INTRODUCTION

Abdominal splenosis is the spontaneous transplantation of splenic tissue to unusual sites (8). This situation usually occurs after splenic trauma or surgery. Another cause is the failure of coalescence during migration of mesenchymal cells of the splenic primordium (15). The deposition of isolated cells from the spleen appears as bluish-red nodules, which can affect the peritoneum, mesentery, liver, kidney and pancreas (8, 15). Pancreatic splenosis (PS) is found, in most cases, by chance and does not require surgical resection once accurately diagnosed (14). Pancreatic splenosis was found most commonly in the tail, was round, hypoechoic, with homogeneous pattern, regular borders, and with scintigraphy negative for somatostatin receptors. The average diameter of these nodules identified by endoscopic ultrasound was 2.15 cm. Microhistology obtained by EUS-FNA confirmed the diagnosis in 9/10 patients. Conclusion - Pancreatic splenosis can be diagnosed by EUS-FNA. Microhistology prevents unnecessary surgeries, and reassures asymptomatic patients with hypoechoic, homogenous, and well circumscribed pancreatic nodules.


ABSTRACT - Context - Pancreatic splenosis is a benign condition which can mimic a pancreatic neoplasm. Objective - To describe the role of the endoscopic ultrasound-guided fine-needle aspiration (EUS-FNA) of pancreatic nodules suspicious for pancreatic splenosis. Method - From 1997 to 2011, patients with pancreatic solid tumors suspicious for splenosis by computed tomography and/or magnetic resonance imaging were referred to EUS-FNA. Those cases with pancreatic splenosis confirmed by EUS-FNA or surgery were included. Endosonographic findings and clinicopathologic features were also analysed. Results - A total of 2,060 patients with pancreatic solid tumors underwent EUS-FNA. Fourteen (0.6%) cases with pancreatic splenosis were found. After applying exclusion criteria, 11 patients were selected. Most patients were male (7), young (mean age: 42 years) and asymptomatic (8). Endoscopic ultrasound imaging alone suspected pancreatic splenosis in 6 cases, and neuroendocrine tumors in 5 cases. Pancreatic splenosis was found most commonly in the tail, was round, hypoechoic, with homogeneous pattern, regular borders, and with scintigraphy negative for somatostatin receptors. The average diameter of these nodules identified by endoscopic ultrasound was 2.15 cm. Microhistology obtained by EUS-FNA confirmed the diagnosis in 9/10 patients. Conclusion - Pancreatic splenosis can be diagnosed by EUS-FNA. Microhistology prevents unnecessary surgeries, and reassures asymptomatic patients with hypoechoic, homogenous, and well circumscribed pancreatic nodules.

METHOD

From January 1997 to October 2011, 2,060 patients with solid pancreatic tumors underwent EUS-FNA at Endoscopic Ultrasound Units from Hospital 9 de Julho, São Paulo, SP, and Hospital das Clínicas, Ribeirão Preto Medical School, Ribeirão Preto, SP, Brazil. In this retrospective study, patients were selected based on pancreatic nodules suspicious for splenosis receptors is the method of choice for diagnosis of NETs, but it still can fail to confirm the tumor in a significative number of cases(15). The aim of this study was to describe the clinical and endosonographic findings, as well as demonstrate the value of microhistology obtained by endoscopic ultrasound-guided fine-needle aspiration (EUS-FNA) for the diagnosis of pancreatic splenosis.
by computed tomography (CT) and/or magnetic resonance imaging (MRI), who were evaluated by EUS, and submitted to FNA with microhistology analysis. Patients with splenosis or accessory spleen located around the pancreatic tail were excluded. The following data were recorded: demographics, imaging findings, and clinicopathologic features.

