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CASE REPORT

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Thoracic Splenosis after a Gunshot: Diffusion-Weighted MRI Findings

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Summary

Background: Intrathoracic splenosis is a rare condition resulting from concomitant rupture of the spleen and left hemidiaphragm after a traumatic event involving the spleen and the diaphragma and is defined as autotransplantation of splenic tissue in thorax.

Case Report: The aim of this study was to present a case report of a combined intrathoracic and subcutaneous splenosis in a patient 19 years after penetrating trauma. She has left dorsal side pain and routine chest roentgenogram shows pleural nodular masses. The patient was referred to us for radiologic work up.

Conclusions: The MRI scans revealed the intrathoracic and subcutan masses as mainly hypointense on T1-weighted images and hyperintense on T2-weighted images and significant restriction in diffusion-weighted images. Scintigraphy revealed abnormal hot spots in subcutaneous tissue and diaphragmatic pleura of the left hemithorax.

MeSH Keywords: Diffusion Magnetic Resonance Imaging • Multidetector Computed Tomography • Splenosis

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Background

Splenosis refers to heterotopic autotransplantation and implantation of splenic tissue, usually occurring after a splenic trauma or surgery. It results from mechanical or hematogenous autotransplantation and ectopic growth of splenic tissue, producing nodular lesions at variable sites and organs of the body [1].

Splenic implants may be located anywhere in the peritoneal cavity but they usually occur on the serosal surface of the small intestine and colon,the parietal peritoneum and the subdiaphragmatic area [2]. Splenosis is mostly an asymptomatic disease that leads to unnecessary investigation in order to differentiate it from other benign or malignant lesions. When multiple sites (with several manifestations) are involved, the situation becomes more complex. The diagnosis is challenging if splenosis is not suspected.

We reported on a case of combined intrathoracic and subcutaneous splenosis, 19 years after a thoracoabdominal penetrating trauma diagnosed on the basis of enhanced magnetic resonance imaging (MRI) and ^{99m}Tc-labeled heat-damaged red blood cell (RBC) scintigraphy.

Case Report

A 39-year-old woman was referred to general surgery department because of a left dorsal pain. On a routine chest X-ray she had pleural nodular masses (Figure 1). A history of the patient revealed a penetrating (gunshot) left thoracoabdominal trauma 19 years earlier. She reported that her spleen had been removed and her diaphragm repaired at that time. Physical examination showed no abnormalities.

A contrast-enhanced CT study of the chest demonstrated a soft-tissue lesion within the subcutaneous tissue of the posterolateral wall of the left hemithorax (Figure 2). In addition, nodular lesions were found in the costal and diaphragmatic pleura of the left hemithorax (Figure 3). Intrathoracic and subcutaneous splenosis were suspected because of the history of trauma and imaging findings. MRI

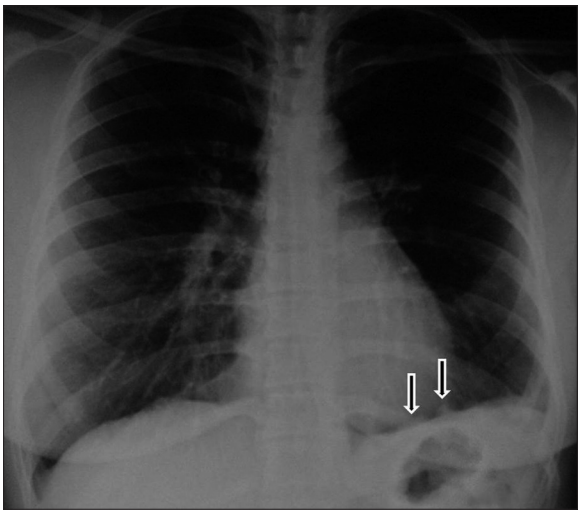

Figure 1. Post-anterior chest X-ray showing the pleura-based nodules (arrows) in the left hemithorax.

