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Original Article

Correlative Studies between Computed Tomography and Magnetic Resonance Imaging Scan Findings and Histopathology of Solitary Fibrous Tumors of Abdomen and Pelvis

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Abstract

Background: Solitary fibrous tumors (SFTs) are a unique group of mesenchymal neoplasms of fibroblastic or myofibroblastic origin. These tumors were originally described as "benign fibrous mesothelioma" of the pleural cavity, but presently they are being reported from all organs in the body. They are reported from abdominal organs and need to be differentiated from other solid tumors such as leiomyosarcomas, neurogenic tumors, pheochromocytomas, lymphoma, desmoid tumors, malignant fibrous histiocytomas, mesothelioma, and fibromas.

Aim of the Study: The aim of the study was to study the radiological features of SFTs of abdomen and pelvis on computed tomography (CT) scan and magnetic resonance imaging (MRI) and to correlate with their pathological features retrospectively.

Materials and Methods: A total of 24 patients with SFTs attending the tertiary teaching hospital were included in the study. Demographic data were collected from the case sheets for analysis. Radiological signs of CT and MRI scans from the patients were observed and correlated retrospectively with the histopathological study of excised surgical specimens to understand and standardize the characteristic features.

Observations and Results: Among the 28 patients there were 18 (75%) male patients and 6 (25%) female patients. The male to female ratio was 1:3. The mean age was 42.65 ± 2.70 years. The presenting symptoms were lump in the abdomen, pain, mass in the abdominal wall, urinary obstruction, constipation and sometimes neurologic or vascular symptoms. CT and MRI scans showed round or oval, homogenous or heterogeneous and markedly enhanced lesions without secondaries. Histopathological examination showed both cellular and fibrous variants of the SFTs.

Conclusions: The radiological signs of solid fibrous tissue tumors are well-defined, hypervascular masses with variable degrees of necrosis, cystic change, or hemorrhage. On MRI they manifested as heterogeneous hyperintensities on T2WI. The specimens following surgical excision retrospectively correlate well with the radiological findings in terms of vascularity and tissues content.

Key words: Computed tomography scan, Magnetic resonance imaging scan Tumors, Pleura, Peritoneum, Solitary fibrous tissue tumors

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INTRODUCTION

Solitary fibrous tumors (SFTs) are rare mesenchymal Tumors and account for <2% of all soft tissue tumors.[1] They were described as a distinct pathological entity in 1931 by Klemperer and Rabin. Earlier they were thought to be occurring only in pleura, pericardium, and peritoneum

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and were thought to be of mesothelial or submesothelial origin. Recent advances in pathology have changed the concept of these tumors, their distribution and remarkable histologic heterogeneity.[2] Now SFTs are considered as pathologically diverse, ubiquitous neoplasms of fibroblastic or myofibroblastic origin. Hemangiopericytoma and SFT form a histologic spectrum of fibroblastic type mesenchymal neoplasms with overlapping clinical, imaging, and cytopathologic features.[3] The new WHO classification considers most of the hemangiopericytomas as SFTs.[2,4] Now they are recognized as more common in extrapleural sites than in the pleura.[5-7] They are typically large, slow-growing soft tissue neoplasms. They can be benign or malignant.[8,9] They are asymptomatic, and symptoms are mainly due to their compression in the neighboring viscera or parenchyma. Computed tomography (CT) scans play a major role in their detection, characterization, and localization and guide the surgeons. Extrapleural SFTs have a favorable outcome after surgical resection. Even today the most extensive reports regarding the imaging characteristics of SFTs in the abdomen and pelvis are reported by Shanbhogue *et al.*,[10] Zhang *et al.*[11] and Ginat *et al.*[12] and others focused on case reports.[13,14] In this study an attempt is made to correlate the CT scan and magnetic resonance imaging (MRI) radiological findings with the histopathological findings of SFTs.

Type of Study

This was a retrospective study.

