizes the radiolabeled colloid to the reticuloendothelial system, including splenic tissue and the liver. However, if liver and splenic tissues have to be differentiated, for example, in hepatic splenosis, Tc-99m-tagged heat-damaged red blood cells or I-111-labeled platelets scintigraphy are more sensitive and specific for splenic uptake [2, 4, 13] since there is no normal accumulation of these radiopharmaceuticals in the liver.

On gross pathology, they have been commonly described bluish-red appearance but can vary in color from pink to dark red to greenish black [9–11].

In addition to the imaging findings described, patients with splenosis also often lack typical changes in the blood smear that can be present after splenectomy (reticulocytosis and Howell–Jolly bodies) [9, 13]. These laboratory changes should be looked for in the patient's medical record as it can help corroborate the diagnosis of suspected splenosis.

In conclusion, in all patients with history of splenic surgery or trauma, splenosis should be on the differential diagnosis of soft tissue nodules in the abdomen and pelvis, especially in the absence of systemic symptoms, to avoid unnecessary biopsy, chemotherapy, or surgery.

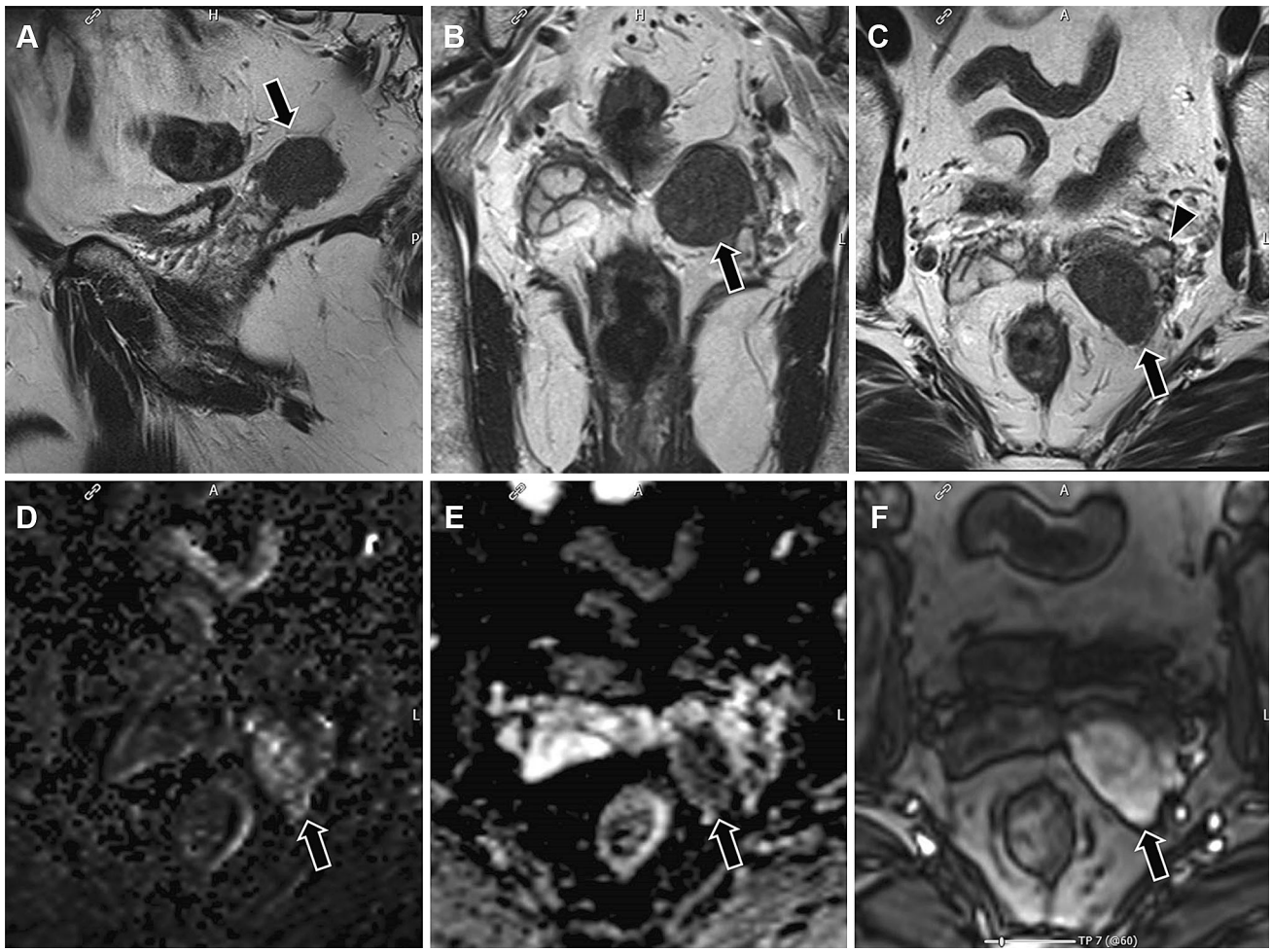


**Fig. 4.** Sagittal (**A**), coronal (**B**), and axial (**C**) T2-weighted images demonstrate a well-circumscribed lobular mass (arrow) with intermediate to low signal intensity abutting the left seminal vesicle (arrow head, **C**). The mass has high signal intensity on diffusion-weighted image (arrow, **D**) and low signal intensity on apparent diffusion coefficient map (arrow, **E**). On axial fat-suppressed and contrast-enhanced T1-weighted image the mass demonstrated intense enhancement (arrow, **F**).

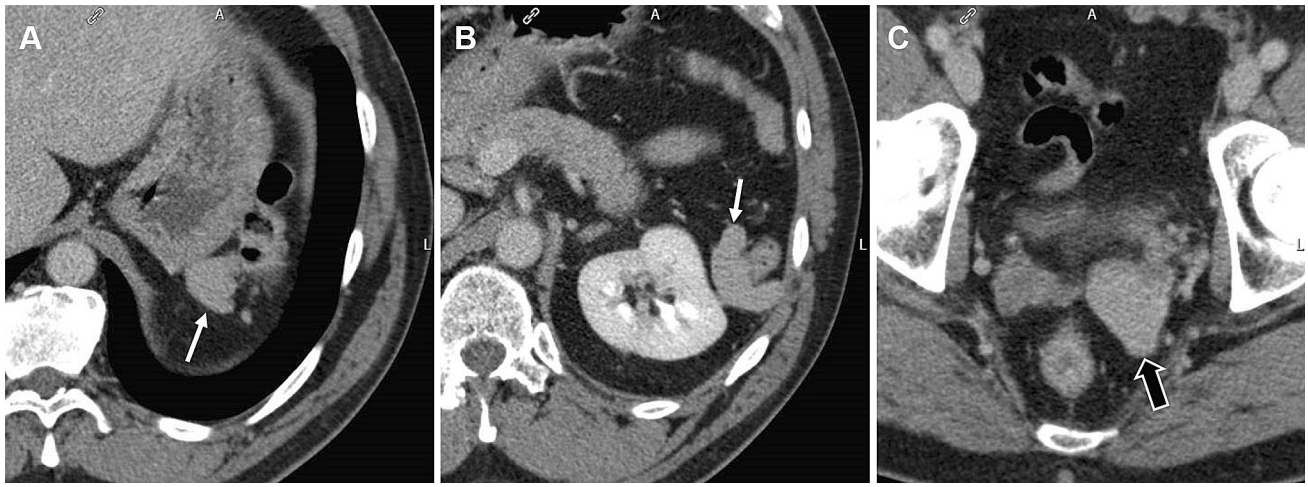


**Fig. 5.** Axial contrast-enhanced computed tomography images of the abdomen (**A**, **B**) and pelvis (**C**) show absence of a normal spleen, with lobulated soft tissue nodules in the splenic fossa (white arrows, **A** and **B**) and a mass adjacent to the seminal vesicle in the pelvis (black arrow, **C**).

