Malignant giant-cell tumours of bone

Clinico-pathological types and prognosis: a review of 29 cases

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Summary. Twenty-nine patients with malignant giant-cell tumours of bone (GCT) were followed-up for between 6 months and 18 years. Seventeen of the tumours were primary and 12 were due to malignant degeneration of initially benign lesions. The clinical features did not differ from those of benign GCT, except for a higher incidence in the distal tibia and sacrum. Anaplastic GCTs were included in the study because their clinical and radiographic features and prognosis were no different from those of the GCT grade III of Jaffe. Eighteen of the tumours were grade III, and 11 were anaplastic. This retrospective study was intended to assess the effects of chemotherapy and surgery for malignant GCT. Three treatment groups were selected, in which treatment was either by surgery alone, surgery plus chemotherapy, or radiotherapy alone. – The prognosis was poor and the 5 year tumour-free survival rate in the series was 50%. The prognosis was the same for primary as for secondarily malignant tumours. There was no statistical difference in survival between malignant grade III and anaplastic malignant tumours. The one-year survival rate for patients treated by chemotherapy and surgery was statistically higher (χ^2 test) than for persons treated by surgery alone. However, the five-year survival rate and the actuarial survival curves were not statistically different in the two groups (log rank test). – Chemotherapy appears to be of

some value in the treatment of these malignant tumours but a larger series is required to confirm the efficacy of this approach.

Résumé. Les auteurs rapportent vingt-neuf cas de tumeurs à cellules géantes (TCG) malignes dont le suivi s'étalait de 6 mois à 18 ans. Dix-sept étaient malignes d'emblée et douze le sont devenues lors de la récurrence d'une TCG initialement bénigne. La clinique de ces tumeurs diffère peu de celle des TCG bénignes, hormis la plus grande fréquence des localisations du tibia distal et du sacrum. Nous avons inclus dans cet étude les TCG dédifférenciées car leur aspect clinique, radiographique et leur pronostic est similaire aux TCG grade III, nous avons dix-huit TCG grade III et douze TCG dédifférenciées. Le but de cet travail était de tenter de mettre en évidence l'intérêt de la chimiothérapie dans le traitement de ces tumeurs malignes, pour cela trois groupes de patients ont été étudiés en fonction de leur traitement: chirurgie seule, chirurgie et chimiothérapie, et radiothérapie seule. Le pronostic de ces tumeurs est mauvais avec un taux de survie à 5 ans qui est de 50% dans notre série. Nous n'avons pas mis en évidence de différence statistiquement significative entre les TCG d'emblée malignes et celles devenues malignes secondairement, il n'y a pas non plus de différence de survie entre les TCG grade III et les TCG dédifférenciées. Dans le groupe des patients traités par chirurgie et chimiothérapie, le taux de survie à un an est supérieur à celui des autres groupes (test du χ^2), par contre la comparaison des courbes de survie (par le test du Log Rank) et de la survie à cinq ans (test du χ^2) ne met pas en évidence de différence significative entre les

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Fig. 1 Survival curves with and without chemotherapy of 29 malignant giant-cell tumours □ Malignant GCT treated by surgery alone, ■ Malignant GCT treated by surgery and chemotherapy

groupes traités avec et sans chimiothérapie. La chimiothérapie néo-adjuvante semble avoir un intérêt dans le traitement de ces tumeurs malignes. L'efficacité de ce traitement devra cependant être confirmée par une étude sur une plus grande série de patients.

Introduction

In defining the malignancy of a GCT, we endorse the criteria proposed by Hutter et al [1] and Dahlin et al. [2]: a primarily malignant GCT is a malignant tumour of bone in which sarcomatous tissue is juxtaposed with zones of typical benign giant-cell tissue, and a secondarily malignant GCT is a sarcomatous lesion occurring at the site of a previously documented benign GCT. If the sarcomatous component is a fibrosarcoma, osteosarcoma or MHF, the lesion is regarded as a dedifferentiated (anaplastic) GCT.

