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Review Article

Diagnosis and management of bone cysts

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ABSTRACT

Bone cysts are benign, fluid-filled lesions primarily occurring in the metaphyseal regions of tubular and flat bones, such as the humerus and femur. These lesions are commonly seen in children and adolescents during periods of rapid bone growth. While often asymptomatic, bone cysts are typically discovered incidentally or after a pathological fracture due to weakened bone structure. Radiographic imaging plays a pivotal role in diagnosis, revealing well-defined, lytic lesions with thin cortical margins. Management of bone cysts has evolved to emphasize minimally invasive techniques, including intralesional steroid or bone marrow injections, as well as curettage with bone grafting. These approaches aim to promote healing, prevent recurrence, and restore bone integrity. In some cases, internal fixation may be required for structural support. The prognosis is generally favourable, with high rates of healing and functional recovery, especially with timely intervention.

Keywords: Bone cysts, Unicameral bone cyst, Minimally invasive surgery

INTRODUCTION

Bone cysts are benign, fluid-filled lesions that commonly arise in the metaphyseal regions of tubular and flat bones, such as the humerus, femur, and occasionally the spine. They are most frequently observed in children and adolescents during periods of rapid skeletal growth, with boys being more commonly affected. Although these lesions are often asymptomatic, they are typically identified incidentally on radiographs or following a pathological fracture due to bone weakening, which is often the first clinical indication.[1,2] Common sites of occurrence include the proximal humerus, distal femur, and proximal tibia. Bone cysts can cause localized bone expansion and may weaken the structural integrity, increasing susceptibility to fractures. Despite this, the surrounding soft tissues are not involved, distinguishing bone cysts from more aggressive bone lesions.[3] Radiographically, bone cysts appear as well-defined, lytic lesions with thinning or erosion of the cortical bone, though the cortex often remains intact. Further diagnostic evaluation may involve advanced imaging techniques such as CT, MRI, or skeletal scintigraphy, which help to assess lesion morphology, size, and any potential complications.[4] Management primarily focuses on minimally invasive interventions, such as intralesional injections of steroids, bone marrow aspirate, or synthetic bone substitutes, aiming to accelerate healing and prevent recurrence. Surgical options like curettage with bone grafting may be necessary for larger lesions or those associated with significant structural compromise. In cases of severe weakening or recurrent fractures, internal fixation devices may be used for stabilization.[5]

The prognosis for bone cysts is generally excellent, with high healing rates and minimal functional impairment when addressed promptly. Recurrence can occur but is less frequent with effective treatment strategies, and long-term outcomes are typically favourable with appropriate monitoring and care.[6]

Types include, unicameral bone cyst (simple or solitary bone cyst), Aneurymal bone cyst, traumatic bone cyst.

UNICAMERAL BONE CYST

Simple bone cyst is a common, benign, fluid-containing lesion, most commonly found in the metaphysis of long bones, typically the proximal humerus or femur. Pathologic fractures are common, often with minor trauma. These cysts typically resolve after skeletal maturity and are not typically associated with bone tumors. The cause is unknown. These were first recognised as a distinct entity in 1910.[7]

Rising bubble sign (gas bubble seen in most non-dependent part of the cyst cavity is pathognomic for UBC).[8]

Classification is important as it impacts treatment, Active, if the cyst is adjacent (~1cm) to the physis. Latent, if normal bone separates cyst from physis.[8] Ninety-four percent of unicameral bone cysts occur in the proximal humerus and proximal femur, with the proximal humerus being affected two to three times more frequently than the proximal femur. The remaining 6% occur in other bones including the calcaneus (2%), ilium (2%), talus, tibia, metatarsals, fibula, ischium, pubic rami, sacrum, vertebral bodies, forearm, and craniofacial bones. The "fallen leaf" sign on plain films is virtually pathognomonic of a multiloculated bone cyst.

Aspiration of unicameral bone cyst in children below age 10 will frequently produce blood, even with gentle aspiration pressure on the syringe. Rarely, simple bone cysts have been noted to cross the physis in very young patients, but this finding has been observed in older patients, as documented by MRI and injection techniques. The primary goal of management is a healed bone that can withstand predictable functional stresses of activity by the patient.[9]

Figure 1: Wrist radiograph (AP view).

