Muscles are among the soft tissues one of the best adapted to ultrasound examination. In fact, it was the first imaging available for the evaluation of muscle disease. The availability, low cost, and ease of examination makes ultrasound superior to MRI for follow-up of lesions and searching for healing problems such as fibrosis, cystic haematomas, or myositis ossificans.

When dealing with fresh traumatic muscle lesions, the main goal of ultrasound is to assess the presence of a muscle tear or not. Haematoma is the key sign of a muscle tear. The ideal time for the examination is between 2 and 48 h after the muscle trauma. Before 2 h, the haematoma is still in formation. After 48 h, the haematoma can be spread outside of the muscle. After healing, ultrasound can depict some complications such as a cystic lesion or myositis ossificans. Muscle atrophy, inflammation, avulsion and tumours are also good indications for ultrasound.

Keywords: Muscle · Ultrasound · Sprains · Tumors

Introduction

Muscles are among the soft tissues one of the best adapted to ultrasound examination. In fact, it was the first imaging available for the evaluation of muscle disease [2]. Due to the multiplanar approach, both transversal and longitudinal, the dynamic examination of the muscle during rest and contraction, the excellence of the spatial resolution and definition of muscle structure, ultrasound keeps its leading edge when dealing with muscle pathology.

The availability, low cost and ease of examination makes ultrasound superior to MRI for follow-up of lesions and detection of healing problems such as fibrosis, cystic haematomas or myositis ossificans.

Since approximately 30% of sports injuries deal with muscle injuries, ultrasound plays a major role in sports traumatology, helping the physician to decide whether the athlete should or should not come back to training and competition.
Dynamic study, at rest and during contraction, is also very important. Finally, comparison with the other limb is mandatory to avoid artefacts or pitfalls.

When looking for a muscle hernia, the probe must be placed very smoothly on the skin, because the hernia could disappear if the compression is too heavy.

Normal aspect

Muscle fibres are organized in grouped bundles surrounded by fibroadipose septa called perimysium. These septa form the tendons by joining at each end of the muscle. Surrounding the entire muscle and separating one muscle from another is the aponeurosis.

Muscle fibres are usually arranged in a parallel manner and form a sort of pennate structure. Muscles can be unipennate, bipennate with a central aponeurosis or circumpennate [2]. The pennate structure is very well demonstrated by ultrasound. Muscle bundles of fibres are seen as hypoechoic zones and the perimysium is seen as hyperechoic lines separating the fibres (Fig. 1). Epimysium, fascia, nerves and tendons appear also hyperechoic relative to muscle.

Contraction as well as exercise increases the overall size of the muscle but also its hypoechogenicity due to the muscle bundles of fibres and to the blood supply during exercise.

Muscle pathology

Sports pathology

The main dilemma for the sports physician is to classify a muscle trauma as a distraction with a tear or not [3]. The lesions can be divided as shown in Table 1.

Ultrasound’s main goal is to assess the presence of a muscle tear or not. If a tear is present, the lesion will be qualified as severe and a resting time of 4–6 weeks will be recommended; if there is no tear, the return to competition will be much earlier [5].

Many authors, including the present one, have recommended in previous reports [2, 6, 7, 8] grading of lesions. Grade 0 corresponds to the lack of any ultrasonic lesion, and grade I corresponds to minimal elongations with less than 5% of muscle involved. These lesions can be quite long in the muscle axis being usually very small on cross-