Material and methods

This retrospective study is based on a review of the case records and radiographs of 29 patients with malignant GCTs seen between 1954 and 1993 at the Hôpital Cochin, Paris (Table 1). Seventeen of the tumours were malignant from the outset and 12 were secondarily malignant lesions. Of the latter, 3 developed after irradiation. These 29 tumours represented 15% of all examples of GCT seen during the relevant period. All the slides were examined by a pathologist specialising in bone tumours. Other malignant tumours which happened to include some giant-cells were excluded from the series. The effects of the different forms of treatment were assessed by comparing the one and five-year survival rates (χ^2 test), by the Kaplan Meier survivorship analysis, and by the actuarial survival curves (log rank test) in different treatment groups (Fig. 1).

Results

Clinical features

The series comprised 14 males and 15 females, aged 23 to 78 years. The highest incidence (9 patients) was in the third decade. The commonest presenting feature in the primarily malignant cases was pain (unilateral sciatica in one instance) or pain and swelling. In the secondary cases, pain alone was the commonest symptom while the lesion was still benign; once malignancy developed, half the patients had pain and/or swelling and in the others the lesion was asymptomatic and discovered incidentally at check radiography.

Anatomical localisation

For the primarily malignant tumours, the knee region was the commonest site, with six in the distal femur and six in the proximal tibia. Of the remaining primary tumours, two were in the sacrum, one in the distal end of the radius, one in the 5th lumbar vertebra and one at the proximal end of the femur.

Of the secondary tumours, four occurred at the lower end of the femur and one in the proximal tibia. Three developed in the distal end of the tibia, two at the proximal humerus, one in the ilium and one, unusually, in the medial cuneiform bone of the foot.

Radiographic findings

Of the 17 primarily malignant tumours, their benign or malignant nature could not be discerned by radiography in five, as the appearances resembled those of a benign GCT (Fig. 2). In the other 12, the diagnosis of malignancy was suggested by marked cortical lysis and invasion of the soft tissues; in one patient a Codman's reactive triangle was observed and another had a "moth-eaten" appearance at the upper end of the tibia.

In the 12 secondarily malignant tumours, the radiographic features were typical of a benign lesion before degeneration occurred. Once malignancy developed, in two patients the image was that of an ordinary benign recurrent lesion, while in nine there was cortical lysis, with cortical perforation and major soft-tissue invasion. Three of these had a "grass-fire" extra-osseous spread which was suggestive of malignancy (Fig. 3). In five, the appearances resembled those of a benign GCT.

Although CT and MRI investigations were undertaken in the more recent cases, and were useful in detecting soft tissue spread, these studies pro-

Fig. 2 Malignant GCT of distal tibia. The appearance resembles that of a benign GCT

Fig. 3 Malignant GCT with a "grass-fire" extra-osseous spread which is suggestive of malignancy

vided no convincing evidence of malignant degeneration.

Pathology and histology

All 17 primarily malignant tumours satisfied the criteria of Jaffe et al. [3] and Dahlin et al. [2], having histological evidence of a giant-cell lesion plus areas of sarcomatous stroma. In 11 patients this sarcomatous zone was well-defined, corresponding to Jaffe's grade III. The other six had anaplastic malignant giant-cell tumours; in five of these the malignant stroma was a well-differentiated fibrosarcoma and in one it resembled a malignant osteosarcoma of Broders' grade III or IV.

In the 12 secondary cases, the histological features of the original lesions were typical of a benign tumour. After malignant degeneration, seven were grade III. In five patients there was a dedifferentiated GCT, and in these, areas of GCT grades I or II were juxtaposed with sarcomatous regions which could be categorised as osteosarcoma grade IV in four and fibrosarcoma in one. In one spinal metastasis and one pulmonary metastasis, the histological appearance was that of the primary tumour.