Once obtained the informed consent for the procedure, patients were sedated with propofol associated with midazolam and fentanyl under cardiorespiratory monitoring. All procedures were performed by the same echoendoscopist with extensive experience in diagnostic and therapeutic echoendoscopy (JCA). The sectorial echoendoscopes used were: Pentax FG 38-UX (Pentax Precision Instruments Corp., Orangeburg, NY, USA) coupled to an ultrasound unit Hitachi EUB 515 (Mitsubishi, Conshocken, Phila, USA), Olympus UCT-160 OL5 (Olympus Optical Corp., Ltd., Tokyo, Japan) coupled to an ultrasonic unit UC-60 (Suzy-Olympus Optical Corp. Ltd., Tokyo, Japan), and Fujinon EG-530UT (Fujifilm Optics Corp. Ltd., Sano, Japan) coupled to an ultrasonic unit SU7000 (Kodai Hi Tec Corp. Ltd., Saitama, Japan). Only needles of 22 gauge and length of 145 cm (Medi Glove, Medizintechnik GMBH, Grassau/Germany) were used for the punctures. Color Doppler was used to ensure the absence of vascular structures along the path of the needle and to assess whether the lesion was hypervascular. The endosonographic features took into account were: location, size, shape, borders, echotexture, and homogeneity. After puncturing the tumor, core specimens were obtained by flushing the needle with 2 mL of saline and then by reintroduction of the stylet inside the needle. All material was placed in 10% buffered neutral formalin solution. As an on-site cytopathologist was not available in our routine, the specimens were considered satisfactory in the presence of non-hemorrhagic small tissue filaments or tissue core samples. The specimens were sent to pathologist with expertise in pancreatic pathology (FV), and prepared according to a previously described cell block technique\(^2\). Diagnosis of PS was based on demonstration of aggregates of splenic tissue, with red and white pulp, scarce pancreatic acinar tissue, and, in the presence of specimens enough for analysis, immunohistochemical studies for synaptophysin and chromogranin-A.

**Statistical analysis**

Demographics, clinical features, endosonographic and pathologic findings were recorded. Continuous variables were described as mean and standard deviation, and dichotomous variables were expressed as simple ratios.

This study was approved by the Ethics Committee of both institutions. Beforehand, every patient gave his/her informed consent for the EUS-FNA of pancreatic nodules, and for evaluation of the specimens by microhistology techniques. The protocol of this study followed the parameters and ethical rules established by the Declaration of Helsinki of World Medical Association, which regulates ethical principles involving medical research on humans.

**RESULTS**

Overall, 14 (0.6%) patients were selected. After applying exclusion criteria, we selected 11 cases with a mean age of 42.3 years (range: 20-56 years). Demographics, imaging and pathology findings of these cases are presented in the Table 1. Most of these patients were men [seven (63%)] and

