Comparison of MRI tumour diameter and volume changes with apparent diffusion coefficient (ADC) values in prediction of pathological response following neoadjuvant chemotherapy (NACT)

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TARGET AUDIENCE: MRI Scientists and Clinicians with an interest in breast cancer and monitoring chemotherapy

PURPOSE: Neoadjuvant chemotherapy (NACT) allows for less extensive surgery in breast cancer patients. Non-invasive imaging techniques can be used to monitor and predict response to treatment. MRI is an established tool for assessing response 1 and functional parameters such as ADC have been suggested as a biomarker of response. 2,3 However, response is typically evaluated using the defined RECIST criteria by measuring changes in the maximum diameter of the tumour. The aim of this study is to prospectively assess whether MR derived volume and diameter assessment or quantitative ADC values can predict pathological response in breast cancer patients receiving NACT.

METHODS: The study was approved by an Ethics Committee and patients with breast cancer scheduled for NACT gave informed consent before recruitment. Dynamic contrast enhanced (DCE) images and diffusion-weighted echo-planar images (DWI) were acquired using a 1.5T whole body scanner (MR450, GE Healthcare, Waukesha, WI) using an 8 channel breast array. Patients were imaged pre-NACT, and after 3 and 6 cycles of treatment. Maximum tumour diameter, total tumour volume and ADC were measured blinded to the pathological outcome. The maximum diameter was measured in three orthogonal planes on DCE images and the longest dimension was used regardless of orientation. Tumour volume was measured on DCE images by manually defining regions of interest on each appropriate slice. ADC maps were calculated from diffusion-weighted echo-planar images (b= 0, 700 s/mm²). Histology assessment with grading of response was performed following treatment by surgical excision of the tumour site. Specimens were characterised into group 1 (pathological complete response or minimal residual disease) or group 2 (partial response or no response). The interaction between pathological response (group 1 versus group 2) and change in each respective metric over time was modelled using a MANOVA test. The study tested two hypotheses: 1. whether the initial rate of change in each metric between baseline and mid-treatment varied between responders (Group 1) and non-responders (Group 2) in ADC (p<0.001) and gross tumour volume and diameter changes were not significantly different between the two groups. There was a statistically significant difference between responders and non-responders in ADC (p<0.001). However, tumour volume and diameter changes were not significantly different between the two groups. There was a statistically significant difference between responders and non-responders in ADC (p<0.001) and gross tumour volume (p=0.007) by the end of the study; maximum tumour diameter was borderline significant (p=0.05). (Fig. 1)

DISCUSSION: As expected tumour volume and diameter changed over the course of treatment. ADC values also changed and the difference in the change in those patients who went on to exhibit a complete pathological response and patients who didn’t, 2, whether change between baseline and end-of-treatment varied using the same analysis.

CONCLUSION: ADC and tumour volume changes can be used to monitor NACT response. ADC changes in combination with other multi-factorial information may have utility in determining the optimal treatment strategy.

REFERENCES

FIGURE 1: ADC (left), the log of tumour volume (middle) and maximal tumour diameter (right) at baseline and following 3 and 6 cycles of NACT. Fits are shown separately for responders (solid line) and non-responders (dotted line).