In summary, all the 17 malignant tumours were grade III of Jaffe and 11 were dedifferentiated (anaplastic).

Treatment and results (Table 1)

Primarily malignant tumours. Eight patients were treated by surgery alone. Of these, four had been treated by curettage elsewhere. Three tumours recurred: one patient had radiotherapy and died of pulmonary metastases after 11 months, one had a mid-thigh amputation and was still alive at 10-year follow-up, and the third had an amputation following an infected resection and died from pulmonary metastases after 20 months. The fourth patient had no recurrence, but when malignancy was diagnosed by histological study of the curettage specimen he underwent an immediate wide resection of the lower femur and was alive without disease after seven years.

One patient had an incomplete resection at the lower end of the femur. The tumour recurred after six months, necessitating of the disarticulation hip-joint; he died of pulmonary metastasis after 30 months.

Two patients underwent a thigh amputation for enormous tumours of the upper end of the tibia after the diagnosis had been confirmed by a small open biopsy. One was still alive after six months; in the other marginal resection for local recurrence at six months was followed by death due to pulmonary metastasis a month later.

One patient had a tumour of the 5th lumbar vertebra, which caused paraplegia and was treated by incomplete resection after radiotherapy. This person had neurological improvement and was alive without local recurrence or metastasis at 5-year follow-up.

In summary, 50% of the eight patients treated only by surgery died of their disease.

Seven patients had combined surgery and chemotherapy. Of these one with a lesion in a femoral condyle, was initially treated by curettage and packing with an allograft. The diagnosis of malignancy was made histologically; he was treated with chemotherapy and radiotherapy prior to wide resection and a Juvara-type arthrodesis. He was still alive after 14 years.

Four other patients had a resection after diagnosis of malignancy by open biopsy. Two of them with a knee lesion (femoral condyle and upper end of the tibia) had preoperative chemotherapy followed by resection and reconstruction with a massive Guepar prosthesis. The tumour proved to be completely necrotic in both instances. The first patient, despite postoperative chemotherapy, died with pulmonary metastases after 66 months while the second was alive without recurrence at 5-year follow-up. Another two patients were treated by

