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Case Report

Soft-tissue Necrosis Complicating Bone-cement Filling in a Patient with Proximal Tibia Giant cell Tumour and Co-morbid Depressive Illness

Sagar Narang,[a,c] Neeta Narang[b,d]

ABSTRACT:

Giant-cell tumors are common around the knee. Proximal tibia is a challenging location for limb-salvage due to paucity of soft-tissue cover. Bone cement has been used in treatment of giant-cell tumors after curettage. Tissue irritant properties of its monomer and exothermic reaction involved in polymerization may compromise surgical outcome to varying degrees. Preoperative planning and intra-operative positioning during cementing process are of importance to avoid complications. Co-occurrence of psychiatric illness in tumor patients should be managed by psychiatric counselling and drug therapy. This case has been presented to suggest measures for preventing soft-tissue complications during cement filling in proximal tibia, and for dealing with concomitant psychiatric problems for a holistic improvement in tumor patients.

Keywords: bone cement • depression • giant cell tumor • proximal tibia • skin burn

INTRODUCTION:

Giant-cell tumors of bone are benign tumors with aggressive potential. The most common site of occurrence is around the knee. Proximal tibia giant cell tumors are fairly common, involving the medial or the lateral tibial plateau. Intra-lesional resection by curettage has a higher recurrence rate, but a satisfactory knee function compared to wide resection, on a long-term follow up.[1] Curettage of tumor and filling the cavity with bone cement is an accepted procedure for the non-aggressive giant-cell tumor.[2] Bone cement usage in proximal tibia has its own set of complications because of proximity of neurovascular structures and sparse soft-tissue cover. We present a case, which made us modify our treatment approach in managing extensive lytic lesions with bone cement filling in proximal tibia. A second salvage surgery was required to manage the complication of full thickness skin necrosis. The presence of co-morbid psychiatric illness especially depression, in patients with bone tumors, needs to be evaluated and managed effectively for good overall outcome.

CASE REPORT:

A 28 year male patient presented to our outpatient department complaining of pain and swelling around the right knee, gradually increasing over a three month period. He had sustained a trivial trauma to the affected area six months ago. He was prescribed medication for the pain (aceclofenac 100 mg twice daily for two weeks), by a local physician, without much improvement in the severity. He was

a - Associate Professor
b - Lecturer
c - Department of Orthopedics and Traumatology
Lumbini Medical College Teaching Hospital, Palpa, Nepal
d - Department of Psychiatry
Lumbini Medical College Teaching Hospital, Palpa, Nepal

Corresponding Author:
Dr. Sagar Narang
e-mail: sagarnarang@jlmc.edu.np

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quite anxious regarding the persistence of pain and appearance of swelling. The swelling had grown appreciably in size over a period of two weeks and he was finding difficulty in climbing stairs and squatting. Due to the above symptoms he was worried about the possibility of it being a cancerous growth. He was sleeping poorly at night; his appetite had reduced considerably, and was gradually losing interest in his work. On examination a globular, bony hard mass was felt on the antero-medial aspect of right proximal tibia measuring 3 cm x 3 cm. It seemed to be arising from the bone. The overlying soft-tissue was non-adherent to the mass. There were no scars, sinus, venous prominence, overlying the involved area. There were no associated masses felt around the knee. Knee flexion was terminally restricted. The right lower limb had no neurovascular deficit.

Radiographs were ordered, which revealed an extensive area of lucency, with bony septations within the proximal tibia, giving a "soap-bubble" appearance (Figure 1). The lucency involved the whole of medial condyle and part of lateral condyle of right tibia. The tumor had not breached the cortex and there was no pathological fracture at presentation. Based on these findings a diagnosis of giant-cell tumor of the proximal tibia was made.

The patient was also referred to a psychiatrist for evaluation of his mental status and management of any co-morbid psychiatric illness. Psychiatric evaluation resulted in the diagnosis of a depressive episode as per ICD-10 guidelines. The instrument used for assessing the severity of the depressive episode was Hamilton Depression Rating Scale (HAM-D SCALE). On the first psychiatric evaluation, a score of 16 was obtained indicating moderate depression. The patient was started on tablet escitalopram 10 mg once a day for treatment of the depressive episode.

