Giant Cell Tumors of Long Bones
Prospective Study

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Abstract
This is a prospective study of giant cell tumors of long bones performed in Beni-Suef University Hospital and Insurance Hospital in the period from 2002-2007. Fifteen cases were included. There were 10 females and 5 males the mean age of the patients was 32 years. The tumor was primary in 11 cases and recurrent in 4 cases. All the patients had been treated with intra-lesional curettage. In 7 patient's curettage and bone graft or bone cement was done. In 8 patients curettage was augmented with high speed burr and or phenol 80%. The overall recurrence rate was 32%. The group of patients treated with curettage alone had a local recurrence rate of 45%. While those treated with curettage and adjuvant treatment had a local recurrence rate of 8%. There was no difference between cases treated with bone cement or bone graft as regard local recurrence rate. Recurrent tumors treated with curettage had a local recurrence rate of 50%.

Key Words: Giant cell tumors – Long bones – Prospective study.

Introduction
GIANT cell tumor of bone is one of the most common primary tumors of bone. These tumors are usually geographic, lytic, eccentric and characterized by its typical location in the epiphysis and tendency to local recurrence. Histologically, the tumor is characterized by the presence of numerous giant cells that may contain as much as 100 nuclei, these cells are evenly scattered among mononuclear stromal cells [1-5].

Treatment of giant cell tumors in 1800's consisted of radical amputation [6]. Bloodgood [7] in 1912 was the first to describe curettage and bone graft for giant cell tumors. Science then intra-lesional curettage had been widely used, the main problem with intra-lesional curettage was the high incidence of local recurrence rate that varied from 25% to 50% [2,8-14]. Some authors advised wide resection to have a better local control of giant cell tumor [14,15], however this procedure was associated with impaired limb function as it scarifies a significant segment of bone and soft tissue [14,16]. Recent techniques and enhancement of intra-lesional procedures with liquid nitrogen, acrylic cement, phenol, and hydrogen peroxide had been used with better local control that sometimes was equal to en-block resection [17-22].

Aim of the study:
This study evaluated the treatment and outcome of 15 patients with giant cell tumors of long bones as reflected by functional limb preservation and local recurrence rate.

Material and Methods
Fifteen patients with giant cell tumors of long bones were treated in Beni-Suef University Hospital and Beni-Suef Insurance Hospital in the period between 2002 to 2007. There were 5 males and 10 females with an average age of 32 years (ranged from 19 to 47 years).

Eleven of the 15 patients were primary tumors while four cases were local recurrences. Diagnosis based on radiological manifestation and confirmed via open biopsy. Staging was done according to Enniking [23] (Stage 1 tumor is that with a surrounding rim of cortical bone, Stage 2 the margin is irregular and the cortex is expanded or deformed, Stage 3 there is cortical destruction and tissue extension) (Fig. 1).

Computed tomography scans and magnetic resonance imaging were done frequently. Table (1) shows the sites of involvement, age, sex, staging and treatment information. The distal femur was affected in 8 patients, the distal radius in 2 cases and the proximal tibia in 3 patients (Table 2). Thirteen patients had stage 3 Enniking and two patients had stage 2. The functional results were assessed by the Musculo-skeletal Tumors Society evaluation system [24].
Surgical technique:

All the tumors in this series were removed with curettage; the entire exposed surface of the defect was curetted with a sharp curette. For the 7 patients treated early in the study cauterization of the exposed surface with electro-cautery was done after curettage followed by filling the defect with either bone cement or autogenous bone graft. High speed burr was used science 1999 to remove any overhanging bony ledges in addition to curettage and electro-cautery. Irrigation with phenol 80% was added science 2001. All the exposed bony surfaces were painted with phenol moistened cotton tipped applicators followed by absolute alcohol and saline irrigation. The choice of the filling material depends on the defect size, if the size of the defect is so large that cancellous or cortico-cancellous bone graft is not enough bone cement was used when there was enough subchondral bone and more than 50% of the circumference of the bone remains. Preoperative CT and MRI provide the most accurate information on the extent of the tumor and status of remaining bone. Patients were allowed early weight bearing when bone cement was used while bone graft required non weight bearing for months when used in distal femur or proximal tibial lesions (Figs. 2,3).

Patients were followed up every 3 months in the first 2 years then every 6 months after that. Patients presented with recurrent tumors were treated in the same manner as if the tumor was seen primarily with curettage and bone cement or bone graft. Wide resection and reconstruction was done with extensive destruction of the bone and or joint surface.

