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Solitary fibrous tumor in the abdomen and pelvis: A case series with radiological findings and treatment recommendations☆

Adrian Fernandez[a,*], Miles Conrad[b], Ryan M. Gill[c], Won-Tak Choi[d], Vishal Kumar[e], Spencer Behr[e]

[a] 1001 Potrero Ave, San Francisco, CA 94110, United States
[b] UCSF School of Medicine, Department of Radiology, 1001 Potrero Ave, San Francisco, CA 94110, United States
[c] UCSF School of Medicine, Department of Pathology, Box 0102, 505 Parnassus Avenue, Room M-559, San Francisco, CA 94143, United States
[d] UCSF School of Medicine, Department of Pathology, 505 Parnassus Avenue, Room M-552, Box 0102, San Francisco, CA 94143, United States
[e] UCSF School of Medicine, Department of Radiology, 505 Parnassus Avenue, San Francisco, CA 94117, United States

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ABSTRACT

This study presents the radiological findings of seven cases of solitary fibrous tumor (SFT) in the abdomen and pelvis. A retrospective search of the pathology database at our institution was performed to identify cases of SFT in the abdomen and pelvis. After identifying seven cases, cross-sectional imaging was reviewed and characterized.

We conclude that SFTs in the abdomen and pelvis should be considered with well-defined, circular, hypervascular masses. Pelvic SFTs should be considered with homogenous, avidly enhancing masses. Embolization of feeding arteries can allow safe surgical resection or biopsy, but embolization appears to not offer a definitive therapy.

1. Introduction

Solitary fibrous tumor (SFT) is a soft tissue mesenchymal neoplasm of fibroblastic or myofibrolastic origin [1]. Although originally described in the pleura and thought to occur primarily in the thoracic cavity, SFT has since been reported to occur throughout the body [2]. SFT is most commonly localized to the pleura, meninges and lower extremities, but can also present infrequently in the abdomen and pelvis [3]. Regardless of localization, SFTs are hypervascular, which can complicate surgical resection [4,5]. Because data regarding the radiological findings of SFT in the abdomen and pelvis is scant, we present the computed tomography (CT), magnetic resonance imaging (MRI), ultrasound (US), and ^{18}F-fluorodeoxyglucose-positron emission tomography (FDG-PET) findings of seven cases of SFT in the abdomen and pelvis from our institution. We also discuss the benefits and drawbacks of preoperative embolization of these vascular tumors and present the angiographic findings.

2. Subjects and methods

After obtaining approval from the Institutional Review Board for this review, a retrospective search of the pathological database from 2002 to 2016 was performed at our institution using the search term "solitary fibrous tumor." The search only included pathology results from abdominal or pelvic locations, excluding all chest and extremity locations. A total of seven (n = 7) cases of SFT were identified. 3 cases were men, and 4 cases were women. The average age was 49 years old (range 21 to 84) (Table 1).

SFT were classified by histology and immunophenotype by attending pathologists on the clinical read. Solitary fibrous tumor (SFT) has a characteristic morphology demonstrating ovoid and spindle cells arranged in a "patternless pattern" around hyalinized vasculature (often staghorn-type) in a collagenous background. Although differential diagnosis includes other spindle cell tumors (such as hemangiopericytoma, synovial sarcoma, fibrosarcoma, etc.), it has a unique staining pattern (positive for STAT6, CD34, CD99, and Bcl-2). Among these stains, STAT6 is probably the most sensitive and specific marker of SFT, as most SFTs have an NAB2-STAT6 fusion gene, which is specific to this tumor type [6]. These histologic patterns were consistent irrespective of tumor location.

Fine needle aspirations (FNA) or surgical pathological specimens were used for diagnosis. Diagnostic sensitivity and specificity increases with surgical biopsy compared to FNA, making surgical biopsy preferable. However, some samples were collected with FNA because of the

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* Corresponding author.
E-mail addresses: Adrian.Fernandez@ucsf.edu (A. Fernandez), Miles.Conrad@ucsf.edu (M. Conrad), Ryan.Gill@ucsf.edu (R.M. Gill), won-tak.choi@ucsf.edu (W.-T. Choi), Vishal.Kumar@ucsf.edu (V. Kumar), Spencer.Behr@ucsf.edu (S. Behr).

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Table 1
Patient characteristics.

Patient number	1	2	3	4	5	6	7
Year of diagnosis	2006	2002	2002	2016	2014	2016	2012
Age	54	73	84	24	53	21	35
Sex	M	M	M	F	F	F	F
Tumor location	Abdominal (liver)	Abdominal (liver)	Abdominal (liver)	Pelvic (Presacral)	Pelvic (numerous locations)	Pelvic (Presacral)	Pelvic (Adnexal)
Metastases?	No	Yes	No	No	Yes	No	No
Presenting symptoms	RUQ pain	Incidental finding	Abdominal mass	RLQ pain	LLQ pain	Incidental finding on workup for irregular menses, lower back pain	Pregnancy with abdominal pain

ease and affordability of this sampling method. All cross sectional imaging was reviewed by a fellowship trained abdominal imager with over 10 years of experience (S.C.B.) and all interventional images were reviewed by a fellowship trained interventional radiologist with over 14 years of experience (M.B.C.).

