CASE REPORT

Imaging of foreign bodies: a radiological conundrum

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SUMMARY

A 24-year-old woman escaped a fire by jumping from the first floor of her house onto a temporary greenhouse. She was brought into the emergency department and later treated surgically. Three years after the initial episode a tender lump in her right thigh was found during regular follow-up for her acute myeloid leukaemia, for which she was in remission. This was treated as a suspicious mass due to her haematological history and further imaging was organised. This was later identified as a piece of the greenhouse that she had landed on 7 years previously. It is a common occurrence for foreign bodies to be missed on initial examination. Fortunately the patient recovered well from her physical wounds and, more importantly, remains humorous when reflecting on her almost 7-year long battle with a piece of plastic.

BACKGROUND

Traumatic implantation of a foreign body in soft tissues is a commonly encountered clinical predicament. Lacking a high index of suspicion and knowledge regarding imaging modalities, the likelihood of missing an implanted foreign body is greatly increased.

Up to half of all foreign body injuries are misdiagnosed in an emergency room setting. In the imaging department, the material composition of the foreign body may occasionally be responsible for this,¹ sometimes causing a foreign body to be misidentified as a medical device.² Identification of foreign bodies for diagnosis involves using imaging modalities including plain radiography, CT, ultrasonography (USG) and MRI. The method used depends on the size, material properties and position of the object and, furthermore, foreign bodies demonstrate different physical properties when viewed with different imaging techniques.³ Indeed, foreign bodies that may not be easily detected with one method may be picked up by another.

Conventional plain radiography is the usual modality of choice for visualising foreign bodies,⁴ allowing radiologists to determine an object's position and whether this location is important clinically.³ CT scanning further displays the exact shape and size of the foreign body in the patient, facilitating eventual surgery if indicated. Although CT scanning is up to 15 times more sensitive at detecting foreign bodies than plain radiography, metal artefacts have been known to hinder detection of foreign bodies using this method.³ Benefits of USG include its lack of radiation exposure and the ability for it to be conducted at the bedside. Sensitivities of 95–100% and specificities of 89.5–100%

have been reported in the use of USG to detect foreign bodies.^{1,3} USG is able to precisely localise the 3D parameters of foreign bodies as narrow as 1 mm in width and as small as 5.6 mm in length¹ in real time.³ If a foreign body is located superficially, USG is a more efficient detection tool than CT or plain radiography.³ However, the effectiveness of this imaging modality is dependent on the skills of the operator, with high intra-observer variations,⁴ and foreign bodies embedded deep in tissues cannot be detected using USG.³

Certain materials produce signals on x-ray-based imaging and are radiopaque, allowing foreign bodies of metal, glass and stone to be visualised on radiography and all other imaging modalities mentioned above.^{1–3} However, organic matter including wood and thorns and most plastics are not radiopaque and therefore can remain undetected in up to 85% of cases using plain radiography.^{1,3} For non-opaque foreign bodies, CT and USG offer great potential for visualisation in selected cases.³ Indeed, when a foreign body is implanted, correlation of radiographic findings with the CT scan will aid in establishing a diagnosis.²

MRI is unsuitable as a primary diagnostic tool as artefacts relating to the foreign body may hinder full evaluation of the body's overall material properties.³ Indeed, before undergoing MRI, all patients should be screened for the presence of foreign bodies.² All metallic objects with the exception of aluminium are opaque and can thus be visualised on plain radiographs.² MRI may be contraindicated for the detection of metallic foreign bodies as the magnetism involved may move and twist the object, presenting a great hazard to the patient.² Wooden foreign objects and organic matter can initially be detected with USG, but they decompose over time and are no longer able to be visualised with this method¹; the wood absorbs the surrounding fluid to become attenuated when seen under MRI.¹

Together with USG, plain radiography can detect most foreign bodies⁴ and CT will aid in diagnosing the presence of a foreign body. Where imaging elicits negative findings yet clinical suspicion remains high, surgical exploration to remove the retained foreign body is advised.¹

CASE PRESENTATION

A 24-year-old woman escaped a fire by jumping from the first floor of her house onto a temporary greenhouse. She was brought into the emergency department where she was managed using ATLS protocols.

She sustained second degree burns to her left lower leg, a left pretibial laceration and a laceration

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Figure 1 Healed scar (arrow) from initial trauma located over distal hamstrings proximal to the popliteal fossa (PF).

overlying the distal hamstring tendons (figure 1) and complained of pain in her right thigh. She remained stable and underwent imaging to assess the extent of her injuries. Standard trauma series of radiographs were taken including the right thigh, all of which were unremarkable. The same evening the patient underwent washout and closure of her lacerations under local anaesthetic. The following day she continued to report a painful thigh and this was thought to be due to a haematoma. She subsequently underwent skin grafting to her burns at the regional burns unit. Her recovery after surgery was unremarkable and her thigh pain settled over the coming months.

