Ultrasonography as a Diagnostic Modality and Therapeutic Adjuvant in the Management of Soft Tissue Foreign Bodies in the Lower Extremities

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Abstract

Background: Foreign bodies are sometimes overlooked in the initial evaluation of soft tissue wounds in the emergency room setting. The physical examination identifies foreign bodies that are superficial enough to be seen or palpated, while radiographs reveal those that are radio-opaque. If these two criteria are not met, however, the foreign body may remain undetected. These patients present later with long-standing pain in the area of penetration sometimes associated with localized tenderness.

Objectives: To assess the role of ultrasonography in the diagnosis and management of patients with a suspected retained foreign body.

Methods: Ultrasound was used in 21 patients with suspected retained foreign bodies and the diagnosis was positive in 19. Fifteen underwent a surgical exploration in which the ultrasound was used as an adjunctive modality either pre- or intraoperatively to assist in the localization of the foreign body.

Results: All procedures were successful. No postoperative complications were recorded at an average follow-up of 2 years. Three patients gradually became asymptomatic and were left untreated. One patient was lost to follow-up.

Conclusion: Sonography is an extremely effective tool for the late diagnosis of retained foreign bodies in the soft tissues. We suggest that its availability in the emergency room may decrease the rate of misdiagnosis and avoid these unfortunate cases, although this remains to be proven.

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Puncture wounds and soft tissue lacerations of the extremities are commonly encountered in the emergency room. These are inspected, palpated and explored to rule out the presence of a foreign body, and X-rays are routinely obtained to visualize radio-opacities within the soft tissues. If both the physical examination and the radiographs are found to be negative for foreign bodies, the wounds are treated by thorough cleaning, extensive debridement, hemostasis and primary or secondary closure. In most patients this protocol is successful but some continue to complain of long-standing pain in the affected extremity associated with discomfort and disability. In these cases one must suspect the possibility that a retained foreign body was overlooked in the initial evaluation in the ER.

Conventional radiography has limited usefulness in this setting as it will detect only radio-opaque objects. Radiolucent foreign bodies such as wooden splinters, vegetal thorns and some types of glass are not visible on the films. Sonography plays an important role in the assessment of these cases due to its sensitivity in detecting foreign bodies in the soft tissue regardless of their type or infrastructure [1–4]. These are visualized as hyper-echoic foci with accompanying acoustic shadows. The shadow may be either partial or complete depending on the angle of insonation and the composition of the foreign body. A hypo-echoic halo surrounding the foreign object is sometimes seen, which represents edema, an abscess or granulation tissue. A high frequency linear transducer has been shown to be helpful in detecting small foreign bodies [5]. Aside from diagnosis, ultrasound is an effective adjunct for the actual localization of the foreign object within the soft tissue. This may be achieved either before or during surgery by marking the skin over the lesion or by inserting a needle into the target area. The intraoperative procedure requires of course the use of a sterile transducer. The present study summarizes our clinical experience using ultrasonography in the management of patients with a suspected retained foreign body.

Materials and Methods

Twenty-one patients were referred for sonographic examination because of possible retention of foreign bodies in the soft tissues of the lower extremities during a 2 year period (1 January 1997 to 1 January 1999). The patients were referred to us by orthopedic and general surgeons as well as by primary care physicians and pediatricians in the community. The 14 male and 7 female patients ranged in age between 1 and 36 years (mean age 13).

Plain radiographs were obtained before sonography in 19 of

ER = emergency room

the patients and were all found to be negative for foreign bodies. In order to localize the foreign body, the suspected area was scanned in both longitudinal and transverse planes. Whenever a foreign object was located, a mark with permanent ink was drawn on the skin directly over it. Care was taken to mark the skin as close as possible to the foreign body and along the proposed line of incision for exploration. Its depth beneath the skin was measured with computerized calipers. Needle localization, whenever used (in five cases), was performed by insertion of an 18 gauge needle under direct sonographic guidance. Intraoperative localization (in three cases) was done with a small curved hemostat inserted under ultrasonographic guidance with a sterile transducer. Sonograms were obtained with Acuson 128 and ATL 3000 (USA) with 5–10 MHz linear transducers. The opposite (contralateral) side was used as a control.