The limb was rested in a knee immobiliser. An urgent operative intervention was planned, to prevent a pathological fracture. Curettage of giant-cell tumor mass was done through an antero-medial approach to proximal tibia, elevating a full-thickness-skin soft-tissue flap. Sterile water was used to lavage the cavity as an adjunct to curettage, for local control. The curetted bone cavity was packed with approximately 80 gm of polymethylmethacrylate (PMMA) bone cement. The choice of PMMA was made, to give immediate stability to the already weakened proximal tibia, and to utilize the tumoricidal (thermal necrosis) properties of PMMA. Post-operative radiographs showed good position of bone cement, supporting the tibial articular surface and the medial pillar (Figure 2).

On the first post-operative day, localized blistering of skin was noticed over the cement implanted area. Patient was able to ambulate pain-free, following the procedure. The skin blister was treated by local dressing change. It evolved to form an eschar at two weeks, the operative incision site healed without complications. On repeated dressings, there was no improvement, and no spontaneous epithelisation of the eschar area was noted. The patient on psychiatric follow up was seen to have improved with the prescribed medication. The HAM-D score was 10 at four weeks follow-up. Anti-depressant medication was continued at the

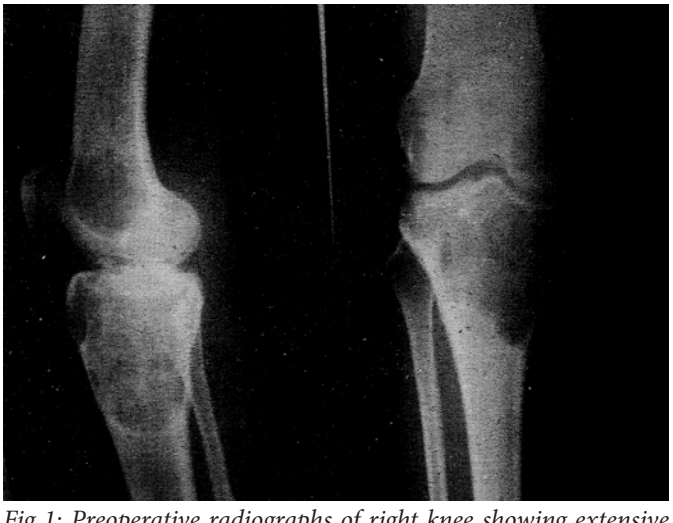

Fig 1: Preoperative radiographs of right knee showing extensive lytic lesion of proximal tibia. Note the "soap-bubble" appearance characteristoc of giant cell tumour.

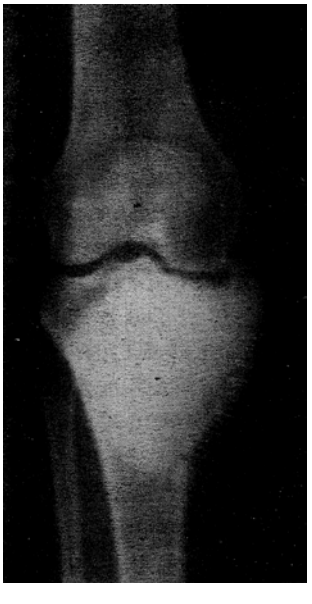

Fig 2: Postoperative Antero-posterior radiograph of right knee showing good articular and medial pillar stability provided by bone cement.

same dosage and follow up was advised.

The eschar detached at four weeks, leaving a circular full-thickness skin and soft-tissue defect, measuring 5 cm x 5 cm. The base of this defect was formed by the implanted bone cement (Figure 3). At this stage, radiographs showed good cement position in the cavity, no lucency and no detachment at cement-bone interface was noted. A decision was made to cover the bare implant surface by a second surgery. Medial gastrocnemius rotation flap, with split-thickness skin graft was done to salvage the situation (Figure 4). The defect area healed well over a one-month period (Figure 5). Psychiatric evaluation at this time showed that severity of the depressive episode had reduced considerably with a HAM–D score of eight. Tab escitalopram was continued at the same dose of 10 mg per day for another four months with regular OPD follow-ups.

At one year follow up, there was no recurrence of the tumor noted, there were no metastases, the bone cement was supporting the tibial articular surface well, and the patient was symptom free, with satisfactory knee function. The patent did not show any symptoms of a mood disorder at one year follow up.

