International Journal of Scientific Research Updates

Journal homepage: https://orionjournals.com/ijsru/

ISSN: 2783-0160 (Online)

(REVIEW ARTICLE)

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Radiological study of splenosis: A great mimicker of tumor a literature review with case reports

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International Journal of Scientific Research Updates, 2023, 05(02), 054–059

Publication history: Received on 18 April 2023; revised on 26 May 2023; accepted on 29 May 2023

Article DOI: https://doi.org/10.53430/ijsru.2023.5.2.0043

Abstract

Splenosis is a harmless condition after a splenic injury or a spleen removal. It is heterotopic autotransplantation of splenic tissue seen inside the abdominal and pelvic holes. On imaging, various conditions can be differential diagnosis with splenosis, including metastatic infection, peritoneal carcinoma, peritoneal mesothelioma, stomach lymphoma, renal disease, hepatic adenomas, or endometriosis, dependent on its transmission. This review aims to increase public knowledge of this condition to avoid needless biopsies, surgeries, or treatments. Methods: We searched the PubMed and Scopus databases for relevant literature from 2002 through 2022 using the Medical Subject Headings Splenosis, Radiological, and Radionuclide diagnostic tools. In total, Thirty-five cases of splenosis were identified and reviewed. Conclusion: Splenosis should always be considered a differential diagnosis for soft tissue nodules in the abdomen and pelvis in patients with splenic surgery or trauma, especially without systemic symptoms. The literature documented only a few examples of splenosis, along with the radiologic features of these lesions. We review instances of splenosis identified by Scintigraphy, magnetic resonance imaging, computed tomography, and ultrasound. Our research expects this review to be considered a unique to compare the diagnosis made by radiologic and Radionuclide testing without any other form of treatment.

Keywords: Splenosis; US; CT; MRI; Scintigraphy

1 Introduction

They first used the term "splenosis" in 1939 by Buchbinder and Lipkopf to describe the implant of splenic tissue. (Buchbinder, J.H., 1939) It is a benign condition that can occur after spleen surgery or splenic trauma with rupture, such as stab wounds, gunshots, and car accidents. (Tandon, Coppa and Purysko, 2018). Most frequently, these splenic implants affect the diaphragmatic surface, mesentery, larger Omentum, Serosal surface of the small and large intestine, parietal peritoneum, and mesentery inside the abdominal and pelvic cavities. (Ribeiro, Silva and Santos, 2006) (Younan, Wills and Hafner, 2015). Splenic seeds may also be situated anywhere within the peritoneal cavity(Narin and Mutlu, 2002). Considering that splenosis occurs in the mesentery, Omentum, and peritoneum (Xuan et al., 2018) However, Splenic implants are observed in the liver, kidney, thorax, subcutaneous tissues, and occipital lobe of the brain in addition to these less familiar places. Up to 67% of individuals with splenic trauma are known to develop splenosis. (Imbriaco et al., 2008) However, because it frequently arises incidentally during imaging or surgery, the actual prevalence of this illness is still being determined. Depending on location, splenosis may be misdiagnosed on imaging as metastatic illness, peritoneal carcinomas, peritoneal mesothelioma, abdominal lymphoma, renal cancer, hepatic adenomas, or endometriosis. (Liu et al., 2012) The characteristic enlargement that resembles the spleen is a helpful indicator of splenosis. Splenosis can occasionally be similar to both benign and malignant masses in the peritoneum as well as in hollow and parenchymal abdominal organs, necessitating further testing, such as Scintigraphy using Tc99m-

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labeled heat-denatured red blood cells or biopsy in difficult situations. Vernuccio et al., in their visual essay, examine the imaging appearance and possible splenosis differential diagnoses based on the place of implantation. (Vernuccio et al., 2020). This review aims to increase public knowledge of this condition to stop needless biopsies, surgeries, and treatments.

