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Case Report

Total Spondylectomy for Upper Thoracic Spine Giant Cell Tumor: A Case Report

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Keywords
Giant Cell Tumor · Thoracic Spine · Spondylectomy · Recurrence · Radiotherapy · Preoperative Angiography

Abstract
Introduction: Giant cell tumors (GCT) are benign lesions that are generally locally aggressive tumors with occasional malignant behavior. These tumors are most frequently encountered in long bones; however, they also occur rarely in the spine. GCT of the spine are rare pathological entities, and spinal involvement shows a sacral predilection, with only a few cases involving the supra-sacral segment (mobile spine). Only a few cases of thoracic spinal GCT are reported in the literature; these tumors are particularly uncommon in the thoracic segment. ***Presentation of Case:*** A 29-year-old man presented with a complaint of neck pain over the previous six months that radiated to his left hand. GCT of the upper thoracic spine was diagnosed, which was surgically managed using a 2-stage approach involving total resection of the tumor followed by spondylectomy and multilevel spinal fixation. ***Discussion:*** Accurate diagnosis of vertebral column lesions, and choosing an optimum management plan are crucial. In the majority of cases, En-bloc resection of GCTs is not feasible ought to the close contact of the lesion with the spinal cord. Larger studies are encouraged to ascertain the efficacy of variable

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management approaches, particularly compared with piecemeal resection techniques. ***Conclusion:*** Spinal GCT are a unique group of tumors with an uncommon and unexpected presentation. Although surgery is the mainstay of treatment for spinal GCT, the management of this tumor can be challenging. No clear management algorithm has been established, and the tumor displays an unpredictable course. Therefore, each case needs tailored treatment.

Introduction

Giant cell tumors (GCT) of the bone are benign neoplasms typically classified as locally aggressive tumors that usually develop after skeletal maturity and show occasional malignant behavior [1–3]. GCT are involved in the pathology of metaphysis and meta-epiphysis of long bones, and infrequently affect the spinal column. When the spinal column is involved, the sacrum is most often involved, and occurrence in the mobile part of the spine is extremely rare (incidence rate, 1.4–9.4%) [1, 4].

Involvement of the spinal column occurs in <5% of primary bone tumors and in approximately 2–8% of all bone GCT [1, 3]. Mobile spine GCT comprise <2% of primary bone tumors of the spine, accounting for 2–5% of spinal GCT and <1% of all bone GCT [5]. These osteolytic lesions occur predominantly in females and present primarily during the 3rd or 4th decade of life [1, 3]. Spinal GCT tend to enlarge, leading to compression of adjacent nerve roots and vasculature, with variable manifestations. Multiple treatment plans with different outcomes are suggested in the literature. Although surgery is considered the mainstay of treatment, large prospective studies are needed to establish a treatment algorithm for spinal GCT.

Using CARE criteria [6], we describe the case of a patient who presented to our institution with a GCT involving the mobile upper thoracic vertebrae. Apparently, this is the first case of its kind to be reported from our region.

Presentation of Case

A 29-year-old man presented to the emergency department with a complaint of neck pain over the previous six months that radiated to his left hand. The pain was progressive, electrical in nature, and associated with numbness at C8-T1 dermatomes. He also complained of weakness for the previous seven days in fine movements of the left hand. This symptom was associated with a weak left-hand grip. Other medical and surgical history was unremarkable.

On clinical examination, marked atrophy of the hypothenar and interosseous muscles of the left hand was noted. Motor examination revealed weakness of left-hand muscles (power, 3/5). Preoperative imaging revealed marked osteolysis and collapse of the T1 vertebra along with an extensive soft tissue component (Fig. 1).

On magnetic resonance imaging, the lesion showed intermediate to low signal intensity on T1-weighted images and intermediate signal intensity on T2-weighted images with heterogeneous enhancement after gadolinium administration. The lesion affected the anterior and posterior longitudinal ligaments without significant compromise of the thecal sac (Fig. 2).

Surgery was accomplished in 2 stages. The 1st stage (anterior approach) involved gross total dissection at the T1 level with spondylectomy, as well as resection of a paravertebral soft tissue component of the tumor and decompression of the spinal cord, followed by anterior placement of a surgical plate and screws at C7-T2 levels. The 2nd stage (posterior approach)

involved bilateral laminectomy and excision of the remaining tumor soft tissue extension, followed by spinal hardwire (cage) fixation at C6-T4 levels (Fig. 3).

