Diagnostic dilemmas

The painless soft tissue mass in childhood – tumour or not?

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Summary

Soft tissue malignancies are uncommon in adults and even rarer in children. Twelve children presented to the radiology department over a three-year period with a clinical diagnosis of a malignant lower limb mass. This diagnosis was usually based on the presence of a firm, painless mass. However, imaging revealed a heterogeneous group of benign pathologies: haemangioma (two cases), haematoma (two cases), aneurysm (two cases), and one case each of infection, myositis ossificans, Baker's cyst, lipoma, muscle rupture, and venous malformation. During the same period there was only one malignant soft tissue neoplasm. A variety of imaging techniques were used but ultrasound combined with colour flow Doppler was the single most helpful modality. The radiological diagnosis was confirmed by biopsy, surgery or clinical follow-up.

Keywords: childhood, soft tissue mass, CT scanning, ultrasound

Introduction

When a firm, painless mass is detected, the clinical concern is usually of a malignant tumour. However, malignant causes of such a mass are much less common in children than in adults. Soft tissue sarcomas account for only 6% of all malignant neoplasms in children less than 15 years of age. Rhabdomyosarcoma accounts for 53% of these cases.¹ A review of 135 cases of paediatric superficial masses revealed only 18 malignancies.²

It is important to consider the possibility of benign pathology (see box), particularly in children in whom an episode of trauma may have been forgotten. A careful clinical history and appropriate imaging often allows a specific diagnosis and early alleviation of anxiety.

In some cases the radiological appearances may prove more reliable than histology, as shown in Case 8, in which the radiology showed myositis ossificans but the histology was reported as osteogenic sarcoma. This pitfall has been previously documented,³ but it is important to emphasise the problems with histology in this situation to avoid unnecessary radical surgery.

Materials and methods

A total of 12 children who presented for investigation of a clinically suspected soft tissue malignancy of the lower extremity are described. The age range of the group was 15 months to 17 years. There were nine boys and three girls. The children were investigated using a variety of imaging modalities usually commencing with a plain film and ultrasound.

Results

Brief clinical case reports and the findings on imaging are outlined below:

Case 1

A 10-year-old girl sustained a head injury and a fractured right femur in a road traffic accident. One month later a tense swelling of the right

Figure 1 Case 1: Peripheral arteriography demonstrates a false aneurysm arising from the distal right superficial femoral artery

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Accepted 30 May 1994

Soft tissue mass in children
<ul style="list-style-type: none">• sarcoma• haemangioma• haematoma• aneurysm• infection• myositis ossificans• Baker’s cyst• muscle rupture• venous malformation

thigh was noted. Even though there had been a history of trauma, a malignant mass was suspected clinically. Benign pathology was not considered. Angiography revealed a false aneurysm of the right superficial femoral artery (fig 1). Diagnosis: aneurysm.

Case 2

A 10-year-old girl presented with a firm mass in the right thigh. There was no history of trauma. Contrast enhanced computed tomography (CT) revealed a true aneurysm of the superficial femoral artery (fig 2). No cause for this has been identified. Diagnosis: aneurysm.

Case 3

A 10-year-old boy presented with a mass in the left buttock. It was initially aspirated and altered blood obtained. He was lost to follow up but re-appeared three years later with a recurrence of the mass. CT was performed because of a persistent hard mass and a low attenuation, non-enhancing mass was found adjacent to the left ischial tuberosity involving several muscle groups (fig 3). This was confirmed to be a resolving haematoma on biopsy and is presumed to be due to bleeding into an arterio-venous malformation. Further investigation has been refused. Diagnosis: haematoma.

Case 4

A 3-year-old boy complained of a painless mass in the left thigh. Ultrasound revealed a well-defined area of low echogenicity consistent with an intramuscular haematoma (fig 4). The mass resolved spontaneously. Diagnosis: haematoma.

Case 5

A 13-year-old boy complained of a mass in his right thigh. Ultrasound showed an echo-poor mass with areas of high echogenicity consistent with fat. A diagnosis of a mixed lipohaemangioma was made. Clinical management was consistent with this diagnosis. Diagnosis: haemangioma.

