Differential diagnosis of calf pain by ultrasonography

Diagnóstico ultra-sonográfico diferencial entre as causas de dor na panturrilha

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ABSTRACT

This paper aims to evaluate the recent and numerous applications of ultrasonography in the differential diagnosis of conditions that affect the popliteal fossa and lower limbs, resulting in calf pain. Popliteal cysts and their ruptures, aneurysms, hematomas, cellulitis, abscesses, soft tissue tumors and other fluid collections are easily identified by this technique. Moreover, post-trauma and inflammatory conditions affecting muscles and tendons, muscle necrosis, deep venous thrombosis and superficial thrombophlebitis are very well demonstrated by the ultrasonographic screening.

Keywords: Lower extremity/ultrasonography; Diagnosis, differential

RESUMO

Este trabalho tem como finalidade analisar as recentes e numerosas aplicações da ultra-sonografia no diagnóstico diferencial das doenças que afetam a fossa poplítea e a extremidade inferior dos membros, com expressão clínica de dor na panturrilha. Cistos poplíteos e suas rupturas, aneurismas, hematomas, celulites, abscessos, neoplasias de partes moles e outras coleções líquidas são facilmente identificadas por esta técnica. Em associação desordens pós-traumáticas e inflamatórias afetando os músculos e tendões, necrose muscular, trombose venosa profunda e tromboflebite superficial são muito bem demonstradas pelo rastreamento ultra-sonográfico.

Descritores: Extremidade inferior/ultra-sonografia; Diagnóstico diferencial

INTRODUCTION

Calf pain usually results from diseases involving the popliteal fossa and the dorsal aspect of the leg – such as the knee joint, the popliteal-tibial-fibular arterial complex, superficial and deep veins, soleus and gastrocnemius muscles and adjacent soft tissues. The range of diseases involved in the differential diagnosis is as follows[1].

CAUSES FOR CALF PAIN AND ULTRASOUND IDENTIFICATION

Baker's cyst

Baker's Cyst is a liquid distension of the gastrocnemius-semitendinious synovial pouch that communicates with the knee joint in 50% of normal adults. It results from synovial diseases or any intra-articular process leading to excessive fluid production that may leak to that region. Medially located in the popliteal fossa, between the tendon of the semitendinous muscle and the medial head of the gastrocnemius. It is visualized as a cystic, anechoic pouch of regular contours (Figure 1A), except the cases, in which there is also synovial proliferation, hemorrhages or infection, when it can assume a heterogeneous aspect with a solid-cystic appearance or forming fluid-fluid level[2]. The rupture of a Baker's

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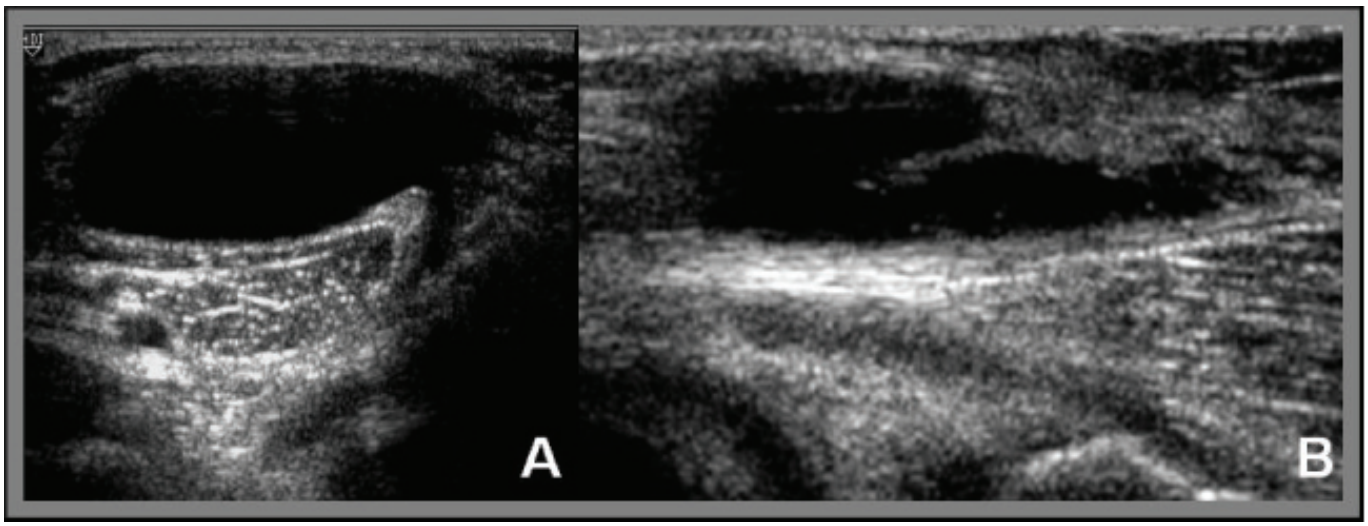

