EVALUATING THE RESPONSE TO THE RADIATION THERAPY OF THE HEAD AND NECK NEOPLASMS BY DYNAMIC CONTRAST-ENHANCED MRI

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Introduction:

In tumor development, progression, metastasis, and angiogenesis play an important role and correlate with the tumor aggressiveness and clinical outcome. To prevent the abnormal blood vessel formations, combining chemotherapy and radiation therapy has been introduced for killing the tumor cells. However, the most severe complication of radiation therapy is the necrosis. In recently years, DCE-MRI has been proposed to monitor the tumor response of the radiation therapy and distinguish the radiation necrosis from the recurrent tumors. Most of the DCE-MRI studies analyzed averaged signal time curves from a tumor region in a single slice and classified the shape of the signal intensity time course into different types to recognize the lesion intrinsic quality.[1] However, the averaged signal could not totally represent the character of the whole tumor. Considering the heterogeneous compositions of tumors, pixel-by-pixel analysis for multislice images is more useful. Therefore, the goal of this study was analyzing the histogram distribution of all initial slopes of enhancement from all signal time curves in abnormal tissues. [2]

Materials and Methods:

8 patients with brain tumor and treated with radiation therapy were participated in this study. 4 patients had delay radiation necrosis, and the others had recurrent malignant tumor. DCE-MRI T1 weighted images in the axial plane were acquired by using a gradient-echo sequence with TR/TE/θ=5.8 msec/2.2 msec/30° by a 3 Tesla scanner. The bolus injection of 0.1 mmol/kg gadoninum agent was administered through the antecubital vein by the power injector. ROIs were selected by a board-certified radiologist and placed in the areas of the strongest enhancement when comparing the precontrast images. Then the initial slops of enhancement of all pixels were calculated. The distributions of the initial slopes of enhancement in the ROI were depicted as a histogram. Statistical indices including skewness and kurtosis were used to evaluate the degree of asymmetry and peakedness of the histogram distribution. Data analysis was performed with Matlab.

Results:

The histogram for the malignant tumor was flatter and more asymmetric because of the heterogeneous compositions in the tissue. For the radiation necrosis, it was marked by a change from heterogeneous to homogeneous tumor components. In the representation of the histogram, left shift of the peak in histogram and uniform distribution could be described by the smaller values of skewness and kurtosis. Figure 1 and figure 2 portrayed the normalized histograms of malignant tumor and radiation necrosis. Table 1 listed the values of skewness and kurtosis. The *p* value for skewness and kurtosis were 0.005 and 0.002, respectively, and these values were considered significant ($p<0.05$).

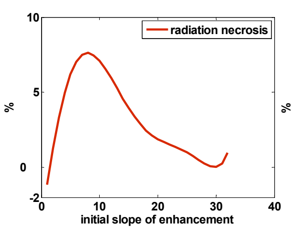

Figure 1 The histogram of the initial slope of enhancement in radiation necrosis

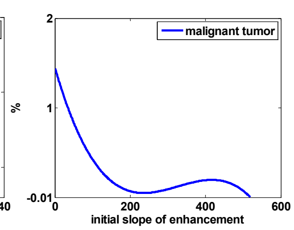

Figure 2 The histogram of the initial slope of enhancement in malignant tumor

	kurtosis		skewness	
	Malignant tumor	Radiation necrosis	Malignant tumor	Radiation necrosis
Subject 1	10.001	6.2623	2.5154	1.9423
Subject 2	8.993	5.4904	2.1924	1.7058
Subject 3	12.9	2.9866	3.003	1.155
Subject 4	12.591	4.4515	2.8236	1.5394
Mean ±SD	11.121±1.924	4.798±1.417	2.634±0.356	1.586±0.331
***p* value**	0.002		0.005	

Table 1 Kurtosis and skewness of malignant tumor and radiation necrosis

Discussion and Conclusions:

The averaged signal time curves from a tumor ROI could not indicate the heterogeneity of the tumor compositions, which could be a key characteristic of response of the radiation therapy. Statistics parameters of histogram distributions not only improved the specificity of diagnosis but also provide the information about the heterogeneity of tumor compositions. Without the complicated calculation of fitting models, the proposed method showed its potential to characterize the heterogeneity of tumor compositions .

References:

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