Growth stimulation by giant-cell tumor of bone?
A case report

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Overgrowth of the femur and tibia was observed in a 20-year-old man who had a giant cell tumor in his distal femur. Growth stimulation by the tumor is suggested to explain the overgrowh.

In children and adolescents bone tumors seldom affect the growth even though they often are located near the physis. When a tumor does cause disturbance, retardation rather then stimulation has been reported (Tachdjian 1972, Enneking 1983). We report a case of giant cell tumor with increased leg length in a young man.

Case report

A 20-year-old man was known to have a gradually growing tumefaction of the left knee region for more than 1 year; exactly how long, he could not tell. He had also gradually become aware that his left leg was longer than his right one. Orthoradiography showed a total left lower limb overgrowth of 3.5 cm, and the radiographic diagnosis of the process in the left distal femur was giant-cell tumor of bone. The largest dimensions of the tumor on the radiographs were transverse 9.5 cm, sagittal 6.5 cm, and longitudinal 10.5 cm. He had had no fractures or other pathology that could explain the leg-length discrepancy. The diagnosis was confirmed by biopsy (Figure 1). Flow cytometric DNA analysis (Fosså et al. 1984) showed 88 percent of the cells in diploid G1 phase, 6 percent in the S phase, and 6 percent in the G2 phase.

The patient was mentally retarded and hesitated to have the tumor operated on and the leg length restituted. After 6 months of observation at our service, he agreed to have the tumor removed. From the first to the last preoperative radiographs, no distinct increase in the size of the tumor was discernible except for probably some increased osteolysis in the proximalmost part of the tumor. Computed tomography showed cortical affection, but not perforation; using our staging system the tumor was classified as T 2 (Alho 1984).

A wide resection with removal of the distal femur and replacement with a deep-frozen dimethylsulphoxide-preserved allograft was performed (Alho et al. 1987) correcting the leg length discrepancy. Histology confirmed the diagnosis; there were large areas of necrosis and bleeding, fibrous tissue with pigmented macrophages, and tumor tissue as shown in the biopsy. In one area a cortical perforation not detected by CT was seen.

Discussion

In diaphyseal fractures in children, growth stimulation by hyperemia and humoral growth factors have been suggested to explain the overgrowth of both femor and tibia associated with femoral shaft fracture (Barfod and Christiansen 1959, Martin–Ferrero and Sanchez–Martin 1986). In arteriovenous fistulae, hypoxemia or circulatory changes have been thought to be the stimulating factor (Petty et al. 1974). Giant-cell tumors

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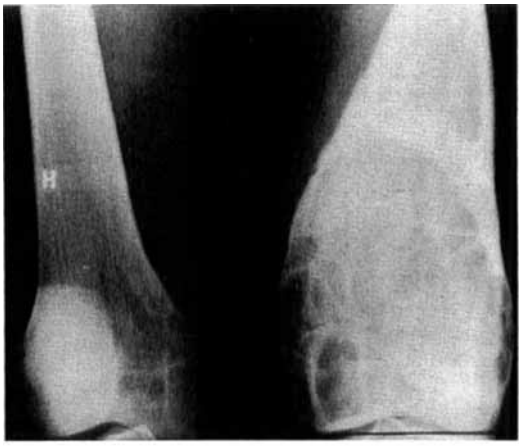

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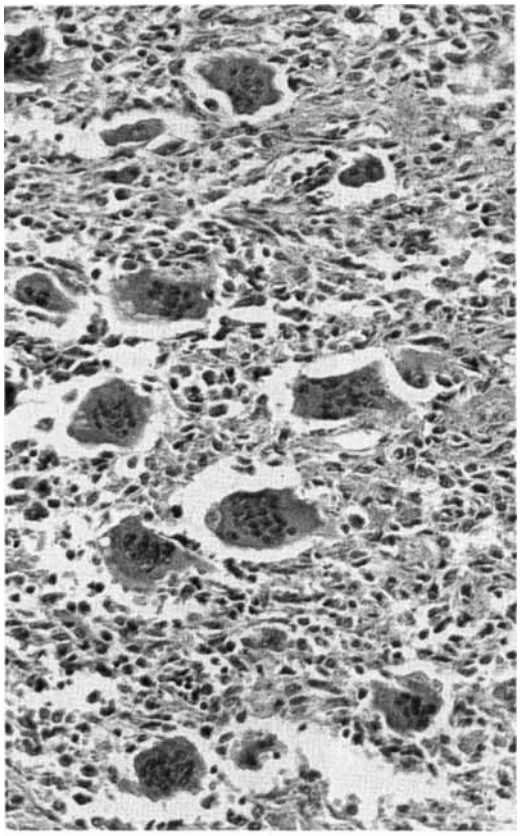

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Figure 1. A giant-cell tumor of the left distal femur in a 20-year-old man.