Figure 1. Non-ruptured Baker's cyst between the tendon of the semitendinous muscle and the medial head of the gastrocnemius muscle (A). Ruptured Baker's cyst (pseudothrombophlebitis), in which the caudal definitions of the cyst are lost, with fluid dissecting the subcutaneous and muscle planes (B)

cyst or pseudo-thrombophlebitis syndrome is an acute event undistinguishable from deep or superficial venous thrombosis, on ultrasound the caudal definitions of the cyst wall are lost, and it assumes a funnel-like appearance, with fluid dissecting the planes of the soleus and grastrocnemius muscles[3](Figure 1B).

POPLITEAL ARTERY ANEURYSM

The popliteal artery aneurysm is the most common aneurysm of the peripheral arteries, and is bilateral in 59% of cases. In the ultrasound, it is an anechoic pulsatile structure at the center of the popliteal fossa and in continuity with the popliteal artery, usually involving its medium and proximal segments, distal to the adductor canal, easily seen on colored Doppler with an anarchic whirled internal flow. There may be thrombii, which are seen as echogenic material in the lumen of the aneurysm, close to the wall. In up to 15% of cases, there may be an association with deep venous thrombosis[4].

Deep venous thrombosis (DVT)

The deep venous thrombosis (DVT) is a common, potentially fatal clinical problem of the lower limbs often associated to pulmonary embolism. The risk factors identified are those impacting the Virchow´s triad (venous stasis, endothelial lesion and hypercoagulability), more often seen in bed-ridden patients and those who suffered orthopedics and pelvic surgeries. Most DVT in the lower limbs begin in calf veins with local pain, which may spread to the popliteal vein and, more proximally, to the femoral veins, with significant edema and redness of the limb. When the process reaches the femoral veins, the risk of pulmonary embolism increases considerably. Dynamic ultrasound enables assessing thrombii through the compression maneuvers. The association with colored Doppler helps differentiating complete from incomplete thrombosis of the venous bed as well as assessing the distal tibial fibular areas[5].

Superficial thrombophlebitis

Superficial thrombophlebitis is the most important risk factor is lower limb varicose veins. Although the initial diagnosis is clinical, about one third of patients with superficial phlebitis will progress to involvement of the deep veins, and 20% of them already have an associated occult DVT. Therefore, ecographic study is really important[6]. Ultrasound with dynamic compression screening associated to color Doppler demonstrates findings similar to those of DVT in the superficial venous system[5-6].

Popliteal hematomas

Popliteal hematomas are usually round or oval-shaped lesions which dissect the muscle planes having the longer axis parallel to the muscle fibers. The ultrasound image varies depending on the length of the process. In the beginning, the lesions are cystic and as they become organized, the walls become irregular and internal echoes appear, becoming cystic again after four to six weeks. A clinical history of recent trauma is mandatory for diagnosis[7].

Abscesses and cellulitis

Abscesses and cellulitis are manifestations of bacterial infections. The term abscess implies pus collection (Figures 2 and 3), whereas cellulitis refers to a diffuse infection of soft tissues without a focal purulent collection (Figure 4). Abscesses may present with the same ultrasonographic

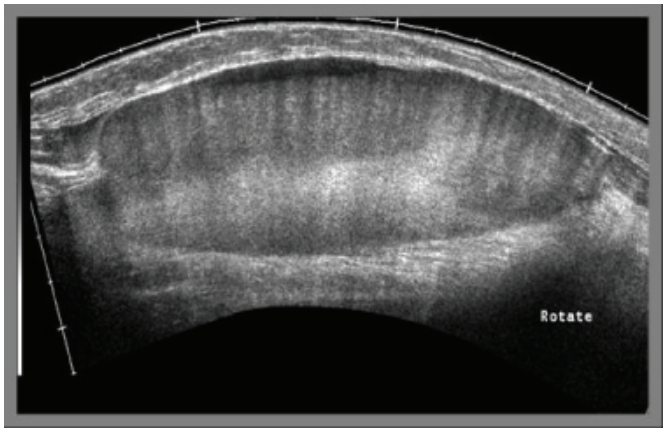

Figure 2. Organized, heterogeneous fluid collection between the subcutaneous and muscle planes in the calf region, representing an abscess

