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Extensive Giant Cell Tumor Involving Entire Tibia with Talar Extension and Pulmonary Metastases: Successful Limb Preservation with Denosumab and Angioembolization

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Learning Point of the Article:

Extensive giant cell tumor involving the entire tibia with talar extension and pulmonary metastases is exceptionally rare. In selected patients with unresectable disease or those declining amputation, combined selective angioembolization and denosumab therapy may provide durable disease control and successful limb preservation.

Abstract

Introduction: Giant cell tumor of bone (GCTB) is a benign but locally aggressive neoplasm with a recognized propensity for recurrence and occasional pulmonary metastasis. Diffuse involvement of an entire long bone is exceptionally rare.

Case Report: A 29-year-old female with four previous surgeries for recurrent distal tibial giant cell tumor presented with extensive involvement of the entire tibia, talar extension, and pulmonary metastases. Histopathology and H3.3G34W immunostaining confirmed the diagnosis. Limb salvage reconstruction was not feasible and amputation was declined. Selective angioembolization followed by denosumab 120 mg monthly for 6 months resulted in significant clinical improvement and disease stabilization. At 24 months, the patient remained independently ambulatory with stable local and pulmonary disease.

Conclusion: Combined angioembolization and denosumab may provide durable disease control and limb preservation in selected patients with extensive unresectable GCTB.

Keywords: Giant cell tumor, tibia, pulmonary metastases, denosumab, angioembolization, limb salvage.

Introduction

Giant cell tumor of bone (GCTB) accounts for approximately 5% of primary bone tumors and predominantly affects young adults [1,2]. Although classified as benign, GCTB frequently demonstrates aggressive local behavior, cortical destruction, soft tissue extension, and local recurrence. Pulmonary metastases occur infrequently but are well documented [1,3]. Most lesions arise around the knee and remain confined to a single epiphyseal-metaphyseal region [1,2]. Diffuse involvement of an entire long bone with contiguous extension into adjacent bones is exceedingly uncommon [1,3]. Management of recurrent GCTB remains challenging, particularly when extensive disease compromises reconstructive options [4]. Recent advances in immunohistochemistry and targeted therapies such as denosumab have expanded treatment possibilities for patients with recurrent or unresectable disease [5,6,7]. We report a rare

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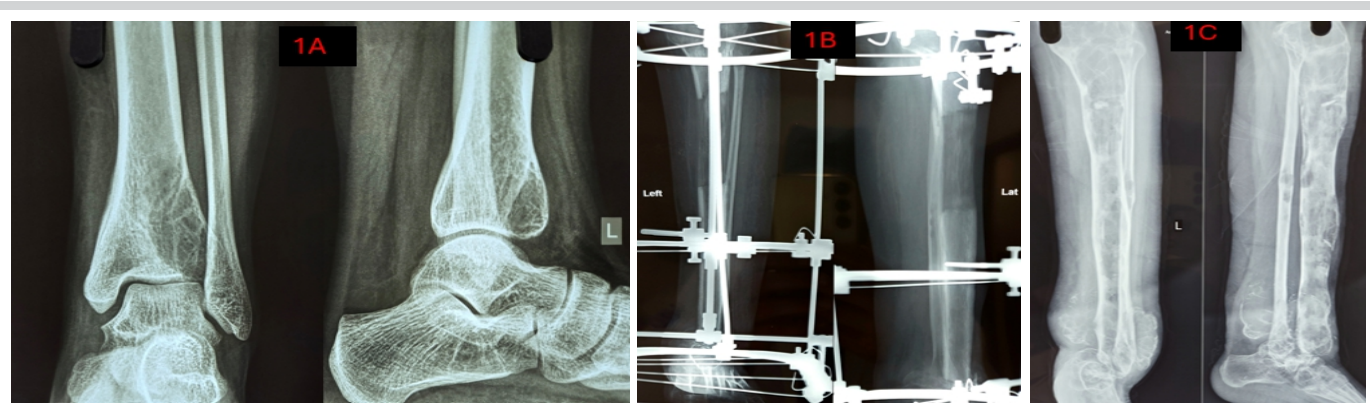

Figure 1: Pre-operative radiographs of the left tibia. (a) Initial presentation. (b) Previous surgical intervention with external fixation. (c) Current radiographs showing extensive lytic destruction.

case of recurrent giant cell tumor involving the entire tibia with talar extension and pulmonary metastases successfully managed using selective angioembolization and denosumab [5,6,7,8].

