Feasibility of Dynamic Contrast Enhanced MRI in Oral Cavity Cancer: A Comparison between Reference Region Model, General Kinetic Model and Pathological Grading

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Purpose: The growing importance of dynamic contrast-enhanced MRI (DCE-MRI) in the oncological application prompted us to examine its clinical feasibility in patients with suboptimal scanning condition, in our case: the patients of malignant oral cavity tumors susceptible to motion artifact and image distortion due to coughing, swallowing, fixed dental implant and etc. We aimed to examine (1) how successful the DCE-MRI was in image distortion-prone oral cavity and (2) if the consistency exists in two main T₁-weighted DCE-MRI perfusion parameters (Ktrans and Ve) generated from two different pharmacokinetic models: general kinetic model (GKM) [1] and reference region model (RRM) [2,3], the former one was regarded as the standard DCE-MRI protocol and the latter one was advantaged by no AIF need, but hampered by relatively suboptimal SNR, and (3) to assess if the DCE-MRI parameters are relevant to the pathologic tumor grading.

Materials and Methods: Within one year period, 22 patients aged 34-80 years (mean age, 50 ± 10 years) who had oral cavity squamous cell carcinomas were enrolled for preoperative MRI evaluation. Surgical pathologic findings were the reference standard for the tumor grading, while the Ktrans and Ve were calculated from DCE-MRI data using two pharmacokinetic models (GKM and RRM). For the RRM analysis, the concentration time curve of a reference region was obtained from the tumor ROI and then fitted to Kovar’s method to estimate Ktrans and Ve. The posterior neck muscle away from the tumor used as reference region for normalization was the same for two models.

Results: (1) Of the 22 cases, the data from 18 cases were analyzable with the DCE quantification (Fig 1). Four cases with severe imaging distortion and insufficient lesion delineation were excluded. The successful rate of DCE-MRI in this study was 82%. (2) Spearman's rank correlation coefficient test was used for DCE parameters between GKM and RRM methods. The significant correlation was noted between Ktrans from RRM and GKM in both absolute and normalized values and Ve from RRM and GKM in absolute value (Ve can not be normalized). The correlation of Ktrans between RRM and GKM became much better in normalized data compared to absolute value (table: The correlation of DCE parameters between GKM method and RRM method disclosed that the high correlation (underlined) in normalized Ktrans and significance (P<.05) (in bold). (3) Mann-Whitney U test was used for assessing the possible correlation between DCE parameters and pathologic grading. It revealed no correlation between the pathological grading and the DCE parameters (Ktrans, normalized Ktrans and Ve).

Conclusion: Due to the inherent low resolution of the DCE-MRI maps, to find a correct carotid artery position, is sometimes difficult. We find that RRM is more suitable than GKM in some certain clinical setting given the fact of the consistent Ktrans data between RRM and GKM, particularly after the normalization process. On the other hand, the permeability parameters, Ktrans and Ve, do not correlate with the pathologic grading. This is presumably consistent with previous studies where the kinetic parameters derived from T₁-weighted DCE-MRI are more of correlated with microvascular density and vascular endothelial growth factor while the kinetic parameters derived from T₂ susceptibility-weighted MRI are more correlated with pathological tumor grading.