Clinical Radiology xxx (2018) 1–9

Contents lists available at ScienceDirect

Clinical Radiology

journal homepage: www.clinicalradiologyonline.net

Intravoxel incoherent motion MRI for differentiating sinonasal small round cell malignant tumours (SRCMTs) from Non-SRCMTs: comparison and correlation with dynamic contrast-enhanced MRI

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ARTICLE INFORMATION

Article history:
Received 27 November 2017
Accepted 5 July 2018

AIM: To investigate the value of intravoxel incoherent motion (IVIM) in the differentiation of sinonasal small round cell malignant tumours (SRCMTs) from non-SRCMTs and to compare and correlate these results with those of dynamic contrast-enhanced (DCE) magnetic resonance imaging (MRI).

MATERIALS AND METHODS: Ninety patients with histologically confirmed sinonasal malignant tumours (53 SRCMTs and 37 non-SRCMTs) who underwent conventional MRI, IVIM, and DCE-MRI before treatment were enrolled. The IVIM and DCE-MRI parameters were measured. Statistical analyses were performed using Student's *t*-tests, receiver operating characteristic (ROC) curve analyses, and Spearman's correlation coefficients.

RESULTS: A lower pure diffusion coefficient (D) value and a higher pseudo-diffusion coefficient (D*) value were found in the sinonasal SRCMTs than in the non-SRCMTs ($p<0.001$ and $p=0.011$, respectively). Moreover, the mean extravascular extracellular space volume ratio (V_e) of the SRCMTs was significantly lower than that of the non-SRCMTs ($p=0.020$). ROC curve analysis showed that the diagnostic performance of D outperformed those of the other perfusion and diffusion parameters. A cut-off D value of 0.56 $\times 10^{-3}$ mm^2/s yielded a sensitivity of 80.4%, a specificity of 75%, and an accuracy of 78.2%, with an AUC of 0.825. Significant but poor-to-fair correlations were found between the parameters from IVIM and DCE-MRI.

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https://doi.org/10.1016/j.crad.2018.07.097
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Please cite this article in press as: Zhong Y, et al., Intravoxel incoherent motion MRI for differentiating sinonasal small round cell malignant tumours (SRCMTs) from Non-SRCMTs: comparison and correlation with dynamic contrast-enhanced MRI, Clinical Radiology (2018), https://doi.org/10.1016/j.crad.2018.07.097

CONCLUSIONS: The D and D* values of IVIM and the V_e value of DCE-MRI are helpful in distinguishing sinonasal SRCMTs from non-SRCMTs, with the D values having the best diagnostic efficiency.

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Introduction

The sinonasal area is usually affected by a wide spectrum of neoplasms.[1] Small round cell malignant tumours (SRCMTs), which form a specific group of malignancies in the sinonasal region, encompass a wide variety of malignant neoplasms, such as malignant melanoma (MM), olfactory neuroblastoma (ONB), neuroendocrine carcinoma (NEC), and lymphoma.[2,3] In contrast, non-SRCMTs, including squamous cell carcinomas (SCCs) and adenoid cystic carcinomas, form another common group of malignant tumours in the sinonasal region. The distinction between these two groups of sinonasal tumours is crucial because therapeutic decisions, surgical planning, and prognosis vary substantially for each tumour type[4,5]; however, because of the considerable overlap of histological findings and variation both within and between cases, reliable differentiation of these two groups of sinonasal tumours is difficult to achieve with conventional haematoxylin and eosin (H&E) staining, especially for pathologists who may not be as familiar with the diagnostic entities of the sinonasal area. Thus, immunohistochemical staining is usually required to obtain a definitive diagnosis, resulting in a substantial increase in diagnosis-related time, costs, and patient anxiety.[4]

As a result, precise preoperative differential diagnosis of sinonasal SRCMTs and non-SRCMTs by cross-sectional imaging, such as computed tomography (CT) and magnetic resonance imaging (MRI), is of great importance to clinical practice.[5,6] Unfortunately, the imaging features of these two entities are often non-specific and overlapping.[5] Novel MRI techniques, such as intravoxel incoherent motion (IVIM) and quantitative dynamic contrast-enhanced MRI (DCE-MRI), can complement physiological information with morphological information that was obtained with conventional MRI. IVIM, which was proposed by Le Bihan *et al.*[7,8] is a functional technique that can provide tissue information about diffusivity and microvascular perfusion without using contrast agents. Therefore, it shows great potential to evaluate and discriminate the cytostructural and haemodynamic differences between tumours. IVIM has now been used to investigate the features of breast cancer[9] and hepatocellular carcinoma,[10] as well as head and neck tumours.[11] DCE-MRI can provide quantitative information regarding tissue vascular permeability and angiogenesis and has been shown to be useful in the preoperative differentiation of malignancies from benign lesions and in monitoring treatment responses in the head and neck[12,13]; however, it should be performed with the application of contrast agents, which may increase the risk of nephrogenic systemic fibrosis (NSF) in patients with severe renal dysfunction.[14]

To the authors' knowledge, no studies using DCE-MRI and IVIM for differentiating sinonasal SRCMTs from non-SRCMTs have been reported. Thus, the aim of the present study was to explore IVIM as a tool for distinguishing SRCMTs from non-SRCMTs by comparison and correlation with DCE-MRI.

Material and methods

Patients

The institutional review board approved this retrospective study, and the requirement for patient informed consent was waived because of the retrospective nature of this study. A total of 98 consecutive patients with sinonasal solid masses were recruited between May 2015 and December 2016 based on the following inclusion criteria: (1) histological types of SRCMTs and non-SRCMTs were definitely confirmed by immunohistochemical staining after surgery/biopsy, and (2) both IVIM and DCE-MRI were performed. The exclusion criteria were as follows: (1) image quality was insufficient due to severe artefacts (n=2 for dental artefacts and n=1 for motion artefact); (2) the lesion was too small (<10 mm in short-axis diameter; n=3); and (3) the patient had a history of treatment or recurrence before the MRI examinations (n=2). Ultimately, 90 patients (66 men and 24 women; mean age 53±15 years; range, 10–81 years) with sinonasal malignant tumours, including 53 patients with sinonasal SRCMTs (15 females and 38 males, ages ranging from 10–81 years with a mean age of 50±15 years) and 37 with sinonasal non-SRCMTs (nine females and 28 males, ages ranging from 22 to 80 years with a mean age of 57±13 years). The SRCMTs included olfactory neuroblastomas (n=18), malignant melanomas (n=14), rhabdomyosarcomas (n=10), lymphomas (n=6), undifferentiated carcinomas (n=2), neuroendocrine carcinomas (n=2), and a plasmacytoma (n=1). The non-SRCMTs included squamous cell carcinomas (n=31) and adenoid cystic carcinomas (n=6).

MRI techniques

All MRI examinations were performed using a 3 T MRI system (Verio; Siemens Healthcare, Erlangen, Germany). Conventional T1-weighted imaging (WI) and T2WI and the IVIM and DCE-MRI were acquired sequentially. IVIM was performed by using a single-shot echo planar imaging (EPI) sequence with a bi-polar scheme along all three orthogonal axes to obtain isotropic DWI images. The imaging parameters were as follows: 5,200 ms repetition time (TR)/83 ms echo time (TE), number of averages = 2, 320×256 acquisition matrix, 230 mm field of view (FOV), five sections, 5 mm

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