All the patients included in this study were treated with intralesional curettage. After curettage bone graft was used to fill the defect in 4 cases and bone cement in 3 cases. A high speed burr was used after curettage in 8 patients. Chemical cauterization with phenol 80% was used after curettage and burr in 3 patients. In this group of patients bone graft was used to fill the defect in 5 cases and bone cement in 3 cases. The mean duration of follow-up of the 15 patients was 28 months (range 24 to 58 months).
Fig. (2B): 18-year-old girl with recurrent giant cell tumor of bone. Postoperative radiograph of left wrist in patient with previously recurrent giant cell tumor of bone treated with curettage, ablation, and placement of bone graft.

Fig. (2C): A 20-year-old girl with recurrent giant cell tumor of bone. Postoperative radiograph after repeated curettage and ablation shows cavity is now filled with polymethyl methacrylate cement that does not undergo resorption. Thin radiolucency and adjacent sclerotic rim (arrow) that have formed around cement are customary findings. Lytic recurrent tumors are often easily detected adjacent to high density of cement.

Fig. (3A): Giant cell tumor of proximal tibia treated with bone grafting
Fig. (3b): Implantation of a sliding prosthesis over a massive allograft.

Fig. (4A): Cement disadvantages: A few months after cement packing of this GCT, the thin bony bridge in the intercondylar notch broke and the residual medial condyle moved medially. At reoperation, destruction of the distal femur was such that we had no other option than to implant a knee prosthesis.

Fig. (4B): A 33-year-old man with recurrent giant cell tumor of bone. Lateral radiograph of knee obtained at same time as B shows posterior cortical expansion (arrow), further verifying recurrent giant cell tumor of bone.

Results

Local recurrence of the tumor was observed in 5 patients out of 15 (32%) (Table 3). Two of the four cases who were initially presented with local recurrence had an additional local recurrence (50%) compared with two who were seen for a primary (9%). Recurrence occurred at an average time of 10 months (range 4-22 months). One of the 3 patients treated with burr and cement had a local recurrence (33%). Two of the three patients treated with curettage and cement had recurrence (66%). Two of the 4 patients treated with curettage and bone graft and no local adjuvant (burr, cement, phenol) had recurrence (50%). None of the 3 patients treated with phenol and burr had a recurrence (Fig. 4). Of the five patients who had local recurrence; four were treated with another curettage and graft or cement, one was treated with wide resection. Two patients out of the 4 treated with curettage had local recurrence (50%), while the patient treated with wide resection had no local recurrence.

Functional evaluation showed that of the 10 patients who had no local recurrence 4 had excellent results (40%), 6 had good results (60%). Of the five patients who have local recurrence three had good results (60%) and one had fair results (20%) and one had poor results (had above knee amputation because of severe infection).

Table (1): Characteristics of the studied cases.

<table>
<thead>
<tr>
<th>Case</th>
<th>Age/y</th>
<th>sex</th>
<th>site</th>
<th>curette</th>
<th>burr</th>
<th>phenol</th>
<th>PMMA</th>
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<th>L.R</th>
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Table (2): Site of the tumor.

<table>
<thead>
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<th>Site</th>
<th>No. of patients</th>
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<td>Distal femur</td>
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<td>Proximal tibia</td>
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<tr>
<td>Distal radius</td>
<td>2</td>
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<tr>
<td>Proximal femur</td>
<td>1</td>
</tr>
<tr>
<td>Distal tibia</td>
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Table (3): Giant cell tumor of long bone treated by curettage, curettage and cement, curettage and adjuvant.

<table>
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<th>Adjuvant</th>
<th>No. of patients</th>
<th>LR</th>
<th>No. LR</th>
</tr>
</thead>
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<td>Cement</td>
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<td>2 (66%)</td>
<td>1 (33%)</td>
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<tr>
<td>Burr+cement</td>
<td>3</td>
<td>1 (33%)</td>
<td>2 (66%)</td>
</tr>
<tr>
<td>Burr+phenol+graft</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Burr+phenol+cement</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>No adjuvant</td>
<td>4</td>
<td>2 (50%)</td>
<td>2 (50%)</td>
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<tr>
<td></td>
<td>15</td>
<td>5 (32%)</td>
<td>10 (68%)</td>
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</table>

LR = Local Recurrence.

