

# Brown tumor as an unusual but preventable cause of spinal cord compression: Case report and review of the literature

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## ABSTRACT

Brown tumor (BT), also known as osteoclastoma, may appear in the context of primary and secondary hyperparathyroidism. Spinal cord compression due to the BT is extremely rare. We present here an unusual case of BT involving thoracic spine and mandible. A 26-year-old woman, who had been on hemodialysis for chronic renal failure for over 6 years, got admitted with dorsal pain and progressive weakness in her lower extremities and gait disturbances. Neurological examination revealed spastic paraparesis and symmetrically hyperactive tendon reflex in the lower extremities. She had hypoesthesia under T10 level. On physical examination, a swelling on the left side of her jaw was also detected. Magnetic resonance imaging (MRI) showed cord compression due to an extradural mass lesion at T8 level. A computerized tomography (CT) scan showed that this expansile lytic lesion was caused by the collapse of vertebra corpus (T8) at that level. CT of the mandible revealed an expansile lytic lesion on left arm of the mandible. Laboratory findings were nearly normal except parathormone level elevation to 1289 pg/mL (normal 30-70 pg/mL). Ultrasound examination showed enlargement of the parathyroid glands. The patient underwent an emergency decompression and stabilization surgery. The lesion was fragile and reddish in appearance and was easy to aspirate. The tumor was reported as "BT." Her weakness in the lower extremities improved in the early postoperative period. Following surgical intervention, the patient was transferred to nephrology clinic for additional medical treatment.

**Key words:** Brown tumor, hyperparathyroidism, osteitis fibrosa cystica, spinal cord compression, spine

## Introduction

Brown tumor (BT), also termed osteoclastoma, is a histologically benign focal lytic bone tumor caused by primary or secondary hyperparathyroidism.<sup>[1]</sup> It is called BT because high hemosiderin level of localized accumulation of osteoclasts, fibrous tissue, and blood gives characteristic brown color.<sup>[2]</sup> The first case of primary hyperparathyroidism involving the spine was reported by Shaw and Davies<sup>[3]</sup> in 1968. BT is found in 3 and 1.5-1.7% of patients with primary and secondary hyperparathyroidism, respectively.<sup>[4]</sup> The most common cause

of BT is a solitary adenoma, followed by hyperplasia and carcinoma in primary hyperparathyroidism<sup>[5,6]</sup> and long-term hemodialysis therapy in secondary hyperparathyroidism.<sup>[7,8]</sup>

BT can emerge as solitary or multiple lesions and can be seen both within bone and adjacent tissue and mainly involves facial bones (mandible, maxilla), pelvic bones, sternum, ribs, phalanx, and femur.<sup>[1,2,4,9]</sup> Multiple BT rarely is rarely found in a patient<sup>[10-12]</sup> and it rarely locates in vertebra,<sup>[13]</sup> In this report, a case of a BT located in mandible and thoracic vertebra is presented with an extensive review of the literature.

## Case Report

A 26-year-old woman, who had been on hemodialysis for chronic renal failure for over 6 years, got admitted with a 10-day history of dorsal pain, progressive weakness in her lower extremities, and gait disturbances. Neurological examination revealed spastic paraparesis and symmetrically hyperactive tendon reflexes in the lower extremities. She had bilateral Achilles clonus and hypoesthesia under T10 level. On physical examination, a swelling on her left side of jaw was also detected. Magnetic resonance imaging (MRI) showed cord compression due to an extradural mass lesion at T8 level [Figure 1a]. The lesion had a heterogeneous intensity on

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**Figure 1:** (a) Sagittal T2-weighted MRI demonstrating a heterogeneous lesion at T8 level. (b) On CT scan, the destruction of the corpus of the vertebra is seen clearly. The hyperdensity of the lesion on non-contrast sagittal CT image is remarkable. (c) Tumor is located on the mandible (black arrow). (d) The postoperative sagittal CT image showing the posterior fixation of the spine

T2-weighted images. A computerized tomography (CT) scan [Figure 1b] showed that this expansile lytic lesion was caused by the collapse of vertebra corpus (T8) at that level. CT of the mandible revealed an expansile lytic lesion on left arm of the mandible [Figure 1c]. Laboratory findings were nearly normal except parathormone (PTH) level elevation to 1289 pg/mL (normal 30-70 pg/mL), and total serum calcium and serum phosphorus were 9.8 mg/dL (8.4-10.2 mg/dL) and 3.8 mmol/L (2.7-4.5 mmol/L), respectively. Ultrasound examination showed enlargement of the parathyroid glands. The patient consulted with nephrology clinic and an emergency surgery was planned as she had progressive neurological deficit. The lesion was fragile and reddish in appearance and was easy to aspirate. The tumor was removed and rigid T5–11 stabilization was performed [Figure 1d]. The lesion was reported as “BT” [Figure 2]. Her weakness in the lower extremities improved in the early postoperative period. Following surgical intervention, the patient was transferred to nephrology clinic for additional medical treatment.

