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Case Report

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Rare Radiological Presentation of Spinal Cord Compression: A Unique Case of Osseous Metastasis from Primary Pulmonary Chondrosarcoma

Arun Krishnadas*

Clinical Fellow in Oncology North Wales Cancer Treatment Centre, Rhyl, GB

***Corresponding Author**
Arun Krishnadas, Clinical Fellow in Oncology North Wales Cancer Treatment Centre, Rhyl, GB, UK.

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Abstract

In this paper, the significance of data analytics for finance and business will be discussed, with a focus on innovation. The introduction provides a clear meaning of data analytics and points out its importance in decision-making. The literature review part of the book gives background information and analyses historical theories up to recent theories that encourage their application.

In this paper, the primary areas of using data analytics in financial decision-making are discussed and they include risk evaluation, investment measurement, and; fraud identification. Also, it explains how data analytics is used in business processes such as improvement operation efficiency, customer targeting, and supply chain. Business intelligence applications and big data frameworks are also described, as well as the difficulties that companies experience in employing them for data analytics.

Examples of sectoral data analytics applications are discussed with examples and detailed methodologies and results that have been achieved. Moreover, the paper also reveals emerging themes in data analytics, such as artificial intelligence integration, real-time, data governance, and ethics.

Thus, the study establishes the imperative for organizations to promote and adopt data analytics as a critical tool in improving organizational decision-making processes, innovation, and sustained organizational growth. Therefore, overcoming the barriers to implementation allows us to make the best use of data analytics and use data to drive changes across organizations.

Key Clinical Message: Pulmonary chondrosarcoma, typically an indolent malignancy, can exhibit rare aggressive behaviour with osseous metastasis. This case underscores the importance of advanced imaging for early diagnosis and multidisciplinary management to address complications like spinal cord compression, which can significantly impact patient outcomes.

1. Introduction

Pulmonary chondrosarcoma is a rare malignant tumour originating from cartilaginous tissue within the lung, accounting for less than 0.5% of all primary pulmonary neoplasms [1,2]. First described in sporadic case reports, this tumour is remarkable for its indolent progression and low metastatic potential, distinguishing it from more aggressive forms of sarcoma. Chondrosarcoma typically arises in the long bones and pelvis, with primary pulmonary manifestations being exceedingly rare [3]. These tumours generally exhibit a slowgrowing nature, characterised by calcified masses detectable on imaging studies. Despite this, they are often clinically silent until they attain a size large enough to cause symptoms or are discovered incidentally.

Histologically, pulmonary chondrosarcoma is composed of hyaline cartilaginous tissue with varying degrees of atypia and calcification. This distinct composition differentiates it from other primary lung neoplasms, such as adenocarcinoma or squamous cell carcinoma. Advanced imaging modalities, including contrastenhanced computed tomography (CT), magnetic resonance imaging (MRI), and positron emission tomography (PET), are invaluable for identifying these tumours and distinguishing them from other calcified thoracic masses. Immunohistochemical markers, such as S100 protein positivity and cytokeratin negativity, further confirm the diagnosis, aiding in its differentiation from mimicking malignancies like sarcomatous carcinoma.

Although pulmonary chondrosarcoma is associated with a low propensity for metastasis, cases with distant spread, particularly to atypical sites, are exceedingly rare and scarcely reported in the literature. When metastases occur, the lungs, liver, and regional lymph nodes are the most commonly involved sites. Bone metastasis, especially with epidural extension leading to spinal has not been extensively documented. Such occurrences represent a

significant clinical challenge, necessitating a thorough diagnostic approach and prompt intervention to manage the associated complications, including neurological deficits.

In this report, we present a novel case of pulmonary chondrosarcoma in a 55-year-old male, which exhibited an uncommon metastatic spread to the lumbar spine. The patient's presentation with severe low back pain, neurological symptoms, and imaging findings underscores the aggressive and rare nature of this disease manifestation. This case highlights the pivotal role of advanced imaging and histopathological analysis in diagnosing and managing this rare malignancy and adds valuable insight into its clinical behaviour and metastatic potential.

