Case Report

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Isolated distal ulnar bone metastasis from lung squamous cell carcinoma: an extremely rare case report

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Abstract

Bone metastases commonly occur in patients with lung cancer. However, metastasis from primary lung carcinoma to the bone below the knee and elbow is rarely encountered. We herein describe a man who developed an isolated distal ulnar bone metastasis originating from lung squamous cell carcinoma. A 68-year-old man presented to our orthopedic outpatient clinic for evaluation of a rapidly progressing tumor over his right wrist area. Tenderness with increased local temperature was noted, and the tumor was firm in consistency, oval-shaped, and 7 × 5 cm in size. Magnetic resonance imaging and radiographic imaging revealed an osteolytic tumor in his distal ulnar shaft. A 99m Tc-phosphate bone scan showed that this tumor was isolated and newly observed compared with the previous bone scan findings during initial diagnosis. Bone tumor biopsy confirmed metastatic squamous cell carcinoma. Segmental tumor resection with cementation was subsequently performed. This rare case report of an isolated ulnar metastasis includes detailed descriptions of the clinical, radiographic, and pathological features of the tumor.

Keywords

Lung squamous cell carcinoma, isolated ulnar bone metastasis, bone tumor biopsy, tumor excision with cementation, case report, bone scan

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Introduction

Approximately 30% to 40% of patients with lung cancer develop bone metastases.[1,2] Bone metastases are associated with morbidity, loss of functional independence, and reduced quality of life,[3] leading to

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increased medical costs and longer hospitalizations.[4] Most bone metastases are located in the spine, pelvis, and femur. In patients with lung cancer, the axial skeleton is more commonly involved than the extremities.[5] Development of isolated metastases to the ulna originating from lung squamous cell carcinoma (SCC) is extremely rare, and to the best of our knowledge, it has not been described in the literature to date.

We herein describe a man with an isolated bone metastasis to the distal ulna from lung SCC.

Case report

In June 2019, a 68-year-old male construction worker presented to the emergency department of Shin-Kong Wu Ho-Su Memorial Hospital because of a 3-week history of general malaise, rapid body weight loss (>5 kg), and poor appetite. The patient had smoked one pack per day for more than 30 years; however, he had quit smoking in 2018. He was diagnosed with chronic obstructive pulmonary disease and left upper lobe SCC (Pancoast tumor), stage cT4N1M0 (whole-body computed tomography [CT]: tumor size, >7 cm [T4], ipsilateral hilar lymph nodes [N1]), and stage IIIA tissues through bronchoscopic lung biopsy. The tumor was staged with reference to the eighth edition of the American Joint Commission on Cancer TNM staging system. The patient had no medical history of cardiovascular disease, which is a known comorbidity that influences the outcome of lung cancer treatment.[6,7] Concurrent chemoradiotherapy (CCRT) was then initiated. The patient underwent radiation at a dose of 60 Gy in 30 fractions with oral vinorelbine and cisplatin beginning in June 2019. The left upper lobe tumor showed regression on the follow-up CT image in February 2020. However, in May 2020, the patient presented to our orthopedic outpatient department with a 10-day history of a rapidly progressing painful swelling on his right wrist.

Systemic examination revealed no abnormalities with the exception of a tender soft tissue swelling with increased local temperature located in the wrist of his right hand. The swelling was firm in consistency, oval-shaped, and 7×5 cm in size. The skin overlying the swelling was reddened, warm, and edematous but had no discharging sinus. Pronation and supination were restricted. A plain forearm radiograph demonstrated an oval osteolytic lesion with a cortical moth-eaten appearance over the distal ulnar area (Figure 1). T2-weighted magnetic resonance imaging revealed an osteolytic tumor in the distal ulnar shaft measuring $5.3 \times 3.2 \times 2.8$ cm with a prominent heterogeneous extraosseous component at the central aspect (Figure 1). Angiography showed that the tumor was supplied mainly by the right anterior and posterior interosseous arteries and small ulnar artery branches (Figure 2). A whole-body 99m Tc-phosphate bone scan showed newly observed and isolated focally increased tracer uptake in the right distal ulna (Figure 3).

The patient was immediately scheduled for tumor biopsy of the bone lesion. Both bone and soft tissue tumor biopsies were performed (Figure 4). The tissue sections showed that the bone and bone marrow were infiltrated by nests of poorly differentiated SCC cells (Figure 5). The tumor cell nests displayed abundant neutrophil infiltration. Extremely focal keratinization was also observed. Staining for p40 and p63 was positive and staining for thyroid transcription factor 1 was negative. Histopathological examination of the resected specimen showed metastatic SCC (Figure 5).