In the literature, including the presented case, we found 42 cases of vertebral BT (27 cases caused in secondary and 15 cases in primary hyperparathyroidism). Thirteen of the 27 BTs due to secondary hyperparathyroidism were females. The average age of them was 38.7 years (range 19-69 years) and dorsal vertebrae were the most commonly involved site in 16 cases [Table 1]. Ten of the 15 BT cases due to primary hyperparathyroidism were females. The average age of them was 48.4 years (range 23-69 years) and dorsal vertebrae were the most commonly involved site in 9 cases [Table 2].

Paraparesis and paraplegia were the most seen symptoms due to the spinal cord compression. Pain, radiculopathy, and numbness were the other presenting symptoms of the patients.

In 10 of the 15 primary hyperparathyroidism cases, parathyroid adenoma resection with tumor excision was the choice of



**Figure 2:** Hematoxylin and eosin with  $\times 100$  magnification; lots of multinucleated giant cells (black arrows) separated by spindle-shaped mononuclear cells

the treatment. In one case, parathyroid adenoma resection following BT excision was not accepted by the patient. The number of patients who underwent parathyroid adenoma resection with tumor excision were only 8 among 27 cases of secondary hyperparathyroidism. In six cases including the presented case, only tumor resection was performed. Only biopsy was performed in three cases of the secondary BT tumors.

## Discussion

When the homeostasis is disturbed between PTH and calcium, hyperparathyroidism occurs with an excess of PTH that causes multiple actions on bone, both directly or indirectly.<sup>[12]</sup> Peritrabecular fibrosis (osteitis fibrosa) and increased osteoclastic activity secondary to phosphate retention and impaired vitamin D synthesis cause erosive bony lesions that are called BTs or osteitis fibrosa cystica.<sup>[14]</sup> BT is a classic manifestation of hyperparathyroidism (primary and/or secondary) and is characterized by bone pain and radiographic

**Table 1: Review of the reported cases of spinal brown tumors due to secondary hyperparathyroidism**

Author	Age/Sex	Presenting symptom	Location	Treatment
Ericsson <i>et al.</i> <sup>[16]</sup>	47/F	Paraparesis, arm pain	C7, T1	Tumor resection Parathyroidectomy
Bohlman <i>et al.</i> <sup>[29]</sup>	69/F	Paraplegia	T8	Biopsy Steroids
Pumar <i>et al.</i> <sup>[34]</sup>	24/F	Paraparesis	T8	Tumor resection -
Barlow and Archer <sup>[21]</sup>	31/F	Neck and arm pain	C5	Biopsy Parathyroidectomy
Fineman <i>et al.</i> <sup>[17]</sup>	37/F	Paraparesis	T9	Tumor resection Parathyroidectomy
Kharrat <i>et al.</i> <sup>[35]</sup>	46/M	Lower extremity pain	T and L (multiple)	- Parathyroidectomy
Mourelatus <i>et al.</i> <sup>[36]</sup>	48/M	Paraparesis and incontinence	T2	? ?
Azria <i>et al.</i> <sup>[33]</sup>	40/M	Neurologically normal	T?	Parathyroidectomy
Masutani <i>et al.</i> <sup>[30]</sup>	39/F	Paraplegia	T4, T7	Tumor resection Parathyroidectomy
Torres <i>et al.</i> <sup>[37]</sup>	24/F	Paraparesis	Midtorcal vertebra	Tumor resection ?
Paderni <i>et al.</i> <sup>[27]</sup>	45/F	Paraparesis	L2, 3, 5, and S1	Tumor resection
Vandenbussche <i>et al.</i> <sup>[1]</sup>	37/F	Paraparesis	T8	Biopsy+tumor resection Parathyroidectomy
Tarras <i>et al.</i> <sup>[26]</sup>	42/M	Cauda equina syndrome	S1	Tumor resection Parathyroidectomy
Kaya <i>et al.</i> <sup>[32]</sup>	72/M	Arm pain, paresis	T1	Biopsy+tumor resection -
Ren <i>et al.</i> <sup>[8]</sup>	47/M	Paraparesis	T4	Tumor resection ?
Pavlovic <i>et al.</i> <sup>[13]</sup>	40/M	Paraplegia	T9	Biopsy+tumor resection -
Noman Zaheer <i>et al.</i> <sup>[2]</sup>	30/M	Back pain, compression syndrome	T12	Tumor resection -
Mak <i>et al.</i> <sup>[7]</sup>	65/F	Pain, paraparesis	T8	Tumor resection -
Geith <i>et al.</i> (2010)	19/M	Cauda equina syndrome	L3	Tumor resection Parathyroidectomy
	25/F	Pain, numbness	C4, C5	Tumor resection Parathyroidectomy
Mateo <i>et al.</i> <sup>[23]</sup>	34/M	Cervical pain	C2	Biopsy Parathyroidectomy
Fargen <i>et al.</i> <sup>[10]</sup>	33/F	Paraparesis	L1	Tumor resection -
Resic <i>et al.</i> <sup>[9]</sup>	27/M	Neck, arm, and leg pain	C6	Tumor resection
Bertal <i>et al.</i> <sup>[38]</sup>	19/M	Bilateral lower-extremity weakness	L1	Biopsy -
Duval-Sabatier <i>et al.</i> <sup>[22]</sup>	32/M	Back pain	T5	Tumor resection Parathyroidectomy
Arujau <i>et al.</i> <sup>[15]</sup>	47/M	Paraplegia	T5	Tumor resection
Hakan, present case	26/K	Paraparesis	T8	Tumor resection -

