The Value of Pre-treatment Dynamic Contrast-Enhanced MR Imaging and Tumor Volume in the Prediction of Nasopharyngeal Carcinoma with Distant Metastasis - A Pilot Study

Shy-Chyi Chin[1,2], Yu-Shi Lin[2,3], and Ho-Ling Liu[1,2]

[1]*Medical Imaging and Intervention, Linkou Chang Gung Memorial Hospital, Taoyuan, Taiwan,* [2]*Medical Imaging and Radiological Sciences, Chang Gung University, Taoyuan, Taiwan,* [3]*Diagnostic Radiology, Keelung Chang Gung Memorial Hospital, Keelung, Taiwan*

Introduction

Although the nasopharyngeal carcinoma (NPC) is markedly radiosensitive, the high rate of treatment failure occurs in patients with advanced stages especially with distant metastasis (DM) (1). NPC, when associated with DM (either synchronous or metachronous), will have much poorer prognosis than the patients without metastasis. Previous studies mainly focused on the N-stage of the AJCC staging system and its relation to DM and outcome (2). Although the extent of neck lymph node metastases is one of the most important factors of NPC with DM, the extension of primary tumor should also be in consideration. Previous article has disclosed that the current T-stage, based on anatomic location, has limitations in the prediction of the DM-free survival (3). In this regard, our study was engaged in assessing other parameters related to the primary tumor such as tumor volume and Dynamic contrast-enhanced (DCE) MRI (4). Previous studies have applied DCE-MRI in head and neck tumor (5), but the study of NPC with the predilection of skull base invasion is lacking. In addition, to the best of our knowledge, no literatures were focused on the topic of DM. This study aimed to understand whether the DCE-MRI technique can gain more information regarding DM of NPC.

Methods

This retrospective study was approved by the institutional review board and the requirement to obtain informed consent was waived. Forty-seven (range, 11-78 year-old) newly diagnosed NPC patients were included. The pre-treatment MRI study was performed at a 3T clinical scanner and included the routine and DCE sequences (a 3D spoiled gradient-echo sequence, TR/TE = 4.9/1.3 ms, flip angle = 30 degrees, in-plane resolution = 1 mm x 2 mm, ASSET = 2, 60 dynamics, a sampling interval =3.9 s). Before the DCE scan, T1 mapping was performed using the same sequence with variable flip angles. An arterial input function was obtained from an artery near the tumor and used for the pharmacokinetic modeling. Using the mTK model, DCE parametric maps of K^{trans}, v_e and v_p were obtained for each patients. A tumor region-of-interest (ROI) and a muscle ROI were drawn by an experienced radiologist, and the DCE maps were normalized by the corresponding mean values of the muscle ROI. The tumor volume, mean and maximal DCE-MRI parameters were then determined for each tumor ROI.

Results

Four parameters, V_{tumor} (tumor volume, mm^3), $nK^{trans,max}$ (the normalized maximal K^{trans}), $nv_{e,max}$ (the normalized maximal v_e), and $nv_{p,max}$ (the normalized maximal v_p) showed significant difference between the DM and non-DM patients ($P < 0.05$) (Table). No significant differences were found between the normalized mean DCE parameters of the two groups. Figure 1 showed two NPC patients (upper row AJCC T1 stage with DM and lower row AJCC T4-stage without DM. The patient with DM had lower tumor volume but greater $nK^{trans,max}$ and $nv_{p,max}$, as comparing to the other patient. According to the results from ROC analysis, we found that AUC of ROC curve of the combined DCE-MRI and tumor size information was significantly greater than that of tumor size alone ($P < 0.05$) (Figure 2). The equation of the multivariate logistic regression model is: $logit(p)=-3.44218+0.00002V_{tumor}-0.00097\ nK^{trans,max}-0.02342\ nv_{e,max}+0.00032\ nv_{p,max}$.

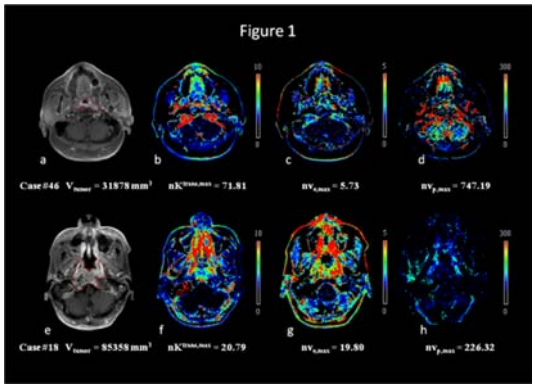
Table

	Non-DM (n=37) Median	DM (n=10) Median	P
V_{tumor}	34930	64001	0.007
$nK^{trans,max}$	29.16	585.12	0.016
$nv_{e,max}$	19.17	10.24	0.014
$nv_{p,max}$	360.77	10970.54	0.003
$nK^{trans,mean}$	5.19	7.51	0.323
$nv_{e,mean}$	3.56	2.68	0.253
$nv_{p,mean}$	32.02	159.61	0.082

Mann-Whitney Utest

Conclusion

This study found that the combination of tumor volume and DCE-MRI parameters has the potential to further increase the prediction capability of DM occurring in NPC patients.



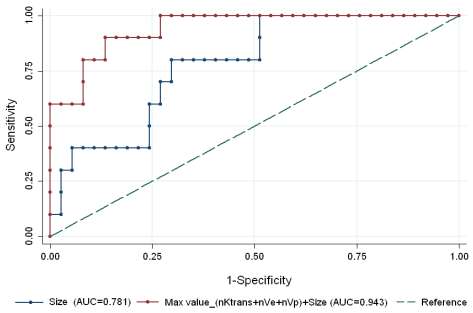


Figure 2

References

1. Wang R, et. al. Journal of cancer research and clinical oncology. 2012. **2.** Mao YP, et. al. Clin Cancer Res. 2008;14(22):7497-503. **3.** Sun Y, et. al. BMC cancer. 2012;12:68 **4.** Yankeelov TE, et. al. Curr Med Imaging Rev. 2009;3(2):91-107. **5.** Yoo DS, et. al. Clin Cancer Res. 2012;18(5):1404-14.