2. Case History

A 55-year-old male presented with a three-month history of progressively worsening low back pain, which was accompanied by bilateral lower limb weakness and paraesthesia. The patient reported a gradual decline in his ability to walk but denied any sphincter disturbances such as urinary incontinence or bowel dysfunction. Initially, the pain was non radiating but later became more pronounced and localized. He had a history of benign enchondroma excision from his left arm two years prior, with no other significant past medical history. He also mentioned intermittent episodes of chest discomfort but denied any respiratory symptoms, such as shortness of breath, cough, or haemoptysis.

3. Examination

On examination, the patient appeared well nourished and was not in acute distress. His vital signs were stable, and he was hemodynamically normal. Chest examination revealed no structural deformities, and breath sounds were clear, with no adventitious sounds such as wheezes or crackles. Neurologically, the patient exhibited significant weakness in the lower limbs, with motor strength graded as 3/5 bilaterally. Sensory testing revealed deficits below the L3 dermatome, indicating potential nerve root involvement. The patient's bilateral knee jerk reflexes were diminished, suggesting possible spinal cord compression. Localized tenderness was noted over the L3 region of the lumbar spine, but there were no visible spinal deformities, such as kyphosis or scoliosis.

3.1 Differential Diagnosis

Based on the clinical presentation and examination findings, several differential diagnoses were considered. These included a spinal tumour, either primary such as meningioma or schwannoma, secondary metastasis from an undiagnosed malignancy, as well as spinal cord compression due to degenerative or structural causes, such as herniated lumbar discs or spinal stenosis. Infectious aetiologies, such as an epidural abscess or vertebral osteomyelitis, were also considered, along with multiple myeloma or plasma cell dyscrasia, given the patient's age and symptoms suggestive of bone involvement. Neurological autoimmune disorders or paraneoplastic syndromes associated with malignancy were additional possibilities. Vascular causes, such as a spinal arteriovenous malformation or ischemic myelopathy, were included in the differential diagnosis. Lastly, recurrence or spread of the previously excised enchondroma, now involving the lumbar spine, was another important consideration.

3.2 Investigations

Laboratory investigations (Table 1) revealed elevated inflammatory markers, with an erythrocyte sedimentation rate of 48 mm/hr and a C-reactive protein level of 18 mg/L, indicating chronic inflammation or a possible infectious process. Bone metabolism markers showed mildly elevated serum calcium at 11.4 mg/dL and an increased alkaline phosphatase level of 189 U/L, suggesting active bone turnover, potentially associated with malignancy or metabolic bone disease. Tumour marker assessment showed a prostate-specific antigen level within normal limits and a negative serum protein electrophoresis, reducing the likelihood of prostate cancer and multiple myeloma respectively. Haematological parameters revealed mild anaemia with a haemoglobin level of 11.5 g/dL, while the white blood cell count was 6,400/mm³ and the platelet count was 200,000/mm³. These findings, along with clinical correlations, warrant further investigation for potential malignancy or systemic bone pathology.

Parameter	Patient Value	Reference Range
Haemoglobin	11.5 g/dL	13.8–17.2 g/dL
White Blood Cell Count	6,400/mm³	4,000–11,000/mm³
Platelet Count	200,000/mm³	150,000–400,000/mm³
Erythrocyte Sedimentation Rate	48 mm/hr	<20 mm/hr
C-Reactive Protein	18 mg/L	<10 mg/L
Serum Calcium	11.4 mg/dL	8.6–10.2 mg/dL
Alkaline Phosphatase	189 U/L	44–147 U/L
Prostate-Specific Antigen	1.9 ng/mL	<4 ng/mL

Table 1: Laboratory Investigations

Imaging findings provided further clues about the patient's condition. A contrast enhanced chest CT revealed a mildly lobulated, well circumscribed nodule in the right upper lung with strip-like and punctate calcifications (Figure 1a). The pre contrast scan (Figure 1b) demonstrated an irregular soft tissue density nodule with a value of 22 HU. The postcontrast arterial phase scan (Figure 1c) showed minimal enhancement of 3 HU, while the post venous phase scan (Figure 1d) revealed a slight increase in enhancement, up to 8 HU, indicating a potentially malignant lesion.