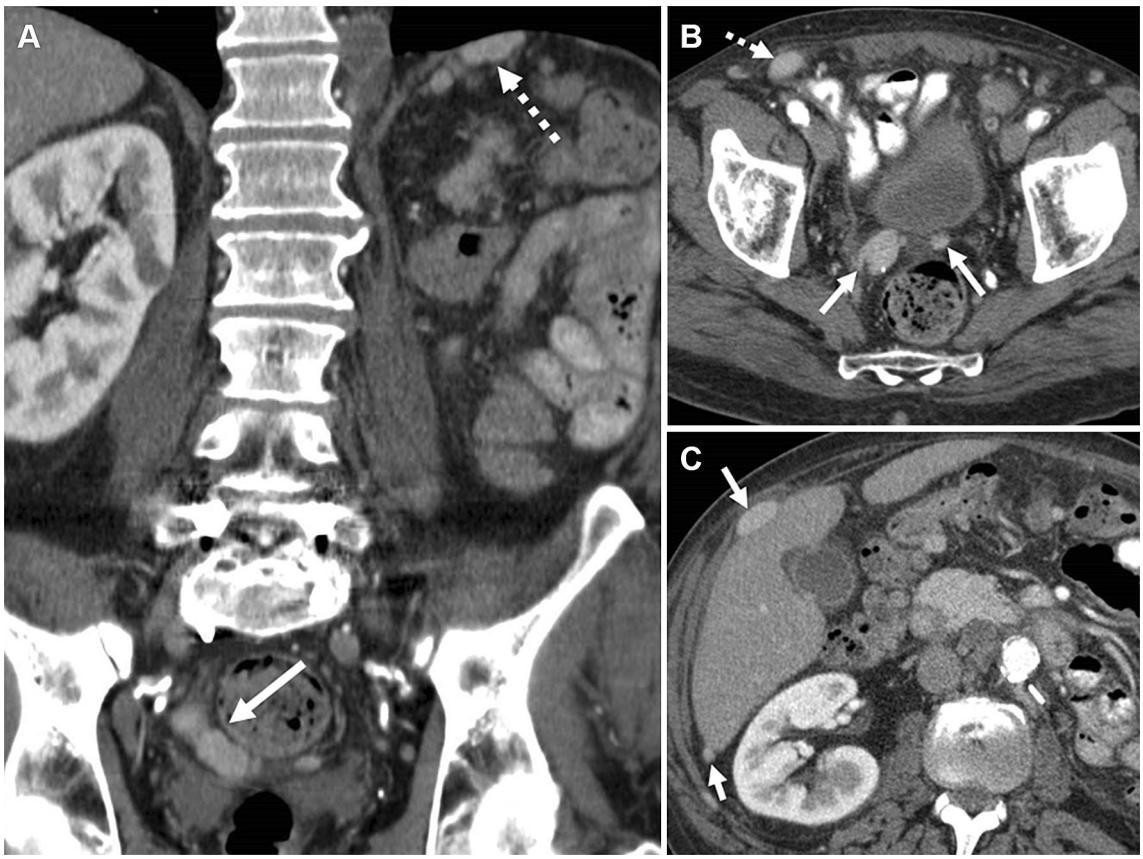


**Fig. 6.** Coronal (**A**) and axial (**B**, **C**) contrast-enhanced CT images demonstrate enhancing soft tissue nodules in the left upper quadrant (dotted arrow, **A**), in the pelvic peritoneal reflection adjacent to the seminal vesicles (solid arrow, **A** and **B**), right inguinal canal (dotted arrow, **B**) and in the perihepatic region (arrows, **C**).

**Compliance with ethical standards**

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**Conflict of interest** None.

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