Imaging of Extremity Soft Tissue Sarcomas

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I have nothing to disclose.
Soft Tissue Sarcoma (STS)

RARE TUMOURS
Arise from mesenchymal tissue.

Distribution –
• Extremity – 59%
• Trunk – 19%
• Retroperitoneum – 15%
• Head and Neck – 9%

2009 – USA
Est. 10,600 new cases of soft tissue sarcoma.
- 5.5% of breast cancer.
- 5% of lung cancer.

Over 50 Histologic Subtypes

Pleomorphic Non-differentiated Sarcoma 28%
Liposarcoma 15%
Leiomyosarcoma 12%
Unclassified Sarcoma 11%
Synovial Sarcoma 10%
Malignant Peripheral Nerve Sheath Tumour 6%
Rhabdomyosarcoma 5%
Fibrosarcoma 3%
Ewing’s Sarcoma 2%
Angiosarcoma 2%
Osteosarcoma 1%
Epithelioid Sarcoma 1%
Chondrosarcoma 1%
Clear cell Sarcoma 1%
Alveolar Soft Part Sarcoma 1%
Malignant Haemangiopericytoma 0.5%
Soft Tissue Sarcoma

Adults > children
Incidence increases with age.
- Rhabdomyosarcoma is most common soft tissue sarcoma of childhood.

Metastases
Haematogenous – dominant.
Lymph nodes - <5%
- exceptions are epithelioid sarcoma, synovial sarcoma, angiosarcoma, rhabdomyosarcoma, clear cell sarcoma.

Radiation – known risk factor.
Risk is dose dependent.
Latent period of 10 years.

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Most common in middle aged and older adults.
Relatively more common in children and young adults.
7-10% of paediatric malignancies.
Bone is 25% less than soft tissue sarcoma.
Represent a disproportionate cancer burden to the young (under 25 years).
Presentation and Diagnosis

Highly variable. Often delayed.

Asymptomatic, often pain free. Increasing in size. May be slow! Those in extremities often diagnosed earlier.

Lack of constitutional symptoms – Fever, malaise, weight loss.

Grow in centrifugal manner. Compress surrounding structures. May impingement on bone or neurovascular bundles – pain, oedema, swelling.
Presentation and Diagnosis

Diagnosis is often delayed!

High index of suspicion.

Any patient with a mass with indeterminate findings should be referred to an orthopaedic or musculoskeletal oncologist.

Management should be by experienced Multi-Disciplinary Teams.

Look out for
- Mass increasing in size.
- Size > 5 cm.
- Deep to the deep fascia.
- +/- Painful.

Purpose of Imaging
- Characterise.
- Localise.
- Stage.
- Plan treatment.
- Assess response to therapy.
Imaging

Radiographs (X-Rays)

Ultrasound

CT

MRI

PET-CT/PET-MR

Imaging Guided Biopsy

Angiography
Imaging

Radiographs (X-Rays)

X-Rays of the Mass
- Size
- Appearance
- Calcification
- Other bony lesions

Chest X-Ray
Nodules
But - <4 mm may not be evident.

Ultrasound

CT

MRI

PET-CT/PET-MR

Imaging Guided Biopsy

Angiography

- Marginal or internal calcification seen in 10-30% of Synovial Sarcoma.
- Liposarcomas may be seen as more lucent areas. Up to 30% of dedifferentiated liposarcomas show internal calcification.
Imaging