Postoperatively, the patient began improving. Pain intensity decreased dramatically along with gradual improvement in power of the left hand. The diagnosis of GCT was confirmed with histopathologic and immunohistochemical examination for specific GCT markers (Fig. 4, 5).

The patient was regularly re-examined for 10 months following surgery using thoracocervical computed tomography (CT) and clinical examinations to locate any local recurrence and possible distant metastatic lesions. He was scheduled for possible adjuvant radiotherapy at another institution.

Discussion

Cooper and Travers first described GCT of the bone in 1818; however, it was not until 1940 when Jeff et al. introduced the first classification approach, based on histopathological characteristics, for the diagnosis and differentiation of GCT from other bone pathologies [7]. GCT are osteolytic and primarily composed of multinucleated giant cells (osteoclast like cells) and mononuclear stromal cells, which are neoplastic and mitotic [8]. Spinal GCT are difficult to diagnose because their imaging and histological characteristics are similar to characteristics of other spinal neoplastic lesions such as primary spinal Aneurysmal Bone Cyst (ABC) and spinal hemangiomas. Further, GCT are the leading cause of secondary ABC, which adds to the complexity of these tumors [9]. However, some imaging and histopathologic differences exist between primary ABC and ABC secondary to GCT. Primary ABC is mainly cystic and ABC secondary to GCT displays mixed solid and cystic regions [9]. Moreover, spinal GCT usually affect the vertebral body, whereas primary ABC frequently occur in posterior spinal elements [3, 9, 10]. Thus, biopsy specimens should be obtained carefully to avoid any sampling errors and misdiagnoses.

Central giant cell lesion (CGCL) and GCT are bone lesions that share similar microscopic features. Although CGCL is considered one of the differential diagnosis of GCT and both entities share histopathological dominance of non-neoplastic osteoclast-like giant cells, immunohistochemical and cytogenetic studies are the only method to distinguish between GCT and CGCL. H3F3A p.Gly34 Trp or p.Gly34 Leu mutations are not often found in CGCL. Thus, the assessment of H3F3A mutations may help in the differential diagnosis of GCT and CGCL Which expressed by neural and vascular markers [11]. Moreover, CGCLs demonstrate focal immunopositivity for SMA, but immunoreactivity of GCT for SMA is controversial. For vascular markers, CGCLs show moderate to the strong expression of CD34 but GCT reveals no significant expression of the same marker [12]. In the retrospective review by Si et al. [9], plain radiography and CT showed similar imaging findings for expansile osteolytic lesions; however, cortical vertebral changes were more pronounced in CT scans. Spinal GCT have a higher rate of lung metastasis than GCT of long bones [2, 13]. Radicular pain is the most common presenting complaint in spinal GCT. Myelopathic complications can also occur because of spinal cord compression. Although it was previously believed that spinal GCT affect mobile spine segments equally, more recent studies have shown different distribution among mobile spine segments [1, 9, 10, 13, 14]. Total en-bloc spondylectomy and intralesional excision with or without adjuvant therapy are now widely used surgical techniques. Because of the locally aggressive nature of the tumors and their high rate of recurrence, total en-bloc spondylectomy including tumor margins is the optimal surgical option. This approach has reported better

prognosis and lower recurrence rate [14, 15]. However, this option is challenging because, in most cases, at diagnosis spinal GCT will have already invaded the cortex and extended to adjacent soft tissues in the thoracic region. Moreover, anatomical complexity and risk of injury to major structures and blood vessels associated with complete excision depend largely on tumor extent within vertebrae and related structures. In most cases for which total en-bloc resection is unfeasible, an alternative treatment can be subtotal or marginal intralesional excision followed by local adjuvant radiotherapy.

Enneking and Weinstein-Boriani-Biagini (WBB) staging systems may be useful in planning surgical treatment [14]. Application of this staging system for benign musculoskeletal tumors for spinal GCT is based on integrity of the tumor capsule and the extent of the surrounding reactive zone [14]. Campanacci et al. [16] classified GCT using a 3-grade system which is similar to Enneking staging. In the presented case, the lesion displayed evidence of cortical breakthrough and was accompanied by a soft tissue mass, which is consistent with Enneking stage III/Campanacci grade III. These classifications were designed to identify the extent of surgery needed for optimal tumor resection. However, the utility of radiology and histopathology for prognosis of spinal GCT local recurrence, aggressiveness, and outcomes is disputed [8, 17]. Boriani et al. [10] described a large series of GCT in the mobile spine; their data showed that total en-bloc resection is the preferred management for Enneking stage III tumors.

