



On-line Case Report

Subcutaneous thigh fat necrosis as a result of tourniquet control during total knee arthroplasty

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The use of a pneumatic tourniquet in total knee arthroplasty has been linked to complications caused by local tissue hypoxia. Fat necrosis is a rare condition that presents as an ill-defined subcutaneous lesion. The clinical features resemble that of a lipoma but histological appearance is characteristic. Ultrasound imaging is helpful in establishing the diagnosis both by sonographic appearance as well as in directing a biopsy if necessary. We present a case of encapsulated fat necrosis caused by the use of a pneumatic tourniquet during total knee arthroplasty.

Key words: Fat necrosis – Total knee arthroplasty – Tourniquet – Complications

An 83-year-old female underwent a left total knee arthroplasty (replacement) as treatment for knee pain secondary to osteoarthritis. The patient attended a routine pre-operative assessment a fortnight prior to an elective admission; she had no other past medical history and was found to be fit to proceed to surgery. She underwent an uncomplicated procedure under a combined spinal epidural anaesthetic implanting a Genesis II Total Knee Replacement prosthesis. A pneumatic tourniquet was used around the left thigh to achieve a bloodless field. A layer of cotton wool padding (velband) was applied over the left thigh and the tourniquet was applied over the padding. The limb was elevated and exsanguinated using a rubber limb exsanguinator and the tourniquet was then inflated to a pressure of 350 mmHg for a period of 90 min until the knee capsule and wound were ready to be closed in layers.

Adequate haemostasis was achieved using diathermy and the knee capsule was closed over two drains. The subcutaneous tissue and skin were then closed, and the

wound was dressed and padded with a compression dressing. Prior to leaving the operating theatre, the patient pressure points were checked as per routine protocol, and there was no evidence of an injury.

The patient made an uncomplicated, early post-operative recovery and was discharged home 6 days later when she was able to mobilise safely with crutches. She was due to be followed up as an out-patient 6 weeks following her operation.

She was reviewed a week later in clinic at her general practitioner's request because of the raised concern of a reported painful lump felt in her thigh suspected to be a superficial abscess. The clinical appearance was that of a soft, lobulated, mobile mass with a poorly defined edge covered by an area of indurated skin.

Ultrasound examination was performed with a high resolution 7–12 MHz linear array probe (ATL HDI 5000, Philips Medical Systems, Andover, MA, USA). This demonstrated a relatively echogenic mass within the subcutaneous fat, with no discrete fluid collection and

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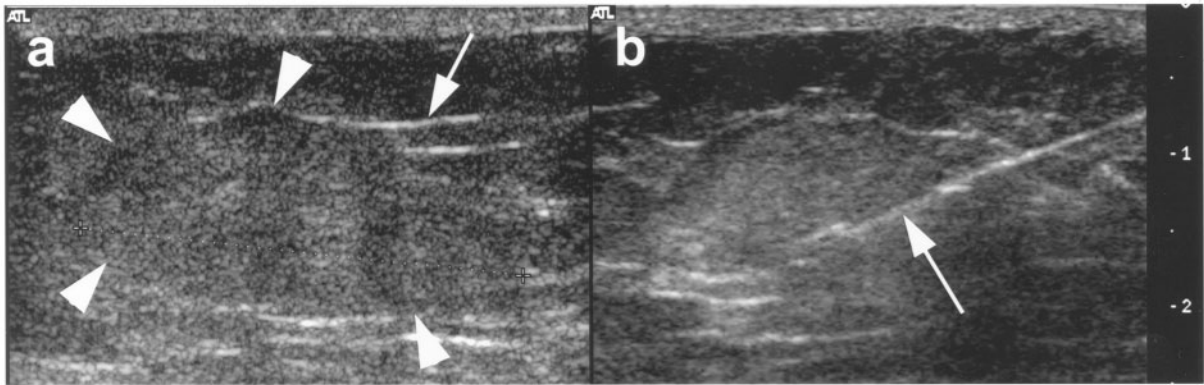


Figure 1 (a) Ultrasound images demonstrate a relatively well-defined lobulated mass (arrowheads) within the superficial fascia. The lesion is slightly hyperechoic to the adjacent subcutaneous fat and has a granular echo texture. Normal interlobular septae (arrow) are absent. (b) The bevel (arrow) of a true cut biopsy needle is demonstrated within the lesion just prior to sampling.

disruption of the septations within the superficial fascia (Fig. 1a). No flow was demonstrated within the lesion when examined with power Doppler imaging. These appearances were consistent with an inflammatory mass of subcutaneous fat. Two core biopsies were obtained under direct ultrasound guidance (Fig. 1b) and sent for histopathological and microbiological analysis.