Results

A foreign body was detected and localized by sonography in 19 of the 21 patients, and hypo-echoic halos were found in 7. The smallest foreign body detected was a vegetal thorn measuring 4.5 mm in length. The foreign objects were detected in the toes, feet, calves, knees and thighs. Sonography revealed a wooden splinter in the sole of the foot in seven patients, who had sustained a puncture wound while walking barefoot during gardening or on the beach. In another seven patients a retained foreign body was diagnosed in the soft tissues of the knee. Penetration of the foreign body in six of them resulted from a fall with the knee hitting the ground in a kneeling position, and in all of them the foreign body was indeed found to be located anterior to the knee joint [Figure 1]. In the seventh patient the foreign body was situated in the posterior aspect of the knee following an arthroscopic surgical procedure. It turned out to be a fragment of a metallic Kirschner wire that was used during the arthroscopy [Figure 2]. Three patients were injured in the thigh by broken glass. In one patient the correct diagnosis was reached during a second inspection on the day of injury, unrelated to the initial examination in the ER. The remaining two cases were diagnosed late, about 2 months after the injury and in both a deep laceration was initially sutured over the foreign body. Fifteen of the foreign bodies were surgically removed in sterile conditions under local anesthesia. All patients were symptom free at follow-up and no short- or long-term complications were recorded. Three other patients had small foreign bodies in the calves or feet [Figure 3] and had only minor complaints with no functional impairment. Two therapeutic options were offered: surgical exploration and foreign body removal, or "skillful neglect" with frequent follow-ups. All chose the second possibility and became asymptomatic within 2 months following diagnosis. The last patient was lost to follow-up.

Discussion

Retained foreign bodies in the soft tissues of the extremities that were initially overlooked and are discovered late are unfortu-

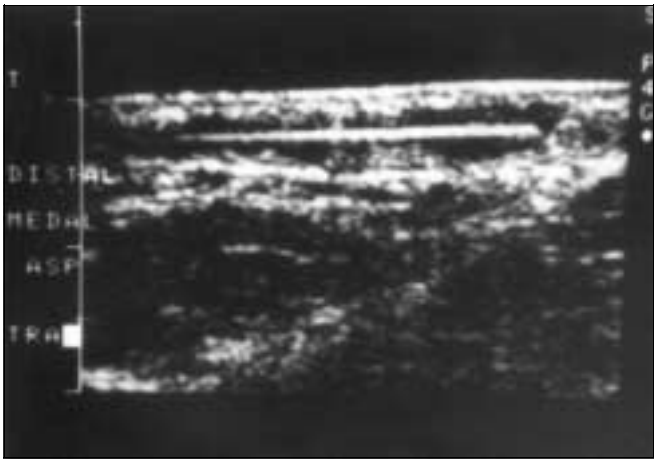

Figure 1. Longitudinal sonogram of the distal quadriceps showing a 3 cm wooden splinter surrounded by a hypo-echoic halo of inflammation.

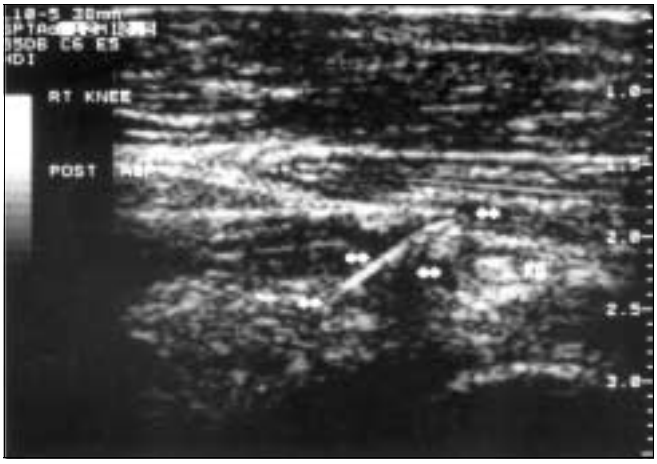

Figure 2. Longitudinal sonogram of the posterior aspect of the knee demonstrating a metallic foreign body.