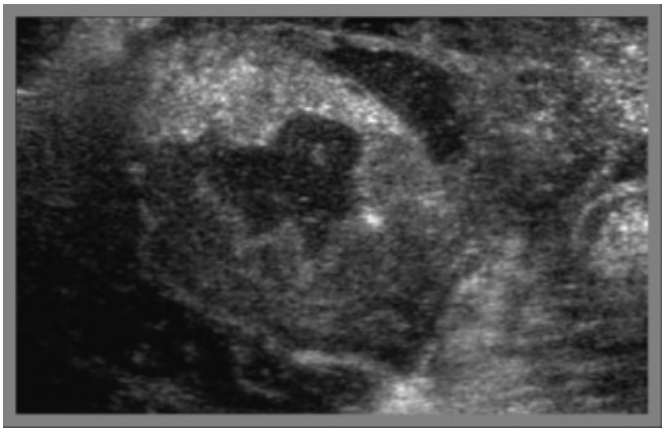

Figure 3. Gastrocnemius infectious myositis in immunosuppressed patient, leading to abscess formation

aspects of hematomas, and the soft tissue edema that occurs with cellulitis cannot be differentiated from those of other causes; hence, the clinical association of hypersensitivity, local pain and the presence of inflammatory signs are necessary for the correct diagnosis[8].

Traumatic muscle and tendon lesions

Traumatic muscle and tendon lesions are due to direct (blunt) or indirect (stretching) trauma. Direct trauma cause muscle or tendon compression against bone, leading to a crushing injury, and the indirect ones are related to stretching for muscle or tendon fiber fatigue, which usually limit the range of motion of joints, particularly in the gastrocnemius and calcaneal tendon in the calf. Among the detectable lesions, there is a range of findings, from small hypoechoic areas associated to zones of deranged fibers in the mild cases, to discontinuity of fibers, interposed by hyperechogenic fibroadipose septa associated to muscular retraction and different hematomas in the cases of partial or complete ruptures (Figures 5 to 8)[9].

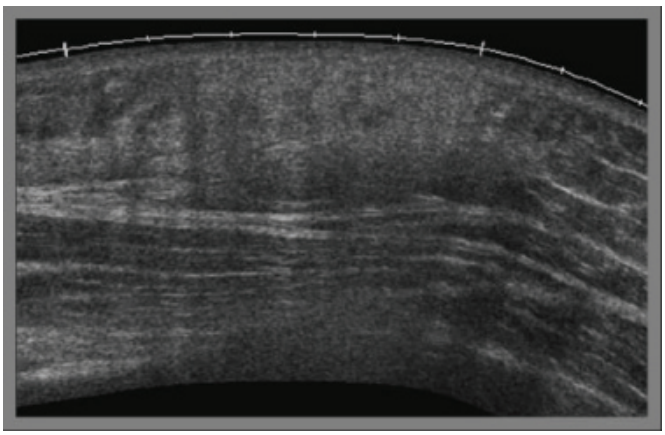

Figure 4. Marked thickening and hyperechogenicity of the calf subcutaneous tissue in a patient with chronic cellulitis

Non-traumatic muscular necrosis

Non-traumatic muscular necrosis is the destruction of the muscle fibers with release of potentially toxic intracellular components in the blood flow, due to disturbed energy production of the glycolytic or oxidative pathway during ATP depletion. The causes for this problem are many,