Culture of the biopsy material showed no bacterial growth. Histological analysis demonstrated fat necrosis with dystrophic calcification and confirmed the diagnosis of fat necrosis.

The patient was reviewed in clinic 6 weeks following her operation and the lump had resolved.

Discussion

Tourniquet use, blood loss and local hypoxia

In 1995, a study by Abdel-Salam *et al.*¹ indicated a slightly higher complication rate if total knee replacement was performed with a pneumatic tourniquet. Major complications such as thrombo-embolic disease and infection do not, however, appear to be influenced by tourniquet use.^{2,3} There is little consensus about peri-operative blood loss.^{2,4}

Tourniquet use is an obvious cause of peri-operative hypoxia and has, thus, been linked with a number of complications including local necrosis, neurapraxia, vascular injury and local postoperative pain. Vessels distal to the tourniquet constrict and become blocked with cellular debris. It has also been shown that wound oxygenation after use of a tourniquet in total knee replacement is reduced and remains so for a prolonged period of time; this may, therefore, compromise wound healing and give rise to wound breakdown and deep infection.⁵

Fat necrosis

Fat necrosis was first described in 1975 in the German literature accounting for lesions in the breast.⁶ Later, in 1977, there was a report for multiple nodules found in the legs of small boys.⁷ Since then, most reports were found in the Japanese literature and a retrospective review of all 49 reported cases between 1975 and 1999 was finally published in 2000.⁸ There have been no reported cases of fat necrosis related to tourniquet application during total knee arthroplasty in the literature to date.

Fat necrosis in the subcutaneous layer is distinct from other types of fat necrosis (*e.g.* pancreatic fat necrosis) in that the clinical appearance is that of an ill-defined mass and histologically that of a well-circumscribed nodule.⁹

A comprehensive literature review of the clinicopathological presentation of 49 reported cases of fat necrosis revealed that: (i) it is mostly prevalent in females (31 versus 18 males); (ii) the age range of all cases was 9–77 years with an average of 40.9 years; and (iii) there was a clear difference between the mean age of males and females (29.9 versus 47.8 years, respectively). The most commonly affected sites were in the lower extremities, with a history of previous trauma evident in only 13 cases.⁸ There is a tendency for lesions to be multiple and most nodules tend to be mobile giving rise to the term 'thigh mouse'.¹⁰

Most of these nodules are found in exposed areas of the body and, thus, the presumed aetiology of fat necrosis is frequent minor trauma giving rise to an interruption of blood supply. Even though the pathophysiological mechanism is unclear, the histopathological appearance is invariable. The nodules are encapsulated with fibrous tissue containing degenerate or necrotic fat tissue associated with inflammation and, occasionally, calcification. Calcification is thought to

represent the end-stage of the lesion and in one series was present in 13 out of 49 cases.⁸

The terms 'nodular-cystic fat necrosis',⁷ 'mobile encapsulated lipoma',¹¹ 'thigh mouse',¹⁰ and 'encapsulated fat necrosis'¹² have all been used but the general consensus is that the latter term is the most representative.

Imaging appearances of fat necrosis

The first line of imaging sought in superficial lesions is usually sonographic and the appearance of fat necrosis is that of a well-defined lesion with several hypo-echoic areas within it and no evidence of flow on Doppler scanning.¹³ MRI may show an area of lobulated fat which gives a high signal on both T1- and T2-weighted sequences. Progression to fibrosis is accompanied by areas of low signal on all sequences. Septations, which are usually obvious on ultrasound, are often not visible on MRI. Fat necrosis does not typically enhance with gadolinium. Lesions that may have similar imaging features include non-acute haematomas, lipomas, liposarcomas, haemangiomas and haemorrhage into an existing mass.¹³

Conclusions

Fat necrosis is an uncommon condition not previously reported in relation to the use of tourniquet control during total knee arthroplasty. The presentation of a subcutaneous lump, which may on occasions be mobile, resembles many other conditions but the histological appearance is characteristic. Sonographic appearances are characteristic demonstrating a well-defined lesion with central hypo-echoic areas. Ultrasound is useful in

establishing the diagnosis both sonographically as well as histologically by means of targeting biopsies.

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