Embolization was performed in 2/7 cases to reduce bleeding complications. One patient (patient 3) underwent embolization to near-stasis with 500–750 μm PVA particles prior to surgical excision. Another patient (patient 7) underwent embolization to stasis with 600–900 μm embospheres and gel foam slurry before core-needle biopsy. Smaller particles were avoided to prevent shunting of coagulants through the tumors' capillary network and into the patients' lungs.

3. Results

3.1. Patient characteristics

Of the seven cases reviewed, three (43%) originated in the liver, and the remaining four (57%) originated in the pelvis. Five (71%) patients presented with abdominal or back pain, and one patient (14%) was diagnosed with SFT following work up for irregular menses (Table 1). Two of the three (66%) patients with hepatic SFTs had a palpable abdominal mass at the time of diagnosis.

3.2. Radiographic findings

Six (86%) patients underwent CT imaging, five (71%) underwent MR imaging, three (43%) had ultrasounds, two (29%) underwent PET imaging, and another two (29%) underwent angiography.

The tumors ranged in size from 4.6 × 4.0 cm to 20.0 × 16.0 cm (Table 2). All tumors had well-defined, smooth margins (Fig. 1A, Fig. 2A, Fig. 3A, and Fig. 4A). The two largest tumors exhibited central necrosis proven by gross specimen (Fig. 3A). Calcifications were found in one of the tumors. None of the tumors exhibited frank hemorrhage, contained fatty components, or invaded local structures. All three of the pelvic tumors that were imaged with contrast showed homogeneous enhancement (Fig. 1A and Fig. 2B), while all three of the hepatic tumors imaged with contrast showed heterogeneous enhancement (Fig. 3A).

All tumors that underwent MR (n = 5) showed T2 hyperintensity (Fig. 1B and Fig. 4A). Patient 4 with benign disease showed low FDG-PET uptake (Fig. 2C), while patient 5, who had malignant disease, showed substantially higher FDG-PET uptake (Table 2). On ultrasonography imaging, 3/3 (100%) tumors exhibited intermediate echogenicity and hypervascularity (Fig. 1D, Fig. 1E, Fig. 4E).

3.3. Embolization

Two of the tumors were treated with embolization prior to intervention to limit bleeding. One was embolized before surgical excision (patient 3), and another underwent embolization before biopsy (patient 7).

In patient 3, the tumor was supplied by the left hepatic artery and by an accessory artery off the left gastric artery. These vessels were successfully embolized with markedly reduced flow to the patient's tumor, permitting surgical resection.

Patient 7 underwent embolization to permit SFT biopsy. The tumor was fed predominantly by the uterine artery and an anterior branch of the left internal iliac artery (Fig. 4G). Embolization was successful with angiographic stasis and markedly reduced flow, as evident on ultrasonography and angiography (Fig. 4F and I). Needle biopsy was immediately performed without any bleeding complications. The patient did not undergo surgery and experienced no symptoms or complications after embolization and biopsy. Follow-up imaging 6 months later showed no significant change in size, small areas of necrosis, and hypervascularity in the tumor.

3.4. Surgical intervention

With the exception of patient 7, all subjects underwent surgical excision of their solitary fibrous tumor. One patient undergoing hepatic lobectomy lost 15 units of blood during the procedure, but recovered well with short-lived hepatic insufficiency. No other patients experienced intraoperative or postoperative complications (Table 3).

Patient 3 underwent en-bloc resection with left partial hepatectomy and cholecystectomy after the tumor's feeding vessels were embolized. The operation proceeded without bleeding complications. Approximately 1 L of blood was lost throughout the operation, and the post operation course was significant for mild pancreatic necrosis, pain, and diarrhea. Otherwise, the patient did exceptionally well. However, the patient's SFT recurred in the epigastric area and was resected four years after the initial surgery with no complications.

4. Discussion

SFT are rare neoplasms of mesenchymal origin. Extrathoracic SFTs are particularly rare, with fewer than 100 cases reported in the abdomen or pelvis [7]. Therefore, the diagnosis and treatment of extrathoracic SFTs can be a challenge. The cases of hepatic and pelvic SFT presented here add to the sparse literature on radiological findings associated with these neoplasms and the role of embolization in treatment.

The radiological findings from our set of patients are mainly consistent with those described in the literature. SFTs in all locations are characteristically well-circumscribed, circular or ovoid, and hypervascular [3,8]. Peripheral feeding vessels are common, while calcifications are relatively rare, and they feature varying degrees of central necrosis [4,8,9]. T2 hyperintensity is seen in as many as 89% of SFTs [4]. The cases reported here were consistent with these findings.

There are some noted radiographic differences between our cases and those reported in the literature. SFTs throughout the body are typically described as heterogeneously enhancing with contrast [10]. However, all pelvic SFTs imaged with contrast from this series demonstrated intensive and homogeneous enhancement. While this homogeneous enhancement pattern has been reported in other pelvic SFTs in the literature [11], reviews that focus on pelvic SFTs describe