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An Instance of Radiation-Related Vertebral Displacement Fracture Simulating Solitary Bones Lung Cancer Metastatic Development

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Abstract

The critical role of pharmaceuticals and radiotherapy in lung cancer management cannot be overstated. Despite the well-documented adverse effects of electromagnetic radiation, identifying them can often be a complex task. In a particular case, a male patient aged 58 was diagnosed with stage III squamous cell lung cancer, categorized as cT1aN2M0. His treatment regimen included a combination of biweekly chemotherapy using carboplatin and cisplatin over a six-week period, accompanied by a course of 80 Gy distributed across 30 sessions of thoracic radiotherapy. This was followed by bi-monthly administration of durvalumab over the course of a year.

At the conclusion of this durvalumab cycle, the patient complained of back discomfort. The cause was determined by magnetic resonance imaging to be a break caused by compression at the sixth thoracic spine. Further imaging with a CT scan and chlorine-17 fluorodeoxyglucose PET scan indicated minimal uptake at the seventh thoracic vertebra, suggesting a potential for bone metastasis. However, this was not supported by a laparoscopic biopsy, which found no malignant cells. It was ultimately determined that a radiation-induced fracture was responsible for the symptoms, particularly since the fracture was located within the irradiated area near the seventh cervical vertebra.

After the patient underwent surgery, a dual-energy X-ray absorptiometry scan revealed osteopenia in the spine. Initially, pre-surgery imaging had hinted at bone metastases, but ultimately, the postoperative biopsy was instrumental in diagnosing a fracture related to the radiation treatment, ruling out metastasis after the patient had undergone extensive chemotherapy and radiotherapy.

***Keyword**: lung cancer, chemotherapy, radiotherapy, durvalumab, bone metastasis, spinal fracture*

Introduction

Radiotherapy plays a pivotal role in managing lung cancer, offering a range of beneficial treatments including intensive combined chemotherapy and radiotherapy, the treatment of brain tumors, supportive care through palliative chemo, and precise stereotactic radiotherapy for thoracic tumors. For advanced stages III and IV of persistent non-small cell lung cancer (NSCLC), aggressive chemoradiotherapy has become the norm, particularly with the emergence of new pharmaceuticals like antibodies against the protein PD-1 on the surface of cells. For patients with previously untreated stage III NSCLC, survival rates using adjuvant durvalumab following chemoradiotherapy reached 64% at the two-year mark, in contrast to a 60% fatality rate in the comparative group according to studies. As survival rates in lung cancer patients improve, the late effects of radiation therapy become more prevalent. These complications pose a challenge for physicians, as they must differentiate between the side effects of treatment and the progression of the disease in cancer patients upon encountering unexpected symptoms.

We explore a patient's treatment history in this conversation who has stage three non-small cell lung cancer. The results of the medical biopsy indicated that the compressive pressures from the chemoradiotherapy had a significant impact on the spinal fracture.

Investigations

A discernible mass on the chest CT scan prompted the referral of a 60-year-old Japanese man to our medical center (referenced as Figure 1a). This individual had been under consistent chest CT surveillance due to persistently elevated levels of gastrin-releasing peptide, which were above 95 pg/mL during annual health examinations over a period of three years. The patient, a former smoker, had a history of consuming three and a half packs of cigarettes daily for 37 years and was a regular sake drinker, with an intake of three glasses at least five times a week. At the time of assessment, he had ceased smoking. His body mass index was recorded at 21.5 kg/m².

A transbronchial needle aspiration of the subcarinal lymph node and a bronchoscopic biopsy of a visible tumour in the left B4 segment led to the diagnosis of lung squamous cell carcinoma (Figures 1a and 1b). Programmed death-ligand 1 expression in the cancer was evaluated by immunohistochemical analysis utilising the 22C3 pharmDx test to be between 5 and 10%. Mediastinal lymph node metastases were identified by neuroimaging including positron radiation tomography using fluorine-18 fluorodeoxyglucose; their greatest standardised uptake value was 3.24 (illustrated in Figure 1c). Particularly, FDG scanning failed to reveal the presence of the primary tumour in the left middle lobe. The cancer was categorised as stage III, precisely c-T1aN2M0, based on the latest version of the TNM classification procedure used by the Organisation for Global Cancer Control.

