Imaging of Primary Soft Tissue Infections in the Pediatric Patient

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Introduction

- Prior to the advent and widespread availability of magnetic resonance imaging (MRI), diagnosis of soft tissue inflammation was frequently clinical and often delayed.

- MRI enables prompt and accurate diagnosis of soft tissue infections and decreases morbidity and mortality.
Introduction

- Soft tissue inflammation is often seen in the setting of osteomyelitis

- This presentation addresses soft tissue infection that occurs in the absence of osteomyelitis

- Soft tissue infections occurring in a setting of prior surgery, presence of prosthesis and immune depressive states are also excluded
Purpose

- Demonstrate various patterns of primary soft tissue inflammation occurring in otherwise healthy pediatric patients

- Review the MRI findings, discuss the differential diagnosis and pathogenesis
Signs and Symptoms

- Patients usually have systemic signs and symptoms including fever, night sweats, and leukocytosis.

- Patients also present with focal symptoms such as swelling, erythema, pain and tenderness.
Soft Tissue Inflammation

- Cellulitis
- Fasciitis
- Myositis
Cellulitis

- Cellulitis is acute inflammation of the skin and superficial subcutaneous tissue.
- Diagnosis is often clinical.
- MRI aids in detection of extension into the underlying fascia (fasciitis) and muscle (myositis), and presence of concurrent abscesses.
Fasciitis

- Fasciitis is non-specific inflammation of the deeper subcutaneous tissues and muscle sheath

- Commonly associated with cellulitis or myositis

- Necrotizing form due to “flesh-eating” or gas-forming bacterial infection
Myositis

- Normal muscle is inherently resistant to infection

- Myositis is acute inflammation of the muscles, commonly seen in the setting of osteomyelitis, immune depression, or trauma

- Primary pyomyositis is uncommon in an otherwise healthy patient
MR Imaging Protocol

- T2-weighted (long TR and TE) images in both axial and longitudinal planes
  - Fast Spin Echo (FSE) sequences with fat saturation are used at our institution
  - Inversion Recovery (IR) sequences may also be used

- T1-weighted (short TR and TE) images in longitudinal plane

- Intravenous contrast is often helpful
  - Pre and post contrast fat saturated T1-weighted images in axial plane
Case 1
2 year old with left leg swelling and erythema

Fat-Suppressed T2-Weighted Image (T2W)

Fat-Suppressed T1-Weighted Image Post-Gadolinium (Post-contrast T1W)
Diffuse high signal intensity of the skin and superficial subcutaneous tissue on T2-weighted imaging.
Diffuse enhancement of the same tissues on post-contrast images
Cellulitis

Coronal T2W  Axial Post-contrast T1W
Case 2
6 year old with right elbow swelling and erythema
Proton density image (left) and T1-weighted image (right) demonstrate low signal collection within the thickened subcutaneous tissue posterior to the olecranon.
- T2-weighted image (left) and post-contrast image (right) demonstrate abscess (arrows) with peripheral enhancement within inflamed subcutaneous tissue.
Cellulitis with Abscess

Proton density  T1W  T2W  Post-contrast T1W
11 year old with right forearm pain and swelling

Sagittal and axial T2W
Diffuse inflammation of the skin and subcutaneous tissues (arrows) as well as within the fascial planes.
- Diffuse inflammation of the skin and subcutaneous tissues as well as within the fascial planes
- Focal irregular collection in the volar aspect of the forearm (arrow)
- Diffuse inflammation of the skin and subcutaneous tissues (arrows)
Diffuse inflammation of the skin and subcutaneous tissues as well as within the fascial planes (arrows)
- Diffuse inflammation of the skin and subcutaneous tissues as well as within the fascial planes

- Focal abscess in the volar aspect of the forearm (arrow)
Fasciitis with Abscess

T2W

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Case 4
11 year old with right hip pain

T2W

Post-contrast T1W
High T2-weighted signal involving an inflamed right obturator internus muscle (arrow)
Post-contrast enhancement of the right obturator internus muscle (arrow)
Focal Pyomyositis

T2W

Post-contrast T1W
5 year old with right hip pain
Diffusely enlarged vastus lateralis muscle with multiple subtle hypointense foci
T1W images show diffusely enlarged vastus lateralis muscle with multiple subtle hypointense foci (arrows)
T2W images show diffuse heterogeneous high signal within swollen vastus lateralis muscle
T2W images show diffuse heterogeneous high signal within swollen vastus lateralis muscle (arrows)
- Multiple high signal collections with peripheral ring of low signal
Multiple high signal collections with peripheral ring of low signal (arrows)
Another high signal focus in the biceps femoris muscle (arrows)
Diffuse contrast enhancement of the vastus lateralis muscle and focal enhancement of the biceps femoris muscle
Diffuse contrast enhancement of the vastus lateralis muscle (arrows) and focal enhancement of the biceps femoris muscle (arrow)
Peripherally enhancing collections in the vastus lateralis muscle (arrows) and in the biceps femoris muscle (arrow)
Multifocal Pyomyositis with Microabscesses

