Solitary pulmonary nodule: Increasing diagnosis and accuracy of biopsy by biparametric MR imaging

Sir,

Computerized tomography (CT) is the imaging procedure of choice in the detection of unusual pleuritic, pulmonary masses,[1,2] and solitary pulmonary nodule (SPN) that remains a diagnostic challenge for the radiologists.

The definition of "lung mass" and SPN and the methods of their evaluating and managing are based on the latest guidelines from the Fleischner Society and American College of Chest Physicians.[3,4]

CT discovers greater number of SPNs, of which numerous are indeterminate (benignant or malignant lesions). The accuracy of CT-guided biopsy of tissue diagnosis is 90.3%[5] and is affected by the presence of the central necrosis in medium and large nodules (>20 mm) in about 10%.[6] In addition, the cytohistological diagnosis with aspiration biopsy may be complicated by pneumothorax, intrapulmonary hemorrhage, and/or intrapleural bloody fluid and very rarely by tumor seeding; this risk is more frequent for necrotic malignant nodules. Hence, to avoid unnecessary aspiration cytology and possible complications, it is necessary to know the preoperative site, size, and nodular solid and/or necrotic composition.

Biparametric magnetic resonance imaging (bp-MRI) (combining morphologic T2-weighted [T2W] and diffusion-weighted imaging [DWI]), thanks to DWI, provides functional information and can increase the potential of MRI in the recognition of the structure and management of SNP. On DWI, signal intensity derives from the motion of water molecules in the extravascular, intracellular, and intravascular space in hypervascularized tumors; significant proportions of signal intensity originates from intravascular space.[7] In malignant tumors with enlarged cells, conspicuous nuclei and reduction of the extracellular matrix, water diffusion is restricted due to tissue cellularity with cell membrane integrity and scarce extracellular spaces, resulting in a decrease of the apparent diffusion coefficient (ADC) value. Neoplastic pulmonary lesions generally have restricted diffusion with lower ADCs and so appear hypointense on ADC maps but hyperintense on the DW, high *b*-value image.[8,9]

In our experience, we performed preprocedural bpMRI protocol (axial and coronal T2W single-shot turbo spin-echo acquisitions and axial single-shot echo-planar DWI with *b*-values of 0 and 1000 s/mm^2 in free-breathing mode with respiratory gating with the generation of the ADC maps), using a 1.5 T system with a 16-channel phased-array torso coil, in 22 patients with SNP (diameter from 15 to 30 mm) potentially candidates to CT-guided biopsy. In all cases, the final diagnosis was established by histological examination (agobiopsy or surgical specimen) and confirmed by follow-up by imaging. The patients had 8 benign lesions (focal pneumonia $n = 2$, hamartoma $n = 3$, aspergilloma $n = 1$, pulmonary infarct $n = 1$, and fibrotic nodule $n = 1$) characterized by no restriction of diffusion [Figure 1] and 14 malignant lesions (large-cell neuroendocrine carcinoma $n = 1$, non-small cell carcinoma $n = 6$, atypical carcinoid $n = 1$, metastasis $n = 5$, and non-Hodgkin's lymphoma $n = 1$) characterized by restriction of diffusion [Figure 2]. Interestingly, on 3 out of 14 malignant lesions, we differentiated solid component with restricted diffusion from necrosis that represents the site avoided by biopsy.

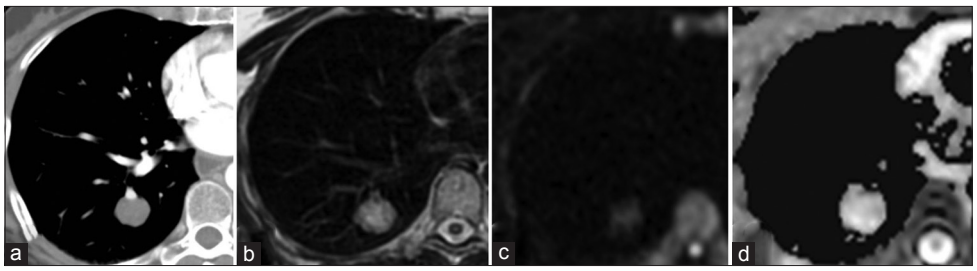

Figure 1: Hamartoma in the lower pulmonary right lobe at postcontrast computerized tomography (a) and T2-weighted images (b), diffusion-weighted imaging at *b* = 1000 s/mm^2 (c) and apparent diffusion coefficient maps (d). The lesion appears moderately hyperintense on diffusion-weighted imaging at *b* = 1000 s/mm^2 (c) with high signal in the corresponding apparent diffusion coefficient maps (d) reflecting an abundant extracellular matrix with non-altered water diffusion facilitating diagnosis of benign lesion

