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## Review

## Imaging of acute unilateral limb swelling: A multi modality overview

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## ABSTRACT

Acute unilateral limb swelling is a common clinical problem that has a relatively wide differential diagnosis both by clinical and imaging studies, nevertheless, the diagnostic list may include conditions that have quite different treatment plans, this mandates early establishment of the correct diagnosis. This review gives a multimodality approach in imaging of unilateral limb swelling with an onset not exceeding 72 h. The most common etiologies for the condition were tabulated regarding the anatomical level from which they arise, aiming to give a step wise imaging work up over viewing the imaging characteristics for each pathological condition.

## 1. Introduction

Acute unilateral limb swelling is a clinical problem that can be categorized as one of two major groups, **the majority** of them is compatible with acute deep venous thrombosis (DVT) and actually the patients don't have venous thrombosis but readily have another disorder (e.g. cellulitis, arthritis, trauma or otherwise), this disorder can be suspected through meticulous history taking and clinical examination, however, it needs to be confirmed by imaging studies, **the second group** which is minority; where the patients have already acute DVT [1].

In about 70% of clinically suspected cases of acute DVT, an alternative diagnosis (other than acute DVT) could be discovered by the imaging studies [2]. So, in order to be more specific, a limb swelling could be unilateral or bilateral as regarding the side of affection, but regarding the onset of condition, it could be acute or chronic.

In acute edema, the timing of the swelling is less than 72 h and may occur in conditions like (acute DVT, cellulitis, acute compartmental syndrome, ruptured Baker's cyst or otherwise), but in chronic edema the timing should exceed 72 h and usually results from chronic fluid accumulation due to systemic conditions or lymphatic obstruction [3].

This review is concerned with the imaging of acute unilateral limb swelling in patients presented to the radiology department in our institute for imaging studies, based on the clinical suspicion and history taking that categorized the condition as a unilateral affection with an acute onset.

The key to a precise diagnosis is the definition of the imaging characteristics of various diseases that can be an etiology for limb swelling after exclusion of acute DVT by venous Doppler scanning.

## Ethics committee approval:

Ethics committee approval had been obtained as well as the patients' consents.

## 2. Differential diagnosis

The anatomical approach is a useful strategy for localizing the spectrum of pathologic conditions seen in patients with clinical findings that mimic acute DVT. We tabulated the most commonly encountered etiologies for acute unilateral limb swelling respectively to the anatomical levels from which the pathology could arise.

So that the examined extremity could be divided into the following planes: (1) skin/subcutaneous tissues (2) vessel (mainly venous system) (3) joints (4) bones (5) muscles/tendons (6) other causes (table 1).

## 2.1. Skin and subcutaneous tissues

## 2.1.1. Cellulitis

Cellulitis is an inflammatory condition resulting from skin or subcutaneous tissue infection almost by streptococci; it usually affects lower limbs more than upper limbs [4]. Its diagnosis is often suspected clinically and needs to be confirmed by imaging.

**Ultrasound (US)** is an initial modality for evaluation of acute cellulitis, it is usually done first to exclude acute DVT then to define the ultrasound findings of cellulitis that may include diffusely swollen subcutaneous tissue with increased echogenicity as compared to the other limb, further accumulation of the fluid in the subcutaneous fat gives "marbled fat appearance" or "cobble-stone appearance", however

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**Table 1**

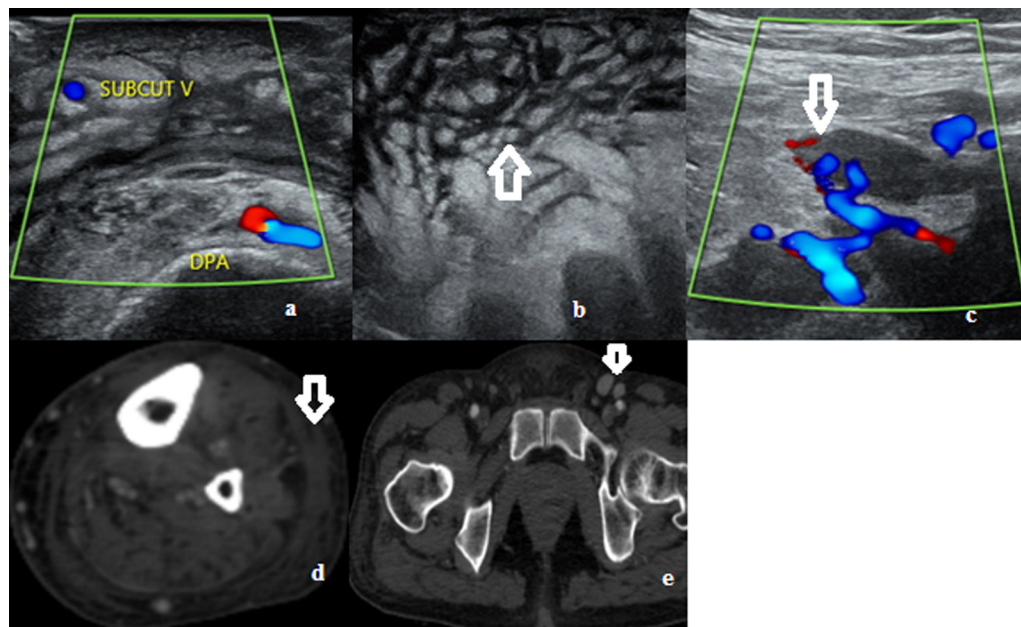
Demonstrating various causes of acute unilateral limb swelling in an anatomical order.