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## Imaging

<table>
<thead>
<tr>
<th>Imaging Modality</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Radiographs (X-Rays)</td>
<td>Ultrasound can be used to evaluate a mass in peripheral or superficial locations.</td>
</tr>
<tr>
<td><strong>Ultrasound</strong></td>
<td>Distinguish between solid and cystic.</td>
</tr>
<tr>
<td><strong>CT</strong></td>
<td>Assess vascularity.</td>
</tr>
<tr>
<td><strong>MRI</strong></td>
<td>Assess adjacent structures.</td>
</tr>
<tr>
<td><strong>PET-CT/PET-MR</strong></td>
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<tr>
<td><strong>Imaging Guided Biopsy</strong></td>
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<tr>
<td><strong>Angiography</strong></td>
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<tr>
<td>Imaging</td>
<td>Details</td>
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<tr>
<td>---------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Radiographs (X-Rays)</td>
<td>Fast. Readily available.</td>
</tr>
<tr>
<td>Ultrasound</td>
<td>Entails radiation exposure.</td>
</tr>
<tr>
<td>CT</td>
<td>Good spatial resolution. Poor contrast resolution.</td>
</tr>
<tr>
<td>MRI</td>
<td>Requires iodinated contrast – risk of adverse reactions.</td>
</tr>
<tr>
<td>PET-CT/PET-MR</td>
<td>Concurrent use to assess lungs, liver and lymph nodes.</td>
</tr>
<tr>
<td>Imaging Guided Biopsy</td>
<td>MRI-Incompatible/Contra-indications.</td>
</tr>
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Imaging

Radiographs (X-Rays)

MRI – Modality of Choice

Superior tissue contrast resolution.
Intravenous contrast aids in evaluation.

Ultrasound

Detect subtle changes in lesion, delineate margins, assess for invasion and spread.

CT

MRI features

- T1 intermediate to low.
- T2 high to intermediate.
- Enhancement pattern variable
- Differentiate from oedema.

PET-CT/PET-MR

Malignant features

- > 5 cm.
- deep location.
- absent central enhancement.
- pseudocapsule.
- respect fascial borders and anatomic compartments till late.
- heterogeneous.

Imaging Guided Biopsy

Angiography
Myxoid Liposarcoma

- Intermediate to high grade malignancy.
- ~ Round cell component.

**MR Features**
- Well-defined, multilobulated.
- T1w ↓.
- T2w ↑.
- <10% adipose tissue – lacy/linear T1w ↑.
- Enhancement -
  - peripheral nodular (60%)
  - central (45%)
  - diffuse (15%).
Benign Lipoma

Coronal T1 TSE

Coronal T1 TSE FS + GD

Coronal T1 TSE FS
Imaging

Radiographs (X-Rays)

Ultrasound

CT

MRI

PET-CT/PET-MR

Imaging Guided Biopsy

Whole Body MRI? – Controversial!

Variations in use.

Focused MR scanning – localised to single limb/body region.
- Entire long bone to exclude synchronous mass.
- Additional body regions if indicated by CT or other imaging methods.
**Imaging**

- **Radiographs (X-Rays)**
  
  18FDG – most common. Tumour or physiologic tissue metabolism.

- **Ultrasound**

  CT/MR scanning – gives concurrent anatomical and functional imaging findings.

- **CT**

  Localisation of metabolically active component of the soft tissue sarcoma for optimal biopsy targeting.

- **MRI**

  Detection of local recurrence and metastases. Assess response to neoadjuvant chemotherapy.

- **PET-CT/PET-MR**

- **Imaging Guided Biopsy**

- **Angiography**

  - 45 M with pectoral histiocytoma.
  - Bone metastases were found with FDG PET-CT.
Imaging

Radiographs (X-Rays)

Ultrasound

CT

MRI

Nuclear Medicine

Imaging Guided Biopsy

Angiography

Tc99m BONE SCANS
Whole body imaging for low radiation dose.
High uptake in areas with bone repair or high turnover.
Lytic destructive lesions may give false negatives.

Part of initial imaging workup.
Imaging

Radiographs (X-Rays)

Under CT or US guidance.

Ultrasound

Approach and track location should be agreed after consultation with Orthopaedic Oncologists.

CT

MRI

PET-CT/PET-MR

Imaging Guided Biopsy

Angiography
Lesion vascularity and blood supply.

Pre-surgical embolisation.

CT Angiography or MR Angiography are available options.

- Vascular neoplasms like haemangiopericytoma, haemangioendothelioma and angiosarcoma can affect both bone and soft tissues and often presents with bleeding.
- Angiosarcoma is an aggressive malignancy with high local recurrence and distant metastases.
So, which imaging modality?

Radiographs:
- Mass
- Chest (CXR)

MRI:
- Characterise the Mass.
- Assess surrounding structures.

CT:
- Screen for lung and liver metastases.