Case Report

A 29-year-old female presented with progressive pain and swelling of the left lower limb for 1 year. She had previously undergone four surgical procedures for recurrent distal tibial giant cell tumor, including curettage and bone grafting followed by repeat interventions for local recurrence. Clinical examination revealed diffuse swelling extending from the proximal leg to the ankle. The lesion was firm in consistency and associated with ankle deformity and painful restriction of movement. Multiple healed surgical scars were present. There were no constitutional symptoms. Radiographs demonstrated extensive osteolytic destruction involving nearly the entire tibia with cortical thinning and talar extension (Fig. 1a, b, c). MRI revealed replacement of the tibial marrow cavity by a large expansile lesion with cortical breaches and soft tissue involvement (Fig. 2a, b, c). Chest imaging demonstrated multiple bilateral pulmonary nodules suggestive of metastatic disease. Histopathological examination showed mononuclear stromal cells admixed with numerous osteoclast-type multinucleated giant cells. Immunohistochemistry demonstrated positivity for H3.3G34W (Fig. 3a, b, c), confirming the diagnosis of GCTB [9]. Differential diagnoses included aneurysmal bone cyst, giant cell-rich osteosarcoma, telangiectatic osteosarcoma, metastatic disease, and brown tumor of hyperparathyroidism. Histological findings and H3.3G34W positivity excluded these entities. The case was discussed in a multidisciplinary musculoskeletal oncology meeting. Given the extent of disease, previous surgeries, complete tibial involvement, talar extension, and pulmonary metastases, biological reconstruction or megaprosthetic reconstruction was considered impractical. Amputation was discussed but declined by the patient.

Selective arterial embolization of the posterior tibial and peroneal arterial supply was performed [8]. Subsequently, denosumab 120 mg was administered subcutaneously every 4 weeks for 6 months [5,6,7]. The patient reported significant reduction in pain and swelling within 2 months. Functional mobility improved progressively. Follow-up imaging at 6 months demonstrated stable local disease without progression. Pulmonary nodules decreased in size. At 24 months of follow-up, the patient remained independently ambulatory with stable radiological findings and no significant treatment-related complications (Fig. 4a, b, c).

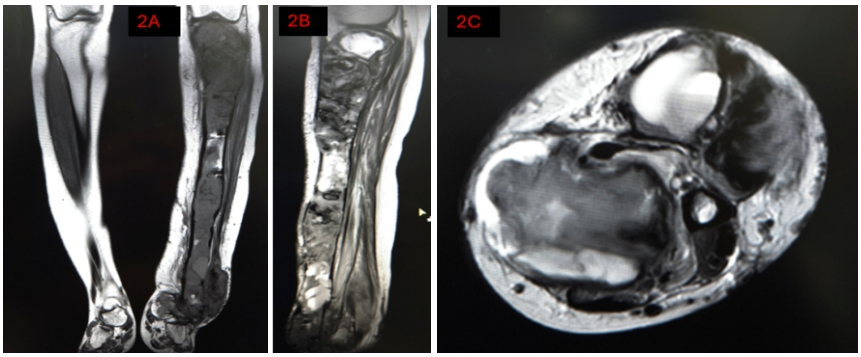

Figure 2: Magnetic resonance imaging demonstrating extensive lesion involvement. (a) Coronal T1-weighted image. (b) Sagittal T2-weighted image. (c) Axial T2-weighted image showing cortical breach and soft tissue extension.

Discussion

This case is remarkable because of the simultaneous presence of complete tibial involvement, contiguous talar extension, multiple recurrences, and pulmonary metastases. Most giant cell tumors remain localized around the epiphyseal region of a

