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Case Report

Primary paraganglioma of the thoracic spine: a rare case report and review of literature

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Abstract: *Background:* Paragangliomas (PGLs) are neuroendocrine tumors that arise from the neuroepithelial cell group called paraganglia. Spinal paragangliomas (SPs) are extremely rare, most of which are observed as intradural tumors in the cauda equine, the filum terminale, and the lumbosacral region, but rarely in the thoracic region. We aimed to study the clinical, radiographic and pathologic characteristics of spinal paragangliomas and review related literatures. *Methods:* This report presented the case of a 46-year-old male patient who was suffered with pathological fracture of the thoracic spine (T4) causing incomplete spinal cord injury. With no other lesions observed, the patient was diagnosed as primary paraganglioma of the thoracic spine. *Results:* Under general anesthesia, total en bloc spondylectomy (TES) via a single posterior approach was performed followed by bone graft fusion using titanium mesh and pedicle screw fixation system. *Conclusion:* This rare case report might be helpful for the future study of the clinical, radiographic and pathologic characteristics of spinal paragangliomas.

Keywords: Paraganglioma, thoracic spine, spinal reconstruction, total en bloc spondylectomy

Introduction

Paragangliomas are originate fromneural crest cells, arising from sympathetic or parasympathetic neural paraganglia. The rare neuroendocrine tumors could locate at various sites in the body. Paragangliomas of spine mainly locate in the lumbosacral region, cauda equina and filum terminale area within the spinal canal. Malignant paragangliomas frequently combine with bone metastasis, but spinal bone metastasis is rare. In the spine, the most affected segment is the lumbar region. Thoracic spinal gangliomas are distinctly unusual, and so far only six cases have been described [1-4]. Here, we reported a case of primary thoracic spinal paraganglioma, obtaining satisfactory curative effect with en bloc tumor resection and reconstruction. The aim of this study was to describe a rare case of paraganglioma in the thoracic spine, and also to review the literature on this topic.

Case description

The patient was a 42-year-old man who reported that he had suffered from painfully swollen in the thoracodorsal region for five years, with progressively weakness of both lower extremities for three months. Five years prior to hospital admission, the patient felt swelling pain around the chest and back, with unclarified etiology. The pain is more obvious after long standing and holding heavy object with upper limbs. Nearly three months ago, the swelling pain of chest and back is further exacerbated, causing burning sensation and progressively loss of muscle strength in both of lower extremities. Since the onset of the disease, the patient has showed normal cauda equina function with no body weight changes.

Physical examination was carried out. No superficial lymph nodes swelling around the body was found, and the examinations of heart, lung, and abdomen were normal. The spine showed no kyphotic-scoliotic deformity. Localized tenderness and percussion pain were positive around the spinous process of T4. Pain, touch, and temperature sensation below the nipple flat on both sides were decreased. Muscular tone was strengthened in both of the lower limbs. The strength of bilateral quadriceps, tibialis anterior

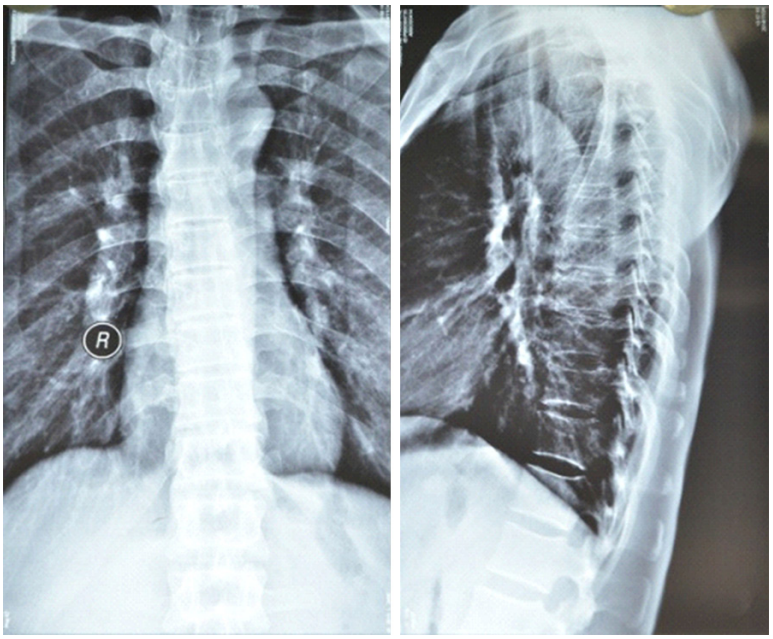

Figure 1. Radiograph of the thoracolumbar spine, showing osteolysis of T4 vertebral body.