Figure 2 Case 2: CT with contrast shows a true aneurysm of the distal left superficial femoral artery with some mural thrombus

Figure 3 Case 3: A lobulated, low attenuation mass surrounds the left ischial tuberosity on the CT scan (arrowheads). Biopsy revealed a resolving haematoma

Figure 4 Case 4: A well-defined low echogenicity area (H) is seen adjacent to the femur (F). These ultrasound appearances are compatible with a resolving haematoma

Case 6

A 5-year-old boy presented with the sudden appearance of a mass in his right calf. Ultrasound revealed a mass with echogenic areas consistent with fat and smaller densely echogenic areas representing phleboliths in addition to vessels with low flow on Doppler. The appearances was consistent with a thrombosed haemangioma. This diagnosis was confirmed at surgery and the lesion excised. Diagnosis: haemangioma.

Figure 5 Case 7: Ultrasound shows an ill-defined area of low echogenicity which crosses several tissue planes. The appearances are those of infection

Case 7

A 13-year-old boy was noted to have a painless mass in high right thigh overlying his hip. Plain films revealed a lytic area in the right femoral neck distant from the mass and a diagnosis of a haemangioma was considered. An arteriogram revealed a 'tumour' blush but no neovascularity. Ultrasound was the most helpful examination, showing an irregular, low echogenicity mass with loss of the normal tissue planes (fig 5). An ultrasound-guided biopsy yielded inflammatory tissue and surgery revealed a sterile abscess, with its origin in the femoral neck. The abscess had tracked inferiorly to present in the thigh. Diagnosis: infection.

Case 8

A 12-year-old boy presented with a 48-hour history of a hard painful mass in his distal left thigh and a vague history of previous trauma. The plain films were initially normal. Ultrasound showed a low density irregular lesion extending to the medial ligament of the knee joint. On CT the mass had both calcified and low-density components and was located in the muscles (fig 6). The lesion was biopsied because of the clinical suspicion of malignancy. The initial histology was a soft tissue osteogenic sarcoma but further review correlated with the radiological findings of myositis ossificans. A plain radiograph two months later showed calcification within the mass (fig 7). Diagnosis: myositis ossificans.

Figure 6 Case 8: CT confirms that this opacity is intramuscular and consistent with myositis ossificans

Figure 7 Case 8: A well-defined area of calcification/ossification lies posterior to the distal femur on the lateral view of the left knee

Case 9

A 17-year-old boy who was in remission from leukaemia presented with a sudden onset of a painless mass in the anterior aspect of his right thigh. This was noted to vary in size with the degree of contraction of quadriceps femoris on ultrasound (figs 8 and 9). The appearances were of a spontaneous partial rupture of the rectus femoris muscle. Diagnosis: muscle rupture.

Figures 8 & 9 Case 9: Ultrasound of the mid thigh with the quadriceps relaxed and contracted shows partial rupture of the rectus femoris muscle. Arrows define the muscle bulge with contraction

Case 10

A 8-year-old boy complained of difficulty in straightening his left knee. Clinical examination revealed a firm mass in the popliteal fossa. Ultrasound showed a well-defined cystic area but communication with the joint could not be identified (fig 10). However, an arthrogram performed to exclude a discoid meniscus revealed a Baker’s cyst (fig 11). Diagnosis: Baker’s cyst.

Figure 10 Case 10: Ultrasound shows a well-defined cystic area in the popliteal fossa consistent with a Baker’s cyst

Figure 11 Case 10: Arthrography confirms the communication of the cyst with the knee joint

Case 11

A 10-month-old girl was noted suddenly to develop a firm mass on the inner aspect of her right thigh. The plain film showed a well-defined lucent mass within the soft tissues of the thigh (fig 12). This was confirmed to be a lipoma by ultrasound which revealed a diffusely echogenic, well-defined mass (fig 13). However, there was persistent clinical concern and CT was performed to exclude a soft tissue component to the mass. This confirmed that the lesion was composed entirely of fat (fig 14). Diagnosis: lipoma.

Figure 12 Case 11: A well-defined lucency is seen within the soft tissues of the medial right thigh consistent with a lipoma

Figure 13 Case 11: A diffusely echogenic mass is shown on ultrasound consistent with a lipoma

Figure 14 Case 11: On CT the mass (arrowed) is composed entirely of fat excluding the possibility of a liposarcoma

Case 12

A 3-year-old boy presented with a painful mass in the left calf. CT revealed a heterogenous low attenuation area with some contrast enhancement (fig 15). The venous phase of a peripheral arteriogram revealed a predominantly venous malformation (fig 16). Partial thrombosis was considered to be the cause of the acute presentation. Diagnosis: venous malformation.