Other treatment options can be considered in addition to surgical resection for primary and recurrent lesions, including embolization, radiotherapy, cement implantation, and biological agents. As most lesions are hypervascular, preoperative embolization of GCT decreases the risk of intraoperative bleeding [18, 19]. Use of radiotherapy induces high rates of local control (up to 77% in both primary and recurrent cases of GCT) [20]. Furthermore, therapeutic radiation is considered the mainstay conservative treatment for inoperable GCT [13]. A recent systematic review of 42 patients suggests that GCT had a 100% response rate with 79% local control and 97.6% overall survival [13]. Moreover, no patients developed sarcomatous transformation after irradiation. The authors attributed this observation to recent improvements in radiotherapy safety [21]. Bone cement is used as an adjuvant to surgical resection to improve stability and to relieve intractable pain. Some authors have suggested that bone cement injection induces cytotoxic tumor necrosis [22, 23]. Trials of monoclonal antibody therapy for GCT, including denosumab as neoadjuvant chemotherapy, have shown favorable effects in combination with surgical downstaging, even in cases with extraosseous epidural extent [24]. Refai et al. [19] and Mahajan et al. [25] reported a combined approach in two cases that used preoperative embolization of the tumor vascular supply, followed by complete resection and postoperative radiotherapy, with no recurrence at 12 months after surgery. Preoperative embolization may provide better intraoperative control and significantly decrease intraoperative bleeding, allowing for better utilization of a dry surgical field and consequently maximizing the chances for total tumor resection. Further, postoperative adjuvant radiotherapy can provide better local control and may substantially decrease the high recurrence rate of spinal GCT. Finally, magnetic resonance angiography can be used before tumor embolization to rule out any spinal arterial feeders. Further studies are needed to assess the outcomes of this "3-step" management plan for spinal GCT.

Conclusion

GCT of the thoracic spine are difficult to treat because of their anatomical complexity and high recurrence rate. Tissue biopsy remains the "gold standard" for diagnosis of spinal GCT, and surgical tumor resection is the cornerstone of treatment. The 3-step management plan for spinal thoracic GCT may provide better outcomes and minimize additional surgery for recurrent tumors. However, in the absence of large prospective studies and a clear consensus on a standard treatment algorithm for spinal thoracic GCT, treatment should be individualized based on tumor extent and patient presentation.

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Statement of Ethics

As per the "Imam Abdulrahman Bin Faisal University (University of Dammam) Institutional Review Board," case reports do not require ethical approval, provided that there was no intervention and that no patient identifiers appear in the report. Written informed consent for publication of the manuscript and the related patient information has been obtained by King Fahd Hospital of the University, Imam Abdulrahman Bin Faisal University. A copy of the consent form is available for review by the Editor of this journal.

Disclosure Statement

The authors have no conflicts of interest to declare.

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Author Contributions

E.A. Al-Shamary, W.F. Al-Dhafeeri and A.M. Al-Sharydah wrote the original manuscript. Radiology image reporting was performed and interpreted by A.M. Al-Sharydah, and S.S. Al-Suhibani. H.A. Al-Kussaibi reported the pathology and interpreted the immunocytochemistry. The revision of the final manuscript was performed by W.M. Al-Issawi. E.A. Al-Shamary drafted the paper, and all authors read and approved the final manuscript.

