Radiol Oncol 1999; 33(3): 189-92.

Sonographic diagnosis of soft-tissue foreign bodies in children

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Background. *The aim of our study was to establish the successfulness of the ultrasound (US) method in diagnosing a soft-tissue foreign body.*

Patients and methods. *We analysed US findings of 14 children with a foreign body in soft-tissue structures. In 6 patients with negative X-ray findings of a foreign body, the identification and extraction of the foreign body during the surgical excision did not succeed. In 5 patients with a small superficial punctured wound, soreness and swelling of soft-tissue structures appeared after a few weeks to a few months and after a negative X-ray finding the US examination was done to diagnose a possible soft-tissue foreign body. In 2 children with foreign body granuloma, which developed after the foreign body had been in soft tissue for a few months, a soft-tissue solid tumour was suspected. In just 1 patient the foreign body was visible on X-ray too (glass), but it was impossible to define its position and depth.*

Results. *According to the US diagnosis and the precise localisation and marking of a foreign body immediately before a surgical excision, the operation was successful in all examined patients. Only in patients with multiple foreign bodies it was necessary to repeat the surgical excision to remove the remaining pieces of the foreign body.*

Conclusions. *The US has indubitably shown the presence of the foreign body and a surrounding granulomatous inflammatory reaction.*

Key words: foreign bodies-ultrasonography; child

Introduction

The detection of a foreign body in superficial soft-tissue at the children age, which are not visible on X-ray, can cause a diagnostic problem. Namely, a foreign body in soft-tissue provokes and supports the surrounding inflammatory reaction and soreness, thus the localisation of a foreign body which is not visible on X-ray can be very difficult during the primary wound closure or subsequent surgery. High resolution ultrasound (US) enables reliable detection, preoperative localisation and marking even of very small pieces of foreign bodies, which significantly facilitates the detection of foreign bodies during the surgical excision.[1,2] As distinguished from X-ray,

Received 2 February 1999
Accepted 6 July 1999

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the US diagnosis of a foreign body does not depend on the type and size of it.

The aim of our study was to establish the successfulness of the US method in diagnosing a soft-tissue foreign body.

Patients and methods

In our study, we reviewed US findings of 14 children with a foreign body in soft-tissue structures.

The equipment used was ACUSON 128/Xp10 and ALOKA 1700, using linear array transducers of 5-7,5 MHz. In all the patients we also used colour and power Doppler in order to estimate local inflammatory hypervascularity.

Eleven children with anamnestic and clinical suspicion of a foreign body were sent to the US examination. In 6 of these patients the identification and removal of a foreign body during the surgical excision was unsuccessful twice or three times.

In other 5 patients the foreign body entered the soft-tissue through a small entrance wound on the skin surface, and due to uncertain anamnestic data about foreign body, a surgical excision was not done. After a few weeks or months due to swelling and soreness, these patients were also sent, after a negative X-ray, to the US examination in order to detect a possible foreign body.

Two children were sent to the US examination in case a solid tumour process on the calf was suspected.

In all children discussed in our study, an X-ray was done before the US examination, while the foreign body was visible in only 1 patient (glass), but it was impossible to define its depth and precise position.

Results

During the first US examination the foreign body was localised in all children, and the position of it was marked down on the skin surface in all patients just before the surgical excision. The removal of a foreign body was successful in all patients.

In all patients we performed the US control 1 week and 2 weeks after the surgical excision in order to control the success of the operation and soothing of inflammatory reaction. In only one patient with US finding of multiple pieces of glass in the upper eyelid there were two pieces of glass left after the excision, so it was necessary to repeat the intervention.

In 8 of 14 patients the foreign body was of organic origin (wood), in 4 patients of pieces of metal, in 2 patients of pieces of glass. Eleven patients had only one piece of a foreign body, 2 patients each had two separated foreign bodies and 1 patient had multiple pieces of glass.

In 7 patients the foreign body was located on the foot, in 1 patient on the knee, in 2 patients on the calf, in 3 patients on the hand and in 1 patient in the upper eyelid.

The size of foreign bodies in our study ranged from 3 to 22 mm. In 12 patients a local inflammatory reaction around the foreign body was observed; in only 1 patient with a piece of glass subcutaneously there was no signs of local inflammation.

In 2 patients - who were sent to the US examination due to the clinical suspicion of the solid tumour in the calf - the ultrasound examination showed the foreign body (thorn) with surrounding granuloma (*"foreign body granuloma"*), which was surgically confirmed.

Discussion

Foreign bodies in the soft tissues of children are usually pieces of wood, glass or metal. Diagnostically, the most frequent problem are pieces of wood because they are visible on X-ray only in 15% of the patients.[3-5] Glass and

metal, although often visible on X-ray, can also be a diagnostic problem because of their localisation, size and structure.[3] Due to its physical characteristic, the US is a very useful method in detection and preoperative localisation of foreign bodies regardless of their types and dimensions. Linear array transducers of high frequency and resolution enable the localisation of even the smallest pieces of a foreign body. A foreign body in soft-tissue almost always causes the inflammatory reaction of surrounding soft tissue with clinically present swelling and soreness of that region.[1] The US enables the precise and reliable localisation and marking of the foreign body before the surgical excision.[6] It frequently happens that, in spite of anamnestic information about a possible foreign body, it cannot be located and removed even after the repeated surgical intervention. The US gives precise information about the localisation of a foreign body in all three levels which simplifies the surgical excision very much. On the US foreign body it is most commonly shown as a hyperechoic linear band with or without associated shadowing or reverberating *"comet-tail"* artifacts[1] (Figures 1,2). As a rule there is almost always inflammatory reaction of surrounding soft-tissue structures which is shown as hypoechoic zone around the foreign body. The analysis by colour and power Doppler shows focal inflammatory hypervascularity around the foreign body.