Period of Study

The study period was from April 2015 to March 2017.

Institute of Study

This study was conducted at Kannur Medical College, Anjarakandy, Kannur, Kerala.

MATERIALS AND METHODS

Based on medical records of 24 patients treated for soft fibrous tumors in the department of surgery of a tertiary teaching hospital a retrospective study was conducted. All the data were collected from the medical records section. An Ethical Committee Clearance was obtained for the study. Inclusion criteria: (1) All the patients irrespective their age were included. (2) Patients with soft fibrous tissue tumors confirmed by Histopathological examination (HPE) were included. (3) Patients with SFTs involving the abdomen and pelvis are included. Excluding criteria: (1) Patients treated for SFT tumors involving the pleura were excluded. (2) Patients not confirmed on HPE to have SFTs were excluded. Demographic data of the patients were collected from the case sheets for analysis. All the patients had undergone CT scan and wherever necessary an MRI scan was done. CT scan was done using a 16 multi-detector CT (light speed VCT, GE Healthcare). MRI scans were performed with a 1.5 T scanner (GE). The images were reviewed by a single radiologist of 12 years' experience. The CT and MRI were evaluated for location, size, shape, margin, internal architecture, CT density, and MRI signal intensity compared with adjacent muscle, pattern of enhancement, and changes in adjacent structures. The radiological features of all the cases were noted. The degree of mass enhancement was assessed subjectively and categorized as follows: Mild, when the enhancement was similar to that of adjacent muscle; moderate, when the enhancement was higher than that of muscle but lowers than that of blood vessels; marked, when the enhancement was approaching that of blood vessels. These imaging findings were correlated with the microscopic findings of the surgically obtained specimens and compared between the histologically benign and malignant groups. Ultrasound-guided needle biopsy was attempted in 11 patients, and the analysis of the reports was done. 23 out of the 24 patients underwent surgery for excision of the tumors. The morphological features and hematoxylin and eosin staining were used to study the cellular pattern of the tumors. Retrospective correlation between radiological features and final HPE reports was done. All the data were analyzed using standard statistical methods.

OBSERVAIONS AND RESULTS

A total of 28 patients presenting with features of abdominal and pelvis tumors were included in this study. Among the 28 patients, there were 18 (75%) male patients and 6 (25%) female patients. The male to female ratio was 1:3. The youngest patient was aged 19 years, and the elderly patient was aged 68 years with a mean age was 42.65 ± 2.70 years. The presenting symptoms were lump in the abdomen, pain, mass in the abdominal wall, urinary obstruction, constipation and sometimes neurologic or vascular symptoms. 3 patients had symptoms of hypoglycemia, and all the tumors in this group were originating in the pelvis [Table 1].

Table 1: The incidence of different symptoms in the study group (*n*-28)

Observation	*n* (%)
Lump in the abdomen	14 (58.33)
Mass in the abdominal wall	03 (12.5)
Pain	12 (50)
Urinary obstruction	04 (16.66)
Constipation	06 (25)
Radiating backache pain	05 (20.83)
Erectile dysfunction	01 (4.16)
Hypoglycemia	03 (12.5)

Among the 24 patients, the origin of the tumor was from different sites involving various organs in the abdomen and pelvis. The tumors presenting in the abdomen were 15 (62.50%) and from the pelvis were 9 (37.50%) distribution of these tumors is shown in Table 2.

Among the 23 operative specimens sent for histopathological reporting, the gross appearance of the tumors showed the size varying from 4.6 to 19.8 cm (mean, 09.35 cm). 15 tumors were round, and 6 were oval, and 3 were lobulated. 17 of the tumors had displaced adjacent organs. They were found capsulated, firm and well circumscribed in 21/23 (91.30%). The cut surface showed a whorled appearance with yellow tan and areas of necrosis and hemorrhage were observed in all the specimens. Microscopic appearance showed typically juxtaposition of either hyper- and hypo-cellular spindle cells proliferation with dense collagenous stroma, and numerous thin-walled blood vessels with a "staghorn configuration" (histologic hallmark) of hemangiopericytoma or SFT [Figure 1].

