

Predicting 5 years survival for breast cancer patients using dynamic contrast enhanced MRI

L. R. Jensen¹, R. Johansen², P. E. Goa^{1,3}, J. Rydland³, K. A. Kvistad³, T. F. Bathen¹, S. Lundgren^{2,4}, and I. S. Gribbestad¹

¹Department of Circulation and Medical Imaging, Norwegian University of Science and Technology, Trondheim, Norway, ²Department of Cancer Research and Molecular Medicine, Norwegian University of Science and Technology, Trondheim, Norway, ³Department of Radiology, St. Olav's University Hospital, Trondheim, Norway, ⁴Department of Oncology, St. Olav's University Hospital, Trondheim, Norway

Introduction

Some of the patients with locally advanced breast cancer fail to respond to neoadjuvant chemotherapy (NAC)¹. The treatment may lead to a significant reduction in tumor size; however, the survival for the patients may not improve. Dynamic contrast enhanced MRI (DCE-MRI) studies have shown that an increase or no change in magnitude and rate of contrast enhancement correlates to poor response^{2,3}. The aim of this study was to investigate the feasibility of DCE-MRI in prediction of 5 years breast cancer survival.

Experimental

Twenty-four women with locally advanced breast cancer undergoing NAC were included in the study. DCE-MRI data were acquired on a 1.5 T system before and 3 weeks after the first cycle of NAC. A 3D spoiled gradient echo sequence (RF-FAST) was used in the sagittal plane, with TR 9 ms, TE 3.8 ms, flip angle 30°, FOV 250 mm, acquisition matrix 128x256, slice thickness 3 or 4 mm, temporal resolution of 57 s and a dose of 0.1 mmol/kg b.w. gadodiamide. The tumor region of interest (ROI) included voxels with more than 50% signal enhancement 1 min. after injection of contrast agent. Tumor volume, relative signal intensity (RSI) 2.5 min. post-contrast and area under the enhancement curve (AUC) 6 min post-contrast were calculated for all voxels in the ROIs. These parameters were correlated to patients still alive after 5 years (survivors) and those who died before 5 years (non-survivors).

Results and discussion

Ten out of 24 patients were still alive after 5 years. The RSI map for a survivor in Fig. 1A shows a larger fraction of lower enhancement compared to the RSI map for the non-survivor in Fig. 1B. The RSI histogram in Fig. 1C for the same tumors confirms this difference. The mean RSI and 10th percentile for survivors were significantly lower compared to the non-survivors prior to NAC (Fig. 2). Thus the contrast enhancement may be of predictive value to overall survival for breast cancer patients, although there is no significant difference after treatment. Pre-treatment tumor volumes were slightly larger the non-survivors (Fig. 2), however both patient groups had a significant tumor size reduction after one cycle of NAC.

Conclusion

This study demonstrates a significant relation between the DCE-MRI derived parameter RSI and 5 years survival for patients with locally advanced breast cancer. Low pre-treatment mean and 10th percentile RSI values increase the probability for longer survival in these patients. The results are now being validated in a larger patient cohort.

References

1) Mamounas EP et al., *Semin Oncol* 28:389-399, 2001, 2) Pickles et al, *Breast Cancer Res Treat* 91:1-10, 2005, 3) Padhani A et al, *Radiology* 2006; 239:361-374

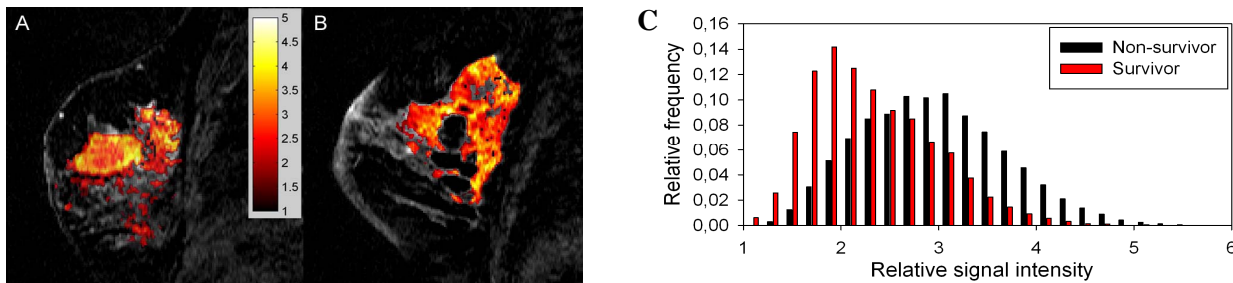


Figure 1: RSI map overlaid subtraction images obtained before neoadjuvant chemotherapy from A) patient still alive after 72 months and B) patient who died after 48 months. C) Distribution of RSI values for the tumor volumes in patient A and B, confirming a substantial difference in the distribution in RSI.

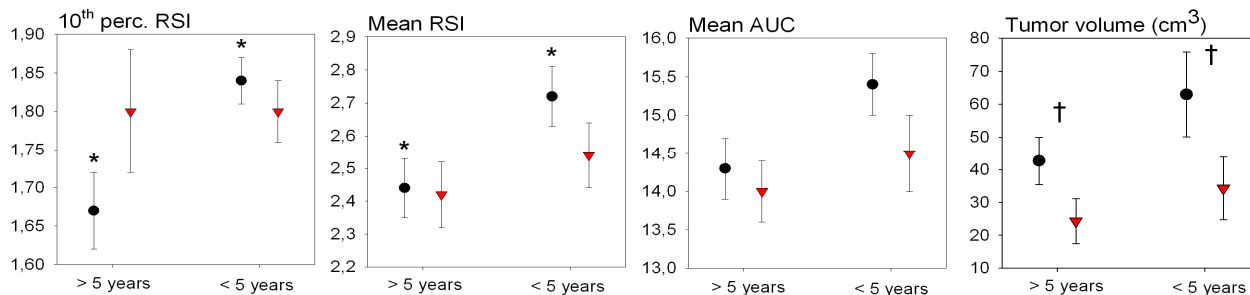


Figure 2: DCE-MRI variables before (●) and after (▼) NAC. * Significant difference between survivors and non-survivors, and † significant difference before and after 1st cycle of NAC (p<0.05).