THE SURGICAL TREATMENT AND OUTCOME OF PATHOLOGICAL FRACTURES IN LOCALISED OSTEOSARCOMA

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We reviewed the surgical treatment and oncological results of 40 patients with pathological fractures from localised osteosarcoma of the long bones to determine the outcome of limb salvage in their management. All had had adjuvant chemotherapy. There were 26 males and 14 females with a median age at diagnosis of 18 years (2 to 46) and a median follow-up of 55 months (8 to 175).

We performed limb salvage in 27 patients and amputation in 13. The margins of resection were radical in five patients, wide in 26, marginal in six, wide but contaminated in two and intralesional in one. Local recurrence developed in 19% of those treated by limb salvage and in none of those who had an amputation. The cumulative five-year survival of all the patients was 57% and in those treated by limb salvage or amputation it was 64% and 47%, respectively (p > 0.05).

Limb-sparing surgery with adequate margins of excision can be achieved in many patients with pathological fractures from primary osteosarcoma without compromising survival, but the risk of local recurrence is significant.

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OSTEOSARCOMA is the most common primary malignant tumour of bone in children and young adults (Glass and Fraumeni 1970), with between 130 and 150 new cases seen in the UK every year (Price and Jeffree 1973). In high-grade primary malignant bone tumours, fractures occur either spontaneously or after minimal trauma because of the high cellularity, poor differentiation and loss of matrix (Enneking 1983). Stress or mechanical weakness caused by diagnostic biopsy and necrosis of the tumour after chemotherapy may contribute to the development of fractures (Clark et al 1977). The incidence of pathological fractures either at diagnosis or during preoperative treatment is between 5% and 10% (Jaffe et al 1987; Mulder et al 1993). The telangiectatic variant of osteosarcoma, which is highly vascular and largely osteolytic, is particularly prone to pathological fractures. In 1982 Huvos et al reported such fractures in 29% of 124 telangiectatic osteosarcomas.

A fracture through a primary bone tumour results in a haematoma which may spread and contaminate the adjacent soft tissue, the neurovascular bundle and an adjacent joint. Hence, amputation has been the most common surgical treatment (Jaffe et al 1987). Damage to the microcirculation may encourage distant haematogenous dissemination of the tumour. Prompt recognition of the underlying pathology is important in such fractures in order to avoid open reduction and internal fixation or intramedullary nailing, which will lead to further dissemination of the tumour and impair the definitive treatment.

The advent of effective neoadjuvant chemotherapy has resulted in improved overall survival in patients with osteosarcoma (Link et al 1991) and the development of modern techniques of limb preservation have led to a reassessment of the surgical treatment of these fractures. Preoperative chemotherapy results in shrinkage of the tumour and, occasionally, union of the fracture will occur (Jaffe et al 1987; Dubousset, Missenard and Kalifa 1991; Thompson, Pritchard and Nelson 1992), but the influence of the fracture on the prognosis of patients with osteosarcoma remains uncertain (McKenna et al 1966; O'Hara et al 1968). After a course of preoperative chemotherapy we have used limb salvage or amputation to treat these patients. We have studied the outcome in patients treated at our centre between 1975 and 1994 to evaluate the influence of the fractures on the survival and preservation of the limb.
PATIENTS AND METHODS

Between 1975 and 1994, a total of 499 patients with conventional osteosarcoma without metastases at the time of diagnosis was treated at the Royal Orthopaedic Hospital Oncology Service. Of these, 41 (8%) presented with fractures or sustained fractures during the course of preoperative treatment. The clinical and radiological records of all the patients with fractures were reviewed. All had full staging studies with routine haematological and biochemical investigations, whole-body bone scintigraphy, CT of the chest and the local tumour, and, more recently, MRI. Clinical and radiological evidence of a fracture had been seen either at diagnosis or during the course of preoperative treatment. Tissue diagnoses were obtained in all the cases.

Before operation the fractures were immobilised in plaster casts or by skin traction. All the patients were offered preoperative chemotherapy consisting of adriamycin and cisplatinum or adriamycin, cisplatinum and methotrexate according to the protocol of the European Osteosarcoma Intergroup (Bramwell et al. 1992). One patient refused chemotherapy and operation and was excluded from the study. All had stage-IIIB tumours according to the Musculoskeletal Tumour Society Staging System (Enneking 1986) and all had surgery after two to four cycles of chemotherapy except for one who had immediate amputation because of severe pain. The decision as to the operation to be undertaken to control the local disease was based on the local extent of the tumour as seen on the imaging scans, the response to preoperative chemotherapy and patient preference. Those with clinical and radiological evidence of intralesional excision of the tumour after limb salvage. Local recurrence developed in three patients with intralesional excisions but only in one of the six with marginal excisions and in one of the 18 with wide excisions. All of these were treated by amputation.

The surgical treatment was excision of the tumour and limb salvage in 27 patients (Fig. 1) with 26 prosthetic reconstructions and one excision with a bone graft. Primary amputation was carried out in 13 patients. The margins of excision were radical in five and wide in eight of those treated by amputation. Of the 27 who had limb salvage, the margins of excision were wide in 18 (66%) and marginal in 6 (22%). The capsule of the tumour had been breached in three (11%), which resulted in contaminated wide margins of excision in two and intralesional margins in one. None of those with amputations developed local recurrence whereas five of the patients who had limb salvage (19%) developed local recurrence between 11 and 16 months after operation. There was a correlation between the development of local recurrence and the margins of excision of the tumour after limb salvage. Local recurrence developed in all three patients with intralesional and wide contaminated excisions but only in one of the six with marginal excisions and in one of the 18 with wide excisions. All of these were treated by amputation.