Discussion

Giant cell tumor of bone has been described as a distinct neoplasm formed of undifferentiated cells that behaves aggressively with a distinct tendency for local recurrence after excision. Histologically, the reported local recurrence rate varied from 20% to 50% [8,12,13]. This study of giant cell tumor of long bones included 15 cases treated in our department in period from 2002 to 2007 with a minimum follow up of 2 years. The study included 8 patients with distal femur tumor, 3 patients with proximal tibial lesions, 2 patients with distal radial lesions and one patient with distal fibula and proximal femur each. Ten out of 15 cases (71%) affected the knee region. There were 5 males and 10 females patients with more female predominant, the demographic characters of our patients was similar to those reported in other series [2,5,10,11]. An overall recurrence rate of 32% was observed in this study. If the patients referred to us with recurrent tumors were excluded the recurrence rate will be 19%. The local recurrence rate was 45% in the group of patients treated early in this study where no local adjuvant was used, there was no difference between those who had been treated with curettage and bone graft or curettage and bone cement. The reported results with curettage alone had varied from 47% to 56% [8,12,13]. The incidence of local recurrence had dropped to 9% when recent techniques and local adjuvant (high speed burr or phenol) was used. The use of high speed burr with curettage has improved the results of local tumor recurrence rate to 25% comparing to 17% in the study of the Canadian sarcoma group [25]. The combination of high speed burr and phenol 80% in this series was associated with significant reduction in local tumor recurrence. The results suggest an improvement in local control rate using curettage, high speed burr and local phenol. When high speed burr was augmented with application of 80% phenol the incidence of local recurrence was zero. The use of high speed burr and phenol is thought to provide a deeper and more thorough curettage compared to liquid nitrogen. The preference of phenol was due to its ease of handling compared to liquid nitrogen [17,18,25], reduced penetration and the safety of using a high concentration of it [3,26-30].

There is no agreement regarding management of locally recurrent cases some authors advised a second or third curettage, depending on the fact that the pathology of recurrent tumors was identical to that of the initial lesions and do not represent biologically more aggressive lesions [10,25]. In this series six cases presented with local recurrent tumors was treated with curettage and graft or cement, the failure rate was high (50%). In this subset of patients Tomeno and Ochao [30] reported 13% local recurrence rate while Turcotte et al. [25] reported 35% local recurrence rate after curettage. Local recurrence had been attributed to residual microscopic tumors [31] and radiotherapy was advised recently by some authors for locally recurrent tumors [25,32,33]. However malignant transformation had been reported after using radiotherapy for giant cell tumors in the past [16]. Due to this high rate of local recurrence wide resection was advised for any locally recurrent giant cell tumor [12] while others [34] advised wide resection only for locally recurrent giant cell tumors in distal radius. We treated local recurrent tumors in the same manner as primary tumors and we now limited the indication for en-block resection in giant cell tumor to cases where more than 50% of the supporting cortex or articular surface had been destroyed.

The nature of the filling material used after curettage had no effect on the incidence of local recurrence in this study, packing the bone defect after curettage with bone cement was accepted and widely used as a result of comparing the outcome of this method with bone graft [3,34]. Acrylic cement initially was reported to have an adjuvant role in the treatment of giant cell tumor either due the toxicity of acrylic monomer or thermal necrosis induced by cement polymerization [20]. In our series there was no significant decrease in the recurrence rate after using bone cement comparing with using bone graft. This result compared to other reports that noticed no difference in local recurrence rate when cement was compared with other filling material [35,36].

The choice between bone graft and bone cement depends on the site, size of the bone defect [27]. The use of bone cement is limited if less than 50% of the circumference of the bone remains or when the subchondral bone is lost [2,34].
The use of bone cement is large proximal tibia or distal femur lesions was recommended to allow early weight bearing and because healing needs a long time [27], in this series bone graft and bone substitute was used in proximal tibia and distal femur lesions with a large bone defect particularly when the subchondral bone was lost, immobilization of the limb in a long leg cast or external fixation for 12-16 weeks did not prevent restoration of a good knee function.

Conclusion:

Intra-lesional curettage and high speed burr augmented with phenol 80% is adequate for the treatment of giant cell tumors of long bones. The nature of filling material had no impact on local recurrence rate. Treatment of locally recurrent giant cell tumors with curettage still has a high local recurrence rate.

References


