

DCE-MRI assessment of neoadjuvant chemotherapy and clinical outcome in locally advanced breast cancer patients

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Introduction

Neoadjuvant chemotherapy (NAC) is administered to patients with locally advanced breast cancer in order to decrease tumor size and increase the possibility of breast conservation surgery. Previous studies have shown that dynamic contrast enhanced MRI (DCE-MRI) can play a role in assessment of treatment effects^{1,2}. The aim of this study was to evaluate the potential of DCE-MRI as a predictive and prognostic tool in management of locally advanced breast cancer patients.

Experimental

Sixty-seven patients (24-78 years, mean 50 years) with locally advanced breast cancer receiving NAC were included in the study. DCE-MRI was obtained using clinical 1.5 T MR scanners (Picker Inc and Siemens Symphony) before initiation (PreNAC) and after completion of NAC (PostNAC). The images were acquired using a 3D spoiled gradient echo sequence (RF-FAST) with a temporal resolution of 57 sec. The voxel size varied between 2,86 and 6,65 mm³. The tumor region of interest (ROI) was defined as voxels with at least 50 % signal enhancement 1 min post contrast. Tumor volume, relative signal intensity (RSI) 2,5 min and area under the curve (AUC) up to 6 min post-contrast were calculated for all voxels in the ROIs. The RSI and AUC distributions were compared to measured treatment effects using clinically defined response criteria or MRI determined tumor volume reduction according to the RECIST criteria³, and to patient survival.

Results and discussion

MRI was obtained both PreNAC and PostNAC in 27 of the patients. The mean RSI and AUC values showed a significant decrease during NAC in patients clinically defined as responders, while no significant decrease was found for non-responders (Table 1). This effect was even more significant when using the MRI defined response criteria. The tumor volume also showed a significant reduction for the responders. However, the standard deviations for the non-responders were high and by excluding one patient with strong volume increase during NAC, a significant decrease in tumor volume was also found for the non-responders (p=0,017). This underlines the need for a larger cohort of patients. All patients (n=67) had a PreNAC DCE-MRI. Mean RSI and mean AUC value obtained in this examination showed no significant correlation to clinically determined responders (n=43) and non-responders (n=24). Based on the RSI-distributions, patients with a skew value higher than the mean skew survived longer (log rank test, p=0,031) (green curve Figure 1A). With higher skew value the distribution is tilted to the lower RSI-values compared to the normal distribution. RSI skew analysis done PostNAC showed no significant difference. This might be a result of the treatment influence of the RSI distribution.

Conclusion

Functional DCE-MRI data of locally advanced breast cancer patients contains both predictive and prognostic information that can be important for clinical individualized breast patient treatment.

Table 1: Mean values for DCE-MRI parameters ± standard deviations before NAC (PreNAC) and after completion of NAC (PostNAC, median 1 day before mastectomy), for patients with clinically and MR determined response and non-response.

DCE-MRI parameters	Clinically determined responders (n=16*)			Clinically determined non-responders (n=10*)		
	PreNAC	PostNAC	P**	PreNAC	PostNAC	P**
RSIMean	2,64±0,38	2,39±0,41	0,023	2,99±0,38	2,87±0,30	0,33
AUCMean	8,93±1,84	7,78±2,10	0,033	10,86±1,99	10,29±1,53	0,34
Volume [cm ³]	40,9±24,2	15,1±23,7	0,000	74,4±43,5	62,9±83,4	0,59
	MR determined responders (n=17*)			MR determined non-responders (n=10*)		
	PreNAC	PostNAC	P**	PreNAC	PostNAC	P**
RSIMean	2,80±0,49	2,50±0,43	0,004	2,78±0,29	2,73±0,39	0,63
AUCMean	9,83±2,47	8,31±2,34	0,003	9,74±1,55	9,60±1,79	0,81

*some of the patients determined to be clinical responders are MR determined non-responders and vice versa. **P values obtained from t-tests.

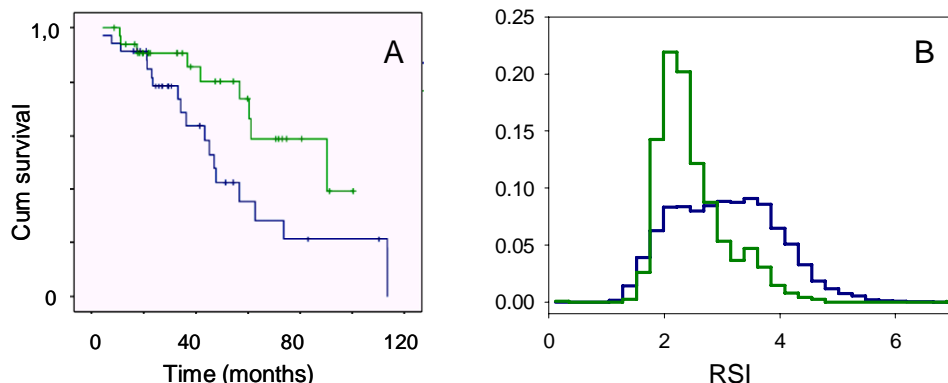


Figure 1: The green curve in Figure A shows survival for patients (n=67) with a higher RSI skew and the blue with a lower RSI skew, than the mean value. In figure B the green curve is an example of a RSI distribution from a tumor with a high RSI skew value. The blue curve shows a tumor with a RSI value near zero, this curve is close to the normal distribution.

References: 1) Pickles et al, Breast Cancer Res Treat 2005, 91: 1-10, 2) Padhani AR et al, Radiology 2006, 239:361-74, 3) Therasse P et al, J Natl Cancer Inst 92: 205-216, 2000.