After the tumor biopsy, the patient was referred to an oncologist and underwent localized palliative radiotherapy with a radiation dose of 35 to 50 Gy in 14 to 20 fractions to the right distal ulnar metastasis

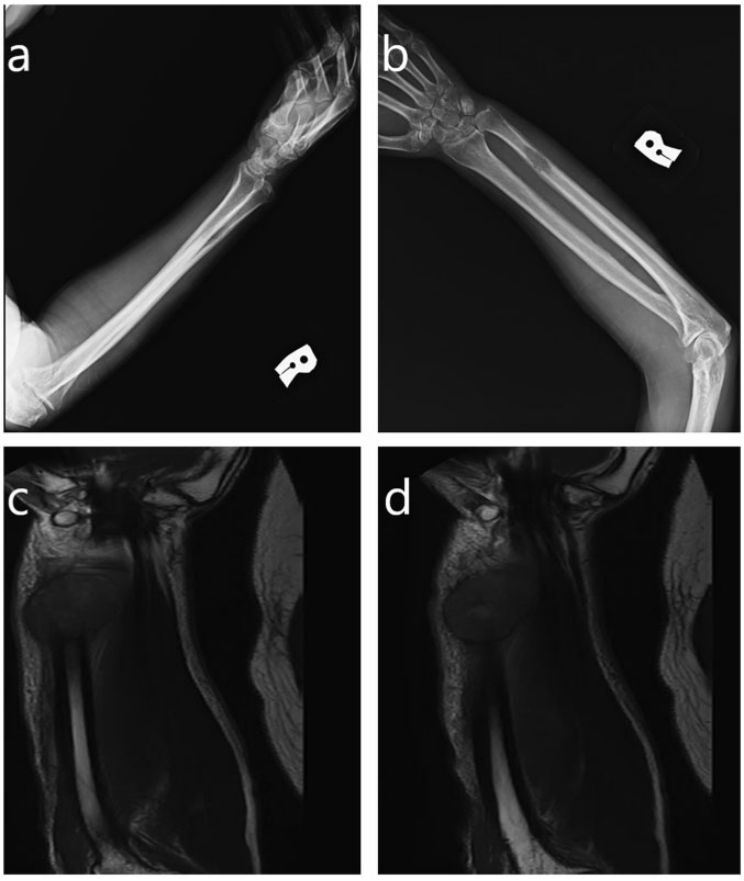

Figure 1. (a, b) Radiographs and (c, d) T2-weighted magnetic resonance imaging. An osteolytic lesion with a central heterogeneous extraosseous component was noted over the right distal ulna.

with chemotherapy. After tumor regression, we discussed the surgical options for the patient: whether to perform below-elbow amputation or localized tumor resection with plating fixation and cementation. The patient preferred to preserve his wrist function, although there was a risk of recurrence.

Thus, wide tumor resection with plating fixation and cementation was performed (Figure 6). The patient tolerated the tumor resection well, and his postoperative treatment and recovery were uneventful. He felt satisfied postoperatively because his wrist function had been preserved. No surgery-related complications occurred. Until September 2020, the patient underwent continuous CCRT and was followed up at the outpatient department with no signs of progression.

Based on our literature review, no previous reports have described isolated bone metastasis located at the distal ulna in patients with lung cancer. This is the first case of lung cancer with isolated ulnar metastasis.

Discussion

Lung cancer accounts for a majority (approximately 20%) of cancer-related

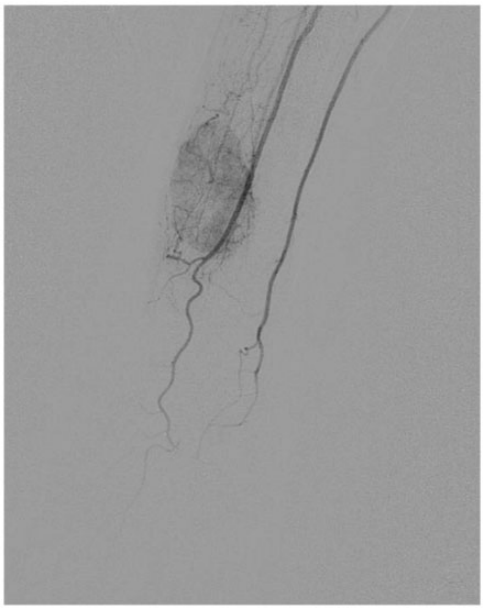

Figure 2. Angiography of the right wrist. The tumor was seeded by the right anterior and posterior interosseous arteries and small branches from the ulnar artery.