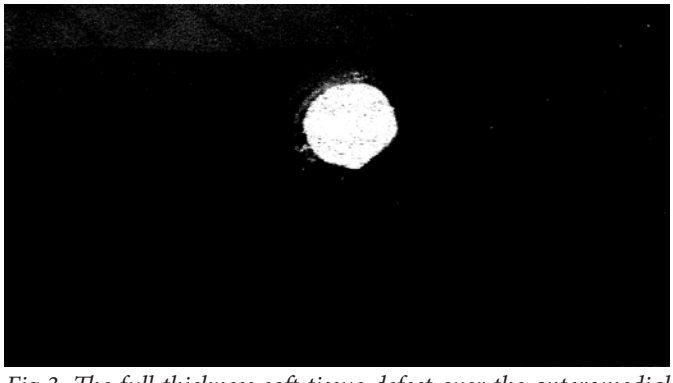

Fig 3: The full thickness soft tissue defect over the anteromedial portion of proximal tibia. The base is formed by the implanted bone cement. The operative scar site has healed normally.

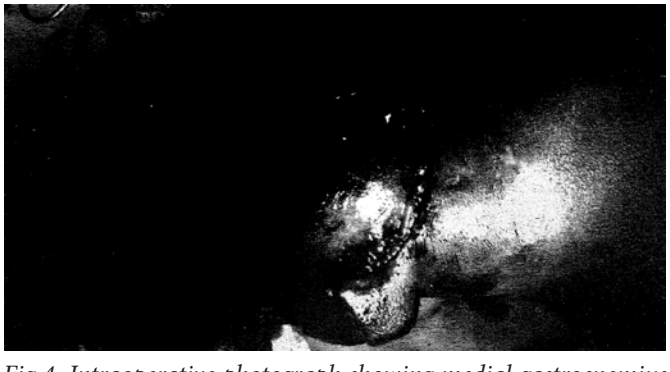

Fig 4: Intraoperative photograph showing medial gastrocnemius rotation flap covering the soft tissue defect.

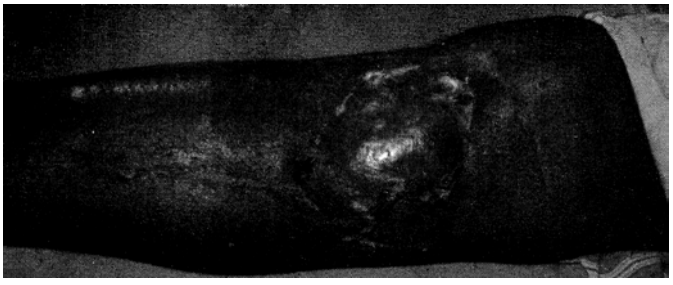

Fig 5: Skin-soft tissue defect healed after medial gastrocnemius rotation flap and split-thickness skin graft application.

DISCUSSION:

Giant-cell tumor of bone has been classified as benign tumor with a potential of becoming aggressive. The most common site of occurrence is the knee area, involving the distal femur and the proximal tibia. Various methods of management of this lesion have been reported in literature depending upon the amount of bone destruction, the location of tumor and the aggressiveness of the tumor. One of the modality of treatment is curettage of the tumor cavity and packing it with PMMA bone cement. PMMA is biologically compatible, provides immediate stability to the applied area, and in addition has tumoricidal effect due to the exothermic reaction involved in its polymerisation.[2] There are complications reported in literature with the use of bone cement. Thermal damage to adjacent soft-tissue structures including nerves and vessels, in various locations has been reported. Cement burns following Total Hip Replacement surgery involving obturator nerve, sciatic nerve, femoral nerve, ureter, and intrapelvic arteries can occur as serious unforeseen complications of a reconstructive surgery.[3-7] Skin and soft-tissue necrosis from discarded bone cement has been reported.[8] Embolism, allergic reactions, venous leakage, hypotension and rarely cardiac arrest have been encountered with usage of bone cement, both intraoperatively and after percutaneous injections. The systemic effects have been attributed to the absorbed methacrylate monomer.[9] The local effects have been related to the heat of polymerisation causing coagulation of proteins, occlusion of metaphyseal arteries producing bone necrosis, and lipolytic and cytotoxic effects of unpolymerised monomer.[10]