Figure 15 Case 12: A poorly enhancing area is seen within the muscles of the calf on CT

Figure 16 Case 12: The venous phase of angiography reveals a venous malformation within the calf

Imaging protocol for soft tissue masses
<ul style="list-style-type: none">• plain radiography• ultrasound with colour Doppler to assess vascularity• MRI or CT

Discussion

Imaging was able to provide a specific diagnosis or used to guide a percutaneous biopsy in each of the 12 cases described. Ultrasound is an ideal imaging technique for the assessment of many musculoskeletal lesions in children and has been in use for investigating soft tissue lesions since 1975.⁴ The now available range of probes with high resolution and short focus,⁵⁻⁷ coupled with colour Doppler means that many lesions may be accurately diagnosed by ultrasound alone, without the need for more expensive investigations. The absence of ionising radiation, the ability to perform dynamic scanning during movement and muscle contraction, even with minimal co-operation from a child, makes it an ideal first investigation, and it can be supplemented by CT or magnetic resonance imaging (MRI) tailored to resolve a specific clinical problem.

A suggested imaging protocol for the child presenting with a soft tissue mass following clinical assessment, is a plain radiograph and ultrasound examination with colour Doppler to assess a lesion's vascularity. In many instances a firm or provisional diagnosis is possible with these investigations. If the diagnosis is unclear from these investigations then MRI or CT are indicated. The full extent of any lesion may require MRI or CT to demonstrate the anatomical relationships for surgical planning. If the lesion proves to be a vascular anomaly, therapeutic embolisation may be a preferred option to surgery.

Rushing into MRI may lead to diagnostic difficulty.^{8,9} MRI, like all other imaging procedures, will not always distinguish between benign and malignant lesions.¹⁰

In general, true aneurysms arise from blunt trauma and false aneurysms from a penetrating injury to the wall of the vessel which may be iatrogenic.^{11,12} In our series, the false aneurysm was secondary to a fractured femur and the true aneurysm presumed to be secondary to a forgotten episode of blunt trauma. A false aneurysm may mimic an aggressive tumour.¹³ Ultrasound provides an accurate means of diagnosing aneurysms and can distinguish reliably between the two types.¹⁴

The appearance of a haematoma on ultrasound varies widely depending on its age.¹⁵ The lesion is initially cystic and develops irregular walls and internal echoes with organisation before reverting to a cystic configuration at 4-6 weeks. The lesions are generally round or oval with their long axis orientated parallel to the muscle bundles.¹⁶ The difficulty in diagnosis is caused by the absence of a history of trauma. Many of these haematomas are due to repetitive

trauma and are more frequent in athletic children.

All haemangiomas contain variable amounts of non-vascular tissue such as fat, smooth muscle, fibrous tissue, myxoid stroma, haemosiderin, thrombus and even bone.^{17,18} If these elements can be identified together with the vessels they allow a definitive diagnosis of haemangioma. Extensive infiltration of musculature and peri-lesion oedema correlates with the aggressiveness of the lesion.¹⁹ It is also important to distinguish between haemangiomas and vascular malformations, which have a different clinical course and prognosis. They have differing imaging features but can usually be differentiated clinically.²⁰

The classical inflammatory signs of erythema, local warmth and fluctuance may be absent in a pyomyositis which is frequently 'woody' on palpation. The absence of inflammatory signs may be due to a deep-seated lesion or a transient bacteraemia superimposed on trauma.²¹ Ultrasound is helpful in distinguishing cellulitis from osteomyelitis²² and is helpful in defining atypical soft tissue infection in neonates.^{23,24}

Myositis ossificans is a rare non-neoplastic, reactive lesion. The clinical and histological features can be very worrying.²⁵ Radiologically it is possible to follow the lesion's progression from a soft tissue density, to a stage of calcification and ossification, and then to a mature phase with a central lucency and a rim of bone. If maturation and shrinkage of the lesion do not occur, other diagnoses should be considered.³

Lipomata are generally soft masses and present little diagnostic difficulty. However, intramuscular lipomata may harden with muscle contraction.²⁶ In our case the sudden appearance of a firm mass was thought to be due to herniation of the lipoma through a fascial plane. Lipomata occur commonly in the posterior compartment of the thigh.²⁷ Simple lipomata have a uniform matrix of fat density on CT whereas liposarcomata usually show prominent areas of soft tissue density.^{28,29}

None of the lesions in this series was investigated by MRI. This was not easily available and it was felt that adequate diagnostic information had been obtained by the other techniques.

We found ultrasound combined with colour Doppler to be the most helpful initial imaging modality and used this to guide further imaging and the most appropriate site for biopsy.

We would like to thank Mr J Walsh for his helpful comments and Mrs D Turner for typing the manuscript.

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