At the time of review 16 patients (40%) were alive and free from disease, two (5%) were alive with metastatic disease, and 12 (30%) were dead from their disease. The median follow-up was 55 months (8 to 175).

Table I. Details of 40 patients with pathological fractures

<table>
<thead>
<tr>
<th>Location of fracture</th>
<th>Number (Percentage)</th>
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<tbody>
<tr>
<td>Femur</td>
<td>25 (63%)</td>
</tr>
<tr>
<td>Proximal</td>
<td>5</td>
</tr>
<tr>
<td>Middle</td>
<td>1</td>
</tr>
<tr>
<td>Distal</td>
<td>19</td>
</tr>
<tr>
<td>Humerus</td>
<td>12 (30%)</td>
</tr>
<tr>
<td>Proximal</td>
<td>10</td>
</tr>
<tr>
<td>Middle</td>
<td>1</td>
</tr>
<tr>
<td>Whole bone</td>
<td>1</td>
</tr>
<tr>
<td>Tibia</td>
<td>3 (7%)</td>
</tr>
<tr>
<td>Proximal</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time of fracture</th>
<th>Number (Percentage)</th>
</tr>
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<tbody>
<tr>
<td>At diagnosis</td>
<td>25 (62%)</td>
</tr>
<tr>
<td>During treatment</td>
<td>15 (38%)</td>
</tr>
</tbody>
</table>
disease, 19 (47%) had died from the disease and three (8%) had died from other causes without metastases more than four years after surgery. Treatment by limb salvage or amputation did not influence significantly the development of metastases, which were seen in 12 of the 27 patients with limb salvage and 9 of the 13 who had amputation (p = 0.23). The cumulative overall survival at five years in all the patients was 57% (Fig. 2) and was slightly better in those treated by limb salvage than in those who had amputation (63% v 47%, p > 0.05; Fig. 3).

There was no statistically significant difference in the outcome after limb salvage, the development of metastases and the overall survival in patients who presented with pathological fractures and those who later developed fractures during treatment (p > 0.05). Of the 25 patients who presented with fractures, 12 (48%) developed metastases, 19 (76%) had limb-salvage surgery and four of these developed local recurrence. The cumulative survival at five years of all patients in this group was 60% compared with 53% in the 15 patients who developed fractures during treatment. Nine of these 15 (60%) developed metastases and nine (60%) had limb-salvage surgery with one local recurrence.

DISCUSSION
Effective neoadjuvant chemotherapy has revolutionised the management of patients with primary osteosarcoma of the bone. Local treatment of the tumour without chemotherapy results in survival of 20% at five years (McKenna et al 1966; Sweetnam, Knowelden and Seddon 1971), but with effective chemotherapy this improves to 60% (Link et al 1991; Bramwell et al 1992; Winkler et al 1993).

The local treatment of patients with pathological fractures through a primary bone sarcoma remains controversial. Amputation has been the most common surgical...
treatment (Jaffe et al 1987) but chemotherapy results in shrinkage of the tumours with more distinct margins and, in some instances, union of the fracture. This, and the improvement in imaging techniques, has prompted some to recommend preservation of the limb as the first choice (Delépine and Goutallier 1991; Dubousset et al 1991; Krugluger et al 1993; Cara et al 1995). We offer limb salvage to all patients unless there is involvement of the important neurovascular structures or invasion of a joint by the tumour or haematoma, or where the operation would entail removal of too much muscle to allow adequate function of the limb. Amputation is carried out in these patients. Pathological fractures of the distal tibia are usually managed by below-knee amputation since the subcutaneous portion of the bone and its close proximity to vital structures make salvage difficult.

The decision to perform excision of the tumour with preservation of the limb depends on a thorough assessment of the imaging scans before and after chemotherapy. By these criteria only 15% of all patients presenting to our centre with osteosarcoma of the limbs undergo amputation (Carter, Grimer and Sneath 1991). In our series of patients with pathological fractures amputation was performed in 33%; none of them developed local recurrence. The rate of local recurrence for all the patients treated by limb salvage was 19% compared with 4.5% for all patients with osteosarcoma (Carter et al 1991), but when wide margins of excision were achieved the rates were similar to those for limb-salvage procedures in general (Simon 1988; Springfield et al 1988; Carter et al 1991).

There is debate as to whether patients with pathological fractures should have radiotherapy after limb-preserving operations, but we have avoided using this. Radiotherapy is not successful in preventing local recurrence or metastases in osteosarcoma, and changes induced by it may compromise the functional outcome and any further operation which may be required (Huvos 1991). Only one patient with overt contamination of the surgical margins had radiotherapy after operation but still developed a local recurrence.

Amputation produced a better outcome in the eradication of the local tumour than limb salvage, but the overall survival was not affected. The survival of those treated by limb salvage was slightly better than those treated by amputation but the two groups were not randomised and it is likely that tumour size may be a confounding factor in favour of the patients in the limb-salvage group. A correlation has been shown between the survival of patients with osteosarcoma and the size of the primary tumour, with larger tumours having a poorer outcome (Rehan et al 1993). We did not measure the size of the tumours because we were not convinced that we could establish this accurately on the imaging scans in the presence of significant haematoma and oedema related to the fractures.

The similarity of survival in patients with osteosarcoma treated by amputation or limb salvage has been noted by others (Simon et al 1986; Shin, Rougraff and Simon 1994). The overall survival of all patients with localised osteosarcoma is about 60% at five years (Link et al 1991; Bramwell et al 1992; Winkler et al 1993). We are not aware of any accounts which differentiate between those with or without fractures at diagnosis, but the survival of 57% of our patients with fractures at five years is very similar to this figure.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

REFERENCES