2 Detection of splenosis using nuclear medicine

A Tc-99m sulfur colloid liver-spleen Scintigraphy was performed after computed tomography raised the possibility of thoracic splenosis. A scan of the liver and spleen with Tc-99m sulfur colloid revealed aberrant tracer distribution, with localized uptake in the locations corresponding to the left intrathoracic nodules and the splenic area reported by(Yammine, Yatim and Barbari, 2003). Horger said that spleen scintigraphy did on five individuals. After an intravenous injection of 99mTc-labeled Sn colloid (111 MBq, American Zinnkolloid/Amersham Health, Germany). A combined in vivo/in vitro labeling procedure using stannous pyrophosphate (TechneScan PYP/Tyco Healthcare, Germany), in vitro incubation with 99mTc pertechnetate, heating at 50°C for 15 min., and re-injection of 185 MBq was performed on two patients. They used A double-head gamma camera with high-resolution low-energy collimators (BodyScan/Siemens, Germany) to acquire planar images of the thorax and abdomen (anterior and posterior views) 20–30 min after injection. (Horger et al., 2003).Wick reported that he did Lung scintigraphy using Sulphur colloid and technetium 99mTc Indicator had radioactivity between 700 and 800 MBq was done30 minutes following the infusion, and the acquisition carried out in the static ad SPECT presentations. The lower pulmonary area was examined using a NuclineTM X-Ring/R gamma camera, low energy collimator, and Mediso-Interview software. A further investigation using heat-denatured red blood cells Heat-denatured red blood cell analysis and SPECT CT scan revealed a significant absorption of red cells within the pancreatic lesion as well as within the two accessory spleen-demonstrate a lesion that is partially calcified and is tightly associated with the tail of the pancreas, showing absorption of red blood cells

reported by (Wójcik et al., 2008), (Rogers et al., 2011). (Brandt et al., 2012) note that Patients underwent hepatosplenic Scintigraphy using SnTc99m-labeled colloidal stannous chloride (SPECT/CT) for single photon emission computer tomography. This examination was completed 20 minutes after the SnTc99m colloid tracer injection. This substance was injected and then ingested by the liver and spleen's phagocytic system, a component of the innate immune system. The patient was brought to the gamma camera for examination after administered the radiotracer and take photographs in the anterior, posterior, right, left, and oblique positions. (Lopes et al., 2014). The most common method for obtaining nuclear medicine images is Scintigraphy, which uses Tc-99m sulfur colloid, indium-111-marked platelets, or Tc-99mlabeled damaged by heat erythrocytes. Due to their greater sensitivity and specificity for splenic uptake and lesser uptake by liver tissue, the last two kinds were chosen due to the lack of these techniques in the service—and perform Tc-99 m stain colloid Scintigraphy. (Ekmekçi et al., 2015) The patient received an intravenous injection of one gr of the stannous ion (Sn+2) in pyrophosphate. Following a 20-minute incubation period at 49 °C, take a blood sample (about four ccs), add 20 mCi of NaTc99mO4, and the sample was re-injected into the patient. Scintigraphy started 20 to 30 minutes after that. High-resolution low-energy collimators are used to obtain 5-minute images of the abdomen in the anterior, posterior, left anterior oblique (LAO), left posterior oblique (LPO), and left lateral (LLAT) planes on traditional gamma imaging(Derlin et al., 2017) Following a kidney transplant, a 54-year-old the lady had 68 Ga-pentixafor PET/CT. The patient had undergone a kidney transplant eight years prior and had recurring urinary tract infections. A 68 Ga-pentixafor PET scan was carried out to find hidden infection foci. There were no infectious foci seen outside of the urinary tract. (Van Hecke et al., 2018) Carried out Ga-68 DOTA-NaI3-octreotide (NOC)-PET/CT imaging. A single-photon emission computed tomography (SPECT)/CT scan with technetium (Tc)-99m phytate revealed a large SSTR-expressing abdominal mass in the right fossa and several smaller deposits dispersed throughout the abdomen that was suspected to be NET with peritoneal metastases. The diagnosis of splenosis is more likely when all suspected lesions on Ga-68 DOTA-NOC-PET/CT also showed tracer uptake on Tc-99m phytate scintigraphy. (Holzgreve et al., 2022) Prepared technetium-99m heat-damaged RBCs as previously described and administered intravenously at a median activity of 148 MBq (Q1-Q3 interquartile range, 140-153 MBq). Using a low-energy high-resolution collimator, SPECT and planar imaging were carried out on a dual-headed Siemens Symbia T2 SPECT/CT or a Siemens Symbia Intevo T16 SPECT/CT system (Siemens Healthineers, Erlangen, Germany). The abdomen's planar photos were collected throughout a 10-minute period. Low-dose SPECT was previously described [4] and given intravenously. Using a low-energy high-resolution collimator, SPECT and planar imaging were carried out on a dual-headed Siemens Symbia T2 SPECT/CT or a Siemens Symbia Intevo T16 SPECT/CT system (Siemens Healthineers, Erlangen, Germany). The abdomen's planar photos were collected throughout a 10-minute period. 30 minutes after the administration of the tracer, the SPECT/low-dosage CT scan began. 32 projections per head, 25 seconds for each projection, and a projection grid of 128 × 128 pixels (4.7952 x 4.7952 mm2) were the SPECT acquisition settings