References

1 Sanjay BK, Sim FH, Unni KK, McLeod RA, Klassen RA. Giant-cell tumours of the spine. J Bone Joint Surg Br. 1993 Jan;75(1):148–54.
2 Donthineni R, Boriani L, Ofluoglu O, Bandiera S. Metastatic behaviour of giant cell tumour of the spine. Int Orthop. 2009 Apr;33(2):497–501.
3 Luther N, Bilsky MH, Härtl R. Giant cell tumor of the spine. Neurosurg Clin N Am. 2008 Jan;19(1):49–55.
4 Biagini R, De Cristofaro R, Ruggieri P, Boriani S. Giant-cell tumor of the spine. A case report. J Bone Joint Surg Am. 1990 Aug;72(7):1102–7.
5 Shirakuni T, Tamaki N, Matsumoto S, Fujiwara M. Giant cell tumor in cervical spine. Surg Neurol. 1985 Feb;23(2):148–52.
6 Agha RA, Fowler AJ, Saeta A, Barai I, Rajmohan S, Orgill DP, et al.; SCARE Group. The SCARE Statement: consensus-based surgical case report guidelines. Int J Surg. 2016 Oct;34:180–6.
7 Jaffe HL. Giant cell tumor of bone. Its pathologic appearance, grading, supposed variants and treatment. Arch Path. 1940;30(5):993–1031.
8 Mavrogenis AF, Igoumenou VG, Megaloikonomos PD, Panagopoulos GN, Papagelopoulos PJ, Soucacos PN. Giant cell tumor of bone revisited. SICOT J. 2017;3:54.
9 Si MJ, Wang CG, Wang CS, Du LJ, Ding XY, Zhang WB, et al. Giant cell tumours of the mobile spine: characteristic imaging features and differential diagnosis. Radiol Med (Torino). 2014 Sep;119(9):681–93.
10 Boriani S, Bandiera S, Casadei R, Boriani L, Donthineni R, Gasbarrini A, et al. Giant cell tumor of the mobile spine: a review of 49 cases. Spine. 2012 Jan;37(1):E37–45.
11 Gomes CC, Diniz MG, Amaral FR, Antonini Guimarães BV, Gomez RS. The highly prevalent H3F3A mutation in giant cell tumours of bone is not shared by sporadic central giant cell lesion of the jaws. Oral Surg Oral Med Oral Pathol Oral Radiol. 2014 Nov;118(5):583–5.
12 Kumar VV, Krishanappa SJ, Prakash SG, Channabasaviah GH, Murgod S, Pujari R, et al. Quantification and correlation of angiogenesis with macrophages by histomorphometric method in central and peripheral giant cell granuloma: an immunohistochemical analysis. J Clin Diagn Res. 2016 Mar;10(3):ZC01–05.
13 Ma Y, Xu W, Yin H, Huang Q, Liu T, Yang X, et al. Therapeutic radiotherapy for giant cell tumor of the spine: a systemic review. Eur Spine J. 2015 Aug;24(8):1754–60.
14 Hart RA, Boriani S, Biagini R, Currier B, Weinstein JN. A system for surgical staging and management of spine tumors. A clinical outcome study of giant cell tumors of the spine. Spine. 1997 Aug;22(15):1773–82.
15 Bertoni F, Bacchini P, Staals EL. Malignancy in giant cell tumor of bone. Cancer. 2003 May;97(10):2520–9.
16 Campanacci M, Baldini N, Boriani S, Sudanese A. Giant-cell tumor of bone. J Bone Joint Surg Am. 1987 Jan;69(1):106–14. Available from: http://www.ncbi.nlm.nih.gov/pubmed/3805057
17 Klenke FM, Wenger DE, Inwards CY, Rose PS, Sim FH. Giant cell tumor of bone: risk factors for recurrence. Clin Orthop Relat Res. 2011 Feb;469(2):591–9.
18 Prando A, deSantos LA, Wallace S, Murray JA. Angiography in giant-cell bone tumors. Radiology. 1979 Feb;130(2):323–31.
19 Refai D, Dunn GP, Santiago P. Giant cell tumor of the thoracic spine: case report and review of the literature. Surg Neurol. 2009 Feb;71(2):228–33.
20 Feigenberg SJ, Marcus RB Jr, Zlotecki RA, Scarborough MT, Berrey BH, Enneking WF. Radiation therapy for giant cell tumors of bone. Clin Orthop Relat Res. 2003 Jun;411:207–16.
21 Cahan WG, Woodard HQ, Higinbotham NL, Stewart FW, Coley BL. Sarcoma arising in irradiated bone: report of eleven cases. 1948. Cancer. 1998 Jan;82(1):8–34.
22 Lee CG, Kim SH, Kim DM, Kim SW. Giant cell tumor of upper thoracic spine. J Korean Neurosurg Soc. 2014 Mar;55(3):167–9.
23 Paúl L, Santonja C, Izquierdo E. Complete necrosis of a spinal giant cell tumor after vertebroplasty. J Vasc Interv Radiol. 2006 Apr;17(4):727–31.
24 Yonezawa N, Murakami H, Kato S, Takeuchi A, Tsuchiya H. Giant cell tumor of the thoracic spine completely removed by total spondylectomy after neoadjuvant denosumab therapy. Eur Spine J. 2017 May;26(1 Suppl 1):236–42.
25 Mahajan R, Chhabra HS, Tandon V, Venkatesh R. Giant cell tumor of cervicothoracic region treated by triple corpectomy from posterior only approach: A case report with review of literature. J Craniovertebr Junction Spine. 2015 Oct-Dec;6(4):212–5.

