Advantage of Hybrid ^{18}F-Fluoride Positron Emission Tomography/Computed Tomography to Diagnose Malignant Rib Invasion by Pleural Metastasis in a Background of Reactive Periostitis

Abstract

Diffuse osteoblastic activity in the ribs on bone scan is seen in association with pleural thickening. Irrespective of the pleural pathology, this represents benign finding caused by pleural hyperemia or reactive periostitis, with preserved cortical integrity. However, malignant involvement of the ribs can occur by local invasion of pleural malignancy causing cortical lysis. Herein, we describe the ^{18}F-fluoride positron emission tomography/computed tomography findings of reactive periostitis of the ribs in pleural metastasis and emphasize the advantage of hybrid imaging in detecting local malignant tumor invasion superimposed in such condition.

Keywords: *^{18}F-fluoride positron emission tomography/computed tomography, bone scan, hyperemia, osteoblastic activity, pleural metastasis, reactive periostitis*

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A 65-year-old man diagnosed with moderately differentiated adenocarcinoma of the left lung and ipsilateral malignant pleural effusion was referred for ^{18}F-fluoride positron emission tomography/computed tomography (PET/CT) [Figure 1a] to assess skeletal metastasis. He had been treated with chemotherapy over 2 years. Bone PET/CT showed diffusely increased ^{18}F-fluoride uptake in all ribs in the left hemithorax [Figure 1a] related to diffuse periostitis of the inner cortex of the ribs with adjacent left pleural thickening [arrows in Figure 1b and c] and crowding of the left ribs. There was no abnormal fluoride uptake elsewhere to suggest skeletal metastasis. However, focal intense tracer avid spots [arrows in Figure 1a] were seen in the posterior second rib (maximum standardized uptake value [SUV_{max}] 64.0), anterolateral fourth rib, lateral fifth rib, and posterior ninth rib [SUV_{max} 34.9, arrows in Figure 1a and d] on the left side. Focal lytic erosion of the inner cortex was noted in these sites, suggesting rib invasion [arrow in Figure 1e]. These lytic lesions were overlooked on initial blind interpretation of the CT in bone window.

Ten months prior, the patient had undergone an ^{18}F-fluorodeoxyglucose (FDG) PET/CT following 10 cycles of chemotherapy [Figure 2a]. It showed FDG negative minimal periostitis in the ribs adjoining the thickened pleura [Figure 2b and c] and faintly FDG avid residual lung mass [arrows in Figure 2d and e]. There was no cortical erosion [red arrows in Figure 2d and e, left 9th rib] at that time. Comparative axial CT and PET/CT images of FDG [arrows in Figure 3a and b] and fluoride studies [arrows in Figure 3c and d] at the level of the left fifth rib are shown, demonstrating development of cortical erosion in the inner cortex of the left posterior fifth rib with intense fluoride uptake. Disease progression was thus identified based on the development of rib invasion by preexisting pleural metastases.

Diffusely increased rib uptake on bone scan is usually seen in association with thickened pleura due to inflammation, carcinomatosis, or primary malignancy (mesothelioma).[1-3] Although tracer uptake in malignant pleural effusion can mimic rib uptake, positional change localizes tracer activity within the effusion excluding rib abnormality.[4,5] Hyperemia in the thickened pleura increases tracer delivery to the overlying ribs causing hyperemia-induced tracer concentration in the regional ribs.[6] In long-standing

