Pretreatment dynamic contrast-enhanced and diffusion MRI in predicting locoregional control in oropharyngeal or hypopharyngeal cancer treated with chemoradiation

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Target audience: Neuroradiologist, Oncologist

Purpose: Chemoradiation has recently been accepted as a standard management option for the organ-preservation treatment of oropharyngeal or hypopharyngeal squamous cell carcinoma (OHSCC). The purpose of the study was to investigate the utility of dynamic contrast enhanced (DCE) MRI and diffusion weighted imaging (DWI) in predicting locoregional control (LRC) of OHSCC treated with chemoradiation.

Methods: Fifty-four patients with newly diagnosed OHSCC underwent DCE-MRI and DWI in a 3T MRI scanner (Trio TIM, Siemens). DCE-MRI was acquired using a 3D spoiled gradient-echo sequence with the following parameters: TR/TE/Flip angle = 3.5ms /1.13 ms/15°, matrix size=108×128, slice thickness=4mm. The baseline longitudinal relaxation time values were calculated using different flip angles (4°, 8°, 15° and 25°). A total of 80 volumes were acquired with a temporal resolution of 3.3 s. The arterial input function was estimated using a blind source separation algorithm[1]. The extended Kety model [2] was adopted for the pharmacokinetic analysis. DWI was acquired using a modified Stejskal-Tanner diffusion gradient pulsing scheme [3] with TR/TE = 7800/64 ms and b-value = 800 s/mm^2. The extracted parameters of transfer constant (K^{trans}) in DCE-MRI and the apparent diffusion coefficient (ADC) of DWI was correlated in both primary tumor and its greatest regional metastatic node with locoregional failure (LRF).

Results: With the median follow-up time of 15 months, 36 patients achieved LRC, and 14 patients had LRF. In the univariate analysis, only K^{trans}_{tumor} was significantly associated with LRF (p=0.04); ADC, age, sex, hemoglobin level, T-stage, N-stage, and gross tumor volume did not display a significant correlation with LRF (Fig.1). The K^{trans}_{tumor} of LRC group (0.69min^{-1}) was significantly higher than that of the LRF group (0.48 min^{-1}, p= .03). The K^{trans}_{node} of the LRC group (0.66 min^{-1}) was also higher than that of the LRF group (0.42 min^{-1}) with borderline significance (p= .05). No significant difference was found in ADC$_{tumor}$ or ADC$_{node}$ between the 2 groups. K^{trans}_{tumor} of 0.45 min^{-1},determined by the receiver operating characteristic curve as a cutoff value for predicting local failure, attained 78.6% sensitivity of and 77.8% specificity (Fig.2).

Conclusion: Our results suggest that pretreatment K^{trans}_{tumor} allowed more accurate response prediction than K^{trans}_{node}, and could be a potential indicator of LRF in OHSCC treated with chemoradiation. The pretreatment ADC measurements did not predict response.

References: **1.**Lin YC, Chan TH, Chi CY, et al. Blind estimation of the arterial input function in dynamic contrast-enhanced MRI using purity maximization. *Magn Reson Med.* Nov 2012;68(5):1439-1449. **2.**Tofts PS, Brix G, Buckley DL, et al. Estimating kinetic parameters from dynamic contrast-enhanced T(1)-weighted MRI of a diffusable tracer: standardized quantities and symbols. *J Magn Reson Imaging.* Sep 1999;10(3):223-232. **3.**Morelli JN, Runge VM, et al. Evaluation of a modified Stejskal-Tanner diffusion encoding scheme, permitting a marked reduction in TE, in diffusion-weighted imaging of stroke patients at 3 T. *Invest Radiol.* Jan 2010;45(1):29-35.
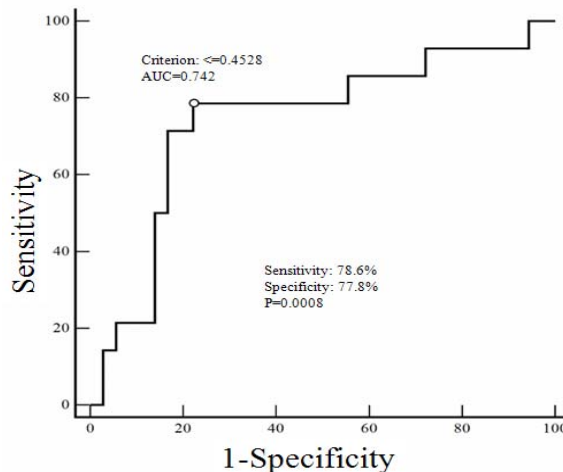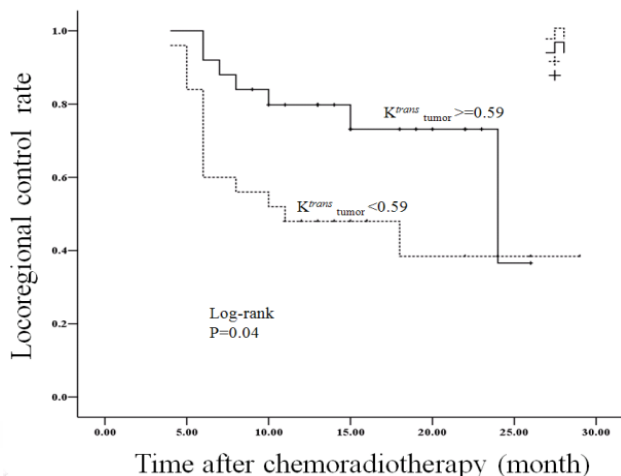
Fig. 1. Kaplan-Meier estimate of LRC probabilities by K^{trans} value with respect to time after treatment. A high K$^{trans}_{tumor}$ (≥ 0.59 min^{-1}) had significantly higher rates of local control than those with a low K$^{trans}_{tumor}$ (< 0.59 min^{-1}).

Fig. 2. Receiver operating characteristic curve in predicting local failure