OUTCOME AND FOLLOW-UP

Three years after the aforementioned episode a tender lump in her right thigh was found during regular follow-up for her acute myeloid leukaemia, for which she was in remission. This was treated as a suspicious mass due to her haematological history, and radiographs (figure 2) and a CT scan (figure 3) were performed. It was felt that the results from her imaging warranted an opinion from a bone tumour unit who diagnosed a benign case of myositis ossificans secondary to blunt trauma sustained from the initial fall. Surgical excision was declined at this time due to her symptoms settling.

Figure 2 Anteroposterior views of the right proximal femur in 2007 (left), 2009 (middle) and 2011 (right) showing remodelling cortical reaction seen in the lateral cortex (arrow).

Figure 3 Axial CT section through the proximal femur with a bone-like mass (arrow) located laterally.

She re-presented in the orthopaedic clinic after another 2 years with recurrent pain in the same region. Examination revealed a mobile soft tissue swelling on the lateral aspect of the right thigh. Knee and hip examination were unremarkable. Repeat radiographs showed marked expansion of the lateral cortex of the femur (figure 2), a definite change from her radiographs performed 2 years previously; however, the appearances on MRI (figure 4) were not suspicious. She was offered surgery but again declined and opted for conservative management.

The lump continued to be symptomatic and was reviewed 2 years later with further femoral cortical thickening apparent on radiographs (figure 2). She was advised she had developed myositis ossificans of the vastus lateralis of the right thigh by the supraregional bone tumour unit and was placed on a waiting list for excision under general anaesthetic at her local orthopaedic unit. A lateral approach was used and, as the iliotibial band was incised, a green plastic foreign body was found in the subfascial layer (figure 5). This was identified as a piece of the greenhouse that she had landed on 7 years previously.

DISCUSSION

Unfortunately it is a common occurrence for foreign bodies to be missed on initial examination. A third of subjects in a review of 200 cases of retained foreign bodies had been missed by the previous treating surgeons. The time period between the injury and the detection of the foreign body in this study ranged from 1 week up to 3 years.⁵ Our case is well beyond this at almost 7 years and had been misdiagnosed by numerous clinicians.

Plain radiography is based on differential absorption of x-rays by objects of different densities.⁶ The relative difference in density of the foreign body when compared with the surrounding soft tissues will determine the likelihood of it being detectable on radiography. Unfortunately, most plastics are radiolucent and hence the foreign body had not been identified on the many radiographs taken of

Figure 4 Coronal T1 section of the right thigh showing a mass (arrow) lateral to the proximal femur under fascia.

this patient's thigh. When a foreign body is not seen, other signs alluding to its presence should be sought. Lytic lesions, periosteal reactions of the bone and pseudotumours of the soft tissues have been reported.^{5,6} The series of radiographs, MR and CT images suggesting an osteosarcoma can now be reflected on as evidence of these alternative signs suggesting the presence of a foreign body.

The reflectivity of a foreign body depends on acoustic impedance which varies with the density of the object. All foreign bodies, including those that are radiolucent (such as plastic) in soft tissues, are seen as hyperechoic foci.⁷ If there is an inflammatory reaction, a surrounding hypoechoic mass can be seen. MRI and CT of the patient's femur had suggested some inflammatory changes that were subsiding with time. It would be highly probable that an ultrasound in the early stages would have identified this as a hypoechoic area surrounding the hyperechoic foci. Blyme *et al* completed a human cadaver study involving ultrasonographic detection of foreign bodies with a sensitivity of 89% and a specificity of 93%.⁸ The need for ultrasound as the second choice imaging modality after plain radiography is strongly suggested from the available data.

We are reliant on the radiologist to report the findings of a scan; however, as primary treating clinicians, we are repeatedly requesting

Figure 5 Plastic foreign body removed from thigh with scale.

inappropriate imaging and hence limit the diagnostic relevance of the investigation.

The only entry point for the foreign body was a wound present on the distal posteromedial aspect of the right thigh. If thoroughly examined at the time of suturing, it is possible that a tract leading proximolaterally may have been discovered leading to the immediate removal of the object. Such traumatic soft tissue wounds must be explored under a general anaesthetic in the operating theatre to allow thorough exploration.

Learning points

- ▶ This case highlights the need for clinicians to remain vigilant with regard to implanted foreign bodies in the trauma setting.
- ▶ It also shows that, in the era of high resolution imaging, there is no substitute for thorough clinical examination, requesting of basic investigations and the need for appropriate surgical exploration of traumatic wounds.
- ▶ If this triad had been completed, the psychological burden of being diagnosed with an osteosarcoma would have been eliminated as well as the cost of unnecessary imaging and consultations.
- ▶ Fortunately the patient recovered well from her physical wounds and, more importantly, remains humorous when reflecting upon her almost 7-year long battle with a piece of plastic.

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