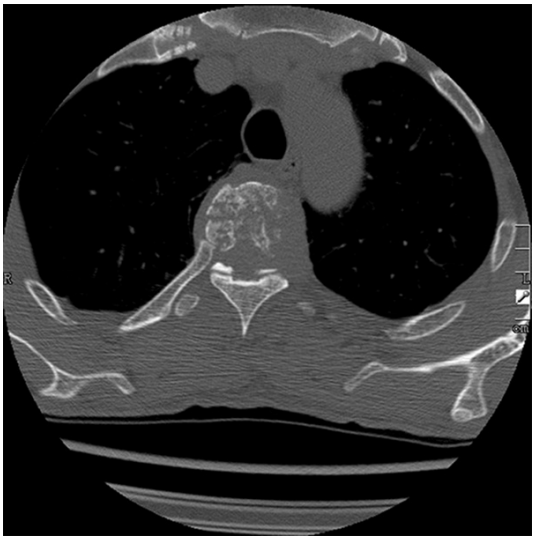

Figure 2. Axial CT image showing more severe osteolysis on the left side of T4 vertebra and vertebral pedicle.

muscle, thumb long extensor, and extensor digitorum longus were level III. The strength of triceps surae was level VI. The reflection of abdominal wall on both sides and cremasteric reflex were diminished. Patellar tendon reflex and Achilles tendon reflex were increased. Bilateral Babinski sign is positive. The VAS pain score is 7. No special family history, such as schwannomas, neurofibromas, or other brain and spinal cord tumors were reported.

Imageological diagnosis was performed. X-ray of thoracic vertebra showed osteolytic bone destruction in T4 vertebra, with ground-glass opacity surroundingly and narrowing of intervertebral space (**Figure 1**). Axial CT image showed more severe osteolytic bone destruction in the left side of T4 vertebra and vertebral pedicle, even invading into the fourth ossa costa, and abnormal changes in tissues adjacent to vertebral (**Figure 2**). Sagittal CT image showed T4 vertebral collapse caused by osteolytic destruction (**Figure 3**). MRI showed that T4 vertebra was compressed and flattened. The lesion was hypointense on T1-weighted images and hyperintense on T2-weighted images. Centrum posterior kyphosis and placeholder in spinal canal compressing the spinal cord were observed. No obvious abnormal signal was found in the spinal cord (**Figure 4**). ECT showed a sheet of condensed radioactive accumulation in T4 vertebra, without any abnormal radioactive density collective focus and defect inother bone area (**Figure 5**). Based on the above examination results, a presumptive diagnosis of spinal tumor was made.

Before surgery, vertebral pedicle biopsy was carried out. Grossly, pathological results suggested a soft cellular neoplasm with taupe color comprised of nests and tubular adenoid tumor cells (**Figure 6**), divided by small vascular interstitium that was rich and dilated into blood sinus. Immunohistochemically, the tumor cells were positive for CgA, Syn and CD56, and negative for S-100, GFAP, CKp, EMA and Vimentin. The proportion of Ki-67-positive cells was low (index: 1-3%) (**Figure 7**). On the basis of histologic and immunohistochemical features, a diagnosis of primary paraganglioma in the the fourth thoracic spine was made.