3 Detection of splenosis using radiologic images CT, MRI, and US

3.1 Hepatic Splenosis

Hepatic splenosis is a very uncommon disease. The case in our review is of a 38-year-old male hepatitis B virus carrier who had previously been in a motorbike accident and undergone splenectomy 14 years before the present episode. The radiologic imaging showed a benign tumor in the left hepatic lobe that was difficult to access with preoperative biopsy, and his laboratory values were consistent with a hypo-splenic condition. They found A bluish oval encapsulated lump in the tiny space between the diaphragm, falciform ligament, and left hepatic capsule due to laparoscopic investigation and thorough excision. Hepatic splenosis was the pathologic conclusion. It was treated by laparoscopic technique in the English literature, in contrast to previous patients with numerous intraperitoneal lesions and generally normal spleen. US, CT, and MRI results pointed to the presence of splenosis following prior trauma and splenectomy.

Radionuclide imaging confirmed the diagnosis. Identify the condition and handle using a minimally invasive technique. Liver splenosis is a rare type that is difficult to identify from other liver nodules; therefore, even though many of these instances have been documented, they can only be verified by histology.(Liu et al., 2012) also, a 54-year-old man is suspected of hepatocellular carcinoma after presenting with a liver tumor. The patient had undergone an emergency splenectomy following a high-altitude falling accident and was asymptomatic at the time. Segment IV of the left hepatic lobe was the site of a lesion, according to abdominal contrast-enhanced computed tomography. During the arterial phase, the lesion's amplification was uneven and decreased during the portal and equilibrium phases. On a contrast magnetic resonance imaging scan. Hepatocellular carcinoma was suspected. Thus a partial hepatectomy was done. They discovered Intrahepatic splenosis during the liver specimen's pathological analysis.(Xuan et al., 2018) . Ultrasound scanning of the liver with Doppler capability is noninvasive but has some limitations in case of slow flow and tiny vessels. The use of contrast-enhanced ultrasound CEUS can solve this problem. (Ahmed, 2020) A 21-year-old man complained of epigastric pain, had a history of epigastric trauma with splenic rupture, and had undergone splenectomy 15 years earlier. Physical examination results were expected. Laboratory test results were within normal limits. Ultrasonography showed a highly homogenous hypoechoic solid mass with an increased transmissivity of 34 x 23 mm in the liver left lobe of the liver. This lesion showed nonspecific arterial and venous color Doppler signals. A non-contrast abdominal CT scan showed that this mass was also restricted, slightly hypo dense, and had a pronounced hypo-dense border surrounding the lesion. After contrast administration, lesions were dense in the arterial phase, isodense in the portal phase (Fig. 2B), and hypo dense in the equilibrium phase. Abdominal magnetic resonance imaging was performed at 1.5 T using spin-echo and gradient-echo pulse sequences before and after intravenous administration of dimeglumine gadopentetate. (Narin and Mutlu, 2002)

