Spectrum of MRI Findings of Synovial Sarcoma

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Learning objectives

Describe the radiological spectrum of synovial sarcoma, with special emphasis on the findings provided by magnetic resonance imaging (MRI).

To highlight the most characteristic features of this tumor and document unusual forms of presentation.

Describe the main epidemiological, clinical and pathologic findings of the synovial sarcoma.
Background

Synovial sarcoma is a malignant mesenchymal tumor, described in 1893 and named because of its apparent similarity in the microscopic study with synovial tissue. It is a soft tissue sarcoma accounts for 5-10% of this group of tumors. Its incidence is lower than that of high-grade pleomorphic sarcoma, liposarcoma, leiomyosarcoma and peripheral nerve malignant tumor.

Despite its name, its intraarticular location is uncommon, less than 5% of cases.

In contrast to other soft tissue sarcomas, the highest incidence occurs in the third decade of life. It can occur in children and has not a predilection for any gender.

It is an aggressive behavior tumor with high capacity for distant spread mostly with lung metastasis and recurrence after surgery about 25% of cases.

The clinical manifestation is a soft tissue mass, often painful. The development of the lesion is variable. Sometimes growth is fast but sometimes slow, up to several years and more indolent clinical behavior which may suggest a benign lesion.

Almost 90% of synovial sarcomas are in the extremities, especially the lower ones. However, its occurrence is not uncommon in the hands or feet.

Sarcoma Treatment is surgery and chemotherapy. The best predictors of a good outcome are:

- a first surgery to correct margins.
- and lack of dissemination.

Pathologic Features

Synovial sarcoma is a distinctive pathologic entity shows a dual epithelial and mesenchymal architecture differentiation (spindle cells).

The gross pathologic appearance of synovial sarcoma is typically nonspecific, with a gray to yellow color and fish flesh consistency. These lesions may be well defined, particularly if they are small, or poorly defined.
Synovial sarcomas are frequently multilobulated, and areas of necrosis, hemorrhage, and cyst formation are also common.

Fig. 1

There are three main histologic subtypes of synovial sarcoma: biphasic, monophasic, and poorly differentiated.

Monophasic synovial sarcoma represents 50%-60% (the most common subtype) of all lesions, and in this subtype the mesenchymal spindle cell component predominates.

Biphasic synovial sarcoma represents 20%-30% of lesions and has both a mesenchymal spindle cell component and an obvious epithelial component as seen at light microscopy. The epithelial cells usually form glands, but they may also be seen as solid sheets, nests, cords, and papillary structures, and they may show squamous metaplasia.

Poorly differentiated synovial sarcomas are generally epithelioid in morphology and have high mitotic activity with geographic necrosis. This subtype represents up to 15%-25% of all synovial sarcomas. This subtype of synovial sarcoma can be confused with round cell tumors, such as Ewing sarcoma, although differentiation can be accomplished with immunohistochemical staining and molecular methods.

Fig. 2 - Fig. 3

**Imaging Features**

Radiographs appear normal in approximately 50% of cases of synovial sarcoma, particularly those with small lesions.

When detected at radiography typically appear as nonspecific, round to oval juxtaarticular soft-tissue masses.

Calcification is identified in up to 30% of synovial sarcomas at radiography, far above other types of sarcomas. These calcifications are often eccentric or peripheral within the soft-tissue mass and nonspecific in appearance.

Fig. 4 - Fig. 5
CT appearance of synovial sarcoma is that of a heterogeneous deep-seated soft-tissue mass with attenuation similar to or slightly lower than that of muscle.

Areas of lower attenuation representing necrosis or hemorrhage are also common, although smaller lesions may be more homogeneous. In a minority of cases, low-attenuation areas may be the predominant CT feature, an appearance that simulates a hematoma or cystic mass.

CT is also useful for detecting calcification and bone involvement in synovial sarcoma, particularly in complex areas of the anatomy such as the pelvis, hip, or shoulder or when the lesions are small and subtle.

CT scans obtained after administration of intravenous contrast material show heterogeneous enhancement in 89%-100% of cases. This feature is quite helpful for distinguishing those synovial sarcomas that initially appear as a cystic lesion or hematoma on precontrast images, as the heterogeneous enhancement pattern excludes these diagnoses. Nodular areas of enhancement may also be seen in these lesions.

CT and ultrasound are the techniques that can be used to perform guided biopsy of the tumor.

MR Imaging is the optimal radiologic modality for assessing the extent and intrinsic characteristics of synovial sarcomas (similar to its ability to depict other soft-tissue tumors) for staging and diagnosis, respectively.