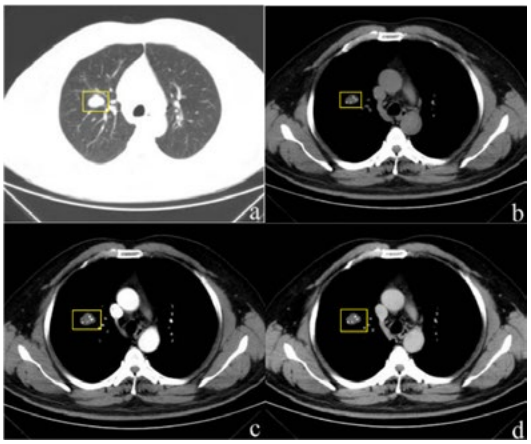

Figure 1: Contrast Enhanced Chest CT

MRI of the lumbar spine revealed a lesion in the third lumbar (L3) vertebral body. The sagittal T2 weighted image (Figure 2a) showed a lobulated lesion with uneven signal intensity, and the sagittal T1 weighted image with contrast (Figure 2b) highlighted the lesion with variably high signal intensity. The axial T1 weighted and T2 weighted images (Figures 2c and 2d respectively) with contrast demonstrated the tumour's expansion into the epidural space, resulting in compression of the spinal cord and nerve roots.

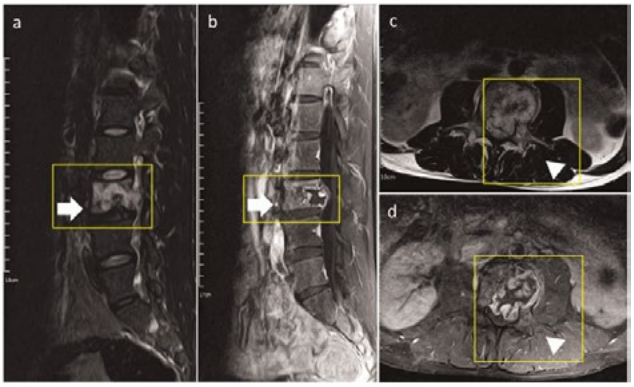

Figure 2: MRI of the Lumbar Spine

Bone scintigraphy revealed increased radiotracer uptake in the L3 vertebra, indicative of a skeletal metastasis. The uptake pattern suggested a primary lesion with subsequent bone involvement, which was further corroborated by imaging findings.

Whole body PET CT confirmed significant metabolic activity in the pulmonary lesion, verifying its malignant nature. Additionally, the L3 vertebral metastasis showed increased metabolic activity, supporting the diagnosis of metastatic spread.

Histopathological examination of a CT guided biopsy from the lung lesion revealed a low-grade chondrosarcoma, with characteristic cartilaginous tissue and calcifications. Immunohistochemistry was positive for S100 protein and negative for cytokeratin, confirming the diagnosis of chondrosarcoma. A biopsy of the L3 vertebral lesion showed identical histopathological features, confirming the diagnosis of metastatic chondrosarcoma (Figure 3).

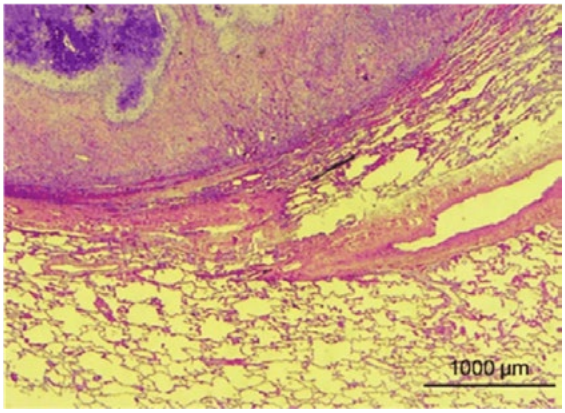

Figure 3: Histopathology

3.3 Treatment

The patient underwent a multidisciplinary treatment plan tailored to address both the primary pulmonary tumour and its metastatic involvement in the lumbar spine. The pulmonary chondrosarcoma was surgically resected via a right thoracotomy, achieving clear margins. Postoperative recovery was uneventful.

For the lumbar metastasis, palliative radiotherapy was initiated, targeting the L3 vertebra to alleviate spinal cord compression and reduce tumour burden. A total dose of 30 Gy was delivered in 10 fractions. The patient also received chemotherapy with a regimen consisting of Ifosfamide and Doxorubicin, which has demonstrated efficacy in treating sarcomatous malignancies. Symptomatic management included pain control with opioids and adjuvant medications such as bisphosphonates to mitigate bone resorption.

