Patellar Metastatic Melanoma in a 13-Year-Old Boy

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Abstract

The incidence of melanoma in US adults is approximately 1.5 per million, with 2% to 5% of patients developing metastatic disease. In children, melanoma is distinctly uncommon, and metastatic disease occurs even more seldom. This case report, the first of a patellar lesion as the initial presentation of metastatic melanoma in a pediatric patient, highlights use of patellectomy and intraoperative radiation therapy in obtaining palliative local control while avoiding periarticular functional morbidity.

Patellar lesions are seldom encountered, owing to the small size and sesamoid nature of the bone. Osteomyelitis, most often secondary to infection by bacterial organisms, is perhaps most frequently encountered. Benign neoplasms include chondroblastoma, giant cell tumor, and aneurysmal bone cyst. Primary malignancies are rare; metastatic deposits, including lymphoma, lung or renal carcinoma, and melanoma, have been reported in adults. As expected, almost all cases of pediatric patellar conditions have proved to be of infectious or benign etiology. Patellar malignancies, either primary or secondary, are almost unknown in childhood. In this case report, we detail the initial manifestation of metastatic disease in the patella of a child with a past history of melanoma, a condition that accounts for just 1% to 3% of all childhood malignancies.[1] Metastatic disease is assumed to occur less than 5% of the time in children, involving bone infrequently; heretofore, pediatric melanoma metastatic to the patella has not been described.

In a patient with a history of melanoma, the pathologic diagnosis of a metastasis might well be relatively straightforward, but management of pediatric patellar malignancy is fraught with potential difficulties, given the functional importance of the bone and the close proximity of the knee joint as well as the physeal plates of the distal femur and proximal tibia. Patellectomy with intraoperative radiation therapy offers the opportunity to obtain local control, optimize rehabilitation, and minimize both arthrofibrosis and growth disturbance.

The authors have obtained informed assent from the patient and his guardian for print and electronic publication of this case report.

Case Report

A 13-year-old boy presented with a 10-month history of anterior knee pain. Past medical history was significant for stage IIB nodular melanoma of the left upper arm. Almost 4 years before presentation, this lesion of 2.5 mm depth was biopsied at an outside institution and then was re-excised with negative margins at our institution; a left axillary sentinel lymph node dissection also was negative. Plain radiographs (Figure 1) and magnetic resonance imaging (MRI) (Figure 2) of the knee showed an aggressive process involving the superior portion of the patella. Lack of uptake of the technetium-99m total body bone scan (Figure 3) and relatively limited metabolic activity on the positron emission tomography scan (Figure 4) suggested the diagnosis of eosinophilic granuloma. An incisional biopsy of the patella revealed metastatic melanoma (Figure 5). As the patient had no other evidence of metastatic disease, it was decided to proceed with a total patellectomy. In an attempt to improve the likelihood of local control while minimizing the chance of arthrofibrosis and physeal arrest, intraoperative radiation therapy (IORT) to a dose of 1500 centigray (cGy) was administered using 9 MeV electrons and an 8-cm cone. The patient recovered uneventfully, with full return of normal range of motion, strength, and gait pattern. Follow-up radiographs showed no evidence of local recurrence or physeal closure (Figure 6). The patient received interferon alfa-2b 20 million units/m^2/d for 5 days per week for 4 weeks and then maintenance therapy with 12 million units/m^2/d for 3 days per week. While on ther-

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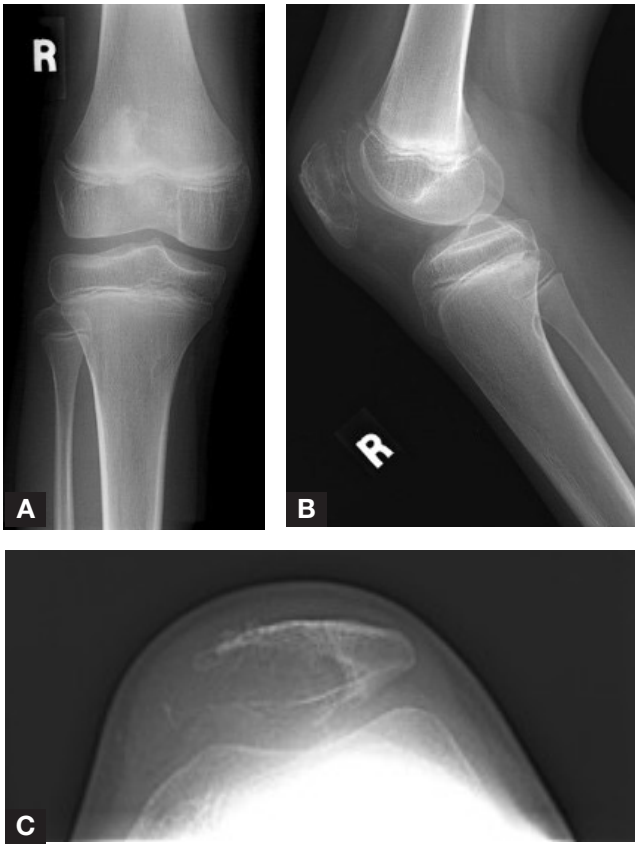

Figure 1. Anteroposterior (A), lateral (B), and sunrise (C) patellar radiographs show destructive, lytic lesion involving the proximal aspect of the bone.

