Giant cell tumour of the sacrum: a suggested algorithm for treatment

Rajkumar Thangaraj · R. J. Grimer · S. R. Carter ·
A. J. Stirling · J. Spilsbury · D. Spooner

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Abstract To investigate the outcome of our management of patients with giant cell tumour of the sacrum and draw lessons from this. A retrospective review of medical records and scans for all patients treated at our unit over the past 20 years with a giant cell tumour of the sacrum. Of the 517 patients treated at our unit for giant cell tumour over the past 20 years, only 9 (1.7%) had a giant cell tumour in the sacrum. Six were female, three male with a mean age of 34 (range 15–52). All, but two tumours involved the entire sacrum and there was only one purely distal to S3. The mean size was 10 cm and the most common symptom was back or buttock pain. Five had abnormal neurology at diagnosis, but only one presented with cauda equina syndrome. The first four patients were treated by curettage alone, but two patients had intraoperative cardiac arrests and although both survived all subsequent curettages were preceded by embolisation of the feeding vessels. Of the seven patients who had curettage, three developed local recurrence, but all were controlled with a combination of further embolisation, surgery or radiotherapy. One patient elected for treatment with radiotherapy and another had excision of the tumour distal to S3. All the patients are alive and only two patients have worse neurology than at presentation, one being impotent and one with stress incontinence. Three patients required spinopelvic fusion for sacral collapse. All patients are mobile and active at a follow-up between 2 and 21 years. Giant cell tumour of the sacrum can be controlled with conservative surgery rather than subtotal sacrectomy. The excision of small distal

tumours is the preferred option, but for larger and more extensive tumours conservative management may well avoid morbidity whilst still controlling the tumour. Embolisation and curettage are the preferred first option with radiotherapy as a possible adjunct. Spinopelvic fusion may be needed when the sacrum collapses.

Keywords Giant cell tumour · Sacrum · Embolisation · Radiotherapy

Introduction

Giant cell tumours are locally aggressive, benign bone tumours with a high risk of local recurrence and a low risk of metastasis after treatment.

They are most common in the second decade and more common in females than males. They typically affect the epiphyseal area of long bones, but can also arise less commonly in flat bones. Various methods of treatment have been advocated, including curettage with or without adjuvant, excision and replacement, cryotherapy and radiotherapy [1–4]. All these treatments have advantages and disadvantages and it is generally accepted that giant cell tumours should be managed in musculoskeletal oncology centres, where there will be expertise not only in the various treatment options, but also in dealing with potential complications of treatment.

The most common complication to arise is local recurrence which has the greatest incidence following curettage alone. However, curettage has the lowest morbidity as compared to excision which has a high rate of tumour control, but which carries with it all the risks of reconstruction of the involved bone. Radiotherapy has been used to control these tumours, but whilst achieving a high rate of

R. Thangaraj (✉) · R. J. Grimer · S. R. Carter ·
A. J. Stirling · J. Spilsbury · D. Spooner
The Royal Orthopaedic Hospital Oncology Service,
Bristol Road South, Birmingham B31 2AP, UK
e-mail: rajkumar306@rediffmail.com

local control is associated with an increased risk of radiation-related malignancy [5].

Giant cell tumour of the sacrum is rare, representing about 3–4% of all giant cell tumours, but is particularly challenging to treat since the tumour is frequently diagnosed late and is often quite extensive within the bone and surrounds the sacral nerve roots, which often produce the initial symptoms, mistaken for sciatica. By the time of diagnosis, there is also often a large soft tissue mass extending anteriorly (Fig. 1).

Treatment of giant cell tumour of the sacrum is not straightforward. Excision of the involved sacrum almost always results in loss of function of the sacral nerve roots with incontinence and sometime lumbopelvic discontinuity if the tumour extends above S2. Curettage alone is challenging due to blood loss and potential damage to nerve roots and complete removal of the tumour is unlikely with

a high risk of recurrence. Repeated embolisation of the tumour has had some success, but is usually used as a precursor to surgery to decrease bleeding [6–8].

Here, we report our experience of managing giant cell tumour of the sacrum and suggest a management algorithm that hopefully offers a high chance of tumour control with minimal morbidity.

Methods

We identified all patients treated in our unit over the past 25 years with a giant cell tumour of the sacrum. We retrieved their case notes and radiographs and reviewed these, recording patient, tumour and treatment factors as well as complications and outcome (Table 1).