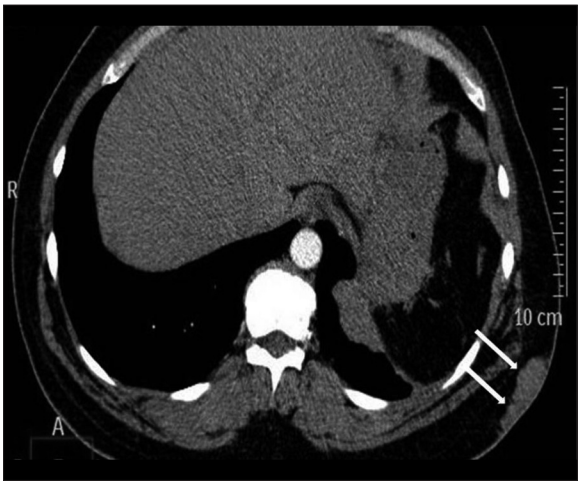

Figure 2. Axial contrast-enhanced CT revealed soft-tissue lesions (arrows) in the subcutaneous tissue of the posterolateral wall of the left hemithorax.

and ^{99m}Tc-labeled heat-damaged red blood cell (RBC) scintigraphy were performed for further evaluation.

MRI examinations were performed on 1. 5-T MRI systems (Avanto MRI systems; Siemens Medical Systems, Malvern, PA) using a phased-array torso coil.

The MRI scans revealed intrathoracic and subcutaneous masses as mainly hypointense on T1-weighted images and hyperintense on T2-weighted images. Homogeneous contrast uptake was observed in intrathoracic and subcutaneous lesions in post-contrast images. The subcutaneous lesion and posterior costal pleural lesion showed significant restriction in diffusion-weighted images (Figure 4). Region of interest was drawn on the ADC map and ADC values were determined 1. 10×10^{-3} mm^2/s and 0. 963×10^{-3} mm^2/s, respectively (Figure 5).

Scintigraphy with anteroposterior planar images, for the lower chest and upper abdomen were obtained about 30 minutes after intravenous injection of 6 mCi of

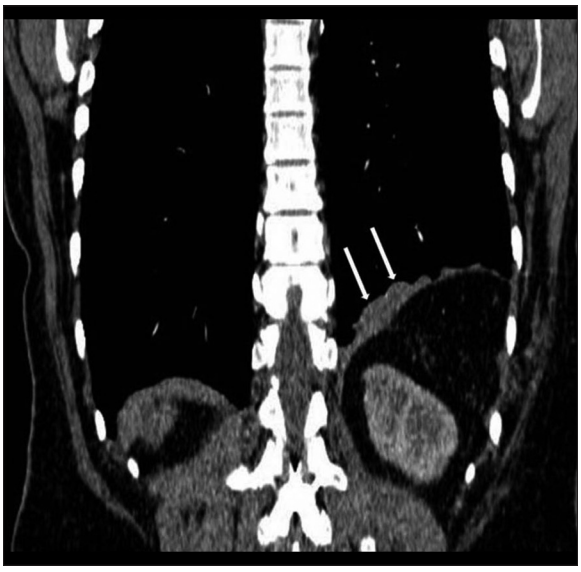

Figure 3. Of note is the soft-tissue lesions (arrows) on the left diaphragmatic pleura on coronal CECT images.

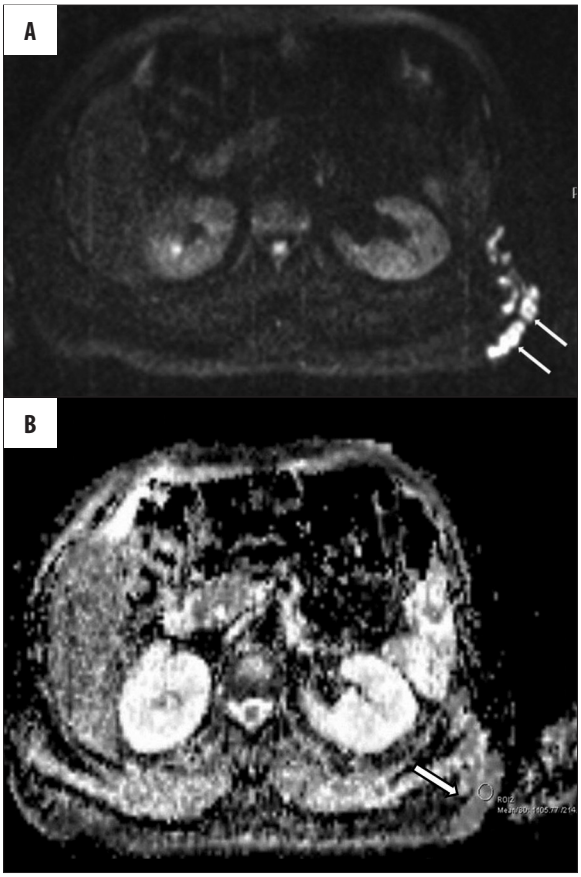

Figure 4. A diffusion-weighted image (**A**) and diffusion coefficient map (**B**) show a significant restriction of the lesions (arrows) within subcutaneous tissue of the posterolateral wall of the left hemitorax. ADC value was calculated.