T1W  T2W  Post-contrast T1W

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5 y.o with right knee pain and swelling

Coronal T2W
5 y.o with right knee pain and swelling

T2W

Post-contrast T1W
Diffuse heterogeneous high signal in the quadriceps, hamstrings and calf muscles
Diffuse heterogeneous high signal in the vastus lateralis and medialis (VL, VM), biceps femoris semimembranosus medial and lateral heads gastrocnemius muscles, and the surrounding deep fascia with joint effusion
Diffuse heterogeneous high signal in the vastus lateralis and medialis biceps femoris (BF), semimembranosus (SM), medial and lateral heads gastrocnemius muscles, and the surrounding deep fascia with joint effusion.
- Diffuse heterogeneous high signal in the vastus lateralis and medialis, biceps femoris, semimembranosus, medial and lateral heads gastrocnemius (MG, LG) muscles, and the surrounding deep fascia, with joint effusion
Diffuse heterogeneous high signal in the vastus lateralis and medialis, biceps femoris, semimembranosus, medial and lateral heads gastrocnemius muscles, and the surrounding deep fascia (arrows), with joint effusion (JE)
- Small collections in the gastrocnemius muscles (arrows)
Heterogeneous enhancement of the quadriceps, hamstring and calf muscles, and the surrounding deep fascia
Diffuse Pyomyositis and Fasciitis with Microabscesses
10 year old with left knee pain
Inflammation near the insertion site of the Pes anserinus (sartorius, gracilis and semitendinosus) tendons, bursa (arrows) and popliteus muscle.
Inflammation near the insertion site of the Pes anserinus (sartorius, gracilis and semitendinosus) tendons, bursa and popliteus muscle (arrowhead)
 Enhancement near the insertion site of the Pes anserinus (sartorius, gracilis and semitendinosus) tendons, bursa (arrow) and popliteus muscle
Enhancement near the insertion site of the Pes anserinus (sartorius, gracilis and semitendinosus) tendons, bursa and popliteus muscle (arrowhead)
Myositis, Tendonitis, Bursitis

T2W

Post-contrast T1W
Case 8
11 year old with right shoulder pain and fever

Axial and Sagittal T2W

Post-contrast T1W
High signal collection in the anterior supraclavicular region (arrows) and surrounding inflammation involving the rotator cuff muscles and subcutaneous tissues.
Peripherally enhancing multiloculated abscess (arrows) and surrounding inflammation involving the rotator cuff muscles and subcutaneous tissues.
Peripherally enhancing multiloculated abscess and surrounding inflammation involving the rotator cuff muscles (ss-supraspinatus, sc-subscapularis) and subcutaneous tissues (arrow)
Pyomyositis with Abscess

T2W

Post-contrast T1W
Cellulitis - MRI Findings

- Diffuse or reticular pattern of increased signal of thickened tissue on T2-weighted images

- Post-gadolinium images show enhancement of affected tissue and peripheral enhancement of abscess cavities
Fasciitis - MRI Findings

- In addition to features of cellulitis there is increased signal in deep soft tissue excluding the muscles on T2-weighted images

- Post-gadolinium images show enhancement of affected tissue
Myositis - MRI Findings

- Diffuse muscle enlargement
- T1-weighted images show low signal or possible reticular or peripheral high signal
- T2-weighted images show diffuse high signal
- Post-gadolinium images show enhancement of affected tissue and peripheral enhancement of abscess cavities
Differential Diagnosis

- Includes:
  - Infection: Osteomyelitis, Septic arthritis, Bursitis
  - Trauma: Hematoma, Subacute muscle tear, Bursitis
  - Neoplastic: Sarcoma, Lymphoma, Congenital generalized fibromatosis (Desmoid tumor)
Discussion

- Isolated soft tissue infections in the pediatric age group may be focal, multifocal or diffuse.

- The skin and superficial subcutaneous tissues may only be involved - Cellulitis.

- The deep subcutaneous tissues and muscle sheath may be affected - Fasciitis.

- Muscle may be involved - Pyomyositis.
Discussion

- More than one soft tissue element is commonly involved, but isolated infection may occur

- Concurrent abscesses may occur

- Other associated findings may include tendonitis, bursitis, joint effusion
Discussion

- Common pathogens include *Streptococcus pyogenes* and *Staphylococcus aureus*, but cultures are not always positive due prior antibiotic treatment.

- Imaging is very useful for treatment planning such as percutaneous or surgical drainage and debridement.
Conclusion

- Primary musculoskeletal soft tissue infections, especially involving the deeper structures, in otherwise healthy pediatric population are uncommon, but awareness is crucial.

- MRI is beneficial in these cases, aiding prompt diagnosis, encouraging adequate treatment and decreasing morbidity.
References


Thank you.