Skeletal Radiol (1998) 27:574–577

CASE REPORT

Hafez Shuhaibar
Lawrence Friedman

Dedifferentiated parosteal osteosarcoma with high-grade osteoclast-rich osteogenic sarcoma at presentation

H. Shuhaibar, M.D. (✉)
Department of Pathology,
St. Joseph's Hospital,
McMaster University,
50 Charlton Ave E.,
Hamilton, Ontario L8N 4A6,
Canada

L. Friedman, M.B., B.Ch.
Department of Radiology,
Guelph General Hospital,
Guelph, Ontario,
Canada

Abstract We report a case of a 32-year-old woman who presented with parosteal osteosarcoma of the distal femur with simultaneous dedifferentiation to a high-grade osteoclast-rich osteogenic sarcoma. This pattern of dedifferentiation is rare, particularly at the time of presentation. We are aware of three other somewhat comparable cases in the literature; however, none is quite similar to our case.

Key words Parosteal osteosarcoma · Osteoclast-rich osteogenic sarcoma · Concurrent · Dedifferentiation · Femur

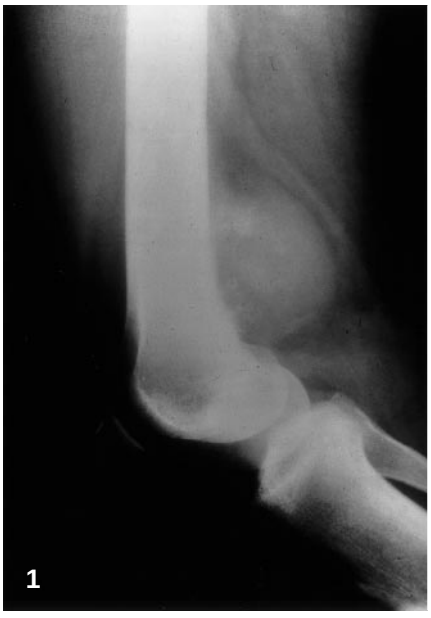
Introduction

Dedifferentiation of tumors is a biologic event that is clinically significant. This usually involves transformation of a low-grade malignant neoplasm that follows a slow progressive course, to a high-grade malignant tumor with a greater metastatic potential and a more rapid lethal clinical course.

Case report

A 32-year-old woman presented in August 1992 with pain in her left knee of several weeks' duration following a twisting injury. A roentgenogram showed a large mass in the popliteal fossa intimately related to the posterior lateral aspect of the distal femur (Fig. 1). MRI confirmed the presence of a lobulated mass attached to the lower posterior femur by a broad ossified base. Ossification was mostly at the base not the periphery. There was no involvement of the underlying medullary bone (Fig. 2). An open incisional biopsy of the mass was performed. Histologically, the lesion consisted of two distinct components (Fig. 3). One component showed parallel "streamers" of woven bone separated by a cellular fibrous tissue with minimal cellular atypia (Figs. 4, 5). There was an abrupt transition to a second component, which showed an osteoclast-rich sarcoma (Fig. 6) with atypical mitoses, scattered anaplastic giant cells (Fig. 7), and focal production of osteoid (Fig. 8). The lesion was initially regarded as a giant cell tumor and wide excision was recommended. A few weeks later, the patient underwent an en bloc resection of the distal left femur. This included the tumor (6×4.1×6 cm) with underlying cortical table (8×2×0.5 cm). The initial biopsy at that time was reviewed and a revised diagnosis of parosteal osteosarcoma with dedifferentiation to high-grade osteoclast-rich osteosarcoma was made. The en bloc resection specimen showed no residual component of parosteal osteosarcoma. The tumor consisted of a high-grade osteosarcoma with numerous osteoclast-like giant cells.