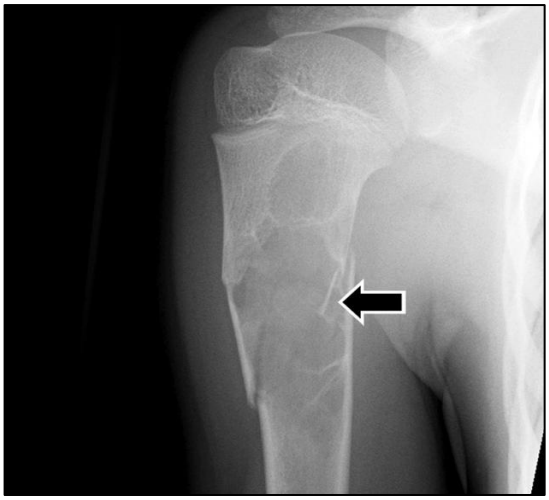

Figure 2: Fallen fragment sign is a pathological fracture associated with unicameral bone cyst and it denotes the fracture fragment seen in dependent part of the lesion.[10]

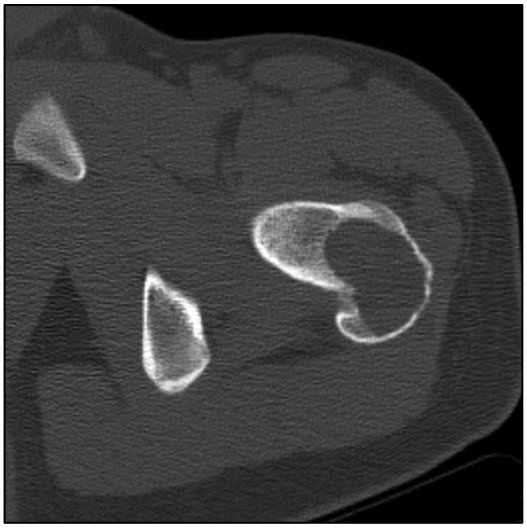

Figure 3: Fluid attenuating expansile lesion in proximal femur.

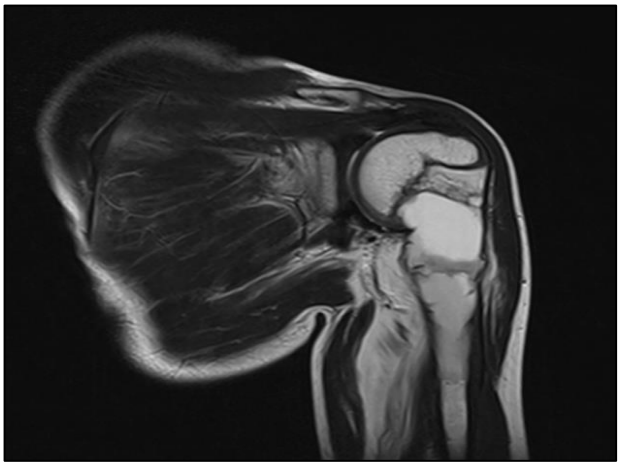

Figure 4: Doughnut sign.

Figure 5: Plain radiography of aneurysmal bone cyst. (A) X-ray demonstrates a lytic lesion in the proximal metaphysis of the tibia with slight expansile features and lucency extending through the cortex; (B) X-ray shows an expansile lucent lesion centered in the medullary cavity of the proximal humeral metaphysis with cortical thinning; (C) X-ray shows an eccentric lucent lesion of the medial side of the distal tibia; (D) X-ray shows an expansile multiloculated lucent lesion of the calcaneus.[12]

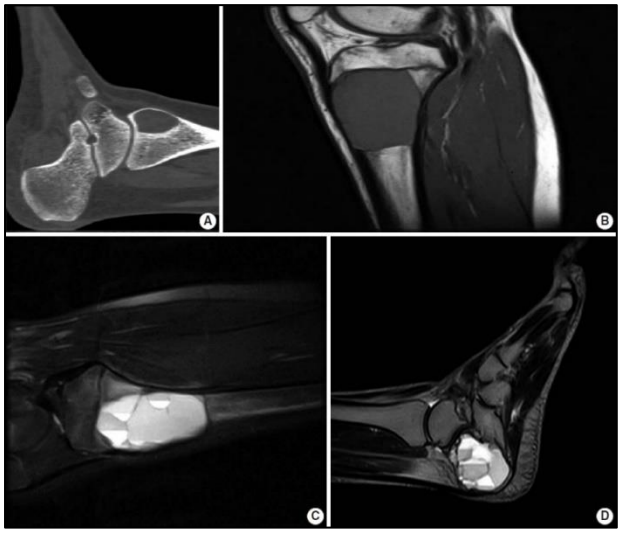

Figure 6: Computed tomography (CT) and magnetic resonance imaging (MRI) of aneurysmal bone cyst. (A) CT scan shows a well-demarcated ovoid area of lucency within the medial aspect of the distal tibia; (B, C) MRI shows an expansile well-demarcated cystic lesion of the proximal tibia with fluid-fluid levels; (D) Sagittal view T2 MRI demonstrates multiple fluid-fluid levels of the cyst involving the calcaneus bone.[12]