Many synovial sarcomas of the extremities are deep lesions that are located near a joint, not inside, and are in contact with a fascia and aponeurosis. Their margins are usually well defined. Subcutaneous lesions are uncommon.

On T1-weighted MR images, synovial sarcoma typically appears as a prominently heterogeneous multilobulated softtissue mass with signal intensity similar to or slightly higher than that of muscle. Hemorrhage or calcification within the tumor, allows viewing foci of high and low signal intensity respectively.

Fig. 6 - Fig 10
On T2-weighted MR images this marked heterogeneity and the "triple sign", is presumably the result of the mixture of solid cellular elements (intermediate signal intensity), hemorrhage or necrosis (high signal intensity), and calcified or fibrotic collagenized regions (low signal intensity).

Areas of hemorrhage, seen as fluid levels or foci of high signal intensity on T1- and T2-weighted MR images are frequent. The combination of these components allows the synovial sarcoma is seen as a solid tumor or a heterogeneous lesion or a cystic lesion or abscess appearance.

MR imaging performed after intravenous injection of contrast material typically shows prominent enhancement in synovial sarcomas. The enhancement is more commonly heterogeneous (83%-100% of lesions). This heterogeneous enhancement reflects the intermixture of nonenhancing necrotic, cystic, or hemorrhagic regions and enhancing solid regions.

Bone involvement, manifested either by cortical erosion it is not uncommon to be seen in 11%-20% of lesions.

The invasion of the marrow space it is more infrequent only seen in 5%. 

Fig. 11 - Fig. 12 - Fig. 13

Fig. 14 - Fig. 15 - Fig. 16 - Fig. 17

Fig. 18 - Fig. 19 - Fig. 20 - Fig. 21

Fig. 22 - Fig. 23 - Fig. 24

Fig. 25 - Fig. 26 - Fig. 27 - Fig. 28

Fig. 29 - Fig. 30 - Fig. 31

Fig. 32 - Fig. 33
Small lesions of synovial sarcomas may be well defined on MR images in 53%-91% of cases. Lesions smaller than 5 cm are much more frequently well defined, again mimicking a less aggressive process.

Following chemotherapy or radiation therapy, progression can be seen, but more frequently stability and response of treatment is seen. Increasing signal intensity may be seen within the synovial sarcoma on T2-weighted MR images, a finding that corresponds to progressive necrosis.

Tumor size may also show a reduction in response to this therapy. Edema surrounding the tumor, typically not a significant feature before therapy, may also develop subsequent to adjuvant treatment. These posttreatment changes are often not apparent on short echo time images.
Fig. 1: Photograph of the coronally sectioned gross specimen shows the synovial sarcoma.

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Fig. 2: Photograph of monophasic synovial sarcoma sectioned specimen (hematoxylin-eosin[HE]stain x 200). Proliferation of spindle cells in a hyaline and fibrous stroma.

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**Fig. 3:** Photograph of biphasic synovial sarcoma (H-E x 100). Proliferation of spindle cells intermingled with epithelial cells forming glandular structures.

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**Fig. 4:** Intraarticular synovial sarcoma. The lateral radiograph of the elbow shows a thickening of soft tissue around the joint.

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Fig. 5: The same patient as in Fig 4. Sagittal T2-spir shows a tumor infiltrating the intraarticular distal humerus.

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Fig. 6: Synovial sarcoma in the left ischioanal fossa. Unenhanced CT: homogeneous, well-defined and a lower density than muscle mass.

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Fig. 7: Same patient as in Figure 6. Contrast-enhanced CT: lesion with heterogeneous contrast enhancement.

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**Fig. 8:** Synovial sarcoma in the quadriceps. T1 axial image showing an intramuscular tumor that isointense to muscle.

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Fig. 9: Same patient as in Figure 8, axial T2-weighted showing a polylobulated and hyperintense lesion.

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**Fig. 10:** Same patient as in Figure 8 and 9. Coronal T1-weighted postcontrast showing a diffuse uptake of the mass.

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**Fig. 11:** Synovial sarcoma of the hand. Axial T2-weighted showing a hyperintense lesion with well-defined edges.

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Fig. 12: Same patient as in Fig 11. Coronal T2-weighted showing a high intensity lesion.

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**Fig. 13:** Same patient as in Fig 11 and 12. Axial T1-weighted fat suppressed postcontrast showing a homogeneous contrast enhancement of the lesion.

