Abstract

The purpose of this pictorial essay is to illustrate the ultrasonographic aspects of the non-traumatic lesions of the fingers. Diffuse (especially dactylitis) and localized (tumors, tophi, calcinosis, etc) lesions of the digits are discussed and illustrated. For a better understanding, the US images are compared with the clinical aspect of the pathological fingers.

Keywords: ultrasonography, fingers, non-traumatic lesions

The development of the high-resolution transducers has increased the performance of ultrasonography (US) in detecting subtle pathological changes in the superficial structures of the musculoskeletal system. For a complete and detailed US evaluation of the fingers 15-18 MHz transducers are required, especially small size transducers (preferable hockey-stick transducer). The normal tendons, joints, ligaments, nerves, vessels, or nails can be accurately imaged (fig 1-4) and the anatomical variants or the different findings of the disorders affecting the digits can be identified.

Apart from the traumatic lesions, commonly found in fingers and toes, the non-traumatic lesions frequently represent a challenge for the clinician. Despite of the easy clinical examination of the digits, the use of the imaging techniques is required to establish the nature and the extension of the underlying pathological process. On behalf of these needs, US is an accessible, quickly performed, and a powerful diagnostic tool for studying disorders which involve different tissues, from the most
superficial layer to the deep ones. Nowadays, in soft tissue pathology examination is considered that US should be the first imaging technique to start with.

The aim of this pictorial essay is to describe the main US findings in non-traumatic lesions of the digits, diffuse or localized, inflammatory or tumoral. Most of the US pictures have been associated with the clinical aspect of the fingers in order to make more clearly the parallelism between clinical and imaging examinations.

**Diffuse lesions of the digits**

The main diffuse lesion of the digit ("the swollen digit") is dactylitis. The term of dactylitis is used to describe the inflammation of a finger or a toe. In clinical practice it is considered a hallmark feature of seronegative spondi- larthropaties (SpA) especially of psoriatic arthritis [1]. The so-called "sausage-digit" appearance is created by "the uniform swelling, such that the soft tissues between the metacarpophalangeal and the proximal interphalan- geal, proximal and distal interphalangeal, and/or distal interphalangeal joint and digital tuft are diffusely swollen to the extent that the actual joint swelling could no longer be independently recognized" [2]. Dactylitis is considered to be so specific for SpA that it was included in the new criteria for the diagnosis of the whole disease group [3].

These changes are explained by various abnormalities. Olivieri et al showed that diffuse digital edema and inflammation of the digital flexor tendon sheats are the main cause of dactylitis in SpA [4]. Sometimes the enlargement of the digit joints contributes to the pathological aspect of the digit but the joint synovitis alone, without edema or flexor tenosynovitis can not give the "sausage-like" appearance [4-6] (fig 5-9). These find- ings have also been confirmed by histopathological ex-aminations in animal models [7]. Dactylitis can be char-acterized as acute (tender) or chronic (non-tender) [8].

In spite of the high specificity of dactylitis for SpA, the differential diagnosis should be careful considered. In *tuberculosis dactylitis*, the osteomyelitis of the short tubular bone of the hands and feet realizes the aspect of spina ventosa on the radiography. *Syphilitic dactylitis* (in congenital syphilis) is bilateral and symmetric. *Blistering distal dactylitis* (due to infection with group A be-
Dactylitis of the 2nd finger in which the synovitis, bone contour irregularities (osteophytes) of the proximal interphalangeal joint and edema had the main contribution to the clinical aspect. A 47 years old woman with psoriatic arthritis. Longitudinal dorsal scan.

Fig. 9. Clinical and US aspect of the thumb in a 56 years old woman with systemic erythematous lupus. The hypervascularized synovitis of the interphalangeal joint was insufficient to produce the aspect of dactylitis.

Fig. 10. A 75 years old man with gout. Longitudinal dorsal scan of the 3rd finger. Swollen aspect of the distal region to the proximal interphalangeal joint due to diffuse deposition of the monosodium urate crystals deposition, even in the nail bed.

Fig. 11. A 28 year-old woman with sarcoid dactylitis of the thumb produced by an important tenosynovitis of the flexor sheath. Some irregularities of bone contours of the interphalangeal joint were present, but no fluid or synovitis was found.