### TABLE 1. Demographics, imaging and pathology findings of pancreatic splenosis

<table>
<thead>
<tr>
<th>n</th>
<th>Age</th>
<th>Gender</th>
<th>History</th>
<th>Symptoms</th>
<th>trauma</th>
<th>CT</th>
<th>MRI</th>
<th>Cytography</th>
<th>EUS diagnosis</th>
<th>Size (cm)</th>
<th>Shape</th>
<th>Site</th>
<th>Echotexture</th>
<th>Border</th>
<th>Microhistology</th>
<th>IHC</th>
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<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>F</td>
<td>Asymptomatic</td>
<td>No</td>
<td>No</td>
<td>Nodule</td>
<td>NA</td>
<td>NA</td>
<td>NET</td>
<td>1.5x1.2</td>
<td>round</td>
<td>Tail</td>
<td>Homogenous</td>
<td>Well-defined</td>
<td>PS</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>70</td>
<td>F</td>
<td>Ovarian tumor</td>
<td>No</td>
<td>Yes</td>
<td>Nodule</td>
<td>NA</td>
<td>NA</td>
<td>NET</td>
<td>1.5x1.2</td>
<td>round</td>
<td>Tail</td>
<td>Homogenous</td>
<td>Well-defined</td>
<td>NET</td>
<td>No</td>
</tr>
<tr>
<td>3</td>
<td>42</td>
<td>M</td>
<td>Epigastric Pain</td>
<td>Yes</td>
<td>No</td>
<td>NA</td>
<td>Nodule</td>
<td>Neg</td>
<td>PS</td>
<td>1.3x1.0</td>
<td>Oval</td>
<td>Tail</td>
<td>Homogenous</td>
<td>Well-defined</td>
<td>PS</td>
<td>Yes</td>
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<tr>
<td>4</td>
<td>43</td>
<td>M</td>
<td>Cirrhosis</td>
<td>No</td>
<td>No</td>
<td>Nodule</td>
<td>Neg</td>
<td>NA</td>
<td>NET</td>
<td>3.5x1.9</td>
<td>Oval</td>
<td>Tail</td>
<td>Homogenous</td>
<td>Well-defined</td>
<td>PS</td>
<td>Yes</td>
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<tr>
<td>5</td>
<td>50</td>
<td>M</td>
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<td>Yes</td>
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<td>NA</td>
<td>Neg</td>
<td>PS</td>
<td>2.1x0.9</td>
<td>Oval</td>
<td>Head</td>
<td>Homogenous</td>
<td>Well-defined</td>
<td>PS</td>
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<td>Acute pancreatitis</td>
<td>Yes</td>
<td>Yes</td>
<td>Nodule</td>
<td>Nodule</td>
<td>Neg</td>
<td>NET</td>
<td>3.6x1.5</td>
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<td>Tail</td>
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<td>No</td>
<td>Nodule</td>
<td>PS (?)</td>
<td>NA</td>
<td>PS (?/?)</td>
<td>1.8x1.4</td>
<td>round</td>
<td>Tail</td>
<td>Homogenous</td>
<td>Well-defined</td>
<td>PS</td>
<td>Yes</td>
</tr>
<tr>
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<td>30</td>
<td>M</td>
<td>Acute pancreatitis</td>
<td>Yes</td>
<td>Yes</td>
<td>Nodule</td>
<td>Nodule</td>
<td>Neg</td>
<td>PS (?)/?)</td>
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<td>Tail</td>
<td>Homogenous</td>
<td>Well-defined</td>
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<td>Yes</td>
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<tr>
<td>9</td>
<td>56</td>
<td>M</td>
<td>Asymptomatic</td>
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<td>No</td>
<td>Nodule</td>
<td>NA</td>
<td>NA</td>
<td>NET</td>
<td>1.2x1.0</td>
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<td>Body</td>
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<td>Well-defined</td>
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<td>No</td>
<td>Nodule</td>
<td>NA</td>
<td>PS (?)/?)</td>
<td>PS (?/?)</td>
<td>1.9x1.7</td>
<td>round</td>
<td>Tail</td>
<td>Homogenous</td>
<td>Well-defined</td>
<td>PS</td>
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</tr>
<tr>
<td>11</td>
<td>56</td>
<td>M</td>
<td>Asymptomatic</td>
<td>No</td>
<td>Yes</td>
<td>Nodule</td>
<td>NA</td>
<td>NA</td>
<td>PS</td>
<td>1.8x1.4</td>
<td>round</td>
<td>Tail</td>
<td>Homogenous</td>
<td>Well-defined</td>
<td>PS</td>
<td>Yes</td>
</tr>
</tbody>
</table>

NA: not available
NET: neuroendocrine tumor
IHC: immunohistochemistry
asymptomatic [eight (73%)]. Three (27%) cases presented abdominal pain. Previous history of abdominal trauma was detected in four (36%) cases [blunt abdominal trauma (two) and car accident (two)], and one (10%) patient had previous abdominal surgery for ovarian cancer. Six (54%) patients had no report of abdominal trauma or surgery.

Imaging findings of round pancreatic nodule in the tail obtained by CT and/or MRI, with well-defined borders, showing the same echotexture of the spleen, and positive scintigraphy for somatostatin receptors, were not enough to think about splenosis in two (18%) cases (Figure 1).

Primary indications for EUS-FNA were: suspicious for nonfunctioning NET (eight), PS (two) and lymphoma (one). EUS imaging alone suspected PS in six (54.5%) cases, and nonfunctioning NET in five (45.5%) cases. The number of nodules identified by EUS was 13 in 11 patients. Nodules were found in the tail (nine), head (two), body (one) and around the pancreatic head (one). The lesions were solitary in most cases (10), and 1 patient had three lesions, 2 in the pancreatic head, and another one around the pancreatic head. EUS revealed round (seven) and oval nodules (four), with average diameter of 2.15 cm.

EUS-FNA was successful in 10/10 patients with an average of 2.2 passes (range: 2-3) without any complication. Final diagnosis was obtained by microhistology (Figure 2) in 9/10 (90%) cases. Immunohistochemistry was performed in 7/10 cases (70%), and all these cases were negative for synaptophysin and chromogranin-A. In a single case, EUS-FNA made the diagnosis of a neuroendocrine tumor, which was modified to splenosis after subtotal pancreatectomy without splenectomy. Another false-positive for NET, also referred to surgery, occurred in a patient not submitted to FNA who was evaluated by EUS imaging alone (Figure 3).