Bone cement has been used in skeletal metastases to relieve pain. The process of cementoplasty in such long bone and vertebral lesions, leads to local extrusion and soft-tissue damage. The extent of damage due to bone cement

has not been quantified and may have been considered insignificant in relation to the short life expectancy of such patients.[11] But the scenario can be of immense importance in association with tumors with near-normal life expectancy, such as Giant-cell tumors. These situations are different from cementoplasty and vertebroplasty cases in which the amount of cement used is in small quantities, and the primary purpose is relief of bone pain. Use of cement in arthroplasty for stabilization of components is also not to the amount used in filling extensive bone cavities, post-curettage. The bone cement is made of a white powder, consisting of polymethylmethacrylate, methyl methacrylate-styrenecopolymer and barium sulphate, with a flammable liquid monomer composed of methyl methacrylate, NN-dimethyl-p-toluidine, and hydroquinone.[11] On mixing the white powder with the liquid monomer, dough is formed, as the monomer starts to polymerize. The setting time is usually 6-10 minutes depending upon the ambient temperature and the initial temperature of the bone cement components, cooling helps prolong the setting time. Nearly 13 kcal (55 kJ) of heat is evolved in polymerization of 100 gms of bone cement.[5] The temperatures can reach 100 degree centigrade in a laboratory setting, although in vivo the temperatures range between 38 degrees to 56 degrees centigrade for arthroplasty patients with a 2-3 mm thick cement mantle.[12-14] The surface temperature of setting cement varies with setting time and thickness of cement, with a 10 mm specimen reaching 107°C at room temperature (25°C).[15] Even when the dough is ready for insertion, there is 4% of unutilised monomer in the mixture.[9] The percentage becomes significant if 80 grams or more of cement are used for the procedure, which increases the amount of unutilised monomer as well. In the past the thermal necrosis properties of bone cement have been studied and many soft tissue burns ascribed to it. There exists a co-component to the soft-tissue damage due to bone cement, which is the unutilised methylmethacrylate monomer, and causes chemical necrosis. As seen in our case, despite taking all precautions, regarding full thickness skin flap for the exposure of tumor, proper curettage and cement packing and cooling of the cement before suturing the flap back in place, full-thickness skin and soft-tissue necrosis did occur. This might have been due to contact thermal necrosis and chemical necrosis properties of PMMA. In a report by Arumilli BRB, Paul AS, the full-thickness skin and soft-tissue necrosis occurred opposite to the incision site.[16] This non-contact thermal necrosis was ascribed to extensive exothermic reaction and thermal conductivity of underlying bone. It was emphasized in this report, that if anterior approach is used for curettage and bone cement application, "There might be noncontact thermal necrosis of soft tissues posterior to the intact proximal tibia that might go undetected and could cause catastrophic neurovascular complicaions". This observation may be true, and as an addition to this we would like to emphasize modifications which might help avoid chemico-thermal necrosis of soft-tissue around proximal tibia. The first one would be regarding the position of the leg during cement application and setting. In the case report with non-contact thermal necrosis,the patient was positioned prone for a prolonged period, so this probably allowed the unutilised monomer to gravitate through the haversian system and damage tissues opposite (anterior) to the site of application of cement (posterior), causing non-contact necrosis.[16] In the anterior approach, when the patient is in supine or lateral position, we believe that after the cement has been filled in the cavity of tibia, the knee should be bent to 90 degree, if possible, to let the neurovascular structures fall-back away from proximal tibia. The second one would be regarding the position of cortical window for tumor curettage. A pre-operative axial CT scan of the involved tibia can be of help. The window should be made in the thinnest cortex and should have the thickest cortex as its floor, to withstand the pressurizing of cement, invaginations in cancellous bone, and distribute (soak) the gravitating liquid monomer in many channels of haversian system, preventing focal accumulations, and soft-tissue burns. To achieve this, the patient should be positioned lateral, with the involved knee up, in case of predominant lateral condylar lytic tumor. For predominantly medial tibial condylar involvement; the patient should be positioned supine, and cementing done in a figure-of-four position of the involved knee. The thinner the bone around the curetted cavity, higher is the chances of soft-tissue complications following bone cement application.

The rate of depressive disorders in somatic illnesses varies between 10 – 40 percent. Hence, it is important to diagnose this psychiatric co-morbidity at the earliest and start anti-depressant treatment in such patients.[17] Amongst the selective serotonin reuptake inhibitors (SSRIs), escitalopram has shown to be superior both in efficacy as well as safety

profile.[18,19] It has also got minimal drug interactions and is well tolerated in the majority of patients.