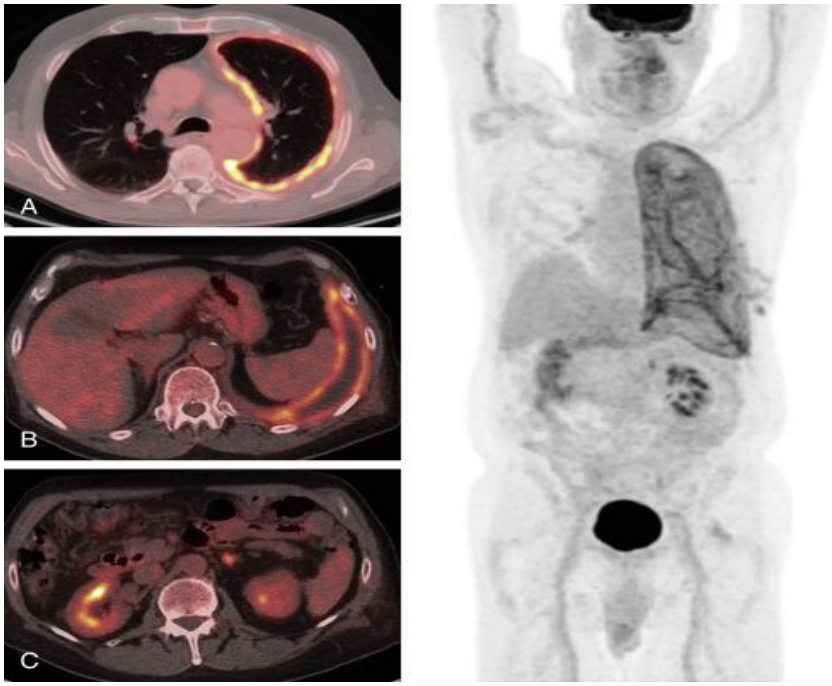

Figure 1 presents the bronchoscopic view of the left B4 segment (image b), along with the corresponding computed tomography and fluorine-18 fluorodeoxyglucose positron emission tomography scans (image c). The initial pulmonary mass is denoted by yellow arrowheads in images (a) and (b), while yellow lines highlight the lymph node metastases in image (c).

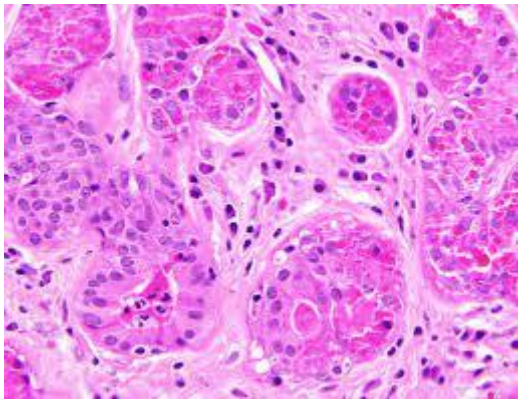

Figure 2. displays a histological section of a tumour taken from the left B4 bronchus, stained with haematoxylin and eosin, commonly referred to as H&E.

Diagnosis

The findings strongly indicated a potential diagnosis of lung cancer-related spinal metastasis, particularly considering the patient's relatively young age and the absence of any prior history of osteoarthritis or bone fractures. Instead of opting for precision-targeted spinal radiation therapy, vertebral reconstruction surgery was deemed the appropriate course of action. This was primarily due to the abnormal tendon reflexes attributed to the mass at the fracture site exerting pressure on the spinal cord. A comprehensive surgical intervention was performed, involving the removal of the vertebral biopsy, a laminectomy, the excision of the intraspinal tumour, and the stabilization with pedicle screw instrumentation by the orthopaedic surgical team.

During the procedure, an observation was made of expanding adipose tissue and broadened yellow ligaments compressing the dura mater. The surgical specimen from the seventh cervical vertebra displayed signs of lamellar bone degradation, fibrosis, and the presence of granulation tissue with an increased number of osteoclasts. The proliferative tissue within the vertebral space was identified as a composite of fibrotic and adipose tissue with incomplete blood vessel formation. Notably, the post-surgical examination of the tissues revealed no presence of cancerous cells or signs of aggressive inflammation such as heightened lymphocyte activity.