The granuloma of the foreign body results from the inflammatory reaction of tissue to the foreign body. Thus, it is most frequently shown on the US as a hypoechoic solid mass of complex structure with the marked demonstration of hyperechoic focus of foreign body in the middle of formation (Figure 3). The analysis by colour and power Doppler shows the increased flow around the foreign body in inflamed soft-tissue (Figure 4).

In conclusion, the ultrasound is a method of choice in detection and preoperative localisation of a foreign body in superficial soft-tissue in case the foreign body is not visible on X ray. The US helps to detect even small pieces of a foreign body. According to our experience, the high resolution US should be routinely used in case of clinical and anamnestic suspicion of the foreign body

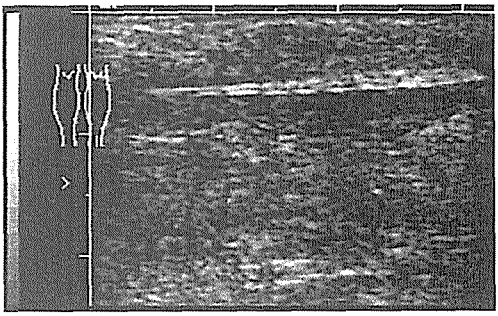

Figure 1a. Foreign body. Longitudinal scan of the soft-tissue (foot) shows a hyperechoic band (piece of wood).

Figure 1b. Foreign body. Transverse scan shows hyperechoic focus.

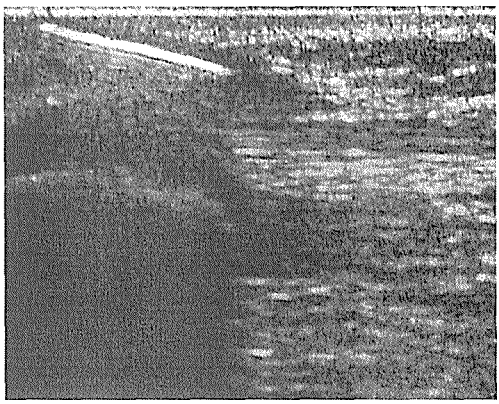

Figure 2. Foreign body - reverberation artefacts. Longitudinal scan shows a hyperechoic band (glass) with reverberation artefacts.

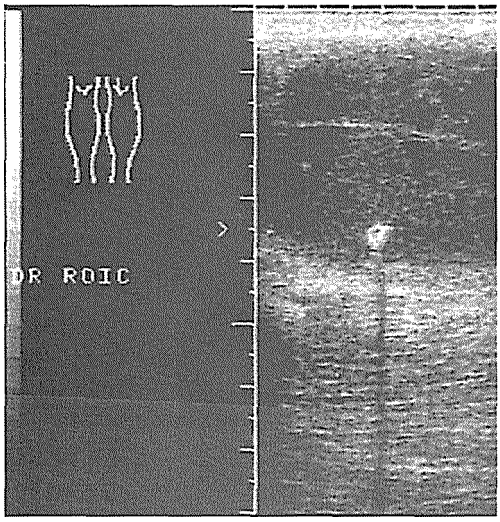

Figure 3. Foreign body - granuloma. Hyperechoic band (thorn) with surrounding hypoechioc mass and through transmission.

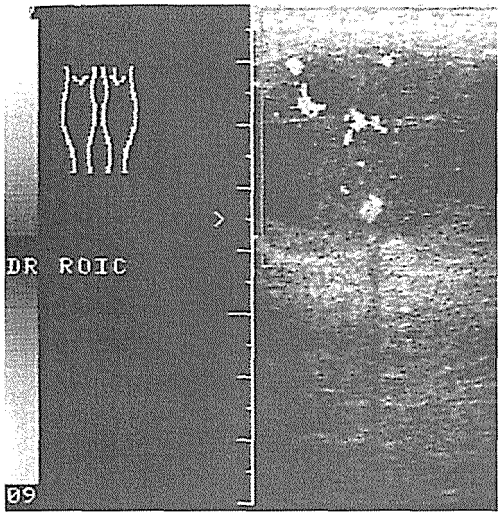

Figure 4. Foreign body - colour Doppler. Colour flow Doppler imaging shows increased blood flow in the hypoechoic mass; central hyperechoic focus with acoustic shadowing - foreign body (metal silver).

which is not visible on the X-ray film. Colour and power Doppler study is a useful adjunct to the grey-scale US in evaluating a focal inflammatory reaction around the foreign body and can aid in defining and clarifying grey-scale abnormalities.

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