deaths worldwide.[8] Approximately 80% of bone metastases are from lung, breast, kidney, prostate, and thyroid gland cancers.[9] Among these, lung cancer is the third most common cancer that results in skeletal metastasis.[10] The incidence of skeletal metastasis reported in the literature to date is high, reaching 15% to 40%.[4,8]

The sequelae of bone metastasis lead to reduced performance of independent activities of daily living and require costly treatments that have limited effects on overall survival. Bone metastasis can be classified into three groups—osteolytic, osteoblastic, or mixed—according to the balance between the bone resorption function of osteoclasts and the bone remodeling and formation mediated by osteoblasts.[11,12]

The three most commonly described locations of lung cancer metastases are the spine, pelvis, and femur.[13] Metastasis of primary lung cancer to the bone below the knee and elbow is very rare and requires a multidisciplinary team approach to establish the correct diagnosis and treatment.[14] Although bone metastases are common in patients with cancer, isolated ulnar metastases are extremely rare or have never been reported.

Bone metastases are believed to occur by seeding via large capillary networks and sluggish blood flow. The peripheral bones do not have sluggish venous flow.[15] Thus, tumors seldom spread to the distal areas of the extremities, such as the hand, wrist, and ankle. The mechanism responsible for the deposition of metastatic tumor cells to distal sites is still unclear and controversial.[16,17] Metastasis to distal sites, such as the distal upper and lower extremities, is considered to involve hematogenous spread of embolic malignant cells.[17]

In 1923, Joll proposed a hypothesis regarding trauma-related skeletal metastasis; i.e., that trauma may degrade the resistance of surrounding tissue, allowing tumor emboli to settle and grow within the skeletal tissue.[18] The patient in the present case was a construction worker. Injury might have occurred while he was working, increasing the risk of skeletal metastasis. More recently, researchers have suggested that the chemotactic factors (prostaglandins) that are released following a traumatic experience may be responsible for cell migration and adherence to the osseous material.[19] This theory continues to support the notion that distal skeletal metastasis may be a result of a preceding physical injury. In a previous study, the incidence of radial and ulnar bone metastases in patients with breast cancer was only 0.31%.[20] In 1985, Huber and Weis[21] reported an occult pancreatic carcinoma that metastasized to the distal ulna. Earlier, in 1965, Clain[22] found that only 0.4% of lesions metastasized to the ulna. Based on our literature review, isolated bone metastasis from lung cancer to the ulna has not been previously

Figure 3. Whole-body 99m Tc-phosphate bone scan images. A focal osteoblastic lesion was newly observed in the right distal ulna. The minimal tracer uptake in the left ninth rib was thought to be a post-traumatic change because of its pre-existing visibility in the previous 99m Tc-phosphate bone scan in November 2019.

reported. Importantly, this case also illustrates that in any patient with a painful bone tumor, the possibility of metastatic bone disease is much higher than that of a primary tumor because secondary tumors of bone are far more common than primary tumors.[23] Patients with small cell carcinoma of the lung may exhibit metastatic manifestations with an initially asymptomatic presentation, but such a presentation is very uncommon in patients with SCC of the lung. Our case was unique in this respect.

Although metastases to the distal ulna rarely occur, these patients often need surgical treatment. When patients perform pronation and supination movements, the distal ulna and radius bear a giant torque load, increasing the occurrence of pathological fractures.[9] Conservative treatment is rarely suggested because of poor functional

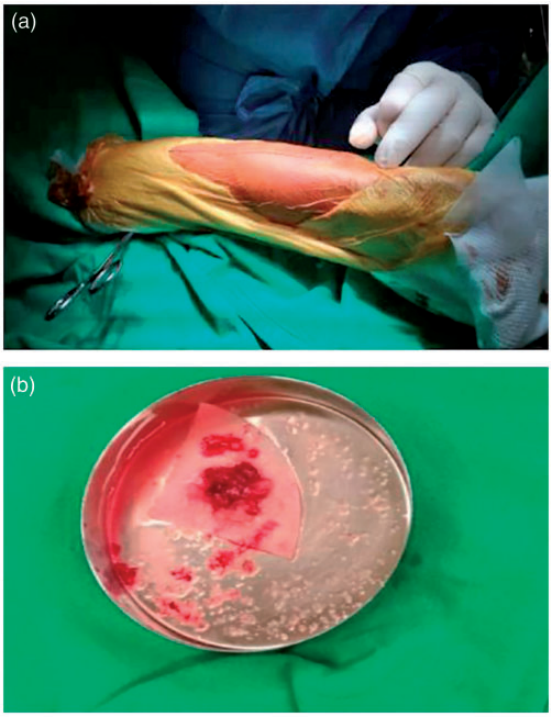

Figure 4. Surgical image of the tumor biopsy. This figure reveals the specimen and the tumor size in total. (a) Intraoperative gross image. (b) Intraoperative specimen.

results and failure to reduce pain.[24] Surgical treatment options include amputation and excision with plating cemented fixation. After our patient had received an explanation of each advantage and disadvantage, he chose limb preservation surgery.