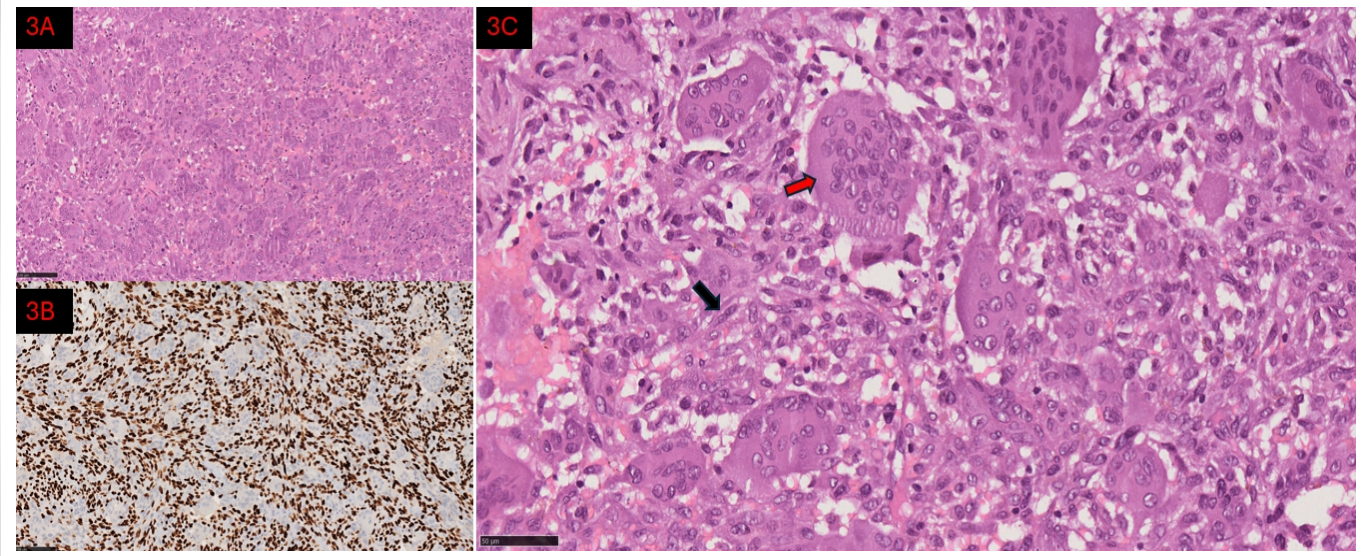

Figure 3: Histopathological and immunohistochemical findings. (a) The section shows sheets of neoplastic mononuclear cells admixed with osteoclast-like giant cells [100x, H&E] (b) H3.3G34W immunostain revealing nuclear positivity in the neoplastic cells and negative in osteoclast-like giant cells [100x] (c) Neoplastic mononuclear cells and osteoclast-like giant cells indicated by black arrow and red arrow, respectively [200x, H&E].

single bone. Diffuse involvement of an entire long bone is extraordinarily uncommon and creates major challenges for both oncological control and functional reconstruction [1,2,3]. Recurrent disease remains a major concern in GCTB [4]. Multiple previous surgeries may further compromise local anatomy and reduce reconstructive options. In the present case, four prior surgical procedures had already been performed before presentation. The extent of disease made conventional limb salvage reconstruction difficult and unlikely to provide a predictable functional outcome. The diagnosis was strengthened by H3.3G34W immunostaining. This marker has emerged as a highly specific diagnostic tool and is particularly useful in distinguishing GCTB from histological mimics [9]. Its routine incorporation into musculoskeletal pathology practice has improved diagnostic accuracy in recurrent and challenging cases. Denosumab has significantly altered the treatment landscape for advanced GCTB [5,6,7]. By inhibiting RANKL-mediated osteoclast activation, denosumab reduces osteolysis, promotes sclerosis, and may facilitate disease stabilization. Several studies have demonstrated favorable clinical and radiological responses in recurrent, unresectable, and metastatic disease. Selective arterial embolization represents another valuable treatment modality, particularly in highly vascular lesions and in patients for whom surgery is not feasible [8]. Embolization reduces tumor vascularity, improves symptoms, and may complement systemic therapy. In the present case, the combination of embolization and denosumab achieved durable disease control and avoided amputation.

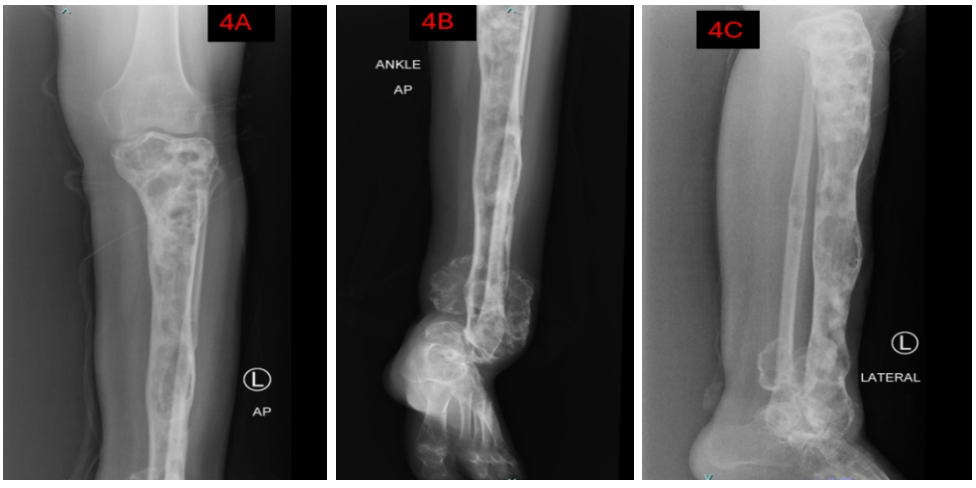

Figure 4: Follow-up radiographs at 24 months. (a,b) Anteroposterior view. (c) Lateral view showing disease stabilization.

Pulmonary metastases in GCTB should not automatically be interpreted as a marker of poor prognosis [1,3]. Unlike conventional sarcomas, metastatic GCTB often demonstrates indolent behavior. Stable disease or regression following denosumab therapy has been reported [5,7]. Our patient demonstrated a reduction in pulmonary nodules during follow-up. An important lesson from this case is the value of individualized treatment planning. Decisions should be based not only on oncological considerations but

also on expected function, patient preference, and feasibility of reconstruction. In selected patients, non-operative management may preserve limb function while maintaining acceptable disease control. Long-term surveillance remains essential because local recurrence and disease progression may occur after discontinuation of denosumab [10]. Continued monitoring of pulmonary lesions is equally important.

Conclusion

Extensive giant cell tumor involving the entire tibia with talar extension and pulmonary metastases is exceptionally rare. Combined selective angioembolization and denosumab provided durable disease control, symptom relief, and preservation of limb function in a patient who declined amputation.

Clinical Message

In extensive unresectable GCTB, especially when amputation is declined, combining denosumab therapy and selective angioembolization may provide an effective limb-preserving treatment strategy.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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