A 36-year-old Woman With Posterior Shoulder Pain

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History and Physical Examination

A 36-year-old woman presented with posterior right shoulder pain. She was referred after imaging studies revealed a proximal humerus lesion. She reported slowly progressive pain in the right shoulder for the past 15 years. The pain was aggravated by activity. Her work as a manual laborer in a factory increased her pain. She denied any constitutional symptoms such as fevers, chills, or weight loss.

Physical examination of the right shoulder revealed no skin abnormalities and no palpable masses or lymphadenopathy. There was some mild posterior shoulder tenderness. She maintained full, nonirritable range of motion in the shoulder. She had full strength throughout the right upper extremity with the exception of 4/5 strength in

shoulder external rotation. There were no sensory deficits in the right upper extremity.

Imaging studies included plain radiographs (Fig. 1), computed tomography (CT) imaging (Fig. 2), and magnetic resonance imaging (MRI) (Fig. 3).

Based on the history, physical examination, and imaging studies, what is the differential diagnosis?

Imaging Interpretation

The anteroposterior (Fig. 1A) and scapular Y (Fig. 1B) plain radiographs of the right shoulder revealed a well-circumscribed, intracortical expansile lesion. The lesion was radiolucent and without periosteal reaction. CT images in axial (Fig. 2A) and sagittal (Fig. 2B) reformatted planes confirmed the intracortical location. The margin was well defined with a sclerotic border. Again, no periosteal reaction was noted and there was no associated soft tissue mass. Tiny calcifications were present within the lesion.

MR images of the right shoulder included coronal T2-weighted with fat saturation (Fig. 3A) and postcontrast T1-weighted with fat saturation in the axial (Fig. 3B) and coronal (Fig. 3C) planes. The lesion had a homogeneous high signal intensity on the T2 weighting, with a lobulated border. The contrast images showed lobular peripheral and central dotlike areas of enhancement. There was no accompanying marrow edema or periosteal reaction.

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Each author certifies that his or her institution has approved the human protocol for this case report, that all investigations were conducted in conformity with ethical principles of research, and that informed consent was obtained.

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Differential Diagnosis

Chondroblastoma
Clear cell chondrosarcoma
Chondroma

Fig. 1A–B (A) The anteroposterior plain radiograph of the right shoulder showed a well-defined, lytic lesion with thin sclerotic borders and (B) the scapular Y plain radiograph showed an eccentric position along the posterior margin of the humeral head and an intracortical location.

Osteoid osteoma
Eosinophilic granuloma
Brodie's abscess

Fig. 2A–B CT images of the lesion in (A) axial and (B) sagittal reformatted planes confirmed the intracortical location.

Curettage and allogenic bone grafting of this lesion were performed. Histologic studies were performed on the excised tissue (Fig. 4).

Based on the history, physical examination, imaging studies, and histologic picture, what is the diagnosis and how should this lesion be treated?

Histology Interpretation

The curettage specimen consisted of numerous small fragments of bluish-gray, glassy-appearing tissue measuring $2.5 \times 2 \times 0.5$ cm in aggregate. Numerous fragments of tan-white bone were separately submitted and measured $1.5 \times 1 \times 0.4$ cm in aggregate. The specimens were entirely submitted for histologic evaluation after decalcification of the bone. Microscopically, the tumor was well delineated from the uninvolved cortical bone and consisted of hypocellular to moderately cellular chondroid matrix

Fig. 3A–C (A) A coronal T2-weighted MR image with fat saturation shows the lesion had a homogeneous high signal intensity with a lobulated border. T1-weighted MR images of the lesion with fat saturation after gadolinium contrast in the (B) axial and (C) coronal planes show lobular peripheral and central dotlike areas of enhancement.

Fig. 4A–B (A) A photomicrograph of the periphery of the lesion shows the sharply demarcated border between the cartilaginous lesion and adjacent nonneoplastic cortical bone (Stain, hematoxylin and eosin; original magnification, $\times 100$). (B) A section shows the hypocellular chondroid matrix containing small, bland chondrocytes (Stain, hematoxylin and eosin; original magnification, $\times 400$). Mitotic figures are not seen.

with a vaguely lobular appearance (Fig. 4A). The chondroid cells (Fig. 4B) revealed small, bland nuclei. Occasional binucleate forms were identified. Mitotic figures were not seen.

Diagnosis

Intracortical chondroma.

Discussion and Treatment

The intracortical lesion near the physis suggested two relatively well-defined and limited differentials. By reviewing the differential diagnoses of intracortical lesions

and epiphyseal lesions in combination with the clinical presentation, radiographic studies, and pathologic examination in our patient, we arrived at our differential diagnosis list of chondroblastoma, clear cell chondrosarcoma, chondroma, osteoid osteoma, eosinophilic granuloma, and Brodie's abscess.

We considered eosinophilic granuloma and infection less likely than the other diagnoses since both would be expected to show greater reactive periosteal bone formation on plain radiography and CT and increased edema on MRI. Furthermore, both of these conditions would be much more likely in a younger patient because the epiphyseal blood supply of children predisposes this area to infections of hematogenous origin and greater than 75% of eosinophilic granulomas occur before the age of 20 years. Osteoid osteoma is another benign bone tumor frequently occurring in an intracortical location. It often has the appearance of a radiolucent lesion with a surrounding rim of sclerosis, as was seen in this case. The typical history of a patient with an osteoid osteoma is a child or adolescent with nighttime bone pain relieved by nonsteroidal antiinflammatory drugs.