After confirming the bone metastasis, wedge resection of the tumor was performed, followed by fixation for prevention of an impending pathological distal ulnar fracture with a cemented augmentation technique. This stabilization method is advantageous because it provides immediate pain relief and rigid fixation, allowing patients to return to their activities of daily living without restrictions and without requiring bony union.[24]

Appendicular bone metastasis is associated with poorer prognosis than is axial bone metastasis.[25] Because ulnar metastasis is extremely rare, its mean survival time has not been reported. However, in 2014, Afshar et al.[15] found that the mean survival of patients with tumor metastasis to the hand and wrist was 7 ± 7 months and 5 months (range, 2 weeks to 39 months), respectively. In another recent study on humeral bone metastasis, the mortality rate was 94% at the end of the study period with a mean survival of 7.1 months.[26] Until recently (September 2020), our patient was continuously receiving CCRT; i.e., 5 months after the diagnosis of isolated bone tumor metastasis. The patient's right wrist was still pain-free, and he continued to demonstrate an impressive range of motion.

With the continuous advancements in oncological treatment, the life expectancy

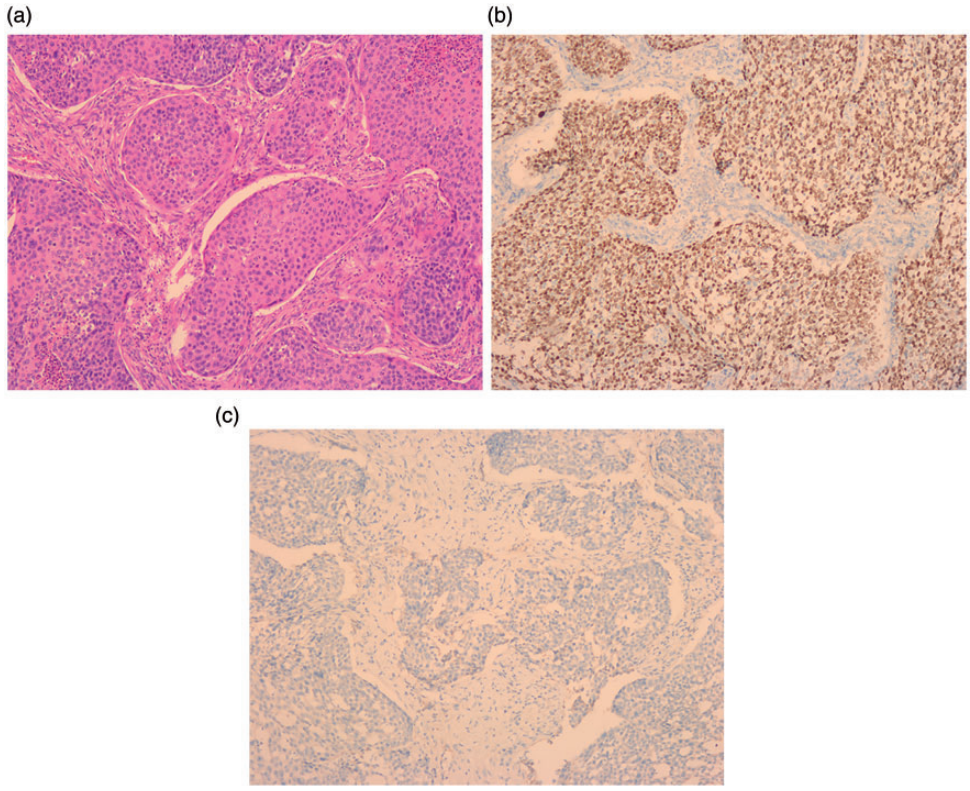

Figure 5. Pathological images of the tumor biopsy. Microscopically, infiltration of poorly differentiated squamous cells and abundant neutrophils in the bone marrow were observed. (a) The bone marrow was infiltrated by poorly differentiated squamous cells. (b) The immunohistochemical examination for p63 showed strong diffuse nuclear staining in the tumor cells. (c) Negative staining for thyroid transcription factor 1.

of patients with metastatic disease is being increasingly prolonged; therefore, their quality of life should be maintained.[24] Thus, the present case should increase clinicians' suspicion of bone metastasis in patients with lung SCC, although such tumors may be located in rare sites such as the distal ulna.