**DISCUSSION**

Pancreatic splenosis occurs usually after splenic trauma, such as automobile accidents, stab or gunshot wounds, and surgery. This occurred in almost 46% of our patients. On
Ardengh JC, Lopes CV, Kemp R, Lima-Filho ER, Venco F, Santos JS. Pancreatic splenosis mimicking neuroendocrine tumors: microhistological diagnosis by endoscopic ultrasound guided fine needle aspiration

Pancreatic NETs are rare, accounting for less than 10% of the pancreatic solid tumors, and are often located in the pancreatic head(1, 6, 20). These tumors are symptomatic in 15% to 53% of the cases due to secretion of biologically active substances. The remaining are nonfunctioning and usually asymptomatic, although 50% are malignant and require surgical resection(6, 13).

The literature reports 13 cases of accessory spleen simulating pancreatic tumors, all of them submitted to surgical resection(7, 15, 25). In our series, two patients were submitted to surgery for suspicion of NETs, both of them due to false-positive diagnoses, one case by the microhistology evaluation, and the other one by the EUS imaging alone in a patient not submitted to FNA. In regard to imaging assessment, PS is a round and homogeneous lesion with well-defined borders(3). Most of these lesions are small, less than 2 cm in diameter(9). However, a definitive diagnosis of PS based on imaging alone can be difficult because CT, MRI and EUS images are very similar to those found in hypervascular pancreatic tumors such as islet cell tumors and acinar cell carcinoma(7, 18, 22, 23).

In our experience, EUS imaging misinterpreted pancreatic nodules, round, homogeneous and with well-defined borders as a NET in 45.5% of the cases. All of these patients have previously been submitted to other imaging procedures (CT and/or MRI) and the echoendoscopist was not blind for these results. Despite their poor contribution for the diagnosis of splenosis, this fact could have influenced the diagnosis of EUS imaging alone. These results are similar to those found by Barawi et al.(3). These authors highlight that PS or a splenic lobulation can also be misinterpreted as malignant tumors by EUS imaging alone. Besides, PS can be hyperechoic (a fact that did not occur in any of our cases) with a homogeneous pattern, which could complicate much more the differential diagnosis of pancreatic nodules based only on EUS imaging. These authors point out that a regular margin and the anatomic location could help prevent misdiagnosis. In addition, CT could be useful to confirm the diagnosis(3). Unlike the experience by Barawi et al,(3), CT and MRI did not identify PS in our series.

Somatostatin receptor scintigraphy has high sensitivity for detection of gastrointestinal NETs (70%-95%), but false-positive results can occur, specially for small lesions(17). This is due to the presence of somatostatin receptors on the surface of lymphocytes in the ectopic splenic tissue, which also have high affinity to octreotide, mimetizing a neuroendocrine tumor(17, 19). In the experience by Heredia et al.(11), gadolinium MRI suspected splenosis in 3/5 patients, but it was not capable to exclude other diagnoses, including NETs, solid-cystic pseudopapillary adenocarcinoma and metastasis.

In our series, MRI raised a suspicion for a PS in only one case. Medical literature refers only three articles about the role of EUS-FNA in the diagnosis of PS(4, 12, 24). These three studies reported 10 cases of PS in pancreatic tail with a sensitivity of 100%. Any diagnostic method should be used in an attempt to increase the accuracy in favor of PS and, this way, avoid unnecessary surgeries. In our series, microhistology obtained by FNA confirmed the diagnosis of PS in 90% of the cases. We had only a false-positive result for a NET in the beginning of our experience.
CONCLUSIONS

Echodendoscopic findings of pancreatic splenosis can be challenging. Even for the most common finding - an hypoechoic, homogeneous, and well circumscribed nodule - EUS-FNA should be mandatory to confirm the lesion as a neuroendocrine tumor or a pancreatic splenosis. The identification of splenic tissue by microhistology obtained by EUS-FNA prevents not only an unnecessary surgery for small nodules, but also reassures a young asymptomatic patient with a pancreatic nodule.

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REFERENCES


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