A. There are probable remains of a metaphyseal fibrous defect distally, medially in the right femur. There was a 2.2-cm length discrepancy in the femora and a 1.3-cm discrepancy in the tibiae.

B. The histologic picture of the biopsy was that of a benign giant cell tumor. Note the similarity between the nuclei of the many large multinucleated giant-cells and the interposed mononuclear cells. x63.

are hypervascular with arteriovenous shunts (Lundström et al. 1977). One may theorize that the rarity of giant cell tumors in children explains the lack of reports of bone overgrowth.

In our case, tumor expansion could explain the increase of the femur length, but not the overgrowth of the tibia. For growth stimulation by the tumor, it should obviously have to have been present when the growth plate was open, approximately 5 years earlier. The patient was mentally retarded, which may explain the delay in presenting for treatment. Tuli et al. (1978) reported histories of 3–5 years in four of 39 giant cell tumors. In the early reports of giant-cell tumors, the size of the tumor was often considerable, with a huge expansion of the bone end (Geschickter and Copeland 1929). Our tumor was unusually large.

Tumor growth depends on two factors: viz., its replicative activity and the death rate of tumor cells, with the balance between the two determining the increase in tumor size (Bresciani et al. 1974). The giant cell tumors have very different replication potentials, with the percentage of G1 phase (nondividing cells) varying from 78 to 96 (Mankin et al. 1985). Our tumor was of an intermediate variety, with 88 percent diploid nondividing cells.

We are not aware of previous reports of growth stimulation by giant-cell tumor or any bone tumor, although the chances for growth stimulation theoretically should be considerable. We admit a certain possibility of simultaneous appearance of two rare, separate conditions — giant-cell tumor and bone overgrowth sui generis.

References

Alho A. Staging and management of bone tumours. Acta Orthop Scand 1984;55:580.

Alho A, Karaharju E O, Korkala O, Laasonen E. Hemijoint allografts in the treatment of low grade malignant and aggressive bone tumours about the knee. Int Orthop 1987; 11(1):35–41.

Barfod B, Christensen J. Fractures of the femoral shaft in children with special reference to subsequent overgrowth. Acta Chir Scand 1959;116:235–50.

Bresciani F, Paoluzi R, Benassi M, Nervi C, Casale C, Ziparo E. Cell kinetics and growth of squamous cell carcinomas in man. Cancer Res 1974;34(9):2405–15.

Enneking W F. Musculoskeletal tumor surgery. Churchill Livingstone, New York 1983;1:14–36.

Fosså S D, Thorud E, Shoaib M C, Pettersen E O, Hoie J, Knudsen O S. DNA flow cytometry in primary breast carcinoma. Acta Pathol Microbiol Immunol Scand (A) 1984; 92(6): 475–80.

Geschickter C F, Copeland M M. Osteitis fibrosa and giant cell tumor. Arch Surg 1929;19:169–271.

Lundström B, Lorentzon R, Larsson S E, Boquist L. Angiography in giant cell tumours of bone. Acta Radiol (Diagn) (Stockh) 1977;18(5):54–53.

Mankin H J, Connor J F, Schiller A L, Perlmutter N, Alho A, McGuire M. Grading of bone tumors by analysis of nuclear DNA content using flow cytometry. J Bone Joint Surg (Am) 1985;67(3):404–13.

Martin-Ferrero M A, Sanchez-Martin M M. Prediction of overgrowth in femoral shaft fractures in children. Int Orthop 1986;10(2):89–93.

Petty W, Winter R B, Felder D. Arteriovenous fistula for treatment of discrepancy in leg length. J Bone Joint Surg (Am) 1974;56(3):581–6.

Tachdjian M O. Pediatric Orthopedics. W.B. Saunders Co, Philadelphia 1972;2:1469.

Tuli S M, Varma B P, Srivastava T P. Giant cell tumor of bone. A study of natural course. Int Orthop 1978;2(3): 207–14.