Table 1. Details of the 29 cases of malignant GCT of bone

Case	Sex Age	Location	Histology	Surgical treatment	Chemo- therapy	Local recurrence (months)	Metastasis (months)	Duration of follow-up (months)
Cab.	F 39	Proximal femur	Primary GCT III	Curettage	No	No	10 Lung	12 Died
Lem	F 51	Distal femur	Primary GCT III	Curettage	No	12 thigh amputation	No	120
Kar	M 39	Proximal tibia	Primary GCT III	Thigh amputation	No	3 marginal resection	6 Lung	6 Died
Pro	M 55	Distal femur	Primary GCT III	Radiotherapy 60 GY and thigh amputation	Before and after surgery (75)	No	14 Bone	14 Died
Mand	F 20	Sacrum	Primary GCT III	Radiotherapy 60 Gy	No	No	5 Lung	5 Died
Vid	M 61	Distal femur	Primary GCT III	Curettage and resection	No	No	No	84
Cha	M 31	L5	Primary GCT III	Radiotherapy & inadequate resection	No	No	No	30
Gue	F 44	Sacrum	Primary GCT III	Radiotherapy	No	81	96 Lung	102 Died
Four	M 24	Proximal tibia	Primary GCT III	Curettage resection & thigh amputation	No	No	12 Lung	20 Died
Bon	F 58	Proximal tibia	Primary GCT III (Total necrosis)	Wide resection	Before and after surgery (88)	No	11 Bone	66 Died
Cou	F 30	Distal radius	Primary GCT III	Resection	After surgery	No	No	120
Boi	F 37	Distal femur	Primary malignant GCT and fibro sarcoma	Inadequate resection	No	6 hip dis- articulation	30 Lung	32 Died
Cey	F 35	Proximal tibia	Primary malignant GCT and fibro sarcoma	Resection	After surgery	No	0 Lung	48 Died
Bouz	F 40	Proximal tibia	Primary malignant GCT and fibro sarcoma	Thigh amputation	No	No	No	6
Gasc	M 20	Distal femur	Primary malignant GCT and osteosarcoma (total necrosis)	Curettage and wide resection	Before and after surgery (82)	No	No	168
Pel	F 23	Proximal tibia	Primary malignant GCT and fibro sarcoma	Resection	Before and after surgery (88)	No	No	60
Leig	F 49	Distal femur	Primary malignant GCT and fibro sarcoma	Thigh amputation	For lung metastasis	No	48 Lung	48 Died
Ford	M 26	First cuneiform	Secondarily GCT III	Resection	After surgery (89)	No	No	59
Val	M 34	Distal femur	Secondarily GCT III	Hip disarticulation	No	No	No	131
Par	M 28	Distal tibia	Secondarily GCT III	Resection	No	No	No	216
Gro	M 38	Distal tibia	Secondarily GCT III	Radiotherapy and leg amputation	After surgery	No	No	48
Bach	M 28	Proximal humerus	Secondarily malignant GCT III	Resection	No	No	No	120
Dol	M 70	Distal femur	Secondarily malignant GCT with osteosarcoma	Curettage	No	3 Radio- therapy	?	6 Died
Rob	M 30	Proximal humerus	Secondarily malignant GCT and osteosarcoma	Forequarter amputation	Before and after surgery	No	1	20 Died
Oud	F 28	Distal tibia	Secondarily malignant GCT and osteosarcoma	Curettage and amputation	No	No	No	108
Bre	F 23	Distal femur	Secondary malignant GCT and fibrosarcoma	Radiotherapy and resection	For lung metastasis	No	4 Lung	96 Died
Cya	F 60	Proximal end of the tibia	Secondarily GCT III after radio therapy	Resection	No	No	No	96 Died
Peis	F 20	Distal femur	Secondarily GCT III after radio therapy	Thigh amputation	No	No	No	96
Rouy	M 36	Pelvis	Secondarily malignant GCT with osteosarcoma after radiotherapy	Hemipelvectomy	No	3	3	6 Died

resection and reconstruction of the upper tibia and distal radius, respectively. The first died after 48 months with pulmonary metastases and the second was still alive after 10 years.

The remaining two patients had a thigh amputation. One had a large tumour of the lower end of the femur and was given chemotherapy after discovery of bone metastases; death followed at 48 months. The other had a pathological fracture of the lower end of the femur, due to a malignant GCT which was initially treated by radiotherapy and chemotherapy. He died of pulmonary metastases at 14 months.

In summary, of these 7 patients treated by surgery and chemotherapy, 4 died from their malignancy.

Two patients were treated by radiotherapy alone. Both had large, inoperable tumours of the sacrum and died after 5 months and after 8.5 years.

Secondarily malignant tumours [9]. Five patients were treated by surgery alone. Whenever the tumour was initially benign, curettage and packing were undertaken. Malignancy was found at the first recurrence in four patients and at the second recurrence in two; in each instance, it was detected by biopsy. Two patients had an amputation and were alive without recurrence after 9 and 11 years respectively. Two patients had wide resections (one of the upper end of the humerus and the other of the distal femur); the first was alive after 11 years and the second had a recurrence which was irradiated but death occurred six months later due to pulmonary metastases. One patient underwent a repeat curettage and bone-grafting for a second benign recurrence; when a malignancy developed, a resection-arthrodesis of the lower end of the tibia resulted in an apparent cure at follow-up after 18 years. The fifth patient, had a benign GCT of the femoral condyle which was treated by curettage. Thereafter a benign recurrence necessitated a block-resection of the knee-joint. A second, malignant recurrence was managed by palliative radiotherapy but the patient died after six months with pulmonary metastases. In summary, of these five patients with secondarily malignant GCTs treated by surgery alone, only one died, of pulmonary metastases.