Physiotherapy was initiated to improve mobility and motor strength in the lower limbs, which were significantly affected by the spinal cord compression. Regular neurological assessments were conducted to monitor recovery and assess the efficacy of the treatment interventions.

3.4 Outcome and Follow-Up

At the six-month follow-up, the patient exhibited a reduction in the size of the primary pulmonary tumour and stabilization of the spinal metastasis, as confirmed by repeat imaging. The chest CT scan showed no evidence of recurrent or residual tumour, while MRI of the lumbar spine demonstrated reduced epidural tumour extension, with no further progression of spinal cord compression.

Clinically, the patient reported improved mobility and a reduction in pain severity. Lower limb motor strength improved to 4/5 bilaterally, and sensory deficits were partially resolved. The patient was able to ambulate with minimal assistance and resumed daily activities with modifications.

The treatment was well tolerated, with manageable side effects such as fatigue and mild chemotherapy-induced nausea. Follow-up imaging and tumour marker evaluations were scheduled every three months to monitor for recurrence or progression.

4. Discussion

Unlike the majority of primary pulmonary chondrosarcomas, which are known for their localised progression, this case demonstrates the tumour's rare ability to metastasise to atypical sites, such as the lumbar spine. Pulmonary chondrosarcomas are often recognised by their distinct calcified appearance, which differentiates them from other pulmonary neoplasms. In the early stages, these tumours are frequently asymptomatic and remain undiagnosed until they grow large enough to cause respiratory issues. Although their overall metastatic potential is low, when dissemination occurs, it typically involves the lungs, liver, or regional lymph nodes. Bone metastasis with epidural extension leading to spinal cord compression is exceptionally rare and scarcely addressed in medical literature. This report of a 55-year-old male with metastatic pulmonary chondrosarcoma affecting the lumbar spine highlights an uncommon and noteworthy deviation from the tumour's usual clinical trajectory.

Most documented cases of pulmonary chondrosarcoma emphasise its slow growing nature and the rarity of distant metastasis. For example, Jiang et al. reported a case of primary pulmonary chondrosarcoma that was initially misdiagnosed as a teratoma due to its calcified characteristics. Despite the rapid growth of the tumour, no bone metastasis was observed, which is consistent with the general pattern seen in many cases of pulmonary chondrosarcoma. A review by Yasin et al. highlights the rarity of distant metastasis in pulmonary chondrosarcoma, noting that these tumours typically remain confined to the lungs or spread to more common sites like the liver. Similarly, Nasri et al. discussed a rare case of pulmonary chondrosarcoma that was limited to the lung without skeletal involvement, further reinforcing the idea that these tumours often follow a non-metastatic course [1-3]. These cases illustrate the typical behaviour of pulmonary chondrosarcoma as a localized, slowly progressing malignancy.

However, our case diverges from these typical presentations, with metastasis to the lumbar spine leading to significant neurological complications. The rarity of bone metastasis in pulmonary chondrosarcoma is further emphasized by Gazendam et al., who pointed out thats keletal involvement is more commonly observed in chondrosarcomas originating from other parts of the body, such as the pelvis or limbs [4]. In this case, lumbar vertebral involvement with epidural expansion and compression of the nerve roots resulted in severe neurological deficits, including motor weakness and sensory loss. Such complications are rarely documented in pulmonary chondrosarcoma, highlighting the aggressive nature of this particular tumour.

Bone metastasis in pulmonary chondrosarcoma is not widely reported in the existing literature. For example, a clinicopathologic study by Kalhor et al. of four cases of pulmonary chondrosarcoma found no evidence of skeletal metastasis, which is consistent with the overall rarity of distant spread [5]. Similarly, Ichimura et al. reported a case of a solitary pulmonary nodule that remained indolent for years before resection, without any evidence of distant metastasis [6]. These findings further highlight the unusual nature of our case, where lumbar vertebral metastasis led to significant clinical deterioration.

Spinal cord compression resulting from metastatic pulmonary chondrosarcoma is extremely rare. While spinal involvement is more commonly observed in other cancers, such as breast or prostate carcinoma, the metastatic spread of pulmonary chondrosarcoma to bone, particularly the axial skeleton, is a complex clinical scenario that has not been widely discussed. Wang et al. documented three cases of primary pulmonary chondrosarcoma, where the tumours presented as intrathoracic masses but did not metastasize to distant sites [7]. In contrast, our case exemplifies the need for vigilance in the early detection and management of rare metastases, particularly when spinal cord compression is a potential complication.