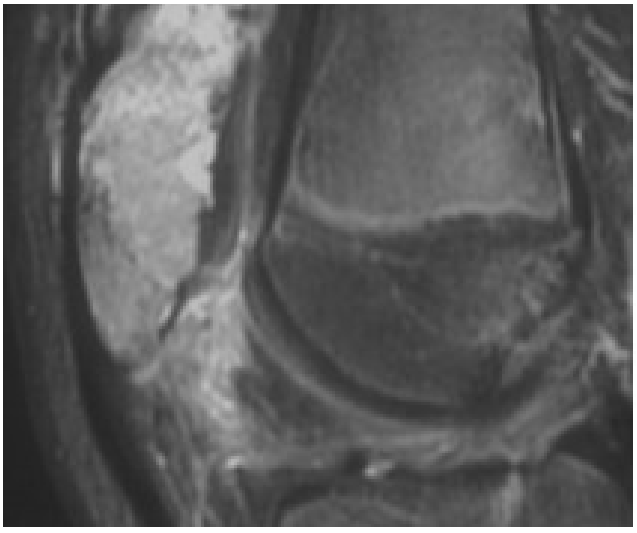

Figure 2. T_2-weighted sagittal magnetic resonance imaging confirmed presence of a large proximal patella bone lesion with extension into the surrounding para-articular soft tissues.

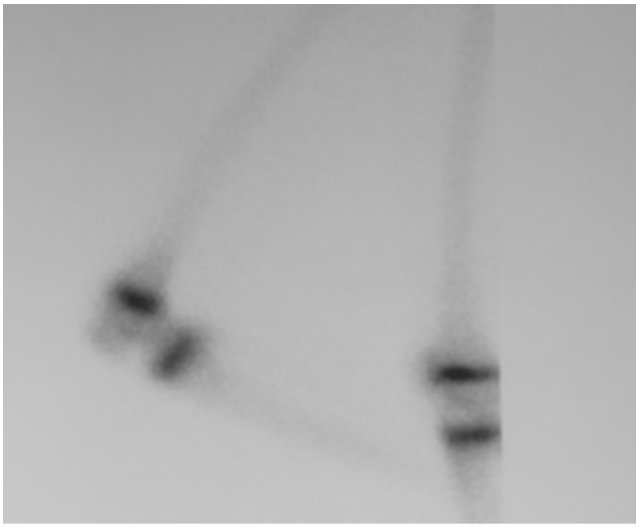

Figure 3. Technetium-99m bone scan of patella shows minimal radioisotope uptake.

apy, he relapsed in the proximal humerus, 4 months after the patellectomy. He was then treated with interleukin 2 before undergoing palliative proximal humeral resection and prosthetic replacement. Two months later, he developed metastatic occipital brain disease, which was treated with palliative intensity-modulated radiation therapy to a dose of 1800 cGy, as well as subsequent brain surgery. The patient remains without any evidence of disease at 3.5 years after patellar surgery; he has a full knee active range of motion, normal quadriceps strength, equal limb lengths, and a nonantalgic gait.

Discussion

Compared with other pediatric malignancies, melanoma is rare,[2,3] but it appears to be increasing in frequency.[1,4-6] There are numerous pediatric melanoma risk factors, including, but not limited to, excessive exposure to ultraviolet radiation (UVR), presence of giant congenital melanocytic nevi, immunosuppression, and family history of melanoma. Race and sex also appear to be factors, as whites and females are at increased risk for developing melanoma.[1,4,7,8] However, UVR exposure contributes to melanoma development in both dark- and fair-skinned populations.[8]

Melanoma survival rates correlate with lesional depth and stage, which are directly related to delay in diagnosis.[9,10] Most melanomas are deeper at presentation in children than in adults.[1,11] Increased depth in pediatric cases could result from higher incidence of deep-tissue congenital nevi, increased percentage of more aggressive nodular melanomas (as in our patient's case), or longer time to diagnosis.[1] Because of the rarity of melanoma in children, delay in diagnosis often results in higher mortality rates for children compared with adults.[1,3,11,12]