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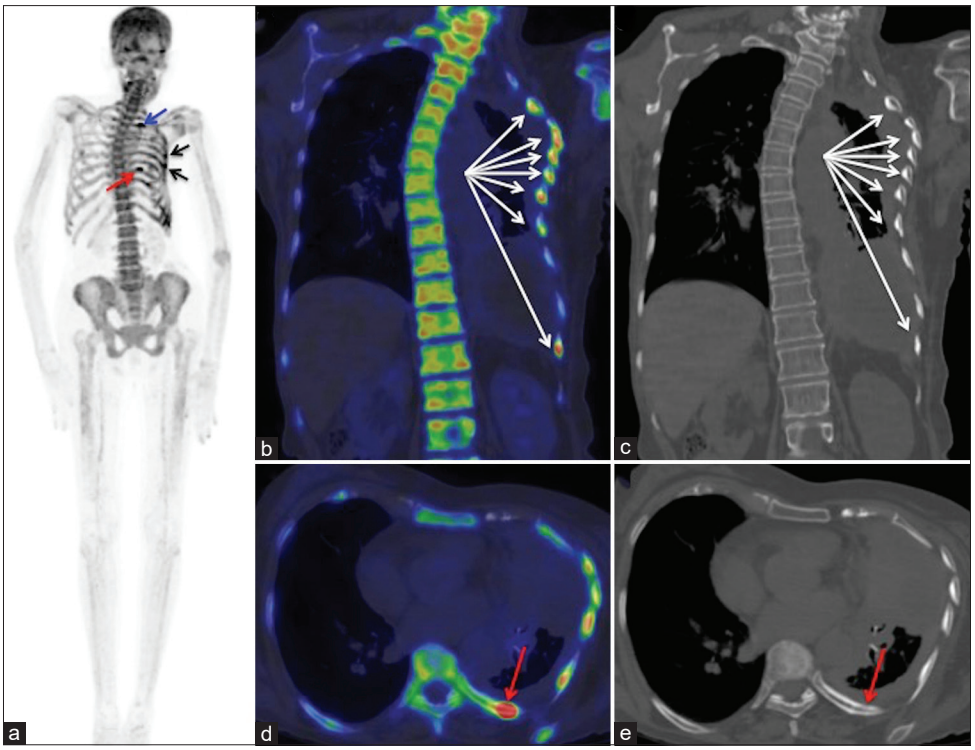

Figure 1: Maximum intensity projection image (a) of the bone positron emission tomography/computed tomography showing diffusely increased ^{18}F-fluoride uptake in all the left ribs. Coronal positron emission tomography/computed tomography (b) and computed tomography (c) showing diffuse periostitis of their inner cortex overlying the thickened pleura (arrows). Focally intense spots are seen in the second (blue arrow in a), fourth and fifth ribs (black arrows in a), and posterior ninth rib (red arrow in a). Axial positron emission tomography/computed tomography (d) and computed tomography (e) showing focal lytic erosion of the inner cortex in the left ninth rib (arrows)