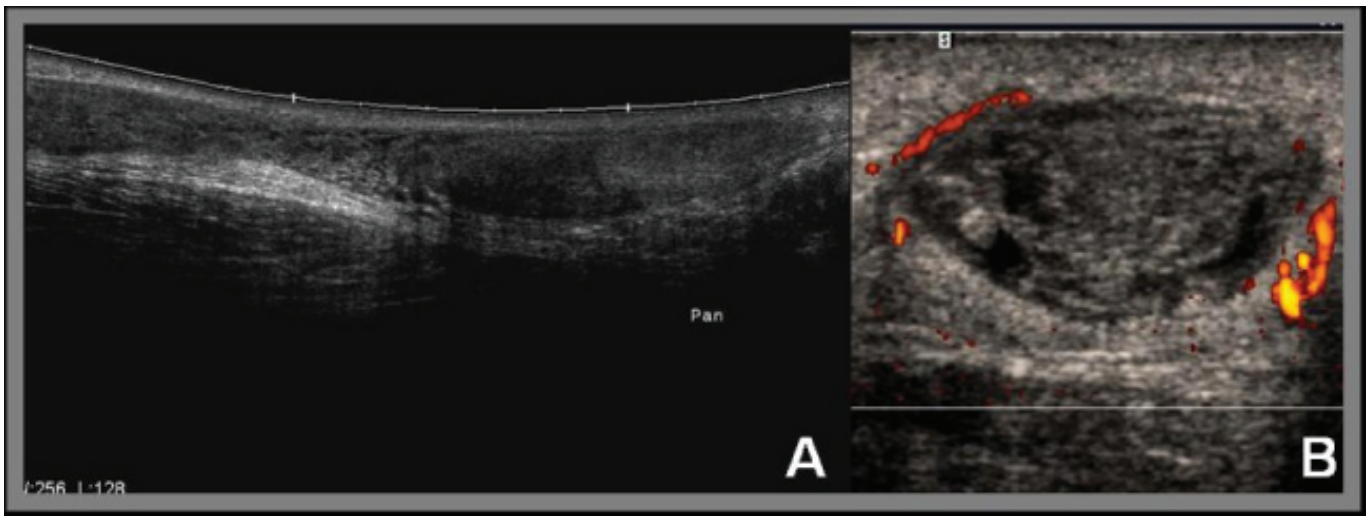

Figure 5. Area of complete rupture of the calcaneal tendon (A). Note increased peritendineal blood flow (B)

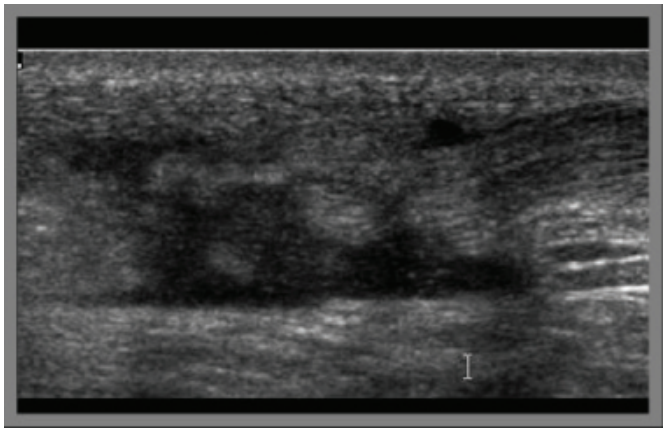

Figure 6. Complete rupture of the calcaneal tendon with hyperechogenic, fatty material interposed among its fibers

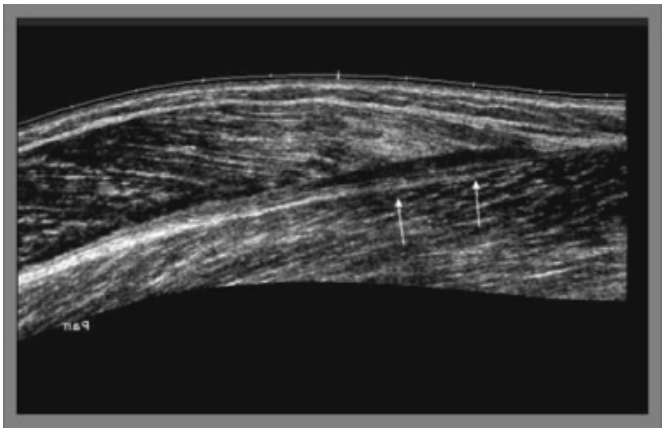

Figure 7. Muscular and aponeurotic avulsion of the medial head of the gastrocnemius *(Tennis Leg)*

including drug abuse, muscle compression secondary to immobilization, extenuating physical exercise, metabolic problems, seizures, immune diseases, and infections. The ultrasound demonstrates a heterogeneous, poorly-defined intramuscular area, mostly hypoechogenic, which does not change on compression with the transducer, associated to posterior acoustic enhancement and to multiple echogenic lines, crossing the lesion internally and corresponding to non-ruptured muscle fibers[10].

Neoplastic lesions

Neoplastic lesions vary in appearance, may be hypo or hyperechogenic, with or without a cystic component. Lipomas, lymphomas, sarcomas, neurofibromas and fibrous histiocytomas are the most important ones. Ultrasound is quite useful to assess the size and nature of the lesion (whether cystic, solid or mixed), and to help monitoring treatment response, although it does not provide a specific diagnosis[11].