CONCLUSION:

Giant-cell tumors in proximal tibia with extensive lysis at presentation can be a challenging situation in limb salvage surgery. The options for reconstruction are limited. Autogenous bone graft is limited in quantity and there is uncertainty about its consolidation, with a risk of pathological fracture during the process of healing. PMMA bone cement is required in large quantities, does not cause donor site morbidity, prevents pathological fracture from occurring, and results in satisfactory knee movement preservation. The amount of damage to soft-tissues following bone cement filling in large tumor cavities of proximal tibia, can be to a larger extent due to increased amount of cement used. This can cause more thermal necrosis and more chemical necrosis, in a confined space of proximal tibia with meagre muscle and fat cover to dissipate heat, and increased chances of damage to neurovascular structures around the knee. Care is advised regarding planning of the position of patient, position of cortical window for curettage and position of knee during the polymerization phase of bone cementing, to avoid disastrous complications. The suspicion and hence the early diagnosis and treatment of depressive episode in this patient played a significant role in the favorable outcome of the surgical procedures. The improvement of mood and reduction in feelings of despair and pessimism with anti-depressant medication and supportive psychotherapy helped the patient to go through the second procedure with hope and confidence.

REFERENCES:

1. Liu HS, Wang JW. Treatment of giant cell tumour of bone: a comparison of local curettage and wide resection. Changgeng Yi Xue Za Zhi. 1998;21:37-43.
2. Wada T, Kaya M, Nagoya S, et al. Complications associated with bone cementing for the treatment of giant cell tumors of bone. J Orthop Sci. 2002; 7(2):194-8.
3. Siliski J, Scott R. Obturator nerve palsy resulting from intrapelvic extrusion of cement during total hip replacement: report of four cases. J Bone Joint Surg Am. 1985;67:1225-8.
4. Birch R, Wilkinson M, Vijayan K, et al. Cement burn of the sciatic nerve. J Bone Joint Surg Br. 1992;74:731-3.
5. Weber E, Daube J, Coventry J. Peripheral neuropathies associated with total hip arthroplasty. J Bone Joint Surg Am. 1976;58:66-9.
6. Waters E, Bouchier Hayes DM, Hickey D. Delayed presentation of ureteric injury after thermal insult at total hip replacement. Br J Urol. 1998;82:594.
7. Nachbur B, Meyer R, Verkkala K, et al. The mechanisms of severe arterial injury in surgery of the hip joint. Clin Orthop. 1979;141:121–33.
8. Burston B, Yates P, Bannister G. Cement burn of the skin during hip replacement: Ann R Coll Surg Engl. 2007;89:151-2.
9. Kirwan WO. Systemic phenomena and bone cement. Ir J Med Sci. 1973;142(6):342-5.
10. Gupta A, Majumdar P, Amit J, et al. Cell Viability and Growth on Metallic Surfaces: in vitro Studies: Trends Biomater. Artif Organs. 2006;20(1):84-9.
11. Hodge JC. Cementoplasty and the Oncogenic population. Singapore Med J. 2000;41(8):407-9.
12. Toksvig-Larsen S, Franzen H, Ryd L. Cement interface temperature in hip arthroplasty. Acta Orthop Scand. 1991;62:102–5.
13. Li C, Kotha S, Huang C-H, et al. Finite element thermal analysis of bone cement for joint replacements. J Biomech Engl. 2003;125:315-22.
14. Reckling F, Dillon W. The bone cement interface temperature during total joint replacement. J Bone Joint Surg Am. 1977;59:80-2.
15. Meyer P, Lautenschlager E, Moore B. On the setting of acrylic bone cement. J Bone Joint Surg Am. 1973;55:149-56.
16. Arumilli BRB, Paul AS. Pretibial Full Thickness Skin Burn following Indirect Contact from Bone-Cement Use in a Giant Cell Tumour. Sarcoma. 2007;2007:1-4.
17. Zun S, Kozumplik O, Opic R, et al. Depressive disorders and comorbidity: somatic illness vs. side effect. Psychiatr Danub. 2009;21(3):391-8.
18. Ali MK, Lam RW. Comparative efficacy of escitalopram in the treatment of major depressive disorder. Neuropsychiatr Dis Treat. 2011;7:39-49.
19. Garnock-Jones KP, McCormack PL. Escitalopram: a review of its use in the management of major depressive disorder in adults. CNS Drugs. 2010;24(9):769-96.