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Pictorial essay: Atypical pulmonary metastases: radiologic appearances

Naile Bolca Topal, Esra Oruc, Gokhan Gokalp, Ugur Topal
Uludag University, Faculty of Medicine, Department of Radiology, Bursa / Turkey

Correspondence: Dr. Naile Bolca Topal, Uludag University, Faculty of Medicine, Department of Radiology, 16059, Bursa / Turkey.
E-mail: nailebolca@yahoo.com

The lungs are among the most common sites of metastases from non-pulmonary malignancies, since the lungs function as the primary capillary filter of venous drainage for most organs.[1] The overall incidence, in those who die from malignancy, ranges from 20%-54%.[1,2] Metastases are usually scattered in the lung parenchyma or pleura and often infiltrate adjacent structures.[1-7] The most common primary sites are breast, colon, kidney, uterus, head and neck.[1-5]

Pulmonary metastases present a wide spectrum of radiologic findings.[3] Typical findings include peripherally located, multiple, round, variable-sized nodules (hematogenous spread) and diffuse thickening of interstitium (lymphangitic spread).[2-4] Although various diseases can present as multiple pulmonary nodules, metastatic disease accounts for a high percentage. Gross *et al* reported that 73% of cases with pulmonary nodules resulted from metastatic diseases.[8]

Sometimes, metastatic disease in adults, presents with unusual radiologic appearances, making it more difficult to distinguish these lesions from nonmalignant pulmonary diseases. This pictorial essay covers the radiologic appearances of atypical forms of pulmonary metastases.

Cavitation

Although cavitation in pulmonary metastases is not as frequent as in primary tumors, metastases should always be considered in the differential diagnosis of multiple cavitary lesions.[9,10] The percentage of cavitation in pulmonary metastases is approximately 4% in contrast to 9% in primary cancers.[2,3]

Squamous cell carcinomas are the most common type of cavitating metastases, associated with a 70% rate of cavitation.[2,3,9] The head and neck and urogenital system are the most common primary organ sites [Figures 1, 2].[2,3,11] Chemotherapy is also known to induce cavitation.[3] Several mechanisms for cavitation of nodules are postulated. Tumor

Figure 1: A 40-years-old woman with a choriocarcinoma developed a metastatic cavitary lesion (arrow) in the left lung, which was confirmed by transthoracic needle biopsy

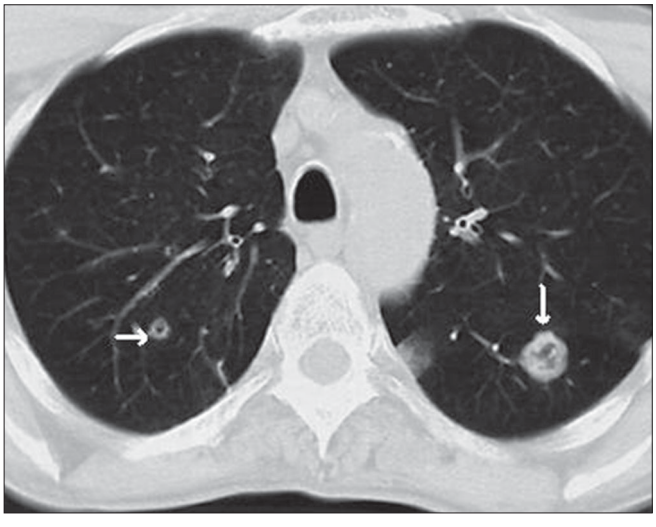

Figure 2: A 55-years-old man with a history of nasopharyngeal carcinoma developed multiple metastatic cavitary lesions (arrows) in both lungs

necrosis and a check-valve mechanism developing by means of tumor infiltration into air-containing structures are some of them.[2,3]

Metastatic sarcomas can also cavitate and result in pneumothorax.[12] They may present as multiple cystic lesions [Figure 3].[10,12-14] They resemble bullae and may have extremely thin walls.[10] Bullae-like lesions on CT, in patients with a known sarcoma, should be interpreted with particular caution.[12]

Calcification

Generally calcification of a pulmonary nodule is suggestive of benignity, as seen in a granuloma or hamartoma.[2,3] Metastases from synovial sarcoma, giant cell tumor of the bone and colon, ovary, breast and thyroid carcinomas may calcify.[2,3,15-21]

Multi-focal calcifications are unusual in metastatic disease, except for those from osteosarcoma and chondrosarcoma [Figure 4].[3,15,17,18] Dystrophic calcification can also occur after treatment of nodular metastases.[3] Bone formation may develop in osteosarcoma and synovial sarcoma.[15,17,18] CT cannot differentiate calcification or ossification in metastatic nodules from those seen in granulomas or hamartomas but multiple calcified nodules may be a sign of metastases,[2] in the correct clinical setting.