Four of the nine patients with secondary malignancy treated by chemotherapy plus surgery had curettage for an initially benign tumour. In two instances, malignant changes were apparent at the first recurrence. One patient had radiotherapy followed by resection of the lower end of the femur, with reconstruction using a massive Guepar pros-

thesis, and was then treated by chemotherapy. He developed pulmonary metastases at six months, again treated by chemotherapy, and was still alive after eight years, with stabilised pulmonary metastases. The other patient received chemotherapy before forequarter amputation for an enormous tumour of the upper end of the humerus which was invading the entire shoulder region and vessels (Fig. 3); he died with pulmonary metastases after 20 months.

In two patients, the malignant changes occurred at the third recurrence. At the first (benign) recurrence, one had a resection-arthrodesis of the lower end of the tibia; at the third (malignant) recurrence, he had chemotherapy and radiotherapy, followed by amputation of the leg; he was still alive after 7 years. The other patient had a tumour of the first tarsal cuneiform bone. A second (benign) recurrence had been treated by curettage and packing. The third (malignant) recurrence was treated by wide resection of the cuneiform and first metatarsal bones and arthrodesis, followed by chemotherapy; he was well and tumour-free after five years. In summary, of the four patients treated by surgery and chemotherapy, one died of the malignancy and one developed pulmonary metastasis.

Patients with a malignant GCT presenting after radiotherapy [3]. A patient had been irradiated for a benign GCT seven years before admission for local recurrence. Biopsy revealed a benign lesion and wide resection was performed, but histological study of the resection specimen demonstrated areas of malignancy. As the resection margins were outside the area which was involved, no further treatment was given. The patient was alive and well after eight years. Two patients had been initially treated by radiotherapy, two and 12 years previously, for benign GCT of distal femur and ilium. They returned with malignant recurrence and underwent a thigh amputation and a hind-quarter amputation, respectively. The first patient was well after eight years but the second died with pulmonary metastasis after six months. In summary, of the three patients developing malignancy after initial radiotherapy, one died from the tumour.

Discussion

Histological findings

Malignant GCTs represented 15% of all cases of GCT seen in the Department during the period of

the survey. This high incidence is due to the fact that tumours referred to the Department were usually those posing surgical problems or with malignancy. The incidence quoted in the literature is as follows: 1.5%, Goldenberg et al. [4]; 7%, Rock et al. [5]; 7%, Sung et al. [6], 7.6%, Campanacci et al. [7]; 8.7%, Dahlin et al. [2]; 9%, Sanerkin [8]; 1.0%, Mnaymneh et al. [9]; 11.3%, Larsson et al. [10]; 13%, Windeyer and Woodyatt [11]; 15%, Murphy et al. [12]; and 30%, Hutter et al. [1].

Like Campanacci et al. [13], we included two types of malignant GCT namely lesions of Jaffe's grade III and dedifferentiated GCTs. Dedifferentiation is indicative of tumoural progression, and this appearance is also found in other tumour types such as periosteal sarcomas and chondrosarcomas. Rock et al. [5] and Dahlin et al. [2] also included these dedifferentiated tumours in their series. In Campanacci's studies [7], the prevalent anaplastic component was malignant histiocytifibroma in 10 cases (8 after radiotherapy). Rock et al. [5] made similar observations. In our series, the predominant type of anaplastic tumour was fibrosarcoma or osteosarcoma.

Nascimento et al. [14] found that grade III primarily malignant giant-cell tumours of bone had a better prognosis (5-year survival rate of 50%) than other malignant giant-cell tumours of the skeleton. According to these authors, only GCTs which were malignant from the outset should be regarded as true malignant GCTs, while secondarily malignant lesions should be classified according to the histological appearances of their dedifferentiated component. In our view, however, these dedifferentiated tumours have no distinctive clinical, radiological pathological or prognostic features and need not be singled out for different management.