Total en-bloc spondylectomy (TES) and bone graft fusion using titanium mesh and pedicle

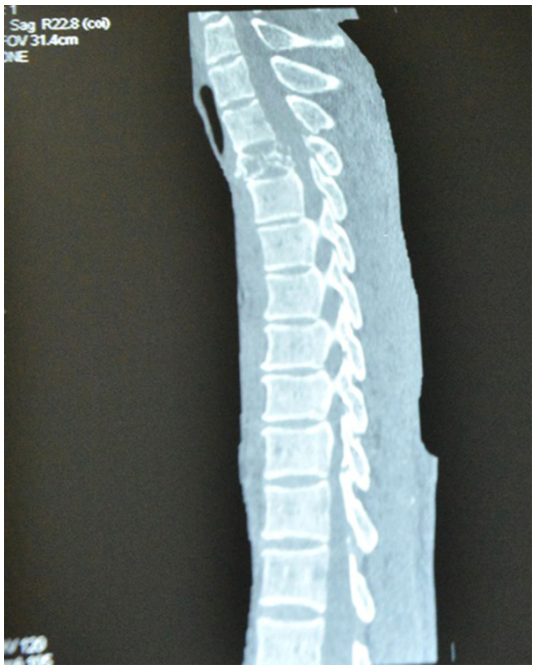

Figure 3. Sagittal CT image showing T4 vertebral collapse.

screw fixation system (4.0 mm diameter and 40 mm in length implanted at T2, T3, T5, and T6) were performed. On the left side of the separated vertebral body, tumor was found to erode the cortex, but still not penetrate into adjacent soft tissues. Anterior and middle spine column reconstruction was then achieved using titanium meshes filling with allogeneic bone. The postoperative pathological examination was consistent with that of preoperative. The chest and back pain of the patient was greatly relieved postoperatively. Two weeks after the operation, the VAS score is 3. Combined with 3 courses of hyperbaric oxygen treatment, the muscular strength of double lower limbs recovered to Level IV one month after the operation. Three months after the operation, the imaging test showed neither loose nor broken of internal fixation (**Figure 8**). Unfortunately, the patient died in a car accident when followed up to 5 months.

Discussion

Paraganglioma is an uncommon vascularized extra-adrenal tumor of neuroectodermal origin representing 0.012% of all tumors of the body [5]. Although most paragangliomas occur sporadically, some are associated with familial syndromes such as Von Hippel-Lindau disease, multiple endocrine neoplasia type 2, neurofibromatosis type 1, or Carney's syndrome [6]. Paragangliomas are generally considered slow-growing and typically present in the fifth and sixth decades of life [7]. 90% of paraganglioma cases occur in the carotid body and bulbus venae jugular, and only about 90 cases has been reported involving the spine in the current literature [8, 10]. Retrospective analysis of recent ten years literature shows that the incidence of primary spinal paraganglioma is not increased, and the male/female ratio is 1.7:1 [16, 17].

Although most patients with spinal paragangliomas are asymptomatic, spinal paragangliomas could lead to pathologic fracture of vertebral body and compression of spinal cord and cauda equine, involving manifestations, such as low back pain, hypokinesia of lower extremities, and dysfunction of intestine and bladder [17-21]. According to the tumor's ability to secrete catecholamines or other hormonal substances, paragangliomas can be subdivided into functional or non-functional categories. Most cases drop into the former category [22]. Only one case of functional spinal paraganglioma that could secrete catecholamines was reported up to now, and besides symptoms of spinal nerve compression, this type of spinal paraganglioma also presents with elevated blood pressure, facial flush, tachycardia, diaphoresis, tremor, weight loss, nausea and emesis due to the release of high concentrations of catecholamines [23]. The present case mainly presents with destruction of T4 vertebral body caused by tumor growth, local pain due to microfracture, symptoms of spinal compression caused by tumor invasion into corresponding vertebral canal, decreased sensation below the nipple flat on both sides, and lower limb dysfunction.