Results

Out of a total of 517 patients treated at our unit over 25 years for giant cell tumour, only 9 (1.7%) had a giant cell tumour of the sacrum. Three were male and six were female. The age range was 15–52 years (mean 34 years) when the diagnosis was made. Four patients presented with back pain for between 4 and 12 months, two patients with buttock pain, one with back and leg pain, one patient with back pain and cauda equina syndrome, whereas one patient was an incidental finding at laparotomy when being investigated for a pelvis mass. The duration of symptoms ranged between 4 weeks and 1 year. Four patients had no neurological deficit at presentation, two patients had mild sensory disturbances and two patients had mild motor weakness while only one presented with a cauda equina syndrome.

The mean size of the tumour at presentation was 10 cm and all, but two of the tumours extended up into S1 with four involving the entire sacrum and only one confined to distal S3.

The treatment decisions were made by a multidisciplinary team involving surgeons, pathologists, radiologists and clinical oncologists. Treatments evolved as experience was gained and as new techniques became available, but our treatment aim throughout was based on a combination of maximising tumour control whilst minimising morbidity. Patient choice was a key element in many of the decisions that were taken.

The first four patients treated in this series were treated prior to 1993 with curettage alone. Two of the four patients had perioperative cardiac arrests due to massive blood loss and both had to have emergency packing of the wound and were successfully resuscitated and later had the packs removed and the curettage procedure completed. The blood

Fig. 1 Typical appearance of a giant cell tumour (GCT) of the sacrum at the time of presentation. The CT scan images (a) show a large defect involving virtually the entire sacrum with involvement of the adjacent ilium and a large anterior soft tissue mass (b)

Table 1 Details of the patients, the tumours, treatment and outcome

Age/ sex	Symptoms	Level	Size (cm)	Spine instability	Initial treatment	Blood requirement	Local recurrence	Treatment of local recurrence	Current status	Neurology at presentation	Neurology at latest follow- up	Complications
1 15/F	Back pain 4 months	Entire sacrum	9	No	Curettage 2 stages	11/52	18 months	Embolise, curettage	NED 21 years	Slight weakness right leg	None	Cardiac arrest during first curettage
2 25/F	Back pain 9 months	Entire sacrum	12	No	Curettage 2 stages	33/12	None		NED 18 years	None	None	
3 48/M	Back pain 8 months	S1 and S2	10	No	Curettage	12	None		NED 15 years	Slight weakness of right EHL	Weakness right EHL, impotence	Pain requiring gabapentin
4 35/F	Back pain 1 year	S2–S4	11	No	Curettage 2 stages	37	None		NED 15 years	None	None	Cardiac arrest during first curettage
5 52/F	Pelvic mass at laparotomy	S3–S4	8	No	Excision	4	None		NED 12 years	None	None	
6 46/F	Buttock pain 8 months	Entire sacrum	11	Yes	Embolisation, RT, spinal stabilisation	8	None		NED 4 years	None	Stress incontinence	
7 18/M	Buttock pain 6 weeks	S1–S4	11	Yes	Embolisation, spinal stabilisation, curettage	11	None		NED 4 years	S2, S3 numbness	None	
8 28/M	Back pain and right leg pain 1 year	Entire sacrum	11	No	Embolisation, curettage	11	19 months	Repeat embolisation	Under observation	S1, S2 numbness	Weakness right foot	
9 37/F	Back pain and cauda equina syndrome 4 weeks	S1 and S2	9	Yes	Embolisation, curettage, spinal stabilisation	8	10 months	Embolisation, RT, curettage	Under observation	Cauda equina syndrome	Incontinent, back pain	Radiation- induced menopause

Fig. 2 Radiological appearance of a GCT of the sacrum following treatment. This patient underwent spinopelvic fusion for mechanical symptoms and also had embolisation and curettage. There has been excellent consolidation of the sacrum following treatment

loss in these two patients was 63 and 37 units, respectively. Both patients have survived and are alive and well 21 and 15 years later. Only one of the four patients (the first one) had a local recurrence successfully controlled by a further curettage preceded by embolisation. One patient suffered with chronic pain requiring treatment at a pain clinic, but had no recurrence of tumour after 15 years.

After this experience, we not surprisingly looked for alternative options for treatment and all subsequent patients had embolisation or ligation of the feeding vessels as part of their management. One patient with the smallest and most distal tumour underwent excision of the distal sacrum without complication (Case 5).