3.2 Left upper quadrant (LUQ) Splenosis

A 67-year-old man with a history of nephrolithiasis complained of sudden-onset left flank discomfort and underwent computed tomography (CT) of the abdomen and pelvis without IV contrast to examine for urinary calculi. A CT scan detected a 4-mm stone in the left proximal ureter, which may explain the patient's symptoms. Additional observations revealed a limited mass of soft tissue in the pelvis between the bladder and rectum and multiple soft-tissue nodules in the upper left quadrant that could be the splenic fossa. Magnetic resonance imaging (MRI) further characterized the pelvic mass, which revealed a firm, smoothly increasing lesion in the rectovesical region. The patient underwent a urological examination and recommended a biopsy of the Tumor. But a closer look at the patient's past medical records revealed that he had had a splenectomy after a car accident when he was 18. Therefore, additional examination by sulfur colloid studies was suggested instead of a biopsy, as the spleen may have caused the pelvic mass. Sulfur colloid imaging found multiple foci of activity in the upper left quadrant, confirming the hypothesis of ectopic splenic tissue. On CT, this was consistent with putative splenic tissue and with focused pelvic imaging correlating with solid mass seen on CT and MRI. No further testing, treatment, or monitoring was recommended. (Tandon, Coppa and Purysko, 2018)

3.3 The mesenteric splenosis: Rare Etiology for Bowel Obstruction

The mesentery of the small intestine is a vascular-rich environment for the growth of splenic fragments. We had a gunshot wound to the left abdomen 15 years before our visit that required splenectomy and bowel resection, as well as a small bowel obstruction that required exploration, adhesion lysis, and resection of the mesenteric splenic plaque. We report the case of a 12-year-old male patient. A preoperative CT scan showed a transition point and a small hyper-intense mass measuring 2 × 3 cm in the left upper quadrant, causing mechanical small bowel obstruction. (Younan, Wills and Hafner, 2015)

3.4 Retro-Vesical Splenosis

This the case represents a 42-year-old man with a history of splenectomy. He was observed with an incidentally discovered posterior bladder mass and suspected ectopic testis. Abdominal laparotomy revealed multiple foci in the pelvic spleen. Because certain imaging studies can diagnose the spleen, splenosis should always be considered in the differential diagnosis of masses discovered years after splenic surgery or trauma. Common imaging modalities (US, CT, MRI) help identify and determine size, structure, and relationship to adjacent organs but are not specific. (Ribeiro, Silva and Santos, 2006)

3.5 Splenosis mimicking a renal neoplasm

They performed computed tomography (CT) and magnetic resonance imaging (MRI) in a rare case of multiple intraperitoneal splenomegalies located along the liver surface adjacent to the superior pole of the right kidney and mimicking a renal tumor. Describes the findings of A 39-year-old man with a history of Crohn's disease admitted to a hospital with persistent abdominal pain. His physical examination and medical history were unremarkable, except for a history of inflammatory bowel disease and an emergency splenectomy after a car accident at 15. Abdominal ultrasonography revealed a thickening of the small bowel wall at the level of the terminal ileum and minimal ascites in the peritoneal cavity. Ultrasonography also revealed the presence of a 4-cm solid echogenic mass in the superior pole of his right kidney. A spiral CT scan revealed a well-defined 3-cm mass in the subcapsular posterior segment 7 of the liver's right lobe adjacent to the superior pole of the right kidney. They performed a subsequent contrast-enhanced spiral MRI scan, which confirmed the presence of a 3-cm hepatic lesion along the posterior aspect of the seventh segment and immediately adjacent to the superior pole of the right kidney. (Imbriaco et al., 2008)

3.6 Pancreatic Head Splenosis

A 53-year-old man was referred to our ultrasound department to evaluate a pancreatic mass incidentally discovered during a transabdominal examination in the United States previously at another hospital. The patient also underwent endoscopic ultrasound (EUS) and extremity CT at the same hospital and diagnosed the mass as an inflammatory pancreatic pseudotumor. The patient had undergone a splenectomy due to a traffic accident 20 years earlier. He had no significant comorbidities. In particular, the patient had no history of pancreatic disease. His physical examination was negative. We report a rare case of intrapancreatic splenosis presenting as a hypoechoic mass in the head of the pancreas in the United States and accurately diagnosed by contrast-enhanced ultrasonography (CEUS). Although an accessory intrapancreatic spleen is not uncommon, intrapancreatic splenosis is a rare condition that can pose differential diagnostic problems. The diagnostic procedure of choice is core scintigraphy(Report, 2007)