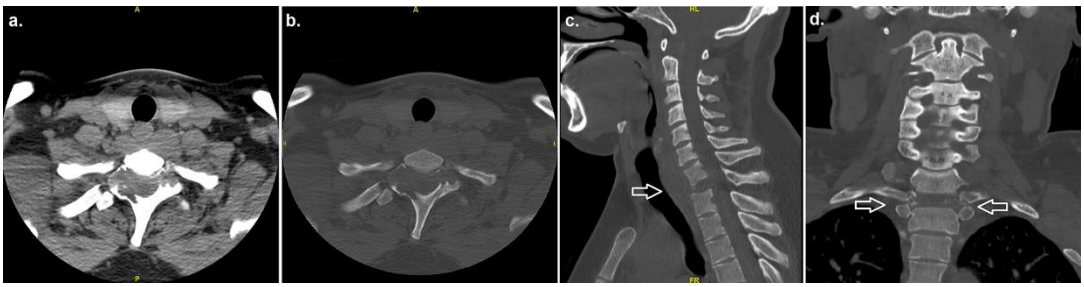

Fig. 1. Initial diagnostic CT scan of the cervical spine: Multiple planes of non-enhanced CT scan of the cervical spine in soft tissue (**a**) and bone window algorithms (**b–d**) demonstrate a T1 vertebral plana with thinning of the cortices associated with the paravertebral soft tissue mass lesion occupying bilateral pedicles and laminae splaying both anterior and posterior longitudinal ligaments (**a–d**).