The fibrous type of HPE reports was observed in 16/24 (66.66%) patients, cellular type in 6 (25%) and 2/24 (08.33%) patients it was mixed type with vascular component [Table 3].

Retrospectively the CT scan and MRI scan pictures were analyzed in this study of patients with tumors of abdomen and pelvis, and out of 24 patients, 11 underwent both the types of imaging studies with contrast. 13 patients had only CT scan pictures. The radiological features of the 24 patients are tabulated in Tables 4 and 5. No lymphadenopathy or distant metastases were detected on the CT and MR images at initial evaluation.

Unenhanced MRI in a patient aged 45 years revealed an SFT arising from the seminal vesicle; a T1-weighted and gadolinium-enhanced T1- weighted homogenous isodense mass lesion is shown in Figure 2.

A contrast-enhanced CT scan, obtained in the arterial phase, shows a well-defined hypervascular mass with intense enhancement (arrow) in the pancreatic tail [Figure 3].

AN MRI showing a SFT arising from the kidney in a 39-year-old woman; axial fat-suppressed T2-weighted image [Figure 4].

Table 2: The sites of origin of the tumour

Site of origin	*n* (%)
Abdominal wall	03 (12.5)
Liver	04 (16.66)
Kidney	02 (08.33)
Pancreas	02 (08.33)
Peritoneum	04 (16.66)
Sigmoid colon	03 (12.5)
Prostate	01 (04.16)
Seminal vesicle	01 (04.16)
Urinary bladder	02 (08.33)
Uterine adnexa	02 (08.33)

Table 3: The HPE findings in the study (*n*-24)

HPE findings	*n* (%)
Fibrous variant	16 (66.66)
Cellular variant	06 (25)
Mixed variant with high vascular component	02 (08.33)

HPE: Histopathological examination

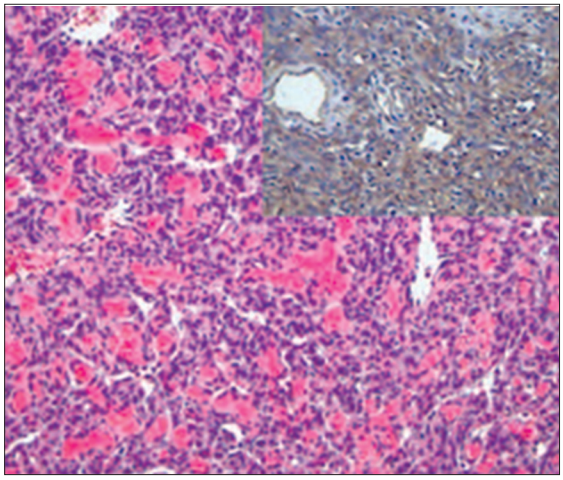

Figure 1: The histopathological examination (Hematoxylin and eosin stain) of the specimen of solitary fibrous tumors

Table 4: Radiological findings of patients with both CT scans and MRI scans with enhancement undertaken (*n*-11)

Tumor site	Size (cm^2)	Shape margin	CT density- MRI intensity	Degree and pattern of enhancement
Liver- 04	04	Round, well defined	Homogeneous hyperintensity (T2WI)	Marked homogenous
Kidney- 02	02	Round, well defined	Homogeneous isodensity	Marked homogenous
Pancreas- 02	02	Round, well defined	Homogeneous isodensity	Marked homogenous
Prostate	01	Oval, well defined	Homogeneous hyperintensity (T2WI)	Marked homogenous
Uterine adnexa	02	Oval, well defined	Homogeneous hyperintensity (T2WI)	Marked heterogeneous

CT: Computed tomography, MRI: Magnetic resonance imaging

Table 5: Radiological findings of exclusively CT scans of patients with SFTs (*n*-13)