3.7 Subcutaneous Splenosis of the Abdominal Wall

A 43-year-old woman who underwent splenectomy due to traumatic spleen rupture at seven years presented for postoperative scar reconstruction. Two asymptomatic subcutaneous nodules were discovered incidentally during her surgery—they confirm the presence of splenic tissue by histological examination. They did not remove the nodule because the patient was asymptomatic. (Papakonstantinou et al., 2013)

4 Methods

We searched the PubMed and Scopus databases for relevant literature from 2002 through 2022 using the Medical Subject Headings (MeSH) "Splenosis." diagnostic tool by Radiological and radionuclide examination. Many Cases of splenosis were identified and reviewed. Most patients were asymptomatic on admission, except for a few who experienced abdominal pain. US, CT, and MRI were common imaging modalities, but they could not clearly distinguish the spleen from other lesions, such as tumors, metastases, and intestinal obstruction. They obtained Scintigraphy in some patients and a correct diagnosis without further invasive measures—most of the spleen was located in the Omentum. The patient had undergone an invasive procedure. Surgery such as laparoscopic resection or laparotomy was the most common invasive procedure, followed by biopsy.

5 Discussion

Splenosis is an acquired heterotopic splenic tissue that has restored function and perfusion after transplantation into a vascular-rich intra- or extra-abdominal environment. Therefore, their vessels are not connected to the splenic artery. The mechanism of splenic fragments spreads through an immediate dissemination process to adjacent surfaces or via hematological diffusion to distant organs such as the liver, breast, and brain. Most cases of spleen occur after traumatic splenectomy. Still, a few cases occur due to elective splenectomy for hematological disorders A few reviews state that

splenic trauma is responsible for up to 93% of all splenosis cases. The mean time from splenectomy to clinical diagnosis of the spleen varies from month to 40 years. Most stenosis is asymptomatic, and deposits are found incidentally in imaging studies and studies of other medical conditions. (Ribeiro, Silva and Santos, 2006)The above splenic diagnoses are usually confirmed after imaging and other surgical tests for the disease. Standard CT and MRI scans can locate and describe the anatomic location of these deposits with adequate sensitivity. Iron oxide-enhanced MRI has recently been used to increase sensitivity in detecting iron oxide particles incorporated into the reticuloendothelial system of the spleen and liver. A technetium (Tc) radionuclide scan is considered the gold standard for spleen diagnosis. Scintigraphy of TC 99m-labeled heat-damaged autologous red blood cells or Indium 111-labeled platelets is more sensitive when it is necessary to distinguish between liver and spleen tissue. (Younan, Wills and Hafner, 2015)

6 Conclusion

In summary, splenosis is a benign mass involving auto grafting of splenic tissue to various surfaces within the abdominal cavity or distant organs. Although splenic deposits are primarily asymptomatic, they can cause multiple conditions, ranging from pain, bleeding, and constipation, and expose patients to unnecessary surgery. Clinical caution is required to avoid invasive procedures in splenectomy patients, as asymptomatic splenic deposits are not risky and cannot be respected.

- Splenosis is much more common in up to 75% of all patients undergoing splenectomy for traumatic injury.
- Splenosis should be considered in the differential diagnosis of masses discovered years after splenic trauma or surgery.
- Invasive therapy is not recommended for asymptomatic patients as the spleen may provide beneficial immune function.
- The aim of this review is to develop an awareness of the increased incidence and survival of the spleen as a cause of intestinal obstruction, especially after abdominal trauma requiring splenectomy. We also emphasize the importance of history and physical examination to add splenosis to the differential diagnosis list for intestinal obstruction.
- In conclusion, all patients with a history of splenic surgery or trauma should consider the splenosis hypothesis in the differential diagnosis of newly discovered masses.

Compliance with ethical standards

Acknowledgments

We thank Inaya medical colleges for providing us direct technical help and data base.

Disclosure of conflict of interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

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