We distinguish between giant-cell tumours of bone that are malignant from the outset and those that have become so secondarily. McGrath [15] added a third group, namely evolutionary tumours that become malignant after a latent period, following treatment of an initially benign lesion. We find this distinction misleading, because it is applied to primarily malignant tumours that were originally misdiagnosed as being benign. In our series, malignant transformation was discovered at recurrence in nine patients who had not undergone radiotherapy. It is significant that there were no clinical, radiographic or histological features which were of predictive value for malignant transformation, nor are any recognised in the literature.

In our series, malignant degeneration of benign GCTs occurred after a mean interval of 31 months (range 6 to 84 months). In the experience of Hutter et al. [1], recurrence after 5 years from the first treatment was very suggestive of malignant transformation.

Malignant transformation may occur after radiotherapy. This risk has been assessed as 7% by Goldenberg et al. [4], 12% by Mnaymneh et al. [9], 15% by Sanerkin [8], 19% by Dahlin et al. and 33% by McGrath and Pymble [15]. In our series, 3 malignant GCTs occurred after radiotherapy, forming 10% of the total of malignant lesions. This number is considerably fewer than the 70% reported by Hutter et al. [1], 80% of Boriani et al. [16] (after 3000 rads of radiotherapy), 80% of Campanacci et al. [13] and 95% of Rock et al. [5]. Campanacci considers that there is a risk of transformation above a radiotherapeutic dose of 40 Gy [7]. The lesser incidence in our series may be because radiotherapy had not been used in our department for a long period. Hutter et al. [1] noted an increase of dedifferentiated forms after radiotherapy, but we found only one such malignancy in the three tumours which occurred after radiotherapy in our series. In our opinion, radiotherapy remains only a palliative treatment for inoperable tumours.

Clinical features

The mean age of the patients in our series was the same as that of those with ordinary benign tumours. Nascimento et al. [14] reported a mean age of 60 years and Hutter et al. [1] a lower average age. We did not find the female predominance which had been reported elsewhere.

The anatomical localisation, as in other studies, was similar to that of benign giant-cell tumours of bone. There was a higher incidence in the distal tibia and sacrum, however, and unusual localisations in the first tarsal cuneiform bone and the 5th lumbar vertebra (1 instance each). Larsson et al. [10] found a higher incidence of distal femoral lesions and several authors [2, 4, 9, 17] noted that sacral lesions had a poor prognosis.

Radiological features

As reported by other workers, in about 33% of malignancies the radiographical appearances resembled those of benign tumours: hence the importance of preoperative biopsy or immediate examination of the resection specimen in the management of any type of GCT. Nascimento et al. [14] found no periosteal changes and only two out

of eight patients had radiographic features which were suggestive of malignancy. The periosteal reaction which was evident in some of our patients was associated with the anaplastic component of the tumour, as in osteosarcoma.

Treatment

Surgery. Five malignant GCTs of benign radiological appearance were initially treated by curettage and packing. Of these, 4 recurred; the survival rate was probably lower in this group, although this was not confirmed statistically. This fact highlights the importance of biopsy or study of the operation specimen. No statistical difference was found between patients treated by wide resection or by amputation, if the former was impossible [5, 13, 16, 18]. Even though the indications were different, amputation was usually reserved for large tumours with considerable soft tissue involvement. Nascimento et al. [14] proposed curettage with cryosurgery of the cavity for primarily malignant lesions of Grade III. This approach appears to be inadequate since such treatment, even for benign lesions, was followed by recurrence in 30% of cases; this is an unacceptable rate for malignant tumours.

Of our 16 patients treated by surgery alone, 11 were still alive after one year while one was lost to follow-up. Eight were still alive at 5-year follow-up and one did not attend the clinic.