Tumor site	Size (cm²)	Shape margin	CT density- MRI Intensity	Degree and pattern of enhancement
Abdominal wall	03	Round, well defined	Isodensity with patchy necrosis	Marked homogenous
Peritoneum	04	Oval, well defined	Isodensity with patchy necrosis	Marked heterogeneous
Sigmoid colon	03	Round, well defined	Isodensity with patchy necrosis	Marked heterogeneous
Seminal vesicle	01	Oval, well defined	Homogeneous isodensity	Marked homogenous
Urinary bladder	02	Round, well defined	Homogeneous isodensity	Marked heterogeneous

CT: Computed tomography, MRI: Magnetic resonance imaging, SFT: Solitary fibrous tumors

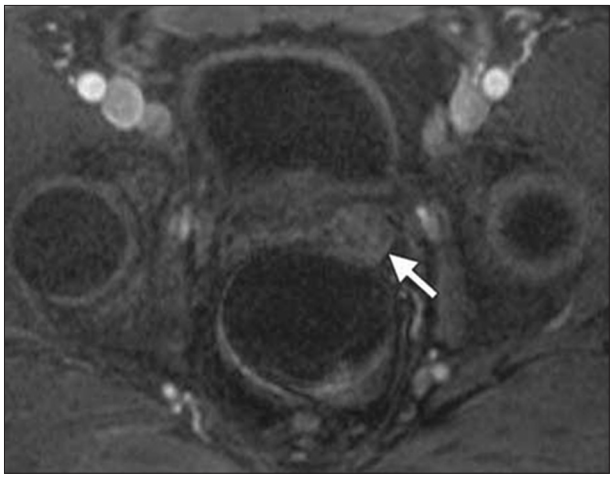

Figure 2: A magnetic resonance imaging finding of solitary fibrous tumors in seminal vesicle

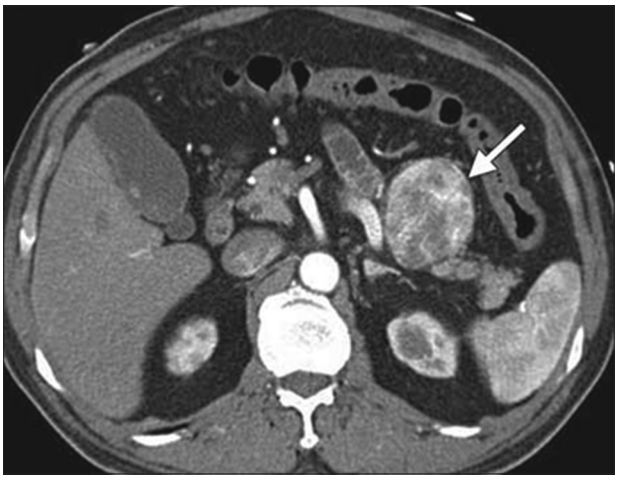

Figure 3: A solitary fibrous tumors arising from the tail of the pancreas showing marked enhancement on computed tomography scan

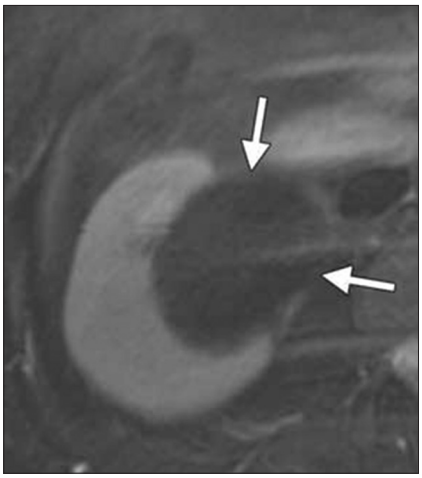

Figure 4: A magnetic resonance imaging scan image of solitary fibrous tumors arising from the kidney