Chondroblastoma is frequently encountered in the epiphysis of the proximal humerus as an eccentric, expansile, lytic lesion and thus was part of the differential in this case. This neoplasm usually presents in the second decade of life in patients with open growth plates but occasionally will be diagnosed in older individuals. These older individuals will sometimes report a long-standing history of dull pain, such as our patient exhibited. The distinction between chondroma and chondroblastoma is often reliant on histologic interpretation; however, like infection and eosinophilic granuloma, chondroblastoma would be expected to have a more reactive appearance on imaging.

Making the distinction between the remaining tumors on the differential, chondrosarcoma and chondroma, is an important and sometimes difficult task. This distinction has clear implications for prognosis and management. Clear cell chondrosarcoma in particular is a low-grade malignancy frequently encountered in an epiphyseal location and presenting most commonly in the third and fourth decades of life. On radiographs, it appears as an expansile, lytic lesion occasionally with mixed areas of sclerosis and scattered calcification. Therefore, it was high on the differential for this patient. However, one would not expect a chondrosarcoma to have the long indolent course that this patient's history presented. Furthermore, the histology in this case showed a benign-appearing chondroid tumor with relative hypocellularity and without substantial cellular atypia. Thus, combining clinical, radiographic, and pathologic findings, we arrived at our diagnosis of a chondroma in an intracortical location.

Intracortical chondroma is one of several benign bone tumors of chondroid origin. Also within this class of tumors are enchondromas, juxtacortical chondroma, and enchondroma protuberans. These tumors are characterized histologically by proliferating nests of hyaline cartilage without obvious atypia. They are indistinguishable from one another based on histologic analysis of the tumor matrix alone. As such, their location in relation to surrounding bone is important in the classification of these tumors. The classification of these chondroid tumors can have implications relative to presenting symptoms and time course of presentation, but all share the same benign natural history.

Enchondromas are the most common within this class of tumors and are relatively common in general. They are characterized by their intramedullary location. They are usually asymptomatic and often identified radiographically as an incidental finding. Gross inspection of these lesions reveals firm bluish-gray lobules of tissue with histologic findings as described above. They are histologically differentiated from chondrosarcoma by a lack of invasive infiltration of the surrounding marrow space [3]. Intraleisional calcification is often observed and a thin layer of lamellar bone rimming the cartilage nodules may also be present. These tumors occur with greatest frequency in the short tubular bones of the hands and feet but may also present in the axial skeleton or long bones. Their characteristic radiographic appearance is one of a solitary lucent lesion within the diaphysis of the short tubular bones or metaphysis of the long bones. Intralesional calcification takes the appearance of fine, punctate stippling. Differentiation between enchondroma and low-grade chondrosarcoma presents a unique challenge and, as stated above, is usually dependent on histologic interpretation. In general, small peripheral lesions are more likely benign whereas large axial lesions have a higher likelihood of malignancy. Chondrosarcoma rarely arises from a preexisting enchondroma [5].

Juxtacortical chondroma is likewise a benign tumor with cartilaginous matrix. It is distinct from enchondroma in its location on the metaphyseal cortex of long and short tubular bones. Radiographically, it presents as a metaphyseal lesion with scalloping of the underlying cortex. Grossly, it is enveloped by periosteum on one side and embedded within the scalloped cortex on the opposite side. It will sometimes present as a painful lesion, perhaps due to reactivity of the overlying periosteum [2].

Enchondroma protuberans could be considered the mirror image of juxtacortical chondroma, occurring on the medullary aspect of the cortex rather than subperiosteally. It has been defined as an exophytic enchondroma of a long bone [4]. Because of this exophytic appearance, it can be easily mistaken for chondrosarcoma. Thus, it presents a

challenge in recognition and avoidance of an unnecessarily wide resection.

Intracortical chondroma is the rarest of the aforementioned class of benign cartilage tumors. To date, there have been fewer than 10 such cases reported in the literature [1, 6–8]. There is some debate as to whether intracortical chondroma represents a distinct clinical entity or is simply a variant of juxtacortical chondroma. Juxtacortical chondroma has a characteristic overhanging edge appearance as a result of periosteal reaction and the advancement of cortical bone around the perimeter of the lesion. This cortical advancement can be extensive, leading to bony coverage of most of the periosteal surface of the chondroma. In our patient, radiographic evidence, including a CT scan, showed an intracortical location of the lesion. Additionally, at the time of surgery, we observed a circumferential rim of cortical bone surrounding the cartilaginous lesion. The lesion in our patient had likely been present for a long time as evidenced by her long-standing history of posterior shoulder discomfort. Thus, it is conceivable her tumor was a juxtacortical chondroma that had progressed such that the entire periosteal surface was encapsulated in bone. However, histologic analysis lends further support to the diagnosis of intracortical chondroma, as the bony specimens submitted from the lesion margins showed mature cortical bone with Haversian systems. The outer rim of bone produced in a juxtacortical chondroma is more likely to be histologically compatible with periosteal bone formation [1, 8].

In this 36-year-old woman with posterior shoulder pain, imaging revealed an intracortical lesion near the proximal

humeral physeal scar. The intraoperative appearance and the gross and histologic analyses of the lesion were consistent with a chondroma of intracortical location. The lesion was treated with curettage and allogenic bone grafting. The patient was seen in clinic at 2 weeks, 1 month, 3 months, and 1 year postoperatively. A clinical examination and radiographic studies were performed at each visit. As of her recent 1-year postoperative visit, she was pain free and radiographs showed incorporation of the bone graft with no evidence of tumor recurrence.

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