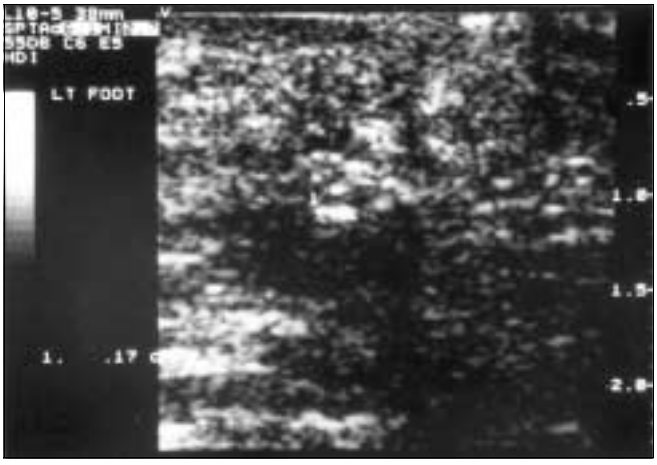

Figure 3. Longitudinal sonogram of the left foot showing a glass fragment with the encircling hypo-echoic halo.

nately not uncommon. The present series of 19 cases in our institution over the short span of 2 years speaks for itself. Misdiagnosis will lead to long-standing suffering of the patient and might ultimately result in an unnecessary litigation. Diagnosis requires awareness of the problem as well as a high index of suspicion. Patient history must be carefully assessed in order to establish the mechanism of injury. A thorough and meticulous physical examination is imperative, including inspection and palpation in and around the wound and exploration with deep probing of the wound. This should ideally be performed under local anesthesia to achieve the patient's maximum compliance.

Conventional radiographs should be obtained to rule out the presence of radio-opaque foreign objects. Localization may be assisted with intraoperative fluoroscopy, which is also reliable to ascertain that all the foreign material has indeed been removed by surgery. It is the non-radio-opaque foreign bodies that represent a problem as they remain undetected by both X-rays and fluoroscopy. Sonography is the modality of choice for their identification. Ultrasonographic evaluation provides important information on the depth, size and shape of the foreign body as well as its anatomical relationship with the surrounding structures [6–11]. Surgical dissection is facilitated by accurate knowledge of the location of the foreign object relative to the skin surface, adjacent muscles and tendons. Doppler sonography may aid in localization if the foreign body lies in proximity to a blood vessel. Foreign bodies must be distinguished from hyper-echoic body tissues such as ossified cartilage, ectopic calcifications, sesamoid bones, scar tissue, etc. Acoustic shadowing is an important clue in the differential diagnosis; it should be sought distal to the echo-rich foreign body and represents failure of the ultrasonic beam to pass through [6–11].

In conclusion, sonography has a definite advantage over conventional radiography and fluoroscopy in the detection and localization of foreign bodies embedded in the soft tissues, since it locates even those that are radiolucent. It is therefore an important adjunctive modality whenever the occult presence of a foreign object is suspected. It also facilitates removal of the object by enabling a shorter exploration with less iatrogenic tissue damage. This raises an interesting question: If ultrasound is so effective and can avoid cases of misdiagnosis, why is it not used as a diagnostic tool in the initial assessment in the ER, as it is for excluding septic arthritis of the hip in toddlers? There is no clear-cut answer at present since other related issues need to be assessed, such as the personal experience of the ultrasound technician (inter- and intra-observer reliability) and the cost-effectiveness, before changing existing policies. The subject certainly warrants consideration.

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