Predicting the short-term response to chemoradiotherapy using intravoxel incoherent motion diffusion-weighted and dynamic contrast-enhanced magnetic resonance imaging in patients with nasopharyngeal carcinoma

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BACKGROUND: Nasopharyngeal carcinoma (NPC) is a common malignancy in Southern China and Southeast Asia. Now chemoradiotherapy is the standard treatment of advanced NPC, whereas local residual and relapse are the main reasons for treatment failure. Predicting tumor response to chemoradiotherapy as early as possible could help determine an optimal treatment regimen.Previous studies have demonstrated the value of diffusion-weighted magnetic resonance imaging (DW-MRI) and dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) in predicting the early (i.e. after the end of induction chemotherapy (IC) and/or chemoradiotherapy) response in NPC. Nevertheless, few published studies focused on the utility of DW-MRI and DCE-MRI for predicting the short-term therapeutic response in NPC.
HYPOTHESIS: DW-MRI and/or DCE-MRI parameters may be helpful for predicting the short-term response to chemoradiotherapy in NPC.
METHODS: This prospective study was approved by the Medical Ethics Committee of our institution and informed consent was obtained from all patients. Forty-three NPC patients (AJCC staging: T1, n = 0; T2, n = 5; T3, n = 20; T4, n = 18; N0, n = 3; N1, n = 7; N2, n = 18; N3, n = 15; M0, n = 36; M1, n = 7) received two cycles of IC (a dose of 135 mg/m^2 Taxol on day 1 accompanied by 80 mg/m^2 nedaplatin on days 1, 2, and 3;cycles repeated every 24 ± 1.7 days) followed by radiotherapy (total dose: 71.3-75.9 Gy;31-33 fractions). Intravoxel incoherent motion (IVIM) DW-MRI and DCE-MRI were performed pre-treatment and post-treatment (20 days after IC initiation). Patients were divided into the good-response or the poor-response group according to whether local residual or relapse lesions were demonstrated on MRI and pharyngorhinoscopy six months after the end of chemoradiotherapy. The IVIM-based parameters（apparent diffusion coefficient , ADC; true diffusion coefficient,D; pseudo-diffusion coefficient ,D* ; and microvascular volume fraction, *f*）and DCE-MRI parameters (the volume transfer constant of the contrast agent, K^{trans} ; rate constant, K_{ep} ; the extravascular extracellular volume fraction of the tissue ,V_e; and fractional plasma volume, fpv) together with their percentage changes (△%) for the primary NPC lesions were compared between the two groups.
Results: None of the perfusion-related parameter' values of IVIM DW-MRI or DCE-MRI showed significant differences between the good-response and poor-response groups (*p* values for postADC, △%ADC, △%D, preD*, postD*,△%D*, pref, postf,△%f, preK^{trans}, postK^{trans}, △% K^{trans}, preK_{ep}, postK_{ep}, △%K_{ep}, preV_e, postV_e and △%V_e were 0.160,0.851,0.876,0.662, 0.585,0.417,0.564, 0.142, 0.275,0.554,0.798,0.556, 0.844,0.209, 0.570,0.869,0.239,and 0.776, respectively).The poor-response group exhibited higher preADC ([1.113±0.256] x10^{-3} mm^2/s vs [0.946±0.219] x10^{-3} mm^2/s ,*p*<0.034), higher preD ([0.878±0.174] x10^{-3} mm^2/s vs [0.688±0.144] x10^{-3} mm^2/s, *p*<0.002) , higher postD（[1.270±0.332] x10^{-3} mm^2/s vs [0.950±0.277]x10^{-3} mm^2/s, *p*<0.013）values than the good-response group. In predicting the treatment response, the area under the curve based on ROC analysis for preD, postD and preADC were 0.854, 0.786 and 0.743, respectively. Our preliminary study suggests that diffusion-related IVIM-based parameters (D and ADC) might be more helpful than perfusion-related IVIM-based and DCE-MRI parameters in predicting the short-term effects of chemoradiotherapy for advanced NPC.