The Role of 3 Tesla DWI in Evaluation of Primary and Metastatic Ovarian Cancer Before and After Neo-adjuvant Chemotherapy

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Introduction

Ovarian carcinoma is the second most common malignancy of the female reproductive tract, but the most frequent cause of death. The most crucial clinical problems remain the high frequency of primary and acquired drug-resistance, despite newer highly active agents, and the paucity of information regarding resistance mechanisms (1). DWI is a functional imaging technique that displays information about water mobility, tissue cellularity and the integrity of the cellular membranes (2). The apparent diffusion coefficient (ADC) value is inversely related to the cellularity of tumours and can be used for evaluation of treatment response (2,3). The aims of this study are to evaluate: (a) baseline ADC values in primary and metastatic ovarian cancer and (b) whether ADC values can act as surrogate markers of tumour response/resistance to chemotherapy in primary ovarian cancer, omental "cake" and peritoneal deposits.

Materials/Methods

The study protocol was approved by the local Ethics Committee. 16 patients with advanced ovarian cancer (FIGO stage 3 or above) and scheduled to undergo neo-adjuvant treatment with chemotherapy prior to interval debulking surgery were included in this study. All patients had a staging CT prior to the start of chemotherapy to assess the bulk and location of 3 marker lesions if present: primary tumour, omental cake and peritoneal deposits.

Imaging protocol: MRI examinations were performed on a 3 T whole body scanner (HDx, GE Healthcare, Waukesha, WI) with an 8-channel cardiac array coil. High resolution T2W axial FRFSE images were used to evaluate the extent of the disease. DWI images were obtained using a diffusion-weighted EPI sequence (TE/TR = 87/2000 ms; slice thickness 8mm; FOV 35cm×28cm; matrix 128×96). Multislice imaging with multiple b-values (0, 100, 150, 200, 250, 350, 500, 750, 1000 s/mm^2) was performed in a single breath-hold.

DWI analysis: Pixelwise analysis was performed using customised software written in Matlab (Mathworks, MA, USA). ADC maps were calculated by performing a non-linear fit to data acquired with b-values 100–1000 s/mm^2. The pelvic tumour and omental/peritoneal deposits were outlined by an experienced radiologist, using the FRFSE and DWI images for guidance (Fig. 1).

Standard of reference: For 14 patients whose pre-and post treatment CT and MRI were available, tumour response to treatment was evaluated by RECIST criteria using sequential CT examinations.

Results

Primary ovarian lesions showed the highest pre-treatment ADC value (Table 1). Baseline ADC values for peritoneal deposits were lower than for ovarian lesions (p=0.059) and significantly lower than for omental cake (p=0.028). After chemotherapy, there was a significant increase in the ADC values of the primary ovarian lesions (p=0.016) (Table 2). Comparison between responders (partial response, n=8) and non-responders (stable disease, n=6) revealed no significant difference in pre-treatment ADC values of primary ovarian lesions and peritoneal deposits. Omental cake in responders showed significantly lower pre-treatment ADC values compared to non-responders (p=0.010).

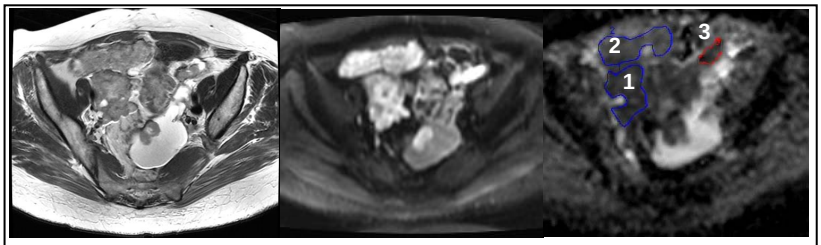

Figure 1: (a) T2W image; (b) b = 500 image; (c) ADC map with the regions of interest placed on the primary ovarian mass (1), omental cake (2) and peritoneal deposit (3) in a patient with advanced ovarian cancer

Lesion	N	ADC pretreatment
Ovarian	16	1040.6±212.3
Omental	14	989.2±188.0
Peritoneal	10	915.6±86.4

Table 1: Site-specific pretreatment ADC values (Mean ± S.D. × 10^{-6} mm^2/s)

Lesion	N	ADC pre	ADC post	Change	P-value
Ovarian	14	1032.6±207.6	1222.1±258.7	190.4±231.3	0.016
Omental	12	1031.2±168.1	1069.7 ± 205.5	34.9 ± 277.9	0.239
Peritoneal	5	922.4±66.9	972±50.0	46.0±104.2	0.345

Table 2: Site-specific changes in ADC values with neo-adjuvant chemotherapy treatment

Conclusions

To our knowledge, this is the first study to evaluate the difference in the ADC values between primary and metastatic ovarian lesions. Our initial results in a small population demonstrate differences in baseline ADC values between primary ovarian cancer, omental cake and peritoneal deposits. These may reflect the mixed treatment response that often occurs at different disease sites and may be related to variations in blood supply and hypoxia influencing delivery and efficacy of chemotherapy. Post-treatment ADC changes also differ between the primary ovarian lesion, omental cake and peritoneal deposits. These findings may help explain and predict treatment response. Further patient recruitment and correlation with pathology and CA125 response is on-going.

References 1) Agarwal R et al. Nat Rev Cancer 3:502 (2003). 2) Ross BD et al. Mol Cancer Ther 2:581 (2003). 3) Sarty GE et al. MAGMA 16:182 (2004).

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