Less commonly encountered than basal cell carcinoma or squamous cell carcinoma, melanoma results in approximately three-quarters of deaths due to skin cancer.[13] Melanoma has been observed to spread by lymphatic and hematogenous routes to almost any major organ or tissue, including bone.[10,14] Sentinel lymph node biopsy has recently become the norm for staging of adolescents as well as adults.[2,5] Skeletal metastasis, suspected on the basis of symptoms of pain, a mass, or

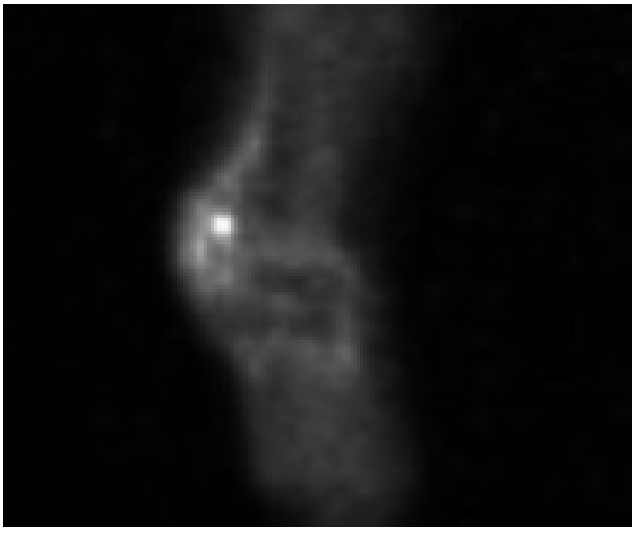

Figure 4. Sagittal ^{18}fluorodeoxyglucose positron emission tomography shows minimal patellar uptake.

functional restriction, is suggested by plain radiographic and scintigraphic tests and confirmed by analysis of histologic material.[10]

Examining the specific location of melanoma metastases, DeBoer and colleagues[14] found differences in survival for various types of metastases. In a comparison of isolated axial and appendicular skeletal metastases, the appendicular cohort had a statistically higher survival rate when undergoing surgery.[14] Although secondary bone lesions are generally thought to have an adverse prognosis, complete resection of isolated appendicular melanoma metastases is thought to be warranted.[14] For the more commonly encountered long-bone lesions, reconstruction would be accomplished with an arthroplasty.[15] For the rare instance of metastasis to the small bones of the hands or feet, or to "expendable" bones such as the patella or proximal fibula, resection alone often suffices.

Owing to the small size and sesamoid nature of the bone, patellar lesions of any sort are quite uncommon. Benign processes such as giant cell tumor,[16-21] chondroblastoma,[16,19,22-25] and bacterial infection[26-35] predominate. Malignant conditions affecting the patella, whether primary or secondary,[36] are even more unusual. Osteosarcoma,[16,37-41] malignant fibrous histiocytoma (MFH),[16,42,43] lymphoma,[19,44-47] and a variety of metastatic deposits from the lung,[48-55] kidney,[56,57] colon,[58] esophagus,[59] breast,[60] and other locations[61-65] have been reported.

There are 2 earlier case reports of melanoma metastasis, but both involved adults, ages 48 and 65 years.[36,66] The present case report is the first to describe patellar melanoma metastasis in a child. In fact, in our review of the literature, the only other reported instances of any form of pediatric patellar malignancy are single cases of hemangioendothelioma,[19] MFH,[16] and osteosarcoma,[16] at ages 13, 17, and 18 years, respectively. To our knowledge, up until now there have been no reported cases of metastasis to a patella in a child.