The margin of the specimen was involved by tumor. Postoperatively, the patient received three courses of chemotherapy (adriamycin and cisplatinum). Three months later, an above-knee amputation of the left leg was performed. A white-gray lobulated tumor mass was found in the posterior distal femur, measuring 4.8×1.0×1.5 cm. It showed several histological patterns. Some areas showed pleomorphic spindle cells, abundant osteochondroid matrix, and scattered osteoclast-like giant cells. Other areas were composed of sheets



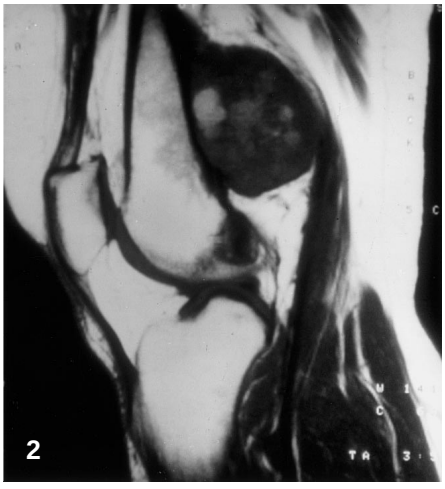


Fig. 1 Radiograph of lateral knee showing a soft tissue mass along the posterior aspect of the distal femoral metadiaphysis. Note the broad area of ossification at the base

Fig. 2 Sagittal T1-weighted image of the knee demonstrating the lobulated mass along the posterior aspect of the distal femur. MRI confirms the presence of ossification at the base and centrally, and not at the periphery. This finding is characteristic of parosteal osteogenic sarcoma

of osteoclast-like giant cells in a background of mononuclear cells with numerous mitoses (up to two per high-power field, 40× objective). The tumor showed 80% necrosis. The histological features of parosteal osteosarcoma were not identified. The patient received postoperative cyclophosphamide, actinomycin D, and bleomycin. In October 1993, she developed metastases to the right and left lower lobes of the lungs. Both tumor nodules were surgically excised. In February 1995, September 1995, and May 1996, tumor nodules were again removed from both lungs. The metastatic tumor deposits consisted of osteoclast-rich osteosarcoma with osteoid production. The patient has had no further recurrences.

Discussion

Parosteal osteosarcoma is a rare neoplasm which in some series accounts for approximately 5% of all osteosarcomas [1, 2]. It is a well-differentiated, predominantly fibro-osseous variant of osteosarcoma that arises from the juxtacortical region of long bones. The most common site is the posterior aspect of the distal femur. Although the peak patient age is in the second decade, the tumor usually occurs at a later age than conventional intramedullary osteosarcoma.

Radiologically, these tumors are eccentrically placed, lobulated, and densely mineralized lesions that appear to be "pasted on" the cortex. The base of the lesion is usually more ossified and the outermost portions generally are the least mineralized. The lesion is attached to the underlying cortex by a broad base with a lucent zone present between the underlying cortex and the tumor [3, 4]. In one study of parosteal osteosarcomas, the underlying cortex was considered normal in approximately 50% of cases. In approximately 25% the cortex was thickened and in the remainder it was destroyed [5].

The histology of parosteal osteosarcoma is that of a fibro-osseous lesion with relatively well-formed osseous trabeculae, commonly arranged as parallel "streamers" separated by cellular fibroblastic tissue with minimal nuclear atypia. There is usually minimal to no involvement of the underlying medullary bone. The cortex is often thickened and deformed. Studies have shown that low-grade parosteal osteosarcomas without dedifferentiation have a favorable prognosis provided prompt en bloc resection of the tumor is done [2]. Adequate initial therapy results in cure for most patients and long-term survival is in the range of 80–90%. Low-grade lesions without intramedullary extension rarely metastasize [6].

This type of osteosarcoma, however, carries a significant risk of dedifferentiation to a high-grade sarcoma. The incidence of this occurrence varies in the literature from 12 to 20% [3, 7, 8]. Radiologically, areas of radiolucency within a parosteal osteogenic sarcoma are suspect for dedifferentiation. The term "dedifferentiation" was first used by Dahlin and Beabout in 1971 to refer to low-grade chondrosarcomas that had transformed to high-grade sarcomas [9]. Since then, this process has been well accepted in the pathology literature. It is known to occur not only in low-grade malignant skeletal neoplasms, which include low-grade chondrosarcomas, parosteal osteosarcomas, well-differentiated intramedullary low-grade osteosarcomas and chordomas, but also in non-skeletal tumors such as lymphomas, lipoma-like liposarcomas, and mixed tumors of the parotid.