In conclusion, metastasis of primary pulmonary SCC to the ulna is rare and requires a multidisciplinary approach for an early and correct diagnosis. In many such cases, the primary site may go undiagnosed by the time a metastatic lesion has been identified. A series of diagnostic tests is required to confirm the diagnosis of metastatic tumors, including radiographs, a complete blood count, biochemical investigations, CT/magnetic resonance imaging, and other investigations such as biopsy. All these investigations, when properly correlated, help to confirm the diagnosis. The diagnosis should always be made on histological basis, which is the gold standard. Although the short-term outcome in our case has been satisfactory to date, long-term follow-up and survival time information are lacking, and further monitoring of disease progression is required.

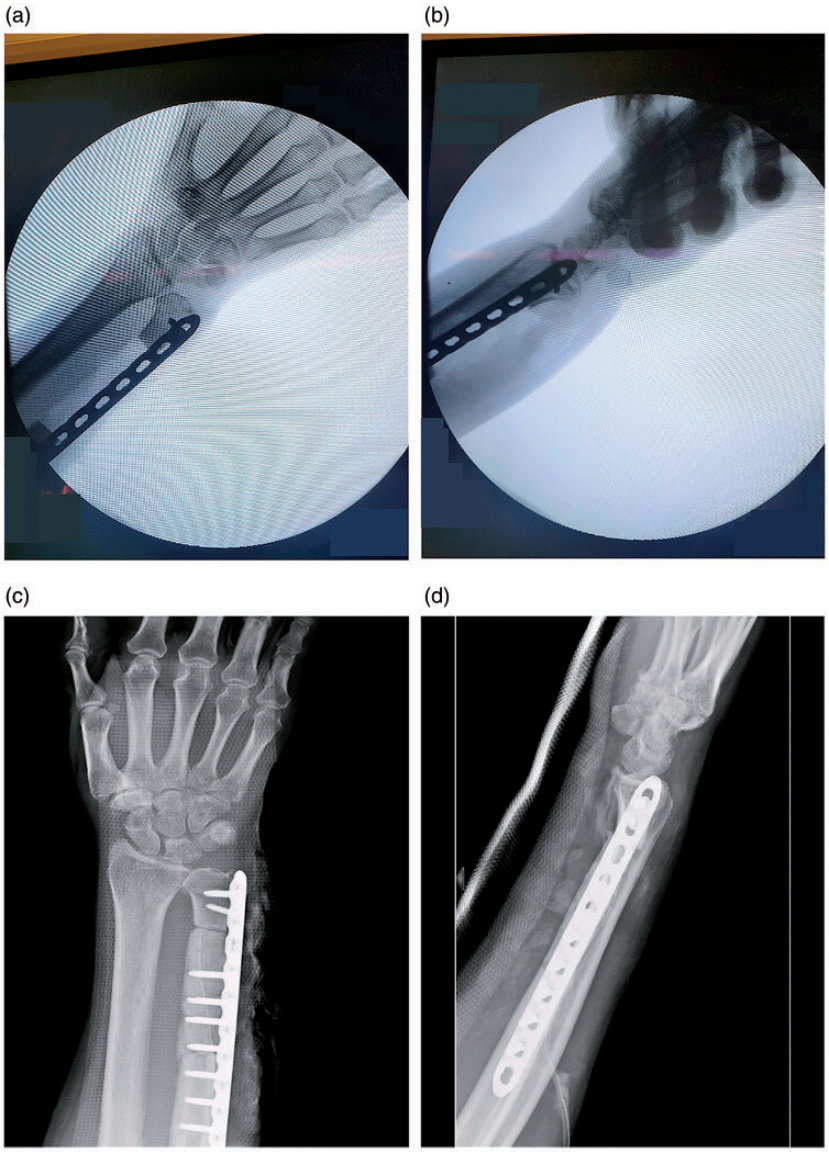

Figure 6. (a, b) Intraoperative and (c, d) postoperative radiographs. The images show resection of the tumor and plating fixation with a cementation technique.

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Availability of data and materials

The patient was from our orthopedics outpatient department. The datasets used and/or analyzed

during the current study are available from the corresponding author on reasonable request.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

Ethical considerations

Written informed consent was obtained for participation in and publication of the present study. This study was approved by the institutional review board of Shin-Kong Wu Ho-Su Memorial Hospital, Taiwan (Approval Number: 20200707R). The present study was conducted in accordance with the principles of the Declaration of Helsinki and the CARE guidelines (https://www.equator-network.org/).

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