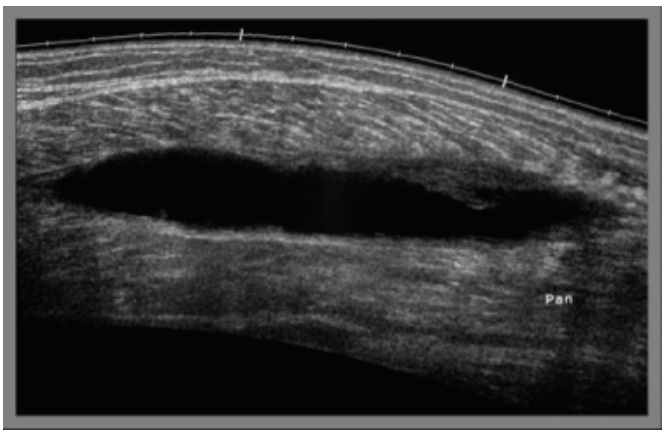

Figure 8. Hypoechogenic fluid collection between the soleus and medial gastrocnemius muscles in a plantar muscle rupture

Occult bone fractures

Occult bone fractures are often not detected on plain film due to their small size, are observed on ultrasound as areas of discontinuity on the cortical bone (Figure 9)[12].

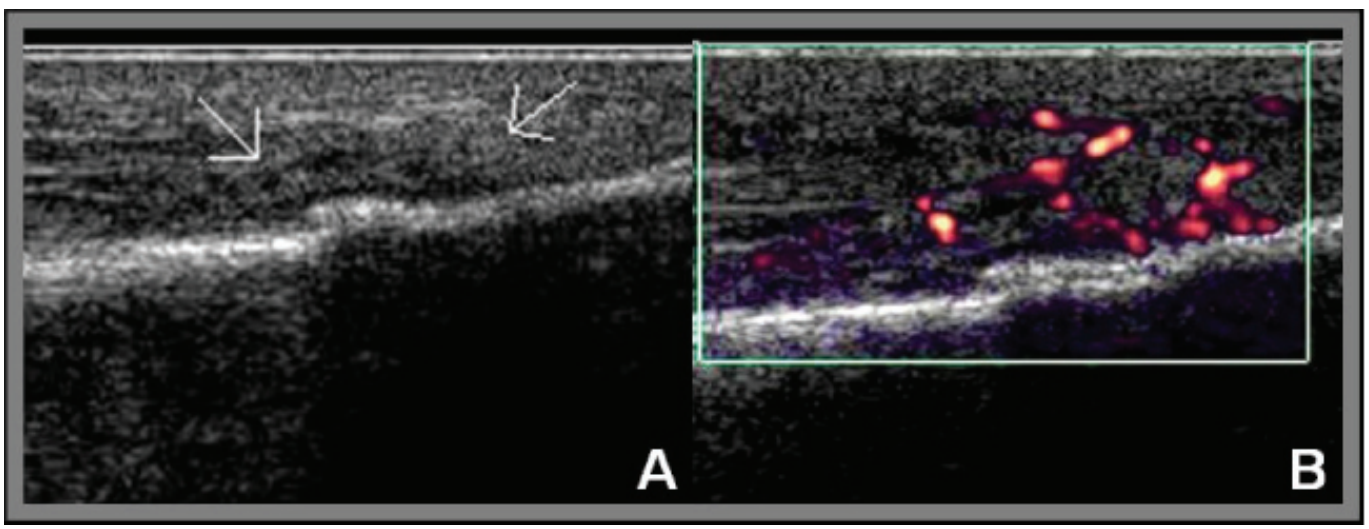

Figure 9. Stress diaphyseal fracture of the fibula in a marathon-runner (A). Notice vascular flow increase surrounding the fracture (B)

CONCLUSIONS

Ultrasound in the differential diagnosis of calf pain is a useful method, and it can be considered an advanced evaluation method, it is not invasive, allows for a dynamic and thorough assessment of the structures of that region and it is a low cost exam. The careful, detailed exam of the patient by a well trained professional, along with the increasing improvement of equipment resolution and the use of transducers with higher frequencies, have been fundamental for diagnosis and increased use of this method.

Another factor that contributed to more relevant information, and to further the scope of the method was, the use of Doppler in the B mode, enabling the study of vascular problems. Hence, calf ultrasound has consolidated as a good image alternative in the diagnostic approach of such problems.

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