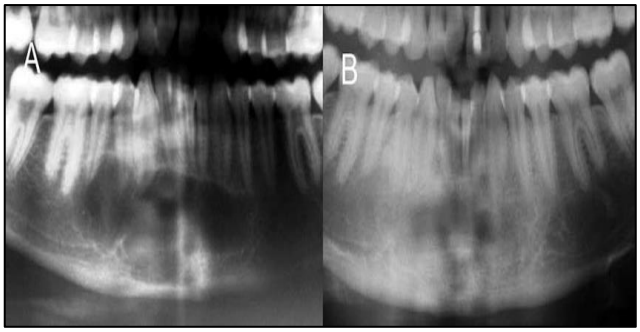

Figure 7: Traumatic bone cyst located in the region of the chin symphysis. (A) Panoramic X-ray detail at the time of diagnosis. (B) Panoramic X-ray detail one year after surgical treatment 14 Complete bone regeneration is observed.

Well defined, lucent lesion with a narrow zone of transition in a skeletally immature and the lesion is centrally located with a thin sclerotic margin. No periosteal reaction or soft tissue component.

CT

In CT characterizing of the lesion, detecting radiograph-occult fractures, and assessing internal density (usually between 10-15 HU).

MRI

Solitary bone cysts are hypointense on T1 & hyperintense on T2WI. Cysts show peripheral enhancement with contrast. Fluid-fluid level seen when there is septae within and which enhance with contrast.

Internal signal heterogeneity, periosteal reaction and soft tissue edema can be seen in the setting of fracture. Internal signal heterogeneity, periosteal reaction and soft tissue edema can be seen in the setting of fracture Simple bony cyst in proximal humerus appearing hyperintense on T2WI with few thin incomplete septae within.[10]

Scintigraphy

Simple bone cyst appears as foci of photopenia (cold spot). This is referred to as doughnut sign which results in increased uptake peripherally and a photopenic center. However, a pathological fracture would cause an increased radioisotope activity.[10]

Management

Elastic stable intramedullary nailing in the case of long bones of children has shown promising results for treating UBC. Current treatment concepts include a combination of decompressions, cyst wall disruption, injection with corticosteroid/demineralized bone matrix/bone marrow aspirate, and internal fixation in the weight-bearing region.

ANEURYSMAL BONE CYSTS[11]

Aneurymal bone cysts are rare skeletal tumours that most commonly occur in the first two decades of life. They primarily develop about the knee but may arise in any portion of the axial or appendicular skeleton. Pathogenesis may be vascular, traumatic, or genetic. Radiographic features include an expansile, radiolucent lesion typically located within the metaphyseal portion of the bone, with fluid-fluid levels visible on MRI. Histologic features include blood-filled lakes interposed between fibrous stromata. Differential diagnosis includes conditions such as telangiectatic osteosarcoma and giant cell tumour. The mainstay of treatment is curettage and bone graft, with or without adjuvant treatment. Other management options include cryotherapy, sclerotherapy, radionuclide ablation, and en bloc resection. The recurrence rate is low after appropriate treatment; however, more than one procedure may be required to completely eradicate the lesion.[12]

TRAUMATIC BONE CYST

The traumatic bone cyst (TBC) is an uncommon nonepithelial lined cavity seen commonly in jaws. The lesion is mainly diagnosed in young patients most frequently during the second decade of life. Clinically, the lesion is asymptomatic in the majority of cases and is often accidentally discovered on routine radiological examination usually as an unilocular radiolucent area with a "scalloping effect".[13] Use of plasma-rich protein as a means of bone regeneration lead to faster favourable healing and are safe for use in children. Obliteration of the cavity by bone formation after surgical exploration is commonly rapid and may take 3 to 12 months.[13] Complications of bone cysts, pathological fracture, pain, Growth disorder-limb length discrepancy, recurrence, arthritis, pressure symptoms.

CONCLUSION

Bone cysts are benign lesions usually noted in young patients and remain asymptomatic. Biopsy is necessary for diagnosis and to differentiate the type of cysts.

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