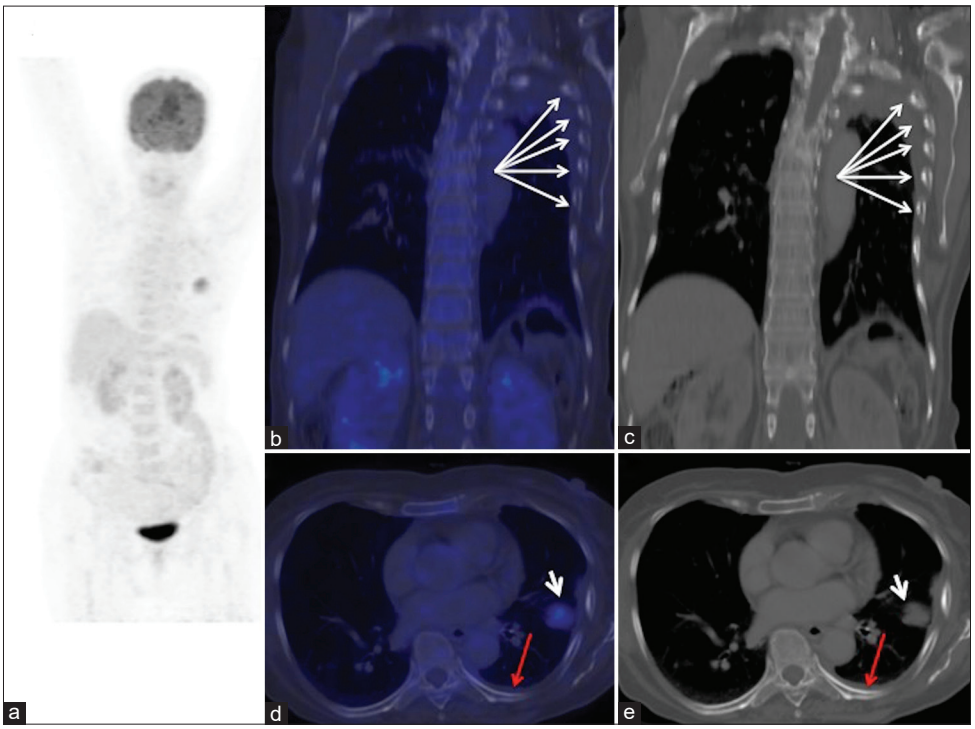

Figure 2: Maximum intensity projection image (a) of ^{18}F-fluorodeoxyglucose positron emission tomography/computed tomography performed ten months prior. Coronal positron emission tomography/computed tomography and computed tomography showing fluorodeoxyglucose negative minimal periostitis in the ribs adjoining the thickened pleura (arrows in b and c). Axial positron emission tomography/computed tomography and computed tomography showing faintly fluorodeoxyglucose avid residual lung mass (arrows in d and e). There was no cortical erosion (red arrows in d and e, left ninth rib) at that time

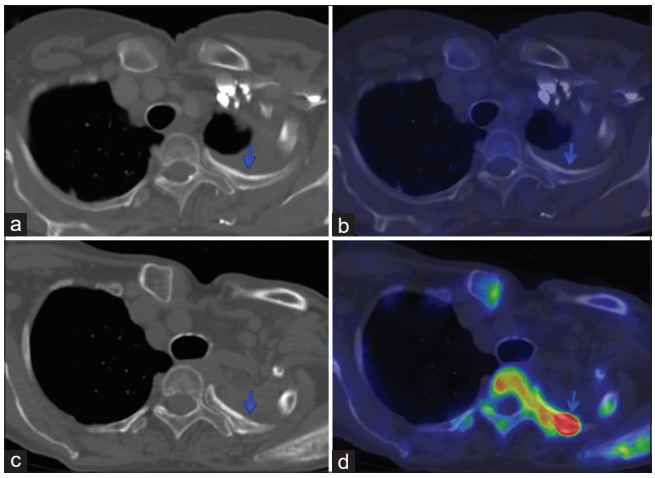

Figure 3: Comparative axial computed tomography and positron emission tomography/computed tomography images of fluorodeoxyglucose (arrows in a and b) and fluoride studies (arrows in c and d) showing development of cortical erosion in the inner cortex of the left posterior fifth rib with intense fluoride uptake

pleural disease, there could be reactive periostitis of the inner cortex of ribs adjoining the pleura, where increased tracer binding is limited only to the inner cortex. In both these conditions, cortical integrity of the ribs is preserved. However, malignant involvement of the ribs can occur by local invasion of tumor across the pleura causing cortical lysis.[7] In certain situations as shown in our case, the cortical lysis could be subtle that it was missed during initial blind interpretation of the CT images. On evaluation of focal increased ^{18}F-fluoride uptake at random sites, the subtle lytic lesions could be appreciated denoting disease progression. Metastasis in the ribs was also ruled out due to the absence of linear pattern of tracer uptake.[8]

In our case, we have described the imaging appearance of reactive periostitis in ^{18}F-fluoride PET/CT as a benign phenomenon of the inner cortex of ribs in pleural metastasis and emphasized the advantage of hybrid imaging in detecting disease progression by local malignant tumor invasion superimposed in such condition.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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