Nuclear Medicine:
PET/CT or PET/MR -
- Tissue activity and viability
Tc99m Bone Scan -
- Skeletal metastases.
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Dx: Histiocytoma
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MRI

MR Signal Characteristics
• T1w, T2w
• Enhancement

Location –
• deep or superficial.
• subcutaneous,
• intermuscular, intramuscular.
• adjacent structures – eg bone, solid organs.
• neurovascular bundle.
• invasion or clear fat-plane.
• wide margin of excision possible?
  • Aim for 1 cm clear margin.
• amenable to image guided biopsy?
• radiosensitive organs if planning for radiotherapy.

For vessels –
Consider extent of circumference involved or in contact.
Perivascular spread or invasion?
MRI

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Synovial Sarcoma

60% lower extremity.
15% upper extremity.
5-10% intra-articular.

25-30% amorphous calcification.
10-20% bone invasion.
+/- juxta-articular osteoporosis.
Synovial Sarcoma

CT:
- Iso-dense to muscle.
- Haemorrhage,
- Necrosis,
- Calcification,
- Enhancement ++
**Differential Diagnosis**

Abscesses.

Rapidly growing.

Painful.

Systemically unwell.

Early presentation.
Differential Diagnosis

Peripheral Schwannoma

Often, signs suggestive of schwannoma are present.
- Pain
- Paraesthesia / anaesthesiae.
- Tender if pressed.

Growth rate is variable.
Differential Diagnosis

Sebaceous cysts.
Inclusion cysts.
AVM
Etc.
Solitary fibrous tumour with low malignant potential
Solitary fibrous tumour with low malignant potential
First presentation with vague lump over right hip region.
Bone Scan 26/12/2013

Three months later...
- Palpable lump in right groin.
- US done on 02/2014
Three months later...
- CT done late 02/2014.
Bone Scan 26/12/2013

CT Scan

- Local recurrence.
- Right Inguinal Lymph Nodal recurrence.
- Lung Metastases.

Rapidly spread.

Dx : Clear Cell Sarcoma
Left arm swelling 2010

T2 TSE FS
T1 TSE
T1 TSE FS + Gd
Dx: Myxofibrosarcoma
2012 – New lumps felt after surgery.
2013 – More local recurrence.

Surgery – Function sparing surgery with megaprostheses.
2014 – Re-recurrence Again

- Lower extremity 50%, upper extremity 25%, retroperitoneum 15%.
- Deep intramuscular 70%. Subcutaneous 5-10%.
- T1w intermediate signal.
- T2w intermediate to high signal.
- Heterogeneous – collagen, myxoid tissue, necrosis +/- haemorrhage.
- Fibrous pseudocapsule – well defined margins.
- Destruction of adjacent bone.

2013 Dec – Forequarter amputation
Diagnostic and Management Dilemna

Synovial Sarcoma
Myxoid Liposarcoma
Well Diffd Liposarcoma
Myxofibrosarcoma

Subcut AVM
Intramuscular Lipoma
Alveolar Soft Part Sarcoma
Pleomorphic Sarcoma
Unable to accurately diagnose the histology of the soft tissue sarcoma.

Imaging features are non-specific and indeterminate with current imaging modalities.

Imaging guided percutaneous or surgical open biopsy.

Consultation with Orthopaedic surgeon is essential prior to any imaging guided biopsy
- to avoid seeding of track.
Continued and frequent follow up imaging is essential as recurrence is common.

Follow up can be –
- Just XRs.
- XRs with MR
- XRs with MR +/- PET-CT
Finally...

For suspected soft tissue sarcoma –

Get X-Rays of the affected body part/extremity.
Get Chest X-Ray.

Consider MRI – focused to the Region of Interest!
Assess the patient for eligibility for intravenous contrast (Gadolinium-chelate) administration.

Consider CT
- If MRI is contra-indicated/not available.
- To characterise the calcifications.

Nuclear Imaging – PET-CT/PET-MR, Bone scans,
- Problem-solver.
- Follow up after therapy.

Multi-Disciplinary Team involvement and discussion essential.
Thank you for listening.

- steven.wong@sgh.com.sg

My thanks to –

SGH Diagnostic Radiology Imaging Specialists
SGH Musculoskeletal Radiology Team
The Organising Committee.