Giant Cell Tumor in an Immature Skeleton

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ABSTRACT

We report a case of giant cell tumor occurring in a 12-year-old girl. Radiographs revealed a radiolucent lesion in the proximal epi-metaphysis of the right fibula, which was initially diagnosed as an aneurysmal bone cyst. Magnetic resonance imaging showed an expansile intramedullary lesion with focal multiloculated fluid-fluid levels and also solid mass in the proximal metaphysis. The latter solid component also extended into the proximal fibular epiphysis. Following the magnetic resonance imaging, the diagnosis was revised to giant cell tumor with focal aneurysmal bone cyst changes, which was subsequently confirmed histopathologically following surgery. The unusual occurrence, location, imaging features, and differential diagnosis of osseous giant cell tumor in the immature skeleton were discussed.

Giant cell tumor (GCT) of bone is a benign but locally aggressive lesion that primarily affects the epi-metaphysis of long bones in adults, especially in their third to fourth decades of life. The disease diagnosed before skeletal maturity is extremely rare. We report a case of GCT of the proximal epi-metaphysis of the right fibula with focal secondary aneurysmal bone cyst (ABC) in a 12-year-old girl. MRI helped to establish accurate image diagnosis and make an surgical planning.

CASE REPORT

A 12-year-old girl presented with a painful mass in her right upper leg that has been noted for months. Physical examination revealed a tender mass in the lateral aspect of her right upper leg, along with local heat and decreased range of motion in the knee joint. Routine radiographs showed a geographic expansile osteolytic lesion, 2.3 × 2.4 × 5.8 cm in size, in the proximal metaphysis of the right fibula. There was no obvious matrix mineralization, periostitis, focal cortical destruction or extrasosseous soft-tissue mass (Fig. 1). Considering the patient’s age, lesion location and morphology, the diagnosis based on plain film radiographs was aneurysmal bone cyst. The differential diagnoses included simple bone cyst, fibrous dysplasia and telangiectatic osteosarcoma. A subsequent MRI revealed focal multiloculation with fluid-fluid levels in the inferior portion and a solid mass with homogeneous appearance in the superior portion of the lesion. The solid mass manifested as homogeneous isointensity to muscle on T1WI, mildly high signal on T2WI, and moderately high signal on fat-saturated T2WI images. Additionally, a small focal extension of the lesion to the proximal fibular epiphysis was demonstrated (Fig. 2). MRI suggested the possibility of primary bone tumor, especially giant cell tumor, with focal secondary ABC change.

Under the impression of unusual GCT occurring in the immature skeleton, intralesional curettage of the tumor, local adjuvant treatment with alcohol, and bone graft reconstruction were performed. Microscopically, the tumor manifested as diffuse sheets of mononuclear cells
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with scanty mitotic figures, multinucleated giant cells, focal hemorrhage and secondary ABC change. The multinucleated giant cells were positive for CD68. Proliferation rate determined by ki-67 was less than 10%. The final histology confirmed a GCT with secondary ABC.

**Figure 1.** Frontal and lateral radiographs of right knee and upper leg disclose a well-defined expansile osteolytic lesion (black arrows) in the proximal fibular meta-diaphysis with cortical thinning but without obvious matrix mineralization, periostitis, or extraosseous soft tissue mass. The bone lesion extends into the proximal fibular epiphysis (white arrow).

**Figure 2.** Sagittal T1WI a, T2WI b, and T2WI with fat saturation c, disclose a solid tumor component with homogeneous isointensity to muscle on T1WI, mildly high signal on T2WI, and moderately high signal on fat-saturated T2WI (thick arrows) in the metaphysis of proximal fibula. Transphyseal extension of the solid tumor to epiphysis is also noted (arrowheads). The inferior portion of the lesion demonstrates multilocular appearance with fluid-fluid levels (thin arrows) indicating secondary aneurysmal bone cyst formation.
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DISCUSSION

GCT of bone accounts for 4-8% of primary bone tumors. It is most commonly seen in patients aged 20 to 40 years. The occurrence of GCT in patients with open growth plates is rare. The reported incidence of GCT in skeletally immature patients ranges from 1.8% to 7.5% [1, 2].

In adult patients, the tumor typically affects the epiphyses of the distal femur, proximal tibia, distal radius, and proximal humerus [3, 4]. The proximal fibula is less frequently involved, with reported incidence of about 3-4% [5]. Approximately 84%–99% of GCT extends to within one centimeter of subarticular bone [5].

The exact site of origin of GCT is controversial. Murphy et al and Kransdorf et al described the lesions almost invariably involve the metaphysis rather than the epiphysis in skeletally immature patients [5, 6]. It was therefore hypothesized that, in the vast majority of cases, GCT of bone originates in the metaphysis and extends into the epiphysis. The case of our report seems agreeable to this thesis. However, there was a reported case of GCT isolated to the epiphysis of distal femur in a 14-year-old girl [7].

GCT demonstrates geographic bone destruction with no significant surrounding sclerosis or matrix mineralization. About 14% of GCT exhibits secondary ABC components [5]. In addition to GCT, many other benign or malignant bone lesions, including chondroblastoma, fibrous dysplasia, osteoblastoma, chondromyxoid fibroma, nonossifying fibroma, osteosarcoma, chondrosarcoma, hemangioendothelioma, and metastatic carcinoma, can also demonstrate secondary ABC change [8, 9]. Among them, GCT is the most common lesion associated with secondary ABC.

Routine radiographs of the patient in our case are characteristic of ABC considering the patient’s age, lesion location and morphology. Fortunately, MRI depicts the solid component of the tumor, focal ABC changes, and epiphyseal extension of the solid tumor. Chondroblastoma, although commonly seen in the immature skeleton, mainly affects the epiphyses with a characteristic multilobular chondral matrix and often internal calcifications. Foci of osteoid and/or fibrous tissue are invariably seen in fibrous dysplasia, osteoblastoma, chondromyxoid fibroma, nonossifying fibroma, and telangiectatic osteosarcoma, leading to focal low or heterogeneous internal signals. Characteristically, telangiectatic osteosarcoma consists of large hemorrhagic or necrotic cavities that compose most (>90%) of the tumor volume with viable high-grade sarcomatous cells around the periphery and septations of these spaces [10]. However, in our case, the lesion presented as a predominant soft tissue mass with homogeneous signal intensity but without periosteal reaction, central cystic change or necrosis, focal mineralization, cortical breakthrough and bulging soft tissue mass. The lesion of our case manifested as homogeneous intermediate to high signal intensity at upper solid tumor. The diagnosis of GCT was therefore made following MRI.

In conclusion, in the presence of an expansile osteolytic...
lesion in the metaphysis of a tubular bone occurring in an immature skeleton with open growth plate, giant cell tumor, although very uncommon, should be considered in the list of differential diagnoses. Further study, MRI or CT scan, can help to identify solid tumor components, establish an accurate imaging diagnosis, and facilitate surgical planning.

REFERENCE