Hemorrhage

Hemorrhage in metastatic lesions can be depicted on CT images. Fragility of neovascular tissue leading to rupture of the vessels is considered the cause of hemorrhage.[2,3] Peripheral hemorrhage causes surrounding ground-glass attenuation, termed the CT "halo sign" [Figure 5].[2,3,22] Angiosarcomas and choriocarcinomas are the most common

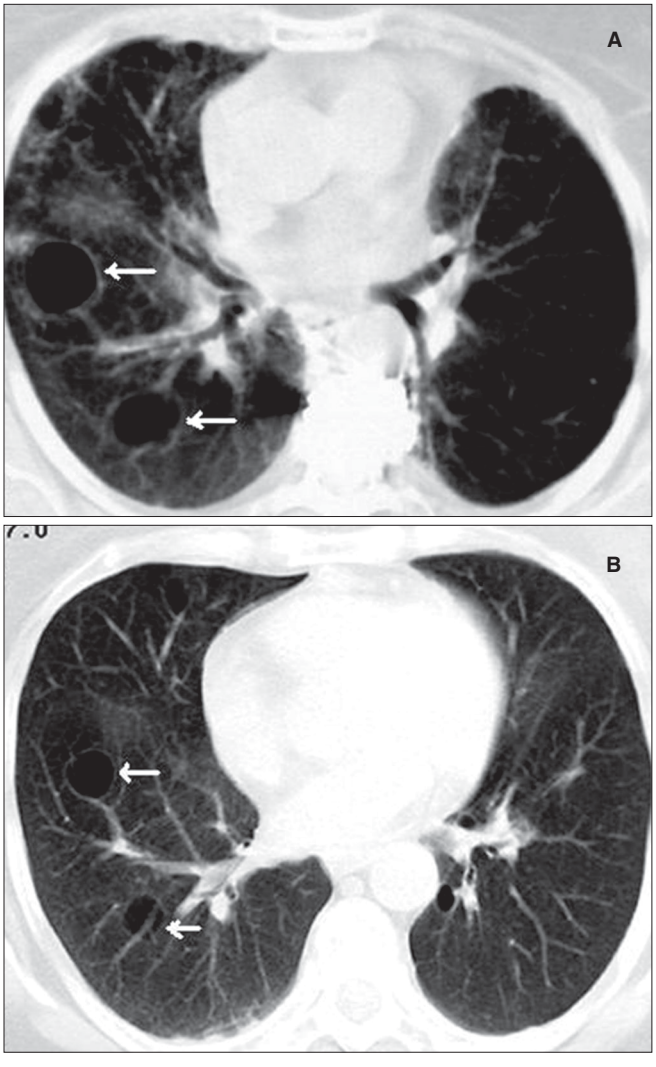

Figure 3 (A, B): A 35-years-old woman with a diagnosis of vertebral osteosarcoma developed thin-walled air containing lesions (arrows) in both lungs. The lesions in the pre-chemotherapy image (A) showed reduction after chemotherapy (B).

