Dynamic contrast enhanced magnetic resonance imaging analysis of different head and neck cancers

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Objective: The aim of the study was to determine the characteristics of three head and neck cancers on dynamic contrast enhanced magnetic resonance imaging (DCE-MRI) and to determine if there are any significant differences between them.

Method: 54 cancer patients with head and neck cancers comprising of undifferentiated nasopharyngeal carcinoma (UD) (n= 22), squamous cell carcinoma (SCC) (n = 24) and lymphoma (n = 8) underwent DCE-MRI in a 1.5T scanner (Intera, Philips Medical Systems, Best, the Netherlands) before treatment. The DCE-MRI protocol included gradient echo acquisitions (TR/TE = 2.7/0.9ms, 128 x 128 matrix, 25 slices, slice thickness = 4mm, FOV = 23 x 23cm, NSA = 1) with different flip angles (2/10/20/30) for T1 determination. It also included dynamic gradient echo acquisition with similar parameters and flip angle of 20, time resolution of 3.5 sec for 371 sec. Contrast agent (Dotarem, Guerbet, France) was injected into the patients at 20 sec after start of dynamic scan using power injector at a speed of 3ml/sec. Pharmacokinetic models were employed for analysis, yielding parameters of k_{trans}, v_p and ve from the Tofts model[1], A, k_{el} and k_{21} from the Brix model[2].

Semi-quantitative analysis was also performed, generating parameters of area under curve of the initial 60 seconds and 90 seconds (AUC60 and AUC90 respectively), peak enhancement and time to peak. Parameter means of the lesions were tested for any significant difference using one-way ANOVA with Bonferroni correction.

Results: The DCE parameters of the different types of head and neck malignancies are tabulated below:

		UD	SCC	Lymphoma
Tofts	k_{trans} (1/min)	1.197 ± 0.577	0.739 ± 0.415	0.591 ± 0.179
	v_e	0.665 ± 0.152	0.632 ± 0.134	0.535 ± 0.174
	v_p	0.093 ± 0.106	0.073 ± 0.049	0.069 ± 0.033
Brix	A (arb. Unit)	50.046 ± 12.381	38.955 ± 11.664	37.125 ± 6.081
	k_{el} (x 10^{-2}/sec)	0.386 ± 0.086	0.501 ± 0.207	0.465 ± 0.251
	k_{21} (x 10^{-1}/sec)	0.235 ± 0.018	0.221 ± 0.022	0.221 ± 0.017
Semi-quantitative	AUC60 (norm. unit)	0.306 ± 0.106	0.225 ± 0.103	0.205 ± 0.054
	AUC90 (norm. unit)	0.743 ± 0.279	0.538 ± 0.206	0.499 ± 0.093
	Peak enhancement (arb. unit)	2.660 ± 0.483	2.666 ± 0.754	2.465 ± 0.133
	Time to peak (sec)	94.5 ± 72.1	119 ± 70	150.5 ± 102.9

* AUC60 and AUC90 are normalized to that of the carotid artery

There was a significant difference between UD and SCC in the k_{trans}, AUC 60, AUC90 and A ($p < 0.01$) and between UD and lymphoma k_{trans}, AUC 60 and AUC90 ($p < 0.01$) and A ($p < 0.05$), but no significant difference between SCC and lymphoma.

Conclusion: There is a significant difference in DCE-MRI parameters of head and neck cancers which has the potential to allow MRI to discriminate between NPC and SCC or lymphoma, but not between lymphoma and SCC. Further studies are required to determine the physiological basis for these differences.

Reference

1. Brix G, Semmler W, Port R et al. *J Comput Assist Tomogr* 1991 (15): 621-628. 2. Tofts PS, Kermode AG. *Magn Reson Med* 1991 (17): 357-367.