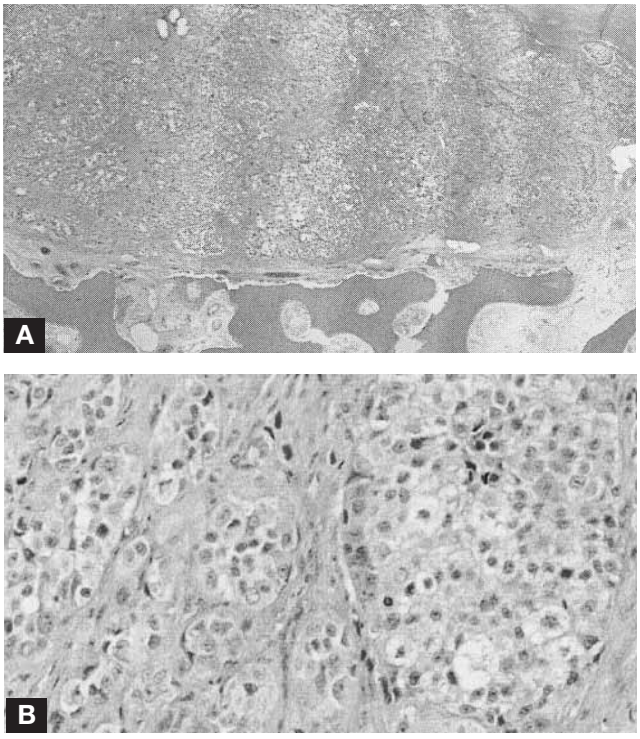

Figure 5. Histology of metastatic melanoma. (A) Tumor between articular cartilage, above, and medullary bone, below (hematoxylin-eosin, original magnification × 20). (B) Characteristic nested architecture, amphophilic cytoplasm, and large nuclei with prominent nucleoli of malignant melanocytes (original magnification × 200).

In light of the preceding fact, and given that no uptake was noted on bone scan, melanoma was not favored on the differential diagnosis list for our patient's presentation. After confirmation of the pathologic diagnosis, medical management options were deferred in favor of local control, as the patient had no other evidence of metastatic disease.[14]

Mercuri and Casadei[19] provided guidelines for managing patellar malignancies according to the

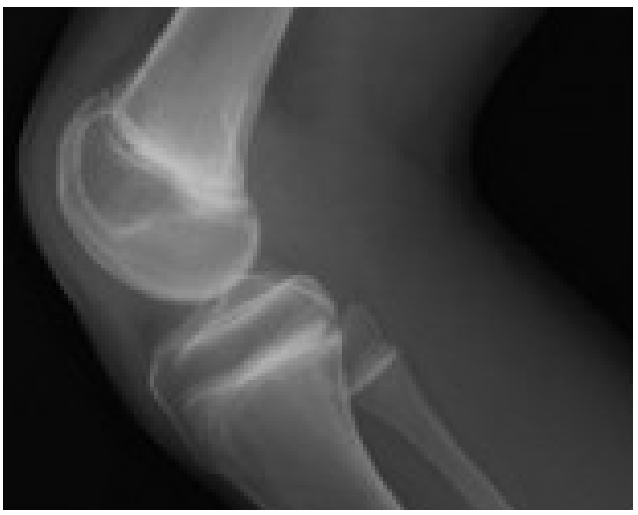

Figure 6. Postoperative lateral radiograph shows no evidence of local recurrence or physeal arrest.

Enneking system.[67-69] Simple patellectomy was thought to suffice for stage IA tumors, whereas "wide excision of the tendons and skin involved" was preferred for stage IB tumors. In the case of stage IIA tumors, extra-articular resection of the knee was sometimes thought necessary, whereas amputation was advocated for stage IIB neoplasms with a large soft-tissue mass. Five of their 9 patients with patellar malignancies received postoperative radiation therapy ranging from 44 to 54 Gray.[19]

In our patient's case, radiologic imaging (Figures 1, 2) and gross findings at time of incisional biopsy confirmed that the tumor was extending through the articular cartilage toward the joint space and into the surrounding soft tissues. As a metastatic deposit not directly classified by the Enneking system, this lesion given its size and extent would nonetheless have dictated that a very aggressive surgical approach be undertaken. However, in light of the patient's very young age, the desire to maximize functional outcome, and awareness of his relatively high risk for further progression of metastatic disease, it was decided to perform a simple patellectomy with intraoperative radiation therapy.

Use of IORT techniques enables higher local control rates through delivery of radiation directly to the tumor bed and limits long-term side effects.[70-76] Early clinical trials using IORT have reported favorable local outcomes, with few patients experiencing IORT-related radiation toxicities.[77,78] IORT has been used successfully as part of a multidisciplinary approach in patients with sarcoma[79,80] and in children with locally advanced malignancies.[81] In our patient's case, IORT was used as a supplement to simple patellectomy to improve the chance for local control while sparing the patient more radical surgery. It also was hoped that avoiding adjuvant radiation would minimize the risks for arthrofibrosis and physeal disturbance. Achievement of these goals was demonstrated clinically over the course of the patient's lifetime.

This is the first reported case of pediatric metastatic melanoma and, indeed, the first reported instance of a pediatric disease metastatic to the patella. That the patella was the patient's first and only site of metastatic disease for 4 months makes the case more illustrative. Patellar malignancies of any type are very rare, particularly in children. Nevertheless, in the appropriate setting, metastatic disease should be considered during initial evaluation and management of patellar lesions. When aggressive surgical resections do become necessary, advanced radiation techniques, such as IORT, should be considered as an adjunct to multidisciplinary management so as to allow more limited resections with superior functional outcomes.

Authors' Disclosure Statement

The authors report no actual or potential conflict of interest in relation to this article.

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