The subsequent four patients had large tumours involving the upper or entire sacrum. One had immediate embolisation followed by surgery to relieve a cauda equina syndrome and curette the tumour (Case 9). This patient had not much neurological recovery and remains incontinent. She developed local recurrence after 10 months treated by repeat curettage and then by radiotherapy (45 Gy). Despite this, she had a further local recurrence now being managed with repeat embolisations that appear to be controlling the disease.

The other three patients were initially treated with embolisation in the hope that this would control the tumour (Cases 6–8). Two developed progressive symptoms of spinal instability and developed collapse of S1 with neurological features. Both had spinopelvic stabilisation (Fig. 2) and one had a curettage and the other elected for radiotherapy treatment. Both have remained disease free at intermediate follow-up with one female having stress

incontinence partially controlled by surgery. One patient developed a local recurrence after 19 months and had sequential embolisations that appear to be controlling the tumour and he works full time in two separate jobs and is symptom free.

The initial treatment of the tumour itself consisted of curettage alone in seven patients, radiotherapy alone in one patient (patient decision) and excision in one. The technique of curettage in the sacrum is different from most other giant cell tumours as the cauda equina is running through the middle of the operative field and needs to be carefully preserved. Tumour is often adherent to the nerve roots and picking it off can be difficult. The whole procedure is complicated by bleeding which is helped by preoperative embolisation within the previous 48 h and by hypotensive anaesthesia. For patients with a large anterior soft tissue extension, an anterior approach may be useful and was required in three patients, in all of whom curettage was done as a two-stage procedure, being followed by a posterior approach either immediately or 2 weeks later.

The surgical complications are shown in Table 1. Blood loss was common even following embolisation and the total blood loss ranged from 4 to 52 units, but there were no transfusion reactions. There was one wound infection in a patient who had a cardiac arrest, but this resolved with antibiotics. Two patients were worse-off neurologically after the procedure than before, with one patient being impotent and another having weakness of his right foot, but not requiring any orthosis.

None of the patients have developed metastases, but local recurrence arose in three patients, all within 2 years of their initial surgery. The local recurrences were treated by embolisation and further curettage in one with cure, but two other patients still have active disease controlled with repeated embolisation.

Discussion

Few centres have a large experience of treating giant cell tumour of the sacrum and patient management needs to be individualised. However, we believe that our experience has taught us useful lessons that have helped us plan an algorithm of treatment based on our own and published expertise.

The best results published thus far in managing giant cell tumour of the sacrum are from Hosalkar et al. [7] who used repeated embolisation alone to control the tumour. This was successful in seven of nine cases and as it is a low morbidity approach must represent the first treatment option at the present time for any patient with giant cell tumour of the sacrum. Hosalkar emphasises the importance of repeated embolisations to ensure that all the major blood

vessels feeding the tumour have been controlled and this should be part of the treatment plan for any patient with a newly diagnosed sacral GCT. If the patient develops local progression or recurrence, then alternative treatment is needed. Although we used embolisation as the initial treatment in recent patients, it failed to control the tumour in any and two developed collapse of the sacrum requiring spinolumbar fusion to prevent neurological deterioration.

The published results of curettage alone have been disappointing. Leggon et al. reported a 48% risk of local recurrence in 31 patients treated with curettage alone and a 49% risk of local recurrence with curettage combined with radiotherapy. In our series, three of the seven patients (43%) treated with curettage had a local recurrence, but in all of these further strategies have controlled the disease process without adding significant additional morbidity. In our series, two patients suffered cardiac arrest during a curettage carried out prior to the use of embolisation. In both cases, this was due to catastrophic blood loss during the procedure. In both cases, the tumour was packed, the patient turned prone and both were successfully resuscitated. The operations were completed at a later date with the first patient still requiring 52 units of blood, despite embolisation of the main feeding vessels 48 h before operation. Needless to say, we strongly recommend that curettage of these tumours should not be carried out without adequate blood being available and ideally following embolisation.