- |  |
|--|
| 1 – Skin and subcutaneous tissue                   |
| ● Cellulitis (superficial and deep types)          |
| ● Closed traumatic injuries and contusions         |
| 2 – Vascular system                                |
| ● Acute DVT  |
| ● Acute superficial thrombophlebitis               |
| 3 – Joint space related                            |
| ● Joint effusion                                   |
| ● Ruptured Bakers' cyst                            |
| ● Septic arthritis                                 |
| 4 – Osseous (bony)structures                       |
| ● Osteomyelitis                                    |
| ● Fractures (stress and pathological)              |
| 5 – Muscular and tendons                           |
| ● Muscular injuries (hematomas, strains and tears) |
| ● Pyomyositis (Muscular abscess)                   |
| ● Tenosynovitis                                    |
| ● Ruptured tendons                                 |
| 6 – Other causes                                   |
| ● Cardiac edema or edema due to heart failure      |
| ● Post thrombotic syndromes                        |
| ● Leg immobilization                               |
| ● Lymphedema                                       |
| ● Lipedema   |
| ● Cyclic edema or Idiopathic edema                 |
| ● Allergy and insect bite reactions                |
| ● Self-induced edema                               |

this appearance is a non specific pattern and may exist in many other causes of edema [5] (Fig. 1).

**Computed tomography (CT)** is particularly helpful to differentiate between the superficial (uncomplicated) type and deep (complicated) type; the latter is usually associated with deep-seated soft tissue infections. In the superficial (uncomplicated) cellulitis, CT demonstrates thickening of the skin and superficial fascia with smudging and septation of the subcutaneous fat [5] (Fig. 1).

In the deep-seated cellulitis the deep tissues are affected and may show: abscess formation, myositis, osteomyelitis, and sometimes, necrotizing fasciitis can occur and is caused by gas-forming pathogens with characteristic air densities can be demonstrated in the CT



**Fig. 1.** (a–c) Lower limb ultrasound and color Doppler images showing subcutaneous edema with marbled fat appearance (open arrow in b) in patient with no vascular occlusions, associated enlarged reactive inguinal lymphadenopathy showing trans-hilar vascularity (open arrow in c), this was correlated clinically as cellulitis (d) lower limb axial CT angiography (CTA) image with subcutaneous and deep fascia thickening (open arrow) in the mid leg associated with increased girth (e) lower limbs axial CT angiography (CTA) image at the level of the groin showing reactive lymph glands enlargement (open arrow).

examination [5] (Fig. 2).

**Magnetic resonance imaging (MRI)** in cellulitis has a non specific pattern similar to that of soft tissue edema, it may show thickened skin with subcutaneous fat reticulations and elicit intermediate signal intensity on T1weighted images (T1WIs) and high signal intensity on T2 weighted (T2WIs) or short tau inversion recovery (STIR) images, often the affected area has a poorly defined margins [6] however, some differentiation can be done after contrast administration with some delay in image acquisition; where the enhancement can be detected in cellulitis but not present in nonspecific edema [7].

In some cases, we noticed associated reactive lymphadenopathy in the regional lymph nodes draining the area of cellulitis; these nodes appeared to be enlarged with nonspecific pattern.

**Teaching point:** If a subcutaneous or deep collection was detected by imaging in cases of cellulitis, it should be mentioned in the radiology report.

2.1.2. Traumatic lesion

**Closed traumatic injuries like contusions** in which there is subcutaneous edema or hematoma may exist and appear in ultrasound as a focal area of increased echogenicity or as a nonspecific pattern of edema [8]. In MRI feathery like an area of increased signal intensity in the affected subcutaneous fat is well seen by the fluid sensitive sequences like T2WIs and STIR images (Fig. 3).

**A traumatic degloving injury like Morel-Lavallée lesion** is a condition in which the skin and subcutaneous fat abruptly get separate from the underlying fascia over the bony prominences; MRI and ultrasound are useful modalities for evaluation of the condition [9]. US shows anechoic or hypoechoic fluid collection with or without internal debris, this collection separates the subcutaneous fat from the underlying deep fascia. MRI shows fluid collection between the subcutaneous fat and the underlying deep fascia, moreover, MRI can give anatomical details with better tissue characterization about the fluid content signal (simple or bloody) and it can exclude coexistent deep fascia or muscular injuries [9] (Fig. 4).

2.2. Vascular disorders (venous system)

2.2.1. Acute DVT

Acute DVT is a well known major health problem with an annual incidence of 600,000 cases in the United States population and if the

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