



Editorial

# Diffusion-Weighted MRI: Potential Tool for Pulmonary Nodule Characterization

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Diffusion-weighted imaging (DWI) has emerged as a promising tool for structural and functional assessment of mass lesions noninvasively and without radiation exposure or contrast administration. Lung lesion evaluation has traditionally been a blind spot for magnetic resonance imaging (MRI), but recent studies have emphasized the role of advanced MRI techniques in comprehensive lesion characterization, classification, staging, and response analysis.<sup>1</sup>

Mohakud et al have explored the concept of DWI in characterizing lung nodules with a combination of qualitative, semiquantitative, and quantitative methods.<sup>2</sup> In their study, diffusion parameters such as lesion-to-spinal cord signal ratio (LSR) and the minimum apparent diffusion coefficient (ADC min) demonstrated good diagnostic capability in distinguishing benign and malignant lung masses. Malignant masses typically had higher LSR value and lower ADC min as opposed to benign lesions, consistent with prior published literature.<sup>3</sup> The authors have deliberately opted for ADC min over mean ADC values, with the intention of mitigating the effects of lesion heterogeneity. Furthermore, they have pioneered a novel parameter, lesion to spinal cord ADC ratio for lesion characterization with sensitivity, specificity, and accuracy comparable to ADC min. A related measurement, ADC ratio, defined as the ratio of ADC of a lesion to ADC value at a normal reference site has been utilized in the evaluation of masses in various organs with encouraging results.<sup>4</sup> However, its application in lung nodules has not been investigated yet and may serve as another potential biomarker for determining the nature of lung masses.

A word of caution is that specific thresholds for the various diffusion parameters, as described in this article, cannot be applied to other studies in the absolute sense. This stems from the fact that quantitative diffusion parameters exhibit significant variability across different clinical settings due to differences in hardware, scanning protocols, b

values, and regions of interest. However, if the diffusion data across scanning systems could be harmonized and standardized, the reference tables thus generated could facilitate greater implementation of the quantitative domain of diffusion analysis. In this context, innovative tools like big data and radiomics have great potential and are matters of future research.<sup>5</sup>

The readers should be aware that DWI as a standalone criterion for segregating benign and malignant masses may at times be erroneous. Both pulmonary abscesses and malignancy are associated with low ADC values, which can pose a diagnostic challenge. To address this dilemma, incorporating T2/short tau inversion recovery-weighted imaging (STIR) may be prudent. Abscesses appear bright on these sequences with a signal intensity directly proportional to the fluid nature of the contents. In contrast, solid masses exhibit an intermediate signal intensity, setting them apart.<sup>6</sup> In this regard, the added value of dynamic contrast-enhanced magnetic resonance imaging/magnetic resonance perfusion imaging (MR perfusion) in assessing tumor neovascularity cannot be over-emphasized. The conspicuous nodular enhancement of the solid components of a mass can aptly distinguish it from the thin smooth rim of an abscess. In addition, the inflammatory flare adjoining the abscesses is a valuable feature depicted on contrast-enhanced images. MR perfusion further advances the utility of contrast imaging by providing quantitative multiparametric maps. They help not only to identify true neoplasms from pseudomasses and inflammatory lesions but also appropriately grade malignancies, suggest their histopathology, and assess therapeutic response and recurrences during follow-up.<sup>7</sup>

Indeed, the ease and safety of performing whole-body DWI make MRI a one-stop shop for comprehensive lung mass analysis and metastatic workup. It even surpasses fluorodeoxyglucose positron emission tomography (FDG-PET) in this regard, due to its high accuracy in detecting brain

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metastasis. Hence, the multiparametric armamentarium offered by MRI stands as one of the most robust imaging approaches to lung mass evaluation. Nevertheless, in a resource-constrained setting, the diffusion characteristics of a lesion in conjunction with its T2 signal can more than suffice to determine its malignant potential.<sup>8</sup>

The concerns over inconsistencies in the evaluation of quantitative parameters as a result of magnetic field susceptibility artifacts at the lesion–air interface persist for this study. While some research articles have asserted to circumvent this pitfall through non-echo-planar diffusion imaging, additional research in this regard may provide more definitive answers.<sup>9</sup>

In conclusion, DWI can serve as a viable safer alternative to fluorodeoxyglucose positron emission tomography computed tomography (FDG-PET-CT) imaging for functional analysis of lung lesions, particularly in young individuals. Nevertheless, further investigation and meta-analysis are imperative to establish its practical value and precise position within the existing lung cancer management guidelines.

#### Conflict of Interest

None declared.

#### References

- 1 Kim HS, Lee KS, Ohno Y, van Beek EJR, Biederer J. PET/CT versus MRI for diagnosis, staging, and follow-up of lung cancer. *J Magn Reson Imaging* 2015;42(02):247–260
- 2 Mohakud S, Das R, Bag ND, Mohapatra PR, Mishra P, Naik S. A prospective observational study of diagnostic reliability of semi-quantitative and quantitative high b-value diffusion-weighted MRI in distinguishing between benign and malignant lung lesions at 3 Tesla. *Indian J Radiol Imaging* 2024;34(01):6–15
- 3 Shen G, Ma H, Liu B, Ren P, Kuang A. Diagnostic performance of DWI with multiple parameters for assessment and characterization of pulmonary lesions: a meta-analysis. *Am J Roentgenol* 2018;210(01):58–67
- 4 Bajgirani AM, Mirak SA, Sung K, Sisk AE, Reiter RE, Raman SS. Apparent diffusion coefficient (ADC) ratio versus conventional ADC for detecting clinically significant prostate cancer with 3-T MRI. *Am J Roentgenol* 2019;213(03):W134–W142
- 5 Koo CW, Kline TL, Yoon JH, et al. Magnetic resonance radiomic feature performance in pulmonary nodule classification and impact of segmentation variability on radiomics. *Br J Radiol* 2022;95(1140):20220230
- 6 Usuda K, Ishikawa M, Iwai S, et al. Combination assessment of diffusion-weighted imaging and T2-weighted imaging is acceptable for the differential diagnosis of lung cancer from benign pulmonary nodules and masses. *Cancers (Basel)* 2021;13(07):1551–1
- 7 Tao X, Wang L, Hui Z, et al. DCE-MRI perfusion and permeability parameters as predictors of tumor response to CCRT in patients with locally advanced NSCLC. *Sci Rep* 2016;6(01):35569
- 8 Usuda K, Ishikawa M, Iwai S, et al. Pulmonary nodule and mass: superiority of MRI of diffusion-weighted imaging and T2-weighted imaging to FDG-PET/CT. *Cancers (Basel)* 2021;13(20):5166–6
- 9 Lei Q, Wan Q, Liu L, et al. Values of apparent diffusion coefficient and lesion-to-spinal cord signal intensity in diagnosing solitary pulmonary lesions: turbo spin-echo versus echo-planar imaging diffusion-weighted imaging. *BioMed Res Int* 2021;2021:3345953