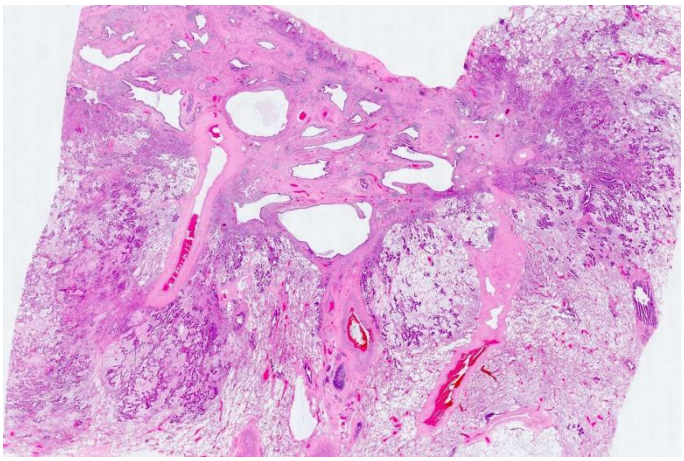

Figure 3. A seventh dorsal vertebrae specimen's histopathology

Intervention

A surgical intervention was performed to mend a bone break. Follow-up evaluations with dual-energy X-ray absorptiometry revealed a decrease in bone mass in the cervical spine, registering at 74% of the

average for a healthy young adult. Bone mass readings of the femoral region also reported values at 85% of the expected norm for younger individuals. Biochemical indicators showed an increase in bone resorption, with urine NTX levels at 61.7 nmol bone connective equivalents per nmol of creatinine mutation and levels of N-telopeptide of type 2 cartilage at 35.5 nmol bone collagen equivalents per nmol. The individual presented with below-normal levels of folic acid, vitamin D metabolites measured at 7.8 ng/mL for 25-hydroxyvitamin D and 55.7 pg/mL for 1,25-dihydroxyvitamin D3. Enzymatic activity assessments revealed serum alkaline phosphatase at 77 units per liter and a bone-specific alkaline phosphatase level of 17.4 micrograms per liter. Hormonal evaluations showed no notable deviations, with albumin-corrected calcium concentration at 9.2 mg/dL and parathyroid hormone at 56 picograms per milliliter, including associated peptides. Given these clinical findings, the bone health specialist initiated a regimen of daily subcutaneous administration of abaloparatide propionate.

Observation and Outcomes

Three months after surgery, the patient remained in excellent health, showing no recurrence of lung cancer. This successful result is linked to the combined approach of medication and chemoradiotherapy.

Discussion:
This case study highlights an unusual side effect of compression spinal fractures from intensive radiation therapy combined with chemotherapy (CRT) for treating localized metastatic lung cancer. Initially misinterpreted as a single bone cancer metastasis, the rupture was accurately identified through surgical biopsies. This underscores the challenges faced by imaging techniques in distinguishing between bone cancer and complications arising from radiation therapy.

Key Takeaways:
Challenges in Neuroimaging: While Magnetic resonance imaging and FDG-PET/CT scans are effective in pinpointing the source of fractures, they can struggle to differentiate between the aftereffects of radiation and bone metastasis. In this case, the FDG-PET/CT scan showed localized FDG absorption, adding to the diagnostic complexity. The MRI also detected abnormal tissue around the fracture site.

Fractures Linked to Radiation Therapy: The scattered, lower-dose radiation in CRT makes fractures less common compared to those seen with stereotactic radiation therapy. The impact of radiation on the body varies based on dosage and frequency; sometimes, radiation-related damage may manifest months or years after the treatment.

Risk Factors: Lung cancer patients might be more prone to osteoporosis and fractures post-radiation therapy due to several factors, including low body mass index, alcohol consumption, smoking history, and vitamin D deficiency. The demographic profile of patients and the use of preventive steroids during chemotherapy are important risk factors to consider.

Durvalumab and Bone Complications: Despite the lack of signs of ongoing inflammation indicative of immune-related side effects from durvalumab, this patient's spinal assessment did not reveal any. This observation is significant, given that immune checkpoint inhibitors like durvalumab can lead to inflammatory toxicities or abnormalities in bone metabolism.

The Role of Surgical Biopsy: The accurate diagnosis of a radiation-related vertebral fracture in this case underscores the importance of considering surgical biopsy when imaging tests yield inconclusive results. The procedure was vital in determining the fracture type and ruling out active inflammation related to durvalumab.

Conclusion

This case report, following extensive CRT for non-small cell lung cancer, provides valuable insights into diagnosing and managing radiation-associated vertebral fractures. Faced with diagnostic ambiguity, healthcare providers should be vigilant about potential predisposing factors and risks. Continuous monitoring for bone toxicities associated with radiation therapy and immunotherapy is essential, and surgical biopsy should be considered when necessary.

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