Three views on the process of dedifferentiation have been summarized by Mirra [10]. The first is that of progressive malignant transformation of a low-grade tumor with loss of histologic differentiation, increased mitotic rate, an increased growth rate, and rapid metastatic spread. The second view is that of a "collision tumor". This theory presumes a coincidental "collision" of two unrelated cancers at a particular site. The third view is the "modified collision tumor thesis". This theory assumes that the connective tissue in contact

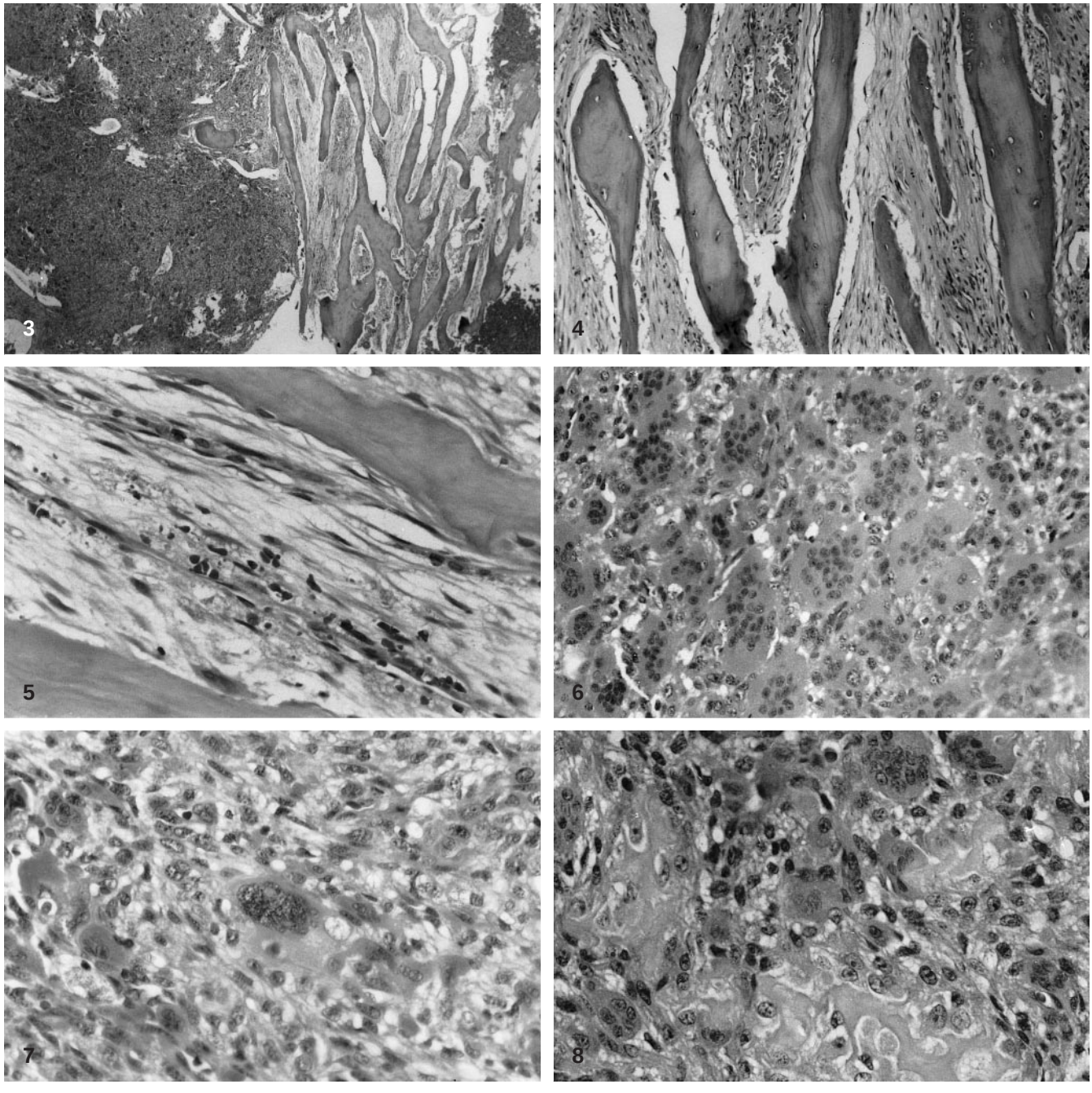


Fig. 3 Low-power view of tumor: conventional parosteal osteosarcoma to the *right* and osteoclast-rich component to the *left*

Fig. 4 Parallel streamers of woven bone with fibroblastic stroma

Fig. 5 High-power view of the parosteal osteosarcoma showing minimal nuclear atypia of the spindle cell stroma

Fig. 6 Numerous osteoclast-like giant cells with stromal cells in the background resembling a giant cell tumor

Fig. 7 High-power view showing atypical giant cell (*center*)

Fig. 8 Focal osteoid deposition within osteoclast-rich sarcomatous component

with a malignant tumor undergoes malignant transformation.

Dedifferentiation in sarcomas more commonly occurs when the tumor recurs. The recurrent tumor may consist entirely of high-grade sarcoma or may include components of both high-grade as well as the initial low-grade sarcoma. Less commonly, however, as in our case, the tumor at initial presentation shows the co-existence of both the low-grade and high-grade sarcomas. The assumption in this situation is that the low-grade tumor (in our case the parosteal os-

teosarcoma) had been present for a period of time during which dedifferentiation occurred (in our case to a high-grade osteoclast-rich osteosarcoma). This transformation of parosteal osteosarcoma to a high-grade sarcoma carries with it a significantly worse prognosis. Studies have shown that patients with dedifferentiated parosteal osteosarcoma had a prognosis similar to that of patients with conventional osteosarcoma [1, 8].