The CT features of spinal paragangliomas revealed homogeneous masses, and homogeneously enhanced hypervascular tumor in contrast enhanced CT scan, sometimes including calcification, bone destruction, pathological fracture, and enlargement of foramen intervertebrale. The MRI characteristics of the present case are quite typical for paragangliomas including low/intermediate signal intensity on T1-weighted scansand intermediate/high signal intensity on T2-weighted scans. A classic

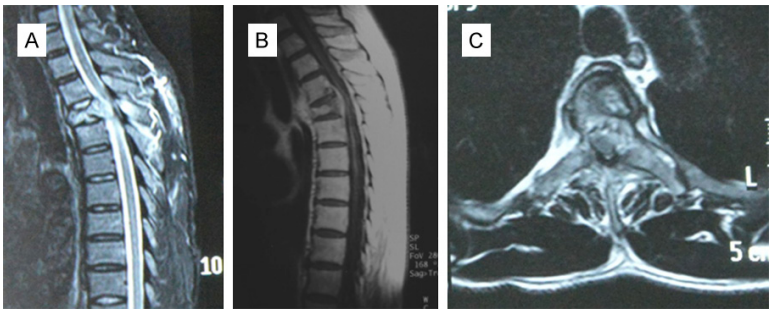

Figure 4. MRI showing T4 compressed and flattened vertebra. A: T2 sagittal MRI showing hypersignal and destruction of the vertebral body; B: T1 sagittal MRI showing vertebral compression in the spinal cord and destruction of the vertebral body, while sparing adjacent discs; C: Axial MRI at the T4 level showing a left paraspinal soft tissue mass.

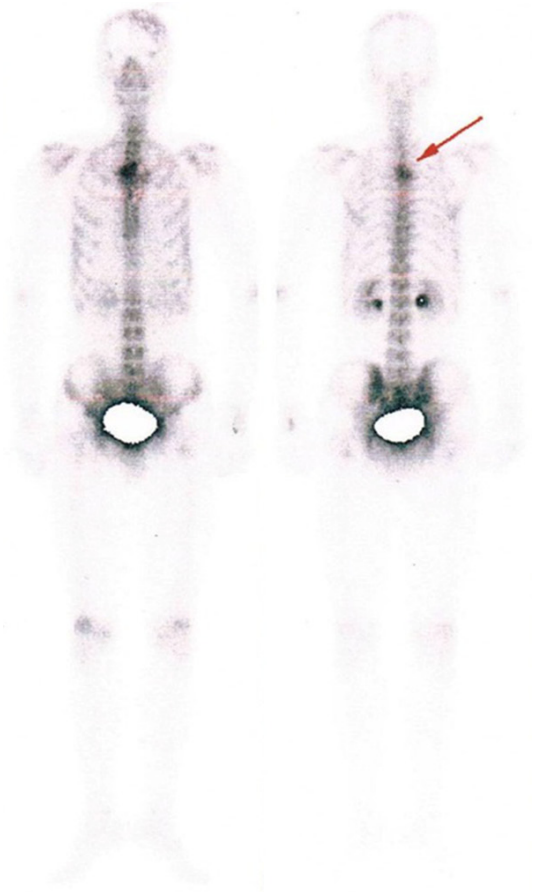

Figure 5. ECT showing a sheet of condensed radioactive shadow in T4 vertebra.

characteristic of paragangliomas is "salt and pepper" sign, which is used to refer to a speckled appearance of tissue in T2WI resulting from a rich vascular nature of paragangliomas [24-28].

Considering the lack of characteristic clinical manifestations of spinal paraganglioma and its low incidence, the preoperative diagnosis is difficult. As MRI manifestation of paraganglioma is not typical, other tumors that are rich in blood vessels, such as vascular tumor, hemangioma, and etc. should also be considered. The confirmed diagnosis can only be made depending on the histopathological examination, in which paragangliomas are mainly composed of nests (Zellballen) of round-to-oval chief cells surrounded by delicate septae composed of sustentacular cells, with minimal exhibition of pleomorphism and mitotic activity [7]. However, myxopapillaryependymoma and schwannoma have the same histopathological manifestations with paragangliomas, but show different immunohistochemical characteristics. Thus, for further identification and confirmation of paraganglioma, immunological stains for chromogranin A, synaptophysin, or S100 protein are necessary and critical [29]. Most paragangliomas are defined as benign in nature, only 10-20% possessing metastatic potential [30, 31]. The accepted criteria for determining the malignancy of paraganliomas preoperatively are based on whether there is tumor spread to regional lymph nodes or distant metastasis [32, 33].

