A 2-year-old previously healthy boy presented to his primary care provider with a bony prominence over his lower right leg just distal to his knee. The mother noted she had felt this hard lump for several weeks. She initially felt the prominence while applying sunscreen. She remarked that the lump had not been red, tender, or bruised, but it had appeared to be growing in size during the few weeks following discovery. The patient never complained about the prominence and it did not seem to affect his ability to ambulate. There was no known history of trauma to the area and his mother never noticed an overlying abrasion or bruise. She had not noticed any other bumps on his body. His mother denied any fevers, weight loss, changes in appetite, sleep disturbances, limping, or change in gait. She also reported a history of “extra bones” in multiple family members, including herself, when they were children.

Upon physical examination, the patient had a temperature of 37.2°C and a weight of 14 kg (33rd percentile). He was an active child who was well developed and well nourished. His HEENT (head, ears, eyes, nose, and throat), cardiovascular, lung, skin, and abdominal examinations were all normal. He had no lymphadenopathy. His extremity examination revealed a non-tender, nonmobile, nonerythematous easily palpable bony prominence just distal and slightly lateral of the right patella. The palpable portion of the lesion measured 1 cm x 1 cm but appeared to extend internally. There was no overlying skin bruising or signs of injury. The remainder of his musculoskeletal examination was normal. He had full range of motion of his joints without pain or swelling. No other palpable masses could be appreciated on physical examination. He had no evidence of leg length discrepancy and walked easily without any appreciable limp.

Because of concerns for a new onset bony tumor, mass, or undiagnosed injury, a radiograph was obtained of the left lower extremity that included the area of concern and surrounding knee joint.
Diagnosis:
Multiple Hereditary Exostoses

The radiograph revealed pedunculated osteochondromas of the distal femur, proximal fibula, and likely developing sessile osteochondroma of the proximal tibia in the metaphysis (Figure 1).

Due to the family history of “extra bones” and the radiographic finding of osteochondromas, the patient was diagnosed with multiple hereditary exostoses. He was referred to our pediatric orthopedist for further evaluation and management. The pediatric orthopedist obtained a pelvic radiograph to rule out additional bony involvement of the pelvis and lower vertebrae, and it was negative. He confirmed the diagnosis of multiple hereditary exostoses and suggested yearly orthopedic examinations to evaluate for malignant transformation or complications.

DISCUSSION

Multiple hereditary exostoses (also called hereditary multiple osteochondromas) is an autosomal dominant, benign orthopedic condition in which several noncancerous bony tumors grow from the metaphyses of bones.1 It occurs in approximately 1 in 50,000 individuals.2 These bony tumors are commonly seen in the pelvis, femur, tibia, fibula, humerus, radius, and ulna.3,4 Although less common, these growths can also involve the vertebra, tarsal bones, and carpal bones.3 The first symptom of multiple hereditary exostosis is the development of palpable abnormal bony prominences, and it generally occurs between ages 2 and 10 years. The growth of the exostoses stops in late adolescence when the epiphyseal plates close. The differential diagnosis of this condition includes both benign and pathologic conditions (Table 1).

Multiple hereditary exostoses stems from a mutation in the EXT1 and EXT2 genes.5 There are recent studies that a third gene, the EXT3 gene, may also be involved.1,2,5 Studies show that individuals who have mutations in the EXT1 gene have more severe symptoms. EXT1 and EXT2 participate in heparan sulfate elongation, which is a protein that is transferred from the Golgi apparatus to the surface of the cell membrane. It has been established that cell functionality depends on cell surface molecules (particularly the glycosaminoglycan), which include heparan sulfate. The direct link between the inability to elongate heparan sulfate chains and how it directly relates to the formation of multiple exostoses is still undetermined. However, in mouse models it has been shown that mutations in EXT1 and EXT2 cause failure of differentiation of cells.5

There are complications that can result from this condition. One of the most common complications is pain at the affected site and surrounding areas. Another complication includes nerve and vessel entrapment from bony overgrowths.1 In rare cases, there can even be spinal cord compression from exostoses involving the vertebral bones.6 Limb growth discrepancy in the arms and/or legs has also been reported as well.2 Of particular concern is the increased risk for oncologic transformation of the exostoses in 3% to 5% of patients with this condition.4 Although these complications are relatively uncommon, it is imperative that the child’s primary care provider be aware of them should they become a possible concern.

Diagnosis is generally established by baseline radiologic studies. Exostoses can present along a spectrum from sessile to pedunculated lesions. Radiologic images will demonstrate cartilaginous capped bony tumor outgrowths from the bone, particularly at the metaphysis. Calcifications in the bony outgrowths may also be seen.3 Magnetic resonance imaging may also be used for evaluation of the exostoses, particularly to detect or evaluate possible complications described above or to better define concerning undifferentiated lesions.4 Treatment of multiple hereditary exostosis is generally supportive unless there are complications of compression, pain, or oncologic transformation.3 In those

Figure 1. Bony excrescences of the proximal medial aspect of the fibula (arrowheads). The cortical thickening along the anterior tibial cortex represents a developing sessile osteochondroma (arrows).
cases, orthopedic or neurosurgical surgical options can be beneficial. For example, laminoplasty has been reported as a possible treatment option for cervical cord compression resulting from hereditary exostosis. Bony lesions resulting in pain, nerve entrapment, and/or vessel entrapment can be treated with surgical excision. Limb-length discrepancy, when symptomatic, could also be treated using osteotomy. A routine surveillance recommendation for malignant transformation screening for exostotic lesions has not been established.

Once diagnosed, these lesions can be managed by a pediatrician or primary care provider who is familiar with this disease process. However, the primary care provider should be knowledgeable and confident in screening for possible complications resulting from this diagnosis. Should complications be suspected, or if the provider is uncomfortable managing this diagnosis, referral to a pediatric orthopedist is necessary to manage this condition and evaluate for potential comorbidities.

CONCLUSION

It is not uncommon for a pediatric primary care provider to evaluate the presentation of a bony mass in a pediatric patient. For this reason, clinicians must be familiar with the differential diagnosis for bony masses and be comfortable initiating a proper evaluation. Although uncommon, multiple hereditary exostoses must be considered as a diagnosis when bony tumors are seen growing from the metaphyses of bones on radiography. Although generally a benign condition, there is a possibility of complications from the growth of these lesions, and in rare cases there is a small risk for malignant transformation. For these reasons, if the primary care provider is uncomfortable diagnosing or managing this condition, or if the patient experiences complications or concern for malignant transformation, then it is essential that a pediatric orthopedic specialist be involved in the patient’s care.

REFERENCES


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TABLE 1.

**Differential Diagnosis of Bone Mass**

- Simple bone cyst
- Aneurysmal bone cyst
- Osteoblastoma
- Osteosarcoma
- Ewing’s sarcoma
- Fibrous dysplasia
- Fibrous cortical defect
- Nonossifying fibroma
- Enchondroma
- Multiple hereditary exostosis
- Chondroblastoma
- Chondrosarcoma
- Osteomyelitis
- Langerhans cell histiocytosis
- Bone metastasis
- Giant cell tumor