Osteoclast-rich osteosarcoma in itself is a rare form of osteosarcoma. Its incidence is difficult to determine from the literature. The figures range from 0.3 to 13% [11–13]. Only 5 of 1648 osteosarcomas (0.3%) in the Mayo Clinic series were considered to be rich in giant cells. Troup, on the other hand, found 13% of all osteosarcomas showed moderate to large numbers of benign osteoclast-like giant cells. This variation in the incidence is probably due to a lack of precise definition for this type of tumor. There is no uniform agreement on the quantity of giant cells necessary before such a designation is rendered. Many osteosarcomas contain osteoclast-like giant cells, which occasionally form clusters, in an otherwise usual type of osteosarcoma. The term osteoclast-rich osteosarcoma is, however, reserved for those osteosarcomas that contain an abundance of osteoclast-like giant cells distributed throughout the tumor. Differentiating this type of osteosarcoma from a giant cell tumor may be problematic. This distinction is particularly difficult when the stromal cells in the background show a slight degree of anaplasia. Fortunately, the vast majority of osteosarcomas are metaphyseal or metadiaphyseal in location, whereas most giant cell tumors occur in the epiphysis. Furthermore, the peak age of incidence for osteosarcomas is the second decade, while that for giant cell tumors is the third decade. Nevertheless, when one is confronted with a difficult case, demonstration of anaplasia of the stromal cells associated with tumor osteoid are the most helpful findings supporting a diagnosis of osteosarcoma [14].

Our case is quite unique in that it showed features of a low-grade parosteal osteosarcoma as well as a high-grade osteoclast-rich osteogenic sarcoma in the biopsy at the time of presentation. Since the tumor continued to grow from the time of initial biopsy, we presume overgrowth of the high-grade sarcoma destroyed the component of low-grade tumor. This would explain the absence of the parosteal osteosarcoma at the time of amputation.