Radiotherapy has been used to treat sacral giant cell tumours, but recurrence rates of 15–49% have been reported and other complications, such as post-radiation fibrosis and radiation-induced malignancy also arise. Chakravarti reported five cases of sacral giant cell tumour treated with radiotherapy with doses between 40 and 70 Gy. Two of the patients developed progression at 5 and 8 months, respectively and both required surgery, whilst the other three patients remained disease free at follow-up between 3 and 10 years [9]. They recommended a dose of >50 Gy to maximise local control. Leggon et al. [5] reported a 49% rate of local recurrence in patients treated with radiotherapy alone for pelvic or sacral giant cell tumour, and there was also 11% risk of radiation-induced sarcomas, although Chakravarti et al. [9] found only 3% risk using pooled data. We believe that radiotherapy should only be used in situations where the benefits are likely to outweigh the risks and in our series was only used once for primary tumour control and once following local recurrence. In our two cases, a dose of 45 Gy in 25 fractions was used. Improvements in radiotherapy targeting, notably the use of intensity-modulated radiotherapy may also prove beneficial for these tumours.

The need for lumbopelvic stabilisation is based on the symptoms experienced by the patient and in our series was

required in three patients, all of whom had progressive symptoms of lumbosacral instability and in two cases progressive neurological symptoms due to downward migration of the lumbar spine into the sacrum. In all cases, the fusions successfully relieved the symptoms and were done separate to the treatment of the giant cell tumour. The technique for this is now well reported in the spinal literature [10].

The excision of a giant cell tumour offers the best chance of obtaining local control, and is the treatment of choice for tumours below the S3 level. In Leggon's series, surgical excision had the best results in terms of local control, but at the expense of iatrogenic nerve injury which will be greater if the higher levels are involved. In all, but one of our cases, the extent of the tumour would have involved partial or complete sacrectomy resulting in division of the cauda equina and almost certain incontinence and impotence as well as complete lumbopelvic disassociation in the majority of cases. Although the surgical procedure is well described, we do not believe that the morbidity and complications that ensue are in most cases justified by the potential improvement in local control, unless the tumour is distal as it was in only one of our patients [11, 12].

We have not used cryotherapy in our series for any case even though favourable results are reported by Marcove et al. [13], but not by Leggon et al. [5] who reported a 62% rate of local recurrence in eight patients treated with curettage and cryosurgery. The potential for permanent nerve damage and other complications means that this treatment is likely to remain in the few centres in the world championing its use. Although there have been promising reports of both biphosphonates and Denosumab in the management of giant cell tumour at the present time, these remain unproven in any clinical trial, but may offer alternative treatment options in the future [14, 15].

Thus, giant cell tumour of the sacrum is a condition leading to significant morbidity and even mortality. Leggon's review of 166 cases of sacral giant cell tumour revealed that 39 patients (23%) had died as a result of the disease or its treatment with 16 dying of the effects of local recurrence, nine of radiation-induced sarcoma, three of secondary sarcoma, five of benign metastases, perioperative deaths in three and other related causes in four. He reported no significant difference in morbidity/mortality between the patients treated with radiotherapy or surgery, with a 51% rate in those treated with radiotherapy and 53% with those treated with intralesional surgery [5].

In our series, despite a 33% rate of local recurrence, all patients remain mobile, the worst neurological deficit after treatment was impotence and all patients are currently alive. We suggest based on this experience that giant cell tumour of the sacrum should be managed at specialist centres, and treatment should be individualised for each

Fig. 3 Suggested algorithm for management of GCT of the sacrum

patient. The algorithm shown in Fig. 3 represents what we believe to be a reasonable management plan based on the currently available expertise. Patients should undergo staging and biopsy. If the tumour can be easily resected with minimal morbidity (i.e. distal to S3 level) then this is the treatment of choice. However, most patients will have more proximal lesions involving S2 and S3 and the patients should be informed of the relative morbidities of sacrectomy with neurological and functional deficit versus a more conservative approach with a higher risk of recurrence, but less functional loss. We believe that patients who accept the more conservative option should be treated initially with serial embolisation. If there is tumour progression, then curettage should be considered as second-line treatment, although radiotherapy could be considered as an alternative option if the patient did not wish to accept the potential hazards of surgical decompression. Spinopelvic stabilisation is indicated for symptoms of instability usually manifest by progressive pain or neurological deterioration. Complete sacrectomy should be the final option in treatment, only if all other modalities have failed, although

clearly small localised giant cell tumours affecting the distal sacrum (as our patient 5) are best treated initially by complete excision. The role of chemical agents may in the future make these surgical treatments redundant, but at the present time we consider the algorithm proposed to be reasonable and worthy of debate.

It remains to be seen whether this treatment protocol is successful, but we consider that it avoids the morbidity that would follow primary excision of the sacrum for this type of tumour.

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