^{99m}Tc-labelled heat-denatured red blood cells (RBC). The posterior planar image revealed abnormal hot spots in the subcutaneous tissue and diaphragmatic pleura of the left hemithorax (Figure 6).

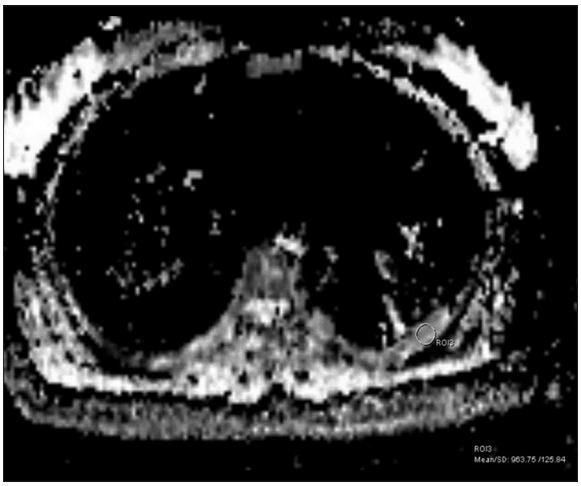

Figure 5. ADC values calculated for the left costal pleural lesion.

Discussion

Splenosis represents autotransplantation after removal of the spleen secondary to a traumatic rupture or surgery. The prevalence of splenosis after traumatic splenectomy ranges from 16% to 67% [1]. The reported average interval between the injury and diagnosis is 18.8 years (range, 5 months to 32 years). Splenosis most frequently occurs in the peritoneal cavity, including the serosal surface of the small intestine and colon, parietal peritoneum, mesentery and diaphragmatic surface [2]; however, uncommon locations such as the retroperitoneal space [3], liver parenchyma [4], subcutaneous tissue [5], and even brain have been reported [6].

The pathonegenesis of splenosis is not clearly explained. Hence, it is impossible to predict when splenic implants will develop. There are two potential mechanisms behind autotransplantation. The first seeding process of spillage of the damaged splenic pulp into the adjacent cavities is a result of a splenic rupture, which can follow either from a trauma, as in our case, or surgical removal [7–9]. The second mechanism is via blood spread of splenic pulp as hypothesized in case reports on intrahepatic splenosis [10,11]. The newly implanted splenic tissue is supplied by adjacent tissues and matures in a benign fashion. The splenic implants are sessile or pedunculated reddish blue nodules ranging from a few millimeters to 7 cm in diameter [1,12].

Intrathoracic splenosis is a rare condition resulting from a concomitant rupture of the spleen and left hemidiaphragm. It follows a traumatic event involving the spleen and the diaphragm and is defined autotransplantation of splenic tissue in the thorax. Subcutaneous splenosis is extremely rare. To the best of our knowledge, only 11 cases have been reported in the literature with histories of splenic rupture [13].

Methods of routine diagnosis include scanning (technetium-99m-labeled sulfur colloid, technetium-99m tagged heat-damaged red blood cells and indium-111-labeled platelets) [14], needle computed tomography, magnetic resonance examination, radionucleotide aspiration and the Tru-cut needle biopsy [15].