In the treatment of paragangliomas, chemotherapy is ineffective [37], and radiotherapy is only feasible in terms of palliative for pain or prevention of fracture [38, 39], thus completely resection of tumor is the preferred treatment method for spinal paragangliomas [10, 35, 36]. If the tumor could be eradicated after one-stage operation, most patients could get relief and have good life quality with low tumor recurrence [33]. Surgical resection is also suggested for the treatment of malignant paragangliomas, but the prognosis depends primarily on whether the tumor metastasis [40, 41]. For patients with functional paragangliomas, preoperative treatment is critical, which requires administration of α-anti-adrenergic agent at least 2 weeks before the surgery to allow the chronically con-

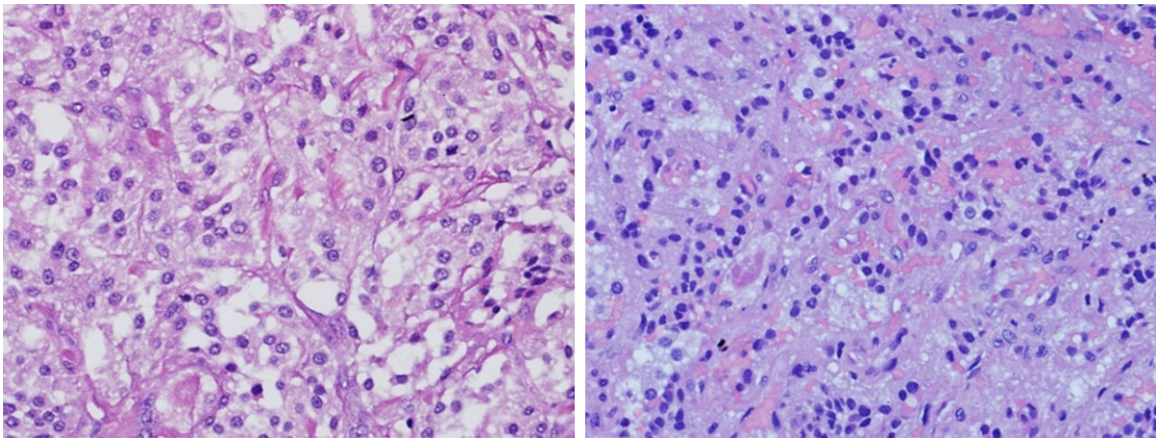

Figure 6. Microscopic analysis of T4 resection product under light microscope at 40 ×. Hematoxylin & eosin staining reveals cuboid, polygonal cells with basophilic cytoplasm containing abundant granules and enlarged and hyperchromatic nuclei. These Type I cells are arrangedin nests (Zellballen s pattern) separated by fibrovascularseptae, surrounded by a single layer of flattened cells and embedded in a fibro-vascular stroma.