**Table 2: Review of the reported cases of spinal brown tumors due to primary hyperparathyroidism**

Author	Age/Sex	Presenting symptom	Location	Treatment
Shaw and Davies <sup>[3]</sup>	58/F	Paraparesis syndrome	T10	Tumor resection Parathyroid adenoma resection
Shuangshoti <i>et al.</i> <sup>[39]</sup>	32/M	Paraparesis	L4	Tumor resection Parathyroid adenoma resection
Siu <i>et al.</i> <sup>[40]*</sup>	63/F	Paraplegia	T10	Tumor resection Parathyroid adenoma resection
Sundaram and Scholz <sup>[6]*</sup>	63/F	Paraplegia	T10	Tumor resection Parathyroid adenoma resection
Ganesh <i>et al.</i> <sup>[41]</sup>	40/M	Paraparesis, pain	T2	- Parathyroid adenoma resection
Yokota <i>et al.</i> <sup>[28]</sup>	58/F	Paraparesis	T5	Tumor resection Parathyroid adenoma resection
Kashkari <i>et al.</i> <sup>[42]</sup>	51/F	Paraparesis	T6, T7	Tumor resection Parathyroid adenoma resection
Daras <i>et al.</i> <sup>[11]</sup>	54/F	Paraparesis	T9	Tumor resection -
Graziani <i>et al.</i> <sup>[43]</sup>	64/F	Unilateral paresis and arm pain	C6	Tumor resection Parathyroid adenoma resection
Sarda <i>et al.</i> <sup>[44]</sup>	23/F	Paraparesis	T3	Tumor resection Parathyroid adenoma resection
Moteanu <i>et al.</i> <sup>[24]</sup>	57/M	Lower extremity radiculopathy	L4	Tumor resection -
Mustonen <i>et al.</i> <sup>[25]</sup>	28/M	Lower extremity radiculopathy	L2	- Parathyroid adenoma resection
Haddad <i>et al.</i> <sup>[18]</sup>	62/F	Paraparesis	T2, T3, 4, T	Tumor resection Parathyroid adenoma resection
Khalil <i>et al.</i> <sup>[45]</sup>	69/M	Lower extremity radiculopathy	L2	Tumor resection -
Altan <i>et al.</i> <sup>[46]</sup>	44/F	Low back pain	S2	Tumor resection Parathyroid adenoma resection
Hoshi <i>et al.</i> <sup>[12]</sup>	23/F	Lower extremity pain	Sacrum	- Parathyroid adenoma resection

changes typically showing bone resorption.<sup>[15]</sup> As the primary hyperparathyroidism was responsible for BT mostly in the past, the secondary hyperparathyroidism is on the rise nowadays probably because of advances in treatment of the patients with end-stage renal disease receiving hemodialysis.<sup>[10]</sup> The first

case of secondary hyperparathyroidism involving the spine was reported by Ericsson *et al.*<sup>[16]</sup> in 1978. BT occurs mostly as isolated masses, but disseminated ones mimicking metastases have also been reported.<sup>[5,11-13,17-19]</sup> Joyce *et al.*<sup>[20]</sup> were the first who reported multiple BTs in primary hyperparathyroidism

due to adenoma mimicking metastasis in 1994. In the presented case, there were two BTs which were localized: One in spine and the other in mandible.