We are aware of three somewhat comparable cases in the literature; however, none are quite similar to this case. Dahlin and Unni [15] briefly refer to a case of classic low-grade parosteal osteosarcoma which recurred as a malignant sarcoma with an abundance of osteoclast-like giant cells. Mirra [3] described a case of an elderly woman with a grade IV sarcoma containing numerous benign osteoclast giant cells adjacent to a grade I-II parosteal osteosarcoma. Forty-one years earlier, a low-grade parosteal osteosarcoma had been removed from the same site and showed foci of osteoclast-like giant cells surrounding hemorrhagic zones. Sciot et al. [16] reported a case of a 26-year-old man with a parosteal osteosarcoma of the posterior distal femur. The microscopic appearance was dominated by large numbers of osteoclast-like giant cells with bone trabeculae and ill-defined islands of osteoid and woven bone surrounded by fibrous stroma. A high-grade sarcoma, however, was not present. Our case of a parosteal osteosarcoma of the distal femur, which at the time of presentation showed dedifferentiation to a high-grade osteoclast-rich osteosarcoma, is a rare pattern of dedifferentiation and, to the best of our knowledge, this occurrence has not been reported previously in the literature.

Acknowledgement The authors thank Jennifer Hines for preparation of the manuscript.

References

1. Unni KK, Dahlin DC, Beabout JW, Ivins JC. Parosteal osteogenic sarcoma. Cancer 1976; 37:2466–2475.
2. Ahuja SC, Villacin AB, Smith J, et al. Juxtacortical (parosteal) osteogenic sarcoma: histological grading and prognosis. J Bone Joint Surg Am 1977; 59:632–647.
3. Mirra JM. Parosteal osteosarcoma. In: Mirra JM (ed) Bone tumors. Clinical, radiologic and pathologic correlations. Washington, DC: Lea and Febiger, 1989:1688–1721.
4. Unni KK. Parosteal osteosarcoma (juxtacortical osteosarcoma). In: Dahlin DC (ed) Dahlin's bone tumors. Philadelphia: Lippincott-Raven, 1996:185–196.
5. Okada K, Frassica FJ, Sim FH, et al. Parosteal osteosarcoma: a clinicopathological study. J Bone Joint Surg Am 1994; 76:366–378.
6. Fechner RE, Mills SE. Osseous lesions. In: Rosai J, Sobin L (eds) Atlas of tumor pathology: tumors of the bones and joints. Washington DC: Armed Forces Institute of Pathology, 1993:25–77.
7. Campanacci M, Picci P, Gherlinzoni F, et al. Parosteal osteosarcoma. J Bone Joint Surg Br 1984; 66:313–321.
8. Wold LE, Unni KK, Beabout JW, Sim FH, Dahlin DC. Dedifferentiated parosteal osteosarcoma. J Bone Joint Surg Am 1984; 66:53–59.
9. Dahlin DC, Beabout JW. Dedifferentiation of low grade chondrosarcoma. Cancer 1971; 28:461–466.
10. Mirra JM. Bone tumor terminology. In: Mirra JM (ed) Bone tumors. Clinical, radiologic and pathologic correlations.Washington DC: Lea and Febiger, 1989:105–120.
11. Bathurst N, Sanerkin N, Watt I. Osteoclast-rich osteosarcoma. Br J Radiol 1986; 59:667–673.
12. Troup JB, Dahlin DC, Coventry MB. The significance of giant cells in osteogenic sarcoma: do they indicate a relationship between osteogenic sarcoma and giant cell tumor of bone. Mayo Clin Proc 1960; 35:179–186.
13. Unni KK. Osteosarcoma. In: Dahlin DC (ed) Dahlin's bone tumors. Philadelphia: Lippincott-Raven; 1996:143–183.
14. Mirra JM. Giant cell tumors. In: Mirra JM (ed) Bone tumors. Clinical, radiologic and pathologic correlations. Washington, DC: Lea and Febiger, 1989:942–1020.
15. Dahlin DC, Unni KK. Malignancy in giant cell tumours of bone. In: Bone tumors. Springfield, Illinois: Charles C. Thomas, 1986:337–345.
16. Sciot R, Samson I, Dal Cin P, Lateur L, Van Damme B, Van Den Berghe H, Desmet V. Giant cell rich parosteal osteosarcoma. Histopathology 1995; 27:51–55.