Rees described a primary pulmonary chondrosarcoma case where the tumour was localized to the lung, without metastasis [8]. Their findings align with the majority of reports that indicate pulmonary chondrosarcomas tend to remain confined to the lung, thus underscoring the exceptional nature of our case with spinal metastasis. The aggressive behaviour observed in our patient further contrasts with the typical slow growing, indolent course usually reported in pulmonary chondrosarcoma.

The patient's progressive neurological deficits were directly related to the epidural extension of the lumbar metastasis, emphasizing the importance of detailed imaging studies in such rare cases. Advanced imaging modalities played a critical role in the diagnosis and management of this patient. Contrast enhanced CT was instrumental in identifying the characteristic calcified mass in the lung, a hallmark feature of chondrosarcoma. MRI of the lumbar spine revealed the extent of the vertebral involvement and the epidural expansion, which contributed to the spinal cord compression and neurological symptoms. In this case, the use of PET CT and bone scintigraphy confirmed skeletal metastasis and helped assess the metabolic activity of the primary tumour and its distant metastasis, providing valuable information for staging and therapeutic planning.

While pulmonary chondrosarcoma generally has a relatively good prognosis, especially when detected early and treated with surgical resection, the presence of bone metastasis complicates the treatment course and prognosis. This is highlighted by the findings of Stanfield et al., who reported a rare primary lung tumour diagnosed as chondrosarcoma via fine needle aspiration cytology [9]. Their case did not involve skeletal metastasis, reinforcing the rarity of this phenomenon. Moreover, Hayashi et al. found that primary pulmonary chondrosarcomas are typically slow growing, with a low likelihood of distant spread. However, this case exemplifies how pulmonary chondrosarcoma can present with unexpected complications, requiring a tailored approach to treatment [10].

The patient in this case underwent surgical resection of the pulmonary tumour, followed by palliative radiotherapy for the spinal metastasis and chemotherapy with Ifosfamide and Doxorubicin. The six months follow up revealed a reduction in the size of the primary tumour and stable spinal lesions, indicating a favourable response to treatment. This outcome aligns with the findings of Watanabe et al., who reported successful management of pulmonary chondrosarcoma through surgical resection, though their case did not include metastasis to bone [11]. The addition of chemotherapy in this case highlights the importance of addressing metastatic disease in rare malignancies, where traditional treatment approaches may need to be adapted. As noted by Morgan and Salama, multimodal treatment strategies such as surgical resection, radiotherapy, and chemotherapy may improve survival outcomes and quality of life in patients with metastatic pulmonary chondrosarcoma [12].

5. Conclusions

This case presents a rare and unique presentation of pulmonary chondrosarcoma with skeletal metastasis to the lumbar spine, resulting in significant spinal cord compression. The use of advanced imaging, including contrast enhanced CT, MRI, bone scintigraphy, and PET CT, was critical in diagnosing the primary tumour and its metastatic spread. This case contributes to the understanding of the metastatic potential of pulmonary chondrosarcoma and emphasizes the importance of a comprehensive, multimodal approach to diagnosis and treatment when managing rare malignancies. Early detection and intervention, guided by advanced imaging, are key to improving patient outcomes in such complex clinical scenarios.

Declarations

Ethical Statement

This case report complies with ethical standards and institutional guidelines. Informed consent was obtained from the patient for publication of this case report and accompanying images. Confidentiality and anonymity have been maintained throughout the manuscript.

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Author Contributions

Arun Krishnadas: Conceptualization, manuscript drafting, patient data analysis, and final manuscript approval, literature review, figure preparation, and critical manuscript revisions, clinical management of the patient, data interpretation, and manuscript review.

Conflict of Interest Statement

The authors declare no conflicts of interest relevant to this publication.

Data Availability

All data generated or analysed during this study are included in this published article. Additional data may be available from the corresponding author upon reasonable request.

Patient Consent Statement

Written informed consent was obtained from the patient for the publication of this case report and any accompanying images. Efforts have been made to ensure patient anonymity, and identifying information has been omitted.

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