DISCUSSION

Solitary fibrous tissues tumors are rare, spindle cell mesenchymal origin, with an age of onset around 50–60 years and equal distribution in men and women. In the present study, the youngest patient was aged 19 years, and the elderly patient was aged 68 years with a mean age was 42.65 ± 2.70 years. Patients in a series study by Li *et al.*[14] the incidence ranged from 1 to 76 years, but the incidence was higher in men than in women with a sex ratio of 4:1. In the present study, the male to female ratio was 1:3. Although SFTs were thought to occur most frequently in the pleura initially, now they are being reported virtually from anywhere or throughout the body, while involvement of the abdomen and pelvis is particularly rare.[4] SFTs in the abdomen and pelvis are a diagnostic challenge to both clinicians and radiologists despite its characteristic histological and immuno histochemical features. Extra pleural SFTs were typically demonstrated as large, slow-growing soft tissue tumors.[10] Symptoms related to the sites of occurrence of tumors and adjacent organs involved are frequent. They usually present as a palpable mass, pain, gross hematuria, bowel obstruction, and urinary retention, or obstruction,[2,15] systemic hypoglycemia is reported in SFTs of pelvic origin in the literature and also reported in the present study.[4,13] All the symptoms usually disappear after removal surgically. Hemangiopericytomas earlier described as a different entity of tumors are now described as a cellular variant of SFT tumors.[2,3] SFTs are usually well demarcated; well capsulated benign tumors and majority of them are highly vascular and have a tendency for hemorrhages, myxoid degeneration, and necrosis.[2] On HPE these tumors show a spectrum of cellularity and vascularity at one end to predominantly fibrous lesions containing fibrous areas and hyalinized thick-walled vessels.[2,3,14] Immuno-histochemical studies of these sections show variable expression of CD34, CD99,

and bcl-2 antigens; and the fibrous form demonstrates strong reactivity with CD34, whereas the cellular form demonstrates weak reactivity.[2] Malignant transformation is noted in SFTs and the histological features that may help to identify them; which includes large size, infiltrative margins, hypercellularity, nuclear atypia, and mitotic activity (≥4/10 high-power fields), and the presence of necrosis and hemorrhage.[2,14] After malignant transformation, these SFTs shed their CD34 immuno reactivity and over express Ki-67, P53, and S-100.[16] In the present study, there was no malignant transformation observed. Recurrence is common following surgical excision of the SFTs, and the cause and risk factor for recurrence are invaded margins of the tumor.[7] Radiological findings provide useful information, such as detection, characterization, and localization of tumors. In addition, it can depict the local extent, possible invasion into adjacent structures, and loco regional, and distant metastases. The most common imaging finding reported in this study was large, well-defined, round, oval, or lobulated hyper vascular tumor masses that tended to displace or invade adjacent structures such as the bowel, urinary bladder, seminal vesicle, and vessels. These findings are similar to studies by other authors.[4,5,12] The common plain CT scan findings were an isodense mass with patchy hypodensity in the present study. The reason for attenuation was that it depended on the collagen content, as hyperdense lesions have abundant collagen.[6] Calcification is rare.[4,6] In the present study, MRI scan showed isointense or slightly hyper intense on T1WI and heterogeneously hyper intense on T2WI images. The images of heterogeneous signal intensity were probably due to components of hemorrhage, necrosis, cystic, or myxoid degeneration, and Hyalinized stromal contents.[4,7] The tumors mimicking the SFTs on CT scan or MRI imaging are leiomyosarcomas, neurogenic tumors, pheochromocytomas, lymphoma, desmoid tumors, malignant fibrous histocytomas, mesothelioma, and fibromas with predominant fibrous content and varying.

CONCLUSIONS

The radiological signs of solitary fibrous tissue tumors are well-defined, hypervascular masses with variable degrees of necrosis, cystic change, or hemorrhage. On MRI they manifested as heterogeneous hyperintensities on T2WI. The specimens following surgical excision retrospectively correlate well with the radiological findings in terms of vascularity and tissues content.

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