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Fig. 14: Synovial sarcoma of foot. Sagittal T1-weighted shows a polylobulated lesion in the plantar region with the same signal intensity than muscle.
**Fig. 15**: The same patient as in Fig 14. Sagittal T2-weighted displays a hyperintense lesion in relation to the muscle.

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Fig. 16: The same patient as in Fig. 14 and 15. Axial T2-weighted displays a hyperintense lesion in relation to the muscle.

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**Fig. 17:** The same patient as in Fig 14-16. Photograph of the sagittal sectioned gross specimen shows the synovial sarcoma.

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Fig. 18: Axial T1-weighted shows a well defined soft tissue tumor in the patellar tendon, with intensity similar to muscle signal.
Fig. 19: The same patient as in Fig 18. Axial T2-weighted reveal a soft tissue tumor, hyperintense in relation to the muscle.
Fig. 20: The same patient as in Fig 18 and 19. Sagittal T1-weighted shows a rounded, well-defined lesion infrapatellar fat, its signal intensity is slightly lower than to of muscle.

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**Fig. 21:** Sagittal T2-weighted shows an infrapatellar fat tumor, hyperintense in this sequence.

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Fig. 22: Synovial sarcoma pharynx. Axial T2-weighted oropharyngeal level displays a isointense tumor with well-defined edges, protruding into the airway and almost completely occluded.

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Fig. 23: Same patient as in Fig 22. Coronal T2 evidencing a heterogeneous tumor occupying a large part of the airway.

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**Fig. 24:** Images that corresponds to patient in Fig 22 and 23. Sagittal CT reconstruction showing a heterogeneous lesion in the oropharynx.

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Fig. 25: Synovial sarcoma vulva. Axial T1-weighted shows perineal lesion with vulvar involvement, isointense compared to muscle.

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Fig. 26: Images that Corresponds to patient in Fig 25. T1-weighted with contrast showing the lesion described, with a heterogeneous catchment of it.

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Fig. 27: The same patient as in Fig 25 and 26. Sagittal T1-weighted with contrast, shows a perineal heterogeneous catchment tumor with involvement of the vulvar region.

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Fig. 28: The same patient as in Fig 25-27. Coronal T1-weighted with contrast, shows a perineal heterogeneous catchment tumor.

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Fig. 29: Synovial sarcoma neck. Axial CT shows a soft tissue injury of the neck with a diffuse capación of intravenous contrast.

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Fig. 30: Images that corresponds to patient in Fig 29. Axial T1-weighted shows a rounded and sharper edges tumor with a slightly higher than to muscle intensity, in the neck posterolateral region.

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**Fig. 31:** The same patient as in Fig 29 and 30. Coronal T1-weighted fat-suppressed shows a hyperintense lesion between the neck muscles.

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Fig. 32: Synovial sarcoma in left elbow. Sagittal oblique T1-weighted with contrast shows a bony invasion of the distal end of the humerus (patient whose radiograph is shown in Fig 4).

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**Fig. 33:** Images that corresponds to patient in Fig 32. Sagittal oblique T1-weighted with contrast and fat suppression. The lesion is located near a joint, not inside.

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Findings and procedure details

A retrospective review of all synovial sarcomas evaluated in our hospital from January 2001 to March 2011 was performed.

All patients were evaluated by magnetic resonance imaging (MRI). In some cases was available radiography, ultrasound or computed tomography (CT).

A 1.5 tesla MRI was used to perform exams. Was included a sagittal T1 and T2 spin echo acquisition completed with axial T1 post gadolinium injection.

The following characteristics were evaluated by MRI:

1 - Tumor size.

2 - Location of the lesion.

3 - Margins of the lesion.

4 - Characteristics of signal (T1 and T2).

5 - Enhance contrast.

6 - Bone Involvement.

7 - Articular Involvement.

8 - Vascular involvement.
Conclusion

1.- Synovial sarcoma is a rare malignant mesenchymal tumor with a highly variable clinical and radiological presentation.

2.- There is no specific radiological pattern of the entity, so its diagnosis should be done by biopsy.

3.- Diagnosis should be suspected at any soft tissue lesion that can not be characterized with absolute certainty.

4.- The diagnosis may be suggested in the case of a young adult with a tumor situated near a joint or in the hands or feet.

5.- For the excellent resolution of the tissues, the ability to study the lesion in multiple planes, assessing the extent of the tumor, the involvement of adjacent structures and help in planning surgery, MRI is the technique of choice in the study of synovial sarcoma.

6.- The management of synovial sarcomas should be multidisciplinary, to optimize the diagnosis and treatment of the tumor, and the preservation and conservation function of the limb.
References