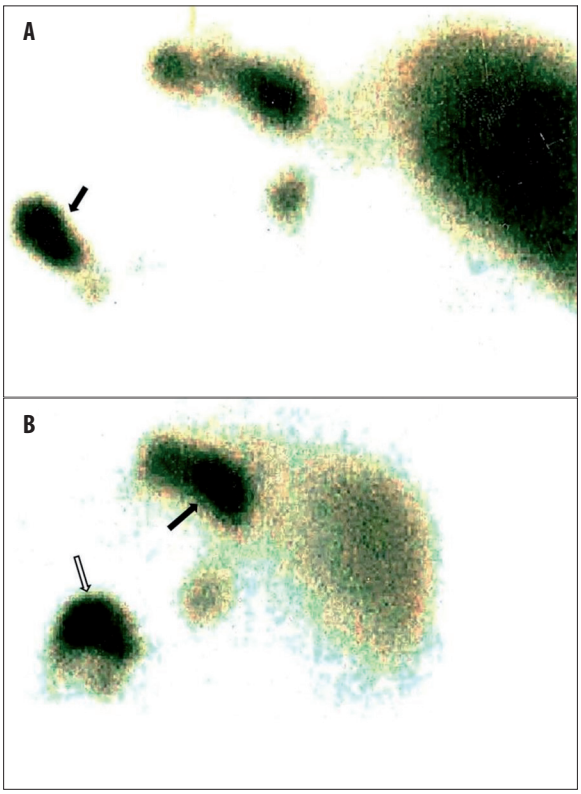

Figure 6. (**A**) A posterior view of 99mTc-labeled heat-damaged red blood cell (RBC) scan shows multiple areas of increased activity in the subcutaneous tissue (arrow). (**B**) The posterior planar image revealed abnormal hot spots on the diaphragmatic (arrow) and posterior costal pleura (open arrow).

Thoracic splenosis typically presents as single or multiple subpleural masses on computed tomographic scan. Pleural-based implants may occur on the parietal or visceral pleura [16]. Pleura-based nodules and masses on chest X-ray or CT are nonspecific and have a differential diagnosis including malignant lymphoma, mesothelioma, and metastatic disease as well as solitary fibrous tumor or pleural plaques [17].

Splenosis can also be diagnosed with scintigraphy. The ^{99m}Tc-labeled Sn colloid is sequestered in reticuloendothelial cells, and can be useful for detecting the whole ectopic splenic tissue. Another radionuclide imaging technique using ^{99m}Tc-labeled heat-damaged red blood cell (RBC) scintigraphy is preferred because of reduced radiotracer uptake by normal liver tissue, resulting in an improved target-to-background ratio. Moreover, the technique is considered more sensitive and specific for splenic tissue and phagocytes [17]. In the present case, ^{99m}Tc-labeled heat-damaged red blood cell (RBC) scintigraphy showed increased uptake in the lesions corresponding to nodules on CT and MRI scans.

On conventional MRI, splenic implants are hypointense on T1-weighted images and hyperintense on T2-weighted images. This MRI appearance is similar to that of a normal spleen [18]. In our case the MRI appearances of the lesions in the subcutaneous fat tissue and pleura were similar to the normal spleen on T1- and T2-weighted images.

In our case, the lesions showed a homogeneous uptake but no serpiginous enhancement was found in contrast-enhanced images. This can be attributed to the small size of the lesions. Heredia et al. reported a similar finding: large lesions displayed a serpiginous enhancement pattern while the small ones showed homogeneous uptake on contrast-enhanced MR studies of the intrapancreatic accessory spleen [19].

Diffusion-weighted imaging is a standard method of central nervous system imaging (20) and it may also be used in other abdominal organs such as spleen. A normal spleen presents with high signal intensity on images due to hypervascularity that results in a restricted diffusion pattern [21]. According to literature, the spleen has the most restricted diffusion, while the kidney has the least restricted diffusion [22]. This was proved quantitatively by another study [23] where the spleen was found to exhibit the lowest ADC value of all visceral organs ($1.26\times0.23\times10^{-3}$ mm^2/s).

In the present case, in diffusion-weighted images, lesions showed a significant restriction pattern, similar to the spleen, and the associated ADC values were found to be close to those reported for healthy spleen tissue in literature. Our literature review showed that there are no significant differences in ADC values or DWI characteristics of the spleen between pre- and post-administration of intravenous contrast [24].

Conclusions

In conclusion, a nodular mass over the base of the pleura or in subcutaneous tissue of the left hemithorax, especially the one accompanying a diaphragmatic laceration in any patient with a history of thoracoabdominal blunt or penetrating trauma, should remind the physicians of probable intrathoracic splenosis. If intrathoracic splenosis is diagnosed preoperatively, unnecessary surgical procedures can be avoided. We believe that an MRI study including diffusion-weighted sequences should be performed as first because of its higher diagnostic value and the use of DWI may replace scintigraphy as a conclusive method to confirm splenosis. When the diagnosis is equivocal, scintigraphy is performed as a further examination.

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