Chemotherapy. The chemotherapy agents used were very varied and the treatment protocols were very different. Several patients had been treated before 1980, a period when the protocols were not the same as today. Some patients received chemotherapy before and after operation, others only postoperatively; in one instance, the chemotherapy was commenced for the treatment of pulmonary metastases. The global value of chemotherapy can be assessed by distinguishing between those persons who received chemotherapy and those who did not. Our 28 patients had a follow-up of one year (one patient was lost to follow-up at 6 months) and 26 had a follow-up of 5 years.

Eleven patients were treated by combined chemotherapy and surgery. All were alive at one-year follow-up, one was lost sight of, and five were still alive after five years. The one-year survival rate was statistically better (χ^2 test) for these persons than in patients treated by surgery alone. The five-year survival rates and the actuarial survival curves (log rank test), however, were not statistically different in the two groups. Nevertheless, if we

exclude patients with metastases at first presentation and individuals treated by chemotherapy before 1986, the survival rate was higher than in persons treated by surgery alone, although this was not significant. It must be emphasised that the chemotherapy protocol was not uniform. Indeed, of the patients treated in this way, some were given chemotherapy because they had metastases at the outset, while others were treated before metastases appeared.

More recently, operated patients have been given preliminary chemotherapy based on the protocol used for osteosarcoma. In 3 out of 4 such instances, the resection specimen showed near-total necrosis. Few authors have reported the use of adjuvant chemotherapy for malignant GCT; Rock et al. [5] employed this technique only as a salvage procedure after inadequate surgery, but without obvious benefit. Nascimento et al. [14] did not treat any of their patients with chemotherapy. Gitelis et al. [18] favoured adjuvant treatment but did not report their results. Adjuvant chemotherapy has also been used for pulmonary metastases from benign lesions and is considered to be of possible value by Bertoni et al. [19]; Maloney et al. [20] could not confirm this observation.

To sum up, although the effectiveness of chemotherapy has not been fully assessed for these tumours, undoubted successes in osteosarcomas and the positive results in some of our own patients justify the use of adjuvant chemotherapy in persons under the age of 60 years although the results require confirmation by a larger, more uniform series.

Radiotherapy. Radiotherapy alone should be restricted to tumours in surgically inaccessible sites. Death occurred in both patients in our series treated by irradiation alone.

Prognosis

The prognosis of malignant giant-cell tumours of bone is generally poor; 50% of the patients in our series were dead at 5 years and there were no differences in survival rates between primary and secondarily malignant GCTs. Equally, there was no difference in survival between malignant lesions of grade III and dedifferentiated malignant lesions. Nascimento et al. [14] identified a type of primary malignant tumour of grade III with a better prognosis (50% five-year survival). Our 5-year survival rate of 50% was higher than those reported in other series, in which the aggressiveness of this tumour was confirmed: 0% for Goldenberg et al. [4],

Larsson et al. [10] and Mnyaymneh et al. [9]; 12.5% for Sanerkin [8]; 10% for Boriani et al. [16] and Campanacci et al. [7]; 25% for McGrath [15]; 26% for Dahlin et al. [2]; 30% for Hutter et al. [1] and 32% for Rock et al. [5].

In our series tumours that became malignant after radiotherapy did not have a worse prognosis than other malignant GCTs.

Conclusion

Malignant giant-cell tumours of bone comprise two entities: GCT grade III and dedifferentiated lesions. No useful purpose is served by separating these tumours, since their clinical, radiological and prognostic features are identical.

The prognosis is poor and the 5-year survival rate varies between 0 and 50%. To improve this prognosis, these tumours should be treated like sarcomas. Neo-adjuvant chemotherapy is already of proven value in osteosarcoma and it is suggested that patients with a malignant GCT should be treated by chemotherapy before and after operation. A larger and more uniform series is required to confirm the efficacy of this treatment.

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