The clinical symptoms of spinal BTs consist of pain,<sup>[21-23]</sup> radiculopathy,<sup>[24,25]</sup> cauda equina syndrome,<sup>[14,26]</sup> paraparesis,<sup>[3,10,27,28]</sup> and paraplegia.<sup>[13,29,30]</sup> In the presented case, swelling and pain of the jaw were additional to the paraparesis and dorsal pain.

Diagnosis of BTs depends on clinical, biochemical, radiological, and pathological factors.<sup>[4]</sup> BT does not have specific imaging characteristics; it can mimic metastases or multiple myeloma. Sarcomas as well as giant cell reparative granulomas, lymphangiomatosis, leukemia, Langerhans cell histiocytosis, multiple bone cysts, aneurysmal bone cysts, and non-ossifying fibromas are the other lesions that should be kept in mind as the differential diagnosis.<sup>[4,13,23]</sup> BT is represented with an area of expanding osteolysis with jagged sharp outline and sclerotic rim on plain radiographs.<sup>[1,11]</sup> Radiographs can also show compression<sup>[6,17]</sup> or collapse<sup>[7]</sup> of the vertebra corpus as in the presented case. On CT, osteolytic and expansile tumor with soft tissue density replaces the cancellous bone of the corpus of the vertebra.<sup>[7,10,23]</sup> Spinal magnetic resonance imaging (MRI) can show bone infiltration and paravertebral and intraspinal soft tissue masses with neural compression.<sup>[14]</sup> On MRI, BT is hypointense on T1-weighted images and hyper/hypointense on T2-weighted images.<sup>[10,23]</sup> Similarly, in the present case, T2-weighted images demonstrated a lesion with heterogeneous intensity. There were both hypointense and hyperintense areas in the lesion; the center of the lesion was hyperintense and the surrounding area was isointense. On CT, the osteolytic and soft tissue parts of the tumor were easily seen.

True neoplastic lesions such as giant cell tumor of the bone may have very similar findings as BT. The histologic similarities between a giant cell tumor of hyperthyroidism and a BT were pointed out by Jaffe<sup>[31]</sup> in 1933. Giant cell tumor of bone most commonly involves the epiphyses of the long bones. In the microscope, giant cells of BT are usually arranged in clusters, but in giant cell tumor the giant cells tend to be disturbed regularly and uniformly.<sup>[13]</sup> Beside the proliferation of multinucleated giant cells and fibrous stroma with spindle-shaped mononuclear cells, focal hemorrhage and hemosiderin deposition can be observed.<sup>[11,12,14]</sup> Neither cellular atypia nor mitotic figures are observed in BT.<sup>[28]</sup> But indeed, there are no available histological criteria distinguishing BT from giant cell tumor.<sup>[1]</sup> Presence of severe hyperparathyroidism and widespread bony changes with patient's medical history help in diagnosis of BT.

The best treatment for BT is to prevent it. Secondary hyperparathyroidism should be monitored and prevented with prolonged dialysis sessions.<sup>[7,8,17]</sup> Normalizing blood levels of calcium and phosphate should be the goal of

prevention in dialysis-dependent patients. Serum phosphate levels should be controlled, dietary phosphorus intake should be restricted, and a high phosphate clearance dialyzer should be selected. Use of phosphate binders, vitamin D, oral calcium supplements, and calcimimetics is recommended for treatment. Biphosphonate infusion therapy – before and after operation<sup>[32]</sup> or preoperative<sup>[33]</sup> – is recommended for resolution of the clinical symptoms.<sup>[32,33]</sup> Total or subtotal parathyroidectomy is valuable for treatment of BT; it usually provides complete clearance of the lesions with remineralization of the vertebra.<sup>[1,12,23]</sup> It eliminates excessive activation of the PTH and usually leads to significant regression of BT.<sup>[18]</sup> Fargen *et al.*<sup>[10]</sup> reported a case of spinal BT which occurred 7 years after subtotal parathyroidectomy and stressed that it will be wise to monitor the laboratory findings of the patients for avoiding recurrence in case of presence of residual parathyroid tissue. Parathyroidectomy and medical treatment may be used together.<sup>[32,33]</sup> The neurological situation of the patient is very important in case of spinal involvement. Emergency decompression can be mandatory for achieving good outcome.<sup>[1,7,8,32]</sup> Extensive osteolysis and involvement of the mobile vertebral segment requires fixation of the vertebra<sup>[1,8,10,17,32]</sup> as the presented case. If the spinal alignment is confirmed radiologically and/or intraoperatively, the patient can be subjected to orthosis without spinal fixation.<sup>[10]</sup>

In conclusion, BT should be remembered in the differential diagnosis of spinal cord compression, especially in the patients with end-stage renal disease. Prevention should be the goal for treatment and patients with the end-stage renal disease should be monitored. Promptly performed decompression surgery may improve the neurological deficits of the patients.

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