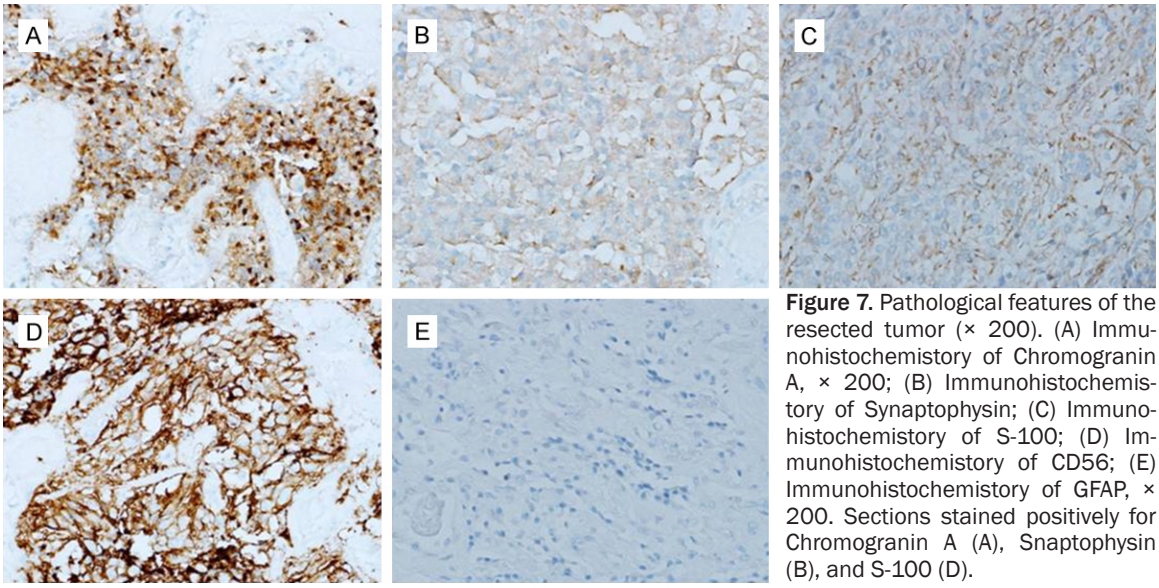

Figure 7. Pathological features of the resected tumor (× 200). (A) Immunohistochemistory of Chromogranin A, × 200; (B) Immunohistochemistory of Synaptophysin; (C) Immunohistochemistory of S-100; (D) Immunohistochemistory of CD56; (E) Immunohistochemistory of GFAP, × 200. Sections stained positively for Chromogranin A (A), Snaptophysin (B), and S-100 (D).

tracted extravascular space to expandand achieve management of hypertension [42, 43]. In our surgical regimen, the tumor was completely resected and at the same time decompression of the spinal cord was obtained. Finally, reconstruction of spinal stability was carried out using titanium mesh and pedicle screw fixation system. Follow-up examination 4 months after the operation revealed satisfactory curative effect. Another problem that we should pay special attention to is the characteristic of paragangliomas which are abundant with blood supply and should apply tumor vascular embolization preoperatively according to existing knowledge [44]. However, in the present case, instead of following the conventional method [45], we did ligation of part of blood vessels in the region of diseased vertebral intraoperatively, effectively reducing the amount of intraoperative bleeding and blood transfusion, and avoiding postoperative complications, assuring the successful completion of operation.

To a very limited literature on thoracic intraosseous paragangliomas, we add the sixth case report. With the introduction of new technologies and techniques, en bloc resection of the tumor is an excellent technique when applied to certain indications. It can be performed with

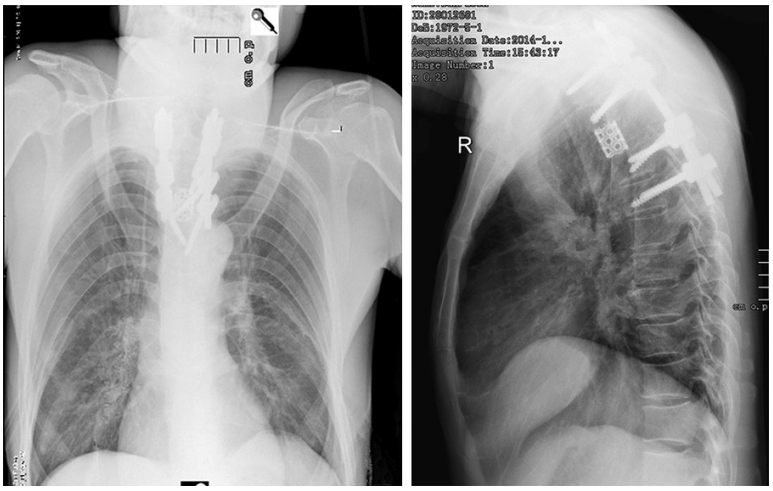

Figure 8. Radiograph in AP view and lateral three months after the operation, showing neither loose nor broken of internal fixation.

low rates of morbidity. We believe that paragangliomas should be included in the differential diagnosis of thoracic intraosseous tumors.

Disclosure of conflict of interest

None.

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