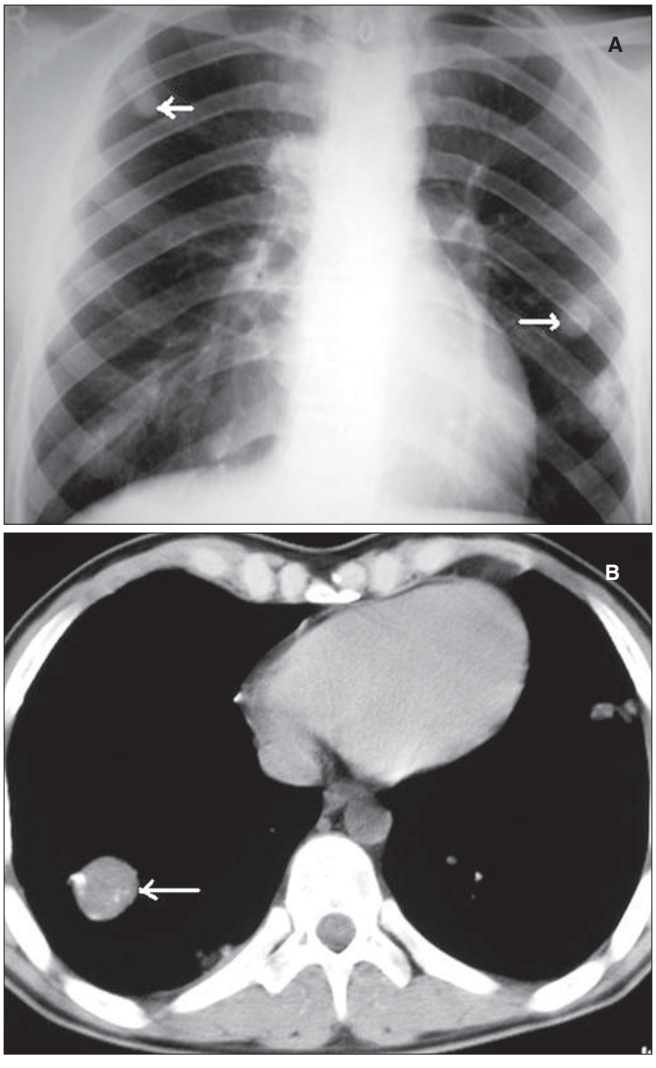

Figure 4 (A, B): A 45-years-old man diagnosed as osteosarcoma of tibia. Chest radiographs (A) and CT scan (B) show calcified nodules (arrows) in both lungs.

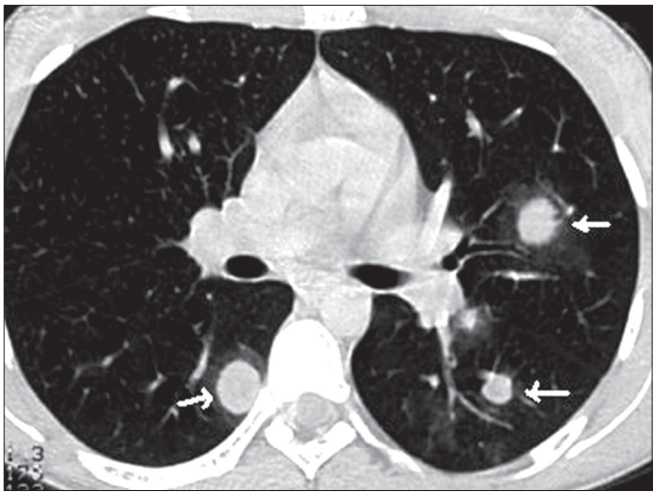

Figure 5: Hemorrhagic metastases in a patient with osteosarcoma. CT scan shows ground-glass attenuation (arrows) around the nodules

causes of hemorrhagic metastases.[2,3,13,22,23] Ground-glass opacity however, is not a specific finding and is also seen in invasive aspergillosis[24,25] as well as in candidiasis, Wegener's granulomatosis, tuberculomas associated with hemoptysis, focal scar, atypical adenomatous hyperplasia, bronchoalveolar carcinoma and lymphoma.[2,3,23,26]

Endobronchial metastases

Endobronchial metastases (EBM) from extrathoracic tumors are rarely seen.[2,3,6,7] The frequency of EBM varies from 2% to 28%.[1,7] There are two mechanism causing EBM. The first is direct invasion of the bronchial wall by means of aspiration of the tumor cells, lymphatic spread or hematogenous metastasis to the bronchial wall. The second is when tumor cells in lymph nodes or lung parenchyma surrounding the bronchus grow along the bronchial tree and some portion of the lesion invades the bronchial wall.[2] Differentiation of EBM from primary lung cancer can be difficult without knowledge of the patient's history.[1,27]

Radiologic findings in EBM are similar to those seen in primary endobronchial lung cancer. A mass in the bronchus and mucus plugging at the periphery are commonly seen [Figures 6, 7], though often the findings are atypical**.** Patients with EBM may also have parenchymal lesions and the diagnosis is often confirmed only after transthoracic biopsy, fine-needle aspiration or open-lung biopsy.[1,28] In the majority of cases, the definitive diagnosis is made by the presence of a primary malignancy at another site, whose histologic appearance is similar to that of the endobronchial lesion.[6,7]

The most common primary sites causing EBM are breast, kidney and colon.[7,29] It is necessary to be aware of this phenomenon, since the treatment differs from that of primary lung cancer.