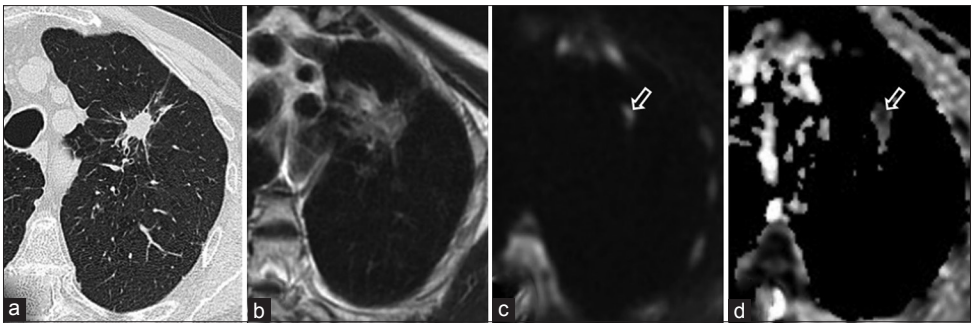

Figure 2: Squamous bronchogenic adenocarcinoma in the upper left pulmonary lobe at high-resolution computerized tomography (a), T2-weighted images (b), diffusion-weighted imaging at $b = 1000$ s/mm^2 (c), and apparent diffusion coefficient maps (d). The lesion appears hyperintense on diffusion-weighted imaging at $b = 1000$ s/mm^2 (arrow in c) with reduction of the signal intensity on apparent diffusion coefficient maps (arrow in d) reflecting a restriction of water diffusion which is related to high tumor cellularity and representing the site for biopsy

In conclusion, the information deriving by bp-MRI (DW-MRI added to T2W images) about the functional environment of water in pulmonary nodules, increases the morphologic detail provided by MRI, reducing costs and acquisition time. The demonstration of intralesional areas of restriction is essential before biopsy, to reduce false-negatives and to avoid inappropriate diagnostic procedures.

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Conflicts of interest
There are no conflicts of interest.

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REFERENCES

1. Pusiol T, Scialpi M. Role of computed tomography in the preoperative diagnosis of giant benign solitary fibrous tumor pleura. Lung India 2013;30:82-5.
2. Pusiol T, Piscioli I, Rondoni V, Scialpi M. Intrathoracic liposarcoma: Case report with emphasis to histogenesis and site of origin classification problems. Lung India 2018;35:186-7.
3. MacMahon H, Naidich DP, Goo JM, Lee KS, Leung ANC, Mayo JR, *et al*. Guidelines for management of incidental pulmonary nodules detected on CT images: From the Fleischner society 2017. Radiology 2017;284:228-43.
4. American College of Radiology ACR Appropriateness Criteria Solitary Pulmonary Nodule. Available from: http://www.acr.org/SecondaryMainMenuCategories/quality_safety/app_criteria/pdf/ExpertPanelonThoracicImaging/SolitaryPulmonaryNoduleDoc10.aspx. [Last accessed on 2012 Apr 29].
5. Zhao G, Shi X, Sun W, Liang H, Mao X, Wen F, *et al*. Factors affecting the accuracy and safety of computed tomography-guided biopsy of intrapulmonary solitary nodules ≤30 mm in a retrospective study of 155 patients. Exp Ther Med 2017;13:1986-92.
6. Hwang HS, Chung MJ, Lee JW, Shin SW, Lee KS. C-arm cone-beam CT-guided percutaneous transthoracic lung biopsy: Usefulness in evaluation of small pulmonary nodules. AJR Am J Roentgenol 2010;195:W400-7.
7. Thoeny HC, De Keyzer F, Vandecaveye V, Chen F, Sun X, Bosmans H, *et al*. Effect of vascular targeting agent in rat tumor model: Dynamic contrast-enhanced versus diffusion-weighted MR imaging. Radiology 2005;237:492-9.
8. Matoba M, Tonami H, Kondou T, Yokota H, Higashi K, Toga H, *et al*. Lung carcinoma: Diffusion-weighted mr imaging – preliminary evaluation with apparent diffusion coefficient. Radiology 2007;243:570-7.
9. Razek AA, Fathy A, Gawad TA. Correlation of apparent diffusion coefficient value with prognostic parameters of lung cancer. J Comput Assist Tomogr 2011;35:248-52.

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