Calcium pyrophosphate deposition in the 3rd flexor tendon sheath (hyperechoic content of the sheath). The diagnosis was established after US guided aspiration of the sheath content and light polarized microscopy examination.

ta-hemolytic Streptococcus or Staphylococcus aureus) involves the distal fat pad and it usually presents as a fluid-filled blister. The sickle cell dactylitis is due to bone marrow infarction, (“hand-foot syndrome”). Gouty dactylitis is a rare finding, seen in chronic polyarticular disease [2,5,9] (fig 10). Sarcoid dactylitis is a rare manifestation of sarcoidosis and tends to occur as the presenting symptom of the disease [9] (fig 11). The deposition of calcium pyrophosphate or uric acid crystals in the flexor tendon sheath of the hand was found to be a rare cause for a swollen finger [10] (fig 12). Differential diagnosis should be done also with local pathology as the presence of foreign body (fig 13, fig 14).
Tenosynovitis, defined as an hypoechoic or anechoic thickened tissue with or without fluid within the tendon sheath that is seen in two perpendicular planes and may exhibit Doppler signal [11], can be easily identified by US. Tendon sheath widening, visible in longitudinal and transverse planes, may be due to synovial hypertrophy (echoic pattern), to the presence of synovial fluid (anechoic pattern) or both (mixed pattern) – exudative or proliferative tenosynovitis. Also, the intraarticular synovial hypertrophy can be the reason for joint swelling. It is defined as an abnormal hypoechoic intra-articular tissue (compared with the subdermal fat, but sometimes found as isoechoic or hyperechoic) which is non displaceable, poorly compressible and may exhibit Doppler signal [11]. On the other hand, the presence of the synovial fluid (an abnormal hypoechoic or anechoic intra-articular material without Doppler signal that is displaceable and compressible with the transducer) [11] contributes to the pathological aspect of the joint.

**Localized lesions (masses) of the digits**

Localized masses of the digits can be characterized by US.

**Cysts**

*Ganglia cyst* is a well-defined structure with anechoic content and posterior enhancement. The most frequent site for ganglia is the base of the fingers, the third and the fourth fingers being commonly involved [12] (fig 15). A communicating duct to the joint space may be detected [13]. Not all the ganglia cysts are anechoic; hypoechoic or complex cysts (internal reflections, thick walls, septations
or locules) may be found [14] (fig 16, fig 17). The tendon sheath cysts generally can be mobilized with the tendon during the dynamic examination (fig 18). These types of lesions are the main etiology for the trigger finger.

Mucous cysts, well-defined hypoechoic lesions, in relation with the distal interphalangeal joint, frequently on its lateral side of the joint are part of the osteoarthrosis process and are associated with Heberden nodes [15] (fig 19). Epidermal inclusion cyst results from implantation of epidermis into the dermis, as in trauma or surgery (fig 20).

US is useful for cysts evaluation: the relation with the adjacent structure, size, localization, needle aspiration, and steroid injection.

Giant cell tumor of the tendon sheath (localized villonodular tenosynovitis) is a well-defined hypoechoic solid mass localized periarticular or paratendineous with increased internal flow in color Doppler examination (fig 21). Bone scalloping due to the pressure of the tumor on the underlying bone cortex can be demonstrated [13,16]. Generally the tumor is painless and the first three fingers of the right hand are more often affected [17].

Glomus tumor is a rare tumor derived from the glomus body found predominantly in the subungual region.
The tumor is characterized by paroxysmal pain, sensitivity to cold, and severe point tenderness [18]. US reveals a hypoechoic solid mass highly vascularized, situated in the nail bed, with the remodeling (scalloping) of the underlying bone [12,19] (fig 22). If the tumor displays unusual features, such as large size, deep location, or infiltrative growth a malignant glomus tumor should be considered [18] (fig 23).

Lipomas, fibrous tumor, and hemangiomas are rarely founded in digits; they occur mainly in the hand or foot. Clinical and US aspects are not different from other localizations

Nerve tumors (schwannomas and neurofibromas) rarely affect the hand or the foot and only exceptional affect the digits.

Soft malignant tumors are rare in the fingers. For bone tumors (benign or malignant) radiography, computed tomography, and magnetic resonance imaging studies are required.

Localized lesions of the fingers may also be represented by gouty tophi: hypoechoic, with homogenous structures and soft on palpation – soft tophi (fig 24) or pseudotumoral dishomogeneous structures, with important posterior shadow, rigid on palpation – firm or mixed tophi (fig 25), even with calcification foci [20]. In systemic forms of scleroderma the calcinosis can cause lumps under the fingers skin (fig 26) that may break through the skin and leak a white liquid similar with chalk.

In nail clubbing (Hippocratic fingers) the distortion of the distal phalanx and of the finger nails consists in increasing the convexity of the nail fold and the thickening of the whole distal phalanx, including the nail bed (fig 27).
Conclusions

US is an important tool for finger imaging examination being an established efficient, safe, cost-effective, and patient-friendly method to evaluate the structure of the normal and pathological digits. The high spatial resolution of the US gives important data to the clinician about the underlying process which produces a diffuse or localized modification in a finger. The method is useful for the clinician for taking decisions – concerning the optimal treatment, conservative or surgical – and for the follow up of the patient.

Reference