Solitary Metastases

When a solitary pulmonary nodule is detected in a patient with an extrathoracic malignancy, the probability of metastasis is approximately 25%.[30] Using CT, 46% of solitary pulmonary nodules detected in patients with extrathoracic malignancies were proven to be metastases after resection by video assisted thoracoscopic surgery.[31] The most frequent malignancies include melanoma, sarcomas and carcinomas of colon, breast, kidney, bladder and testis [Fig. 8].[2-4,32,33] Quint *et al* reported that patients with a solitary pulmonary nodule and a history of head and neck cancer were much more likely to have a primary bronchogenic carcinoma than a lung metastasis. If the primary site is colon, kidney or uterus, the chance of the nodule being a primary lung cancer is higher. But if the extrathoracic primary cancer is melanoma, sarcoma or testicular cancer, the solitary lesion is more likely be a metastasis rather than

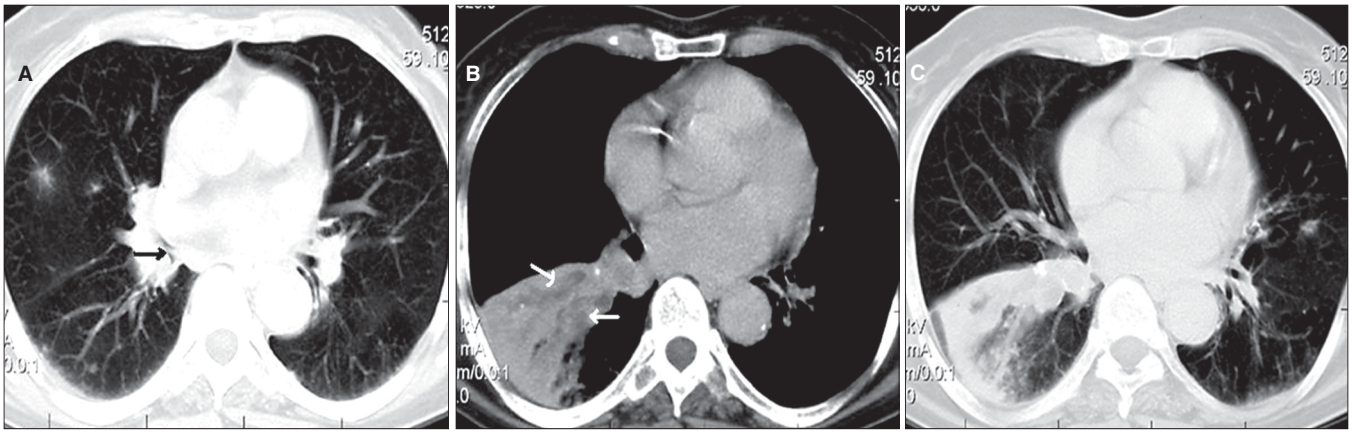

Figure 6 (A-C): A 72-years-old woman with a diagnosis of renal cell carcinoma. Consecutive CT scans show an endobronchial mass (black arrow) in the superior segment of the right lower lobe (A) with atelectasis and mucus-filled basal segment bronchi (arrows) in the soft-tissue (B) and lung window (C) images.

Figure 7: A 45-years-old man with a diagnosis of renal cell carcinoma. CT scan shows finger-like appearance (arrows) in the right lower lobe due to endobronchial metastases

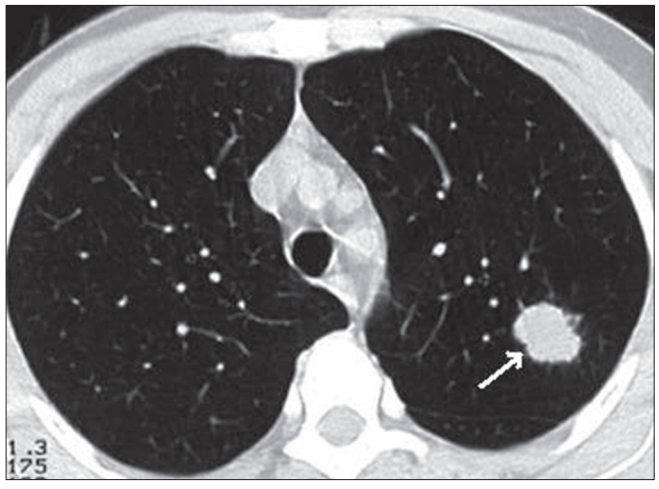

Figure 8: A 65-years-old man with a diagnosis of carcinoma of the pancreas. CT scan shows a solitary nodule (arrow) in the left upper lobe, confirmed to be metastasis by a transthoracic needle biopsy.

a primary lung cancer.[34]

Conclusion

Radiologists should be aware of the spectrum of radiologic appearances in atypical pulmonary metastases as described above.

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