Monitoring therapeutic effect of cetuximab in the treatment of nasopharyngeal carcinoma by DCE-MRI

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Background

Dynamic contrasted enhanced MRI (DCE-MRI) is becoming a popular technique to evaluate the therapeutic effect of anti-angiogenic and anti-vascular drugs for the treatment of cancers. The potential of DCE-MRI to predict treatment outcome is attractive as it can provide valuable information for treatment planning. In this study, we attempted to use this technique to monitor the therapeutic effect of cetuximab (Merck KgaA, Darmstadt, Germany), an epidermal growth factor receptor (EGFR) inhibitor, in the treatment of nasopharyngeal carcinoma (NPC). The effect of this drug in combination with chemotherapy for NPC has been published[2-3], while this report describes the preliminary attempt to examine the potential of the DCE technique in the early detection of drug response.

Method

A total of 11 NPC patients underwent two DCE-MRI scans: 1 week before the commencement of cetuximab treatment and 1 week after, using a 1.5T Intera NT scanner (Philips Medical Systems, Best, the Netherlands) with a head and neck coil. The scanning parameters of the sequences used are shown in Table 1.

Scan	TR/TE/α (msec/°)	Matrix	Δt (sec)	T_{dy} (min)
3D T1W FFE 2 AXIAL	2.7/0.9/2	128x128x25	-	-
3D T1W FFE 10 AXIAL	2.7/0.9/10	128x128x25	-	-
3D T1W FFE 20 AXIAL	2.7/0.9/20	128x128x25	-	-
3D T1W FFE 30 AXIAL	2.7/0.9/30	128x128x25	-	-
3D T1W FFE 20 DYN AXIAL	2.7/0.9/20	128x128x25x106	3.5	6.2
T1W+C SE AXIAL	482/12/-	512x512x30	-	-

Table 1: MRI scan parameters.

Patients were administered with a single dose of gadolinium (Dotarem, Guerbet, France) by bolus injection using a power injector. T1 maps were derived from the four sets of FFE images. The dynamic contrast concentration curves of each pixel were derived from the dynamic FFE images using the Ernst formula. The two compartment model proposed by Tofts et al[4-5] was used to derive the dynamic parameter maps of Ktrans, ve and vp. The area under the contrast concentration curve at the initial 60 and 90 seconds (AUC60, AUC90) of the dynamic scans were also obtained. The primary lesions were contoured on the T1W+C SE image by an experienced head and neck radiologist, and the averages of the acquired parameters within the lesions were obtained.

Results

The mean and standard deviation of the DCE parameters and the absolute percentage change of NPC before and after treatment are shown in Table 2 and 3, respectively.

Ktrans (ml/ml/min)	ve	vp	AUC60 (mM sec)	AUC90 (mM sec)
1.54 ± 0.86	0.7 ± 0.21	0.19 ± 0.15	1977.2 ± 471.4	4728.8 ± 860.3

Table 2: mean and standard deviation of the DCE parameters for primary NPC before cetaximab.

	Tumor size	Ktrans	ve	vp	AUC60	AUC90
Absolute % change	9.7 ± 6.8	91.8 ± 88.8	34.7 ± 33.4	165.7 ± 325.2	27.9± 30.4	21.6 ± 25.2

Table 3: Absolute percentage change in the studied parameters after cetaximab.

A substantial change was observed in the dynamic parameters of Ktrans, ve, vp, AUC60 and AUC90. At the same time no substantial change in lesion size was observed in any of the 11 patients. The absolute percentage difference in lesion volumes between the two scans was 9.7±6.8%.

Conclusions

We report the DCE parameters of primary NPC lesions. We observed a substantial amount of change in the DCE parameters after commencement of cetuximab treatment. Although the reproducibility of the parameters has to be verified in further studies, these substantial changes in the parameters, which precede tumor shrinkage, reveal the potential to use DCE-MRI to monitor therapeutic effect of the drug from the perspective of vascular dynamics. The usefulness of the result relies on the long term study on the predictability of the parameters on the treatment outcome.

References

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