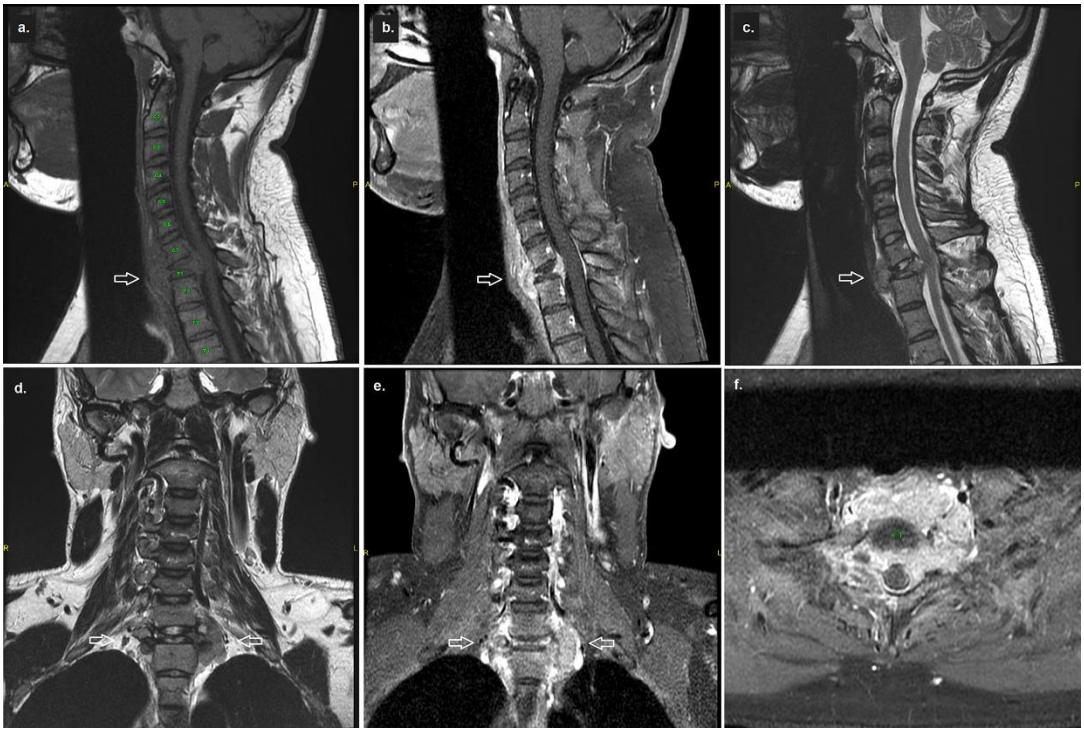

Fig. 2. Multi-sequential multiplanar magnetic resonance imaging of the cervicothoracic vertebrae, that show a flattening of the T1 vertebral body (vertebra plana), with an anteroposterior cortical bulge, resulting from the paravertebral soft tissue mass lesion (**a–e**). This lesion exerts an anterior mass effect upon tracheal and esophageal, as well as, posterior elements causing a significant compromise of the spinal canal (**a–c**, **f**). The lesion measures roughly 5 × 4 × 4.8 cm (transverse, AP, and CC diameters). The lesion displays intermediate to low signal intensity and intermediate signal intensity in the T1 and T2-weighted image, respectively, relative to gray matter. The lesion demonstrates homogenous enhancement with the epidural enhancing component (**b**, **e**, **f**). A focal cystic area is seen within the lesion tracing along the right exiting neural foramina at the same level (**f**). However, disc spaces are spared (**a–e**).

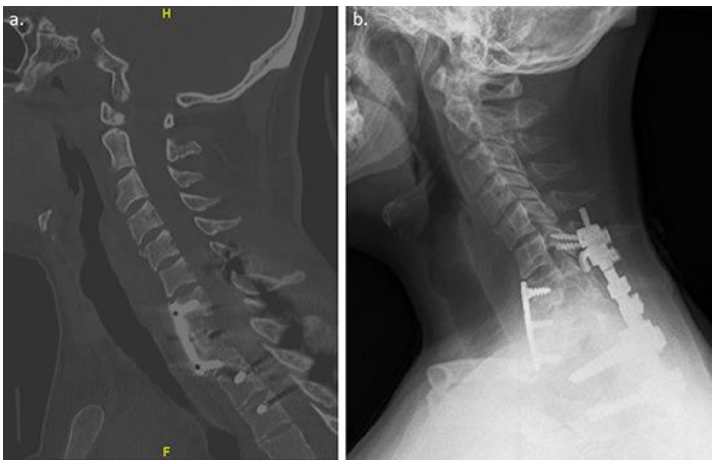

Fig. 3. Follow-up post-operative images. (**a**) Plain CT scan of cervical spine on sagittal plane. (**b**) Cervicothoracic spine X-ray considered from the lateral view. Both images demonstrate status post complete T1 vertebra distraction with debulking of proven giant cell tumor by histopathology with applied anterior and posterior fixation hardwares.

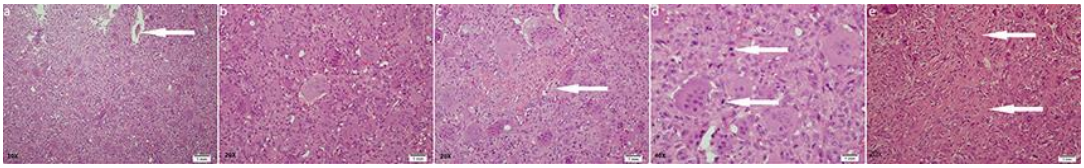

Fig. 4. Histopathological confirmation: Microscopic examination (Hematoxylin & Eosin staining) revealed (**a**) sheets of polygonal to oval mononuclear cells showing cytologically benign nuclei, in a background of abundant evenly distributed multinucleated osteoclast-like giant cells having numerous nuclei similar to the mononuclear cells' nuclei. (**b**) Intravascular plugs by giant cells (arrow). (**c**) Focus of necrosis (arrow). (**d**) Several mitotic figures (arrows). (**e**) Focal areas of fibrosis are also seen (arrows).

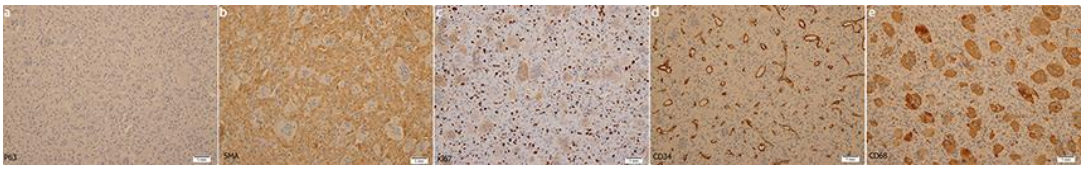

Fig. 5. Immunohistochemical studies: (**a**) Immunohistochemical studies revealed that mononuclear tumor cells are diffusely positive for SMA (smooth muscle actin) (**b–d**) but negative for CD34, CD68 and P63. (**b**) CD34 highlights delicate vascular network in the background. (**c**) CD68 highlights multinucleated giant cells. (**e**) Mononuclear tumor cells showed moderate proliferative activity (10–15% of tumor cells are positive for Ki67).