Diffusion-weighted imaging at 3T for response prediction to chemoradiotherapy in cervical cancer

M. I. Dujardin[1], A. Aldosary[1], P. Gibbs[1], M. D. Pickles[1], and L. W. Turnbull[1]

[1]Centre for MR Investigations, University of Hull in association with Hull York Medical School, Hull, East Yorkshire, United Kingdom

Purpose

Cervical cancer is the second most common cancer in women and a significant cause of mortality worldwide [1]. Moreover, as many women fail to respond to recommended therapy, the management of advanced cervical cancer remains challenging in terms of patient outcome, therapeutic toxicity and cost. Hence, a biomarker that can predict therapy outcome would clearly be beneficial [2]. The use of 1.5T-based diffusion weighted imaging (DWI) and apparent diffusion coefficients (ADCs) to predict tumor response to combined chemoradiation in cervical cancer has already shown some potential [3, 4]. The purpose of this pilot study was to investigate the ability of ADCs acquired at 3T to predict response to chemoradiotherapy in advanced cervical cancer.

Methods

Prior to chemoradiotherapy, 14 women (mean age 50 ± 19 years) with histopathologically proven advanced squamous cell carcinoma of the cervix (FIGO stage IIa to IVa) underwent conventional pelvic MRI including DWI on a 3T MRI system (Discovery 750, GE Healthcare) using a 32-channel phased array coil. DWI imaging parameters were: b-value 1200 mm²/s, TR= 3500 ms, TE= 67.5 ms, slice thickness= 6 mm, gap= 0.6 mm, matrix= 160*160. Treatment response was determined by an experienced radiologist on conventional T2-weighted images by comparing the largest lesion diameter on the initial (3T) and follow up scan (either 1.5T (N=11) or 3T (N=3)) after 1 to 2 months of chemoradiotherapy. Following the revised RECIST guideline [5], treatment response was then classified as complete response (CR) (N=2) , partial response (PR) (N=6), stable disease (SD) (N=2) or progressive disease (PD) (N=4). ADC maps were calculated pixel-by-pixel using built-in software (AW 4.5 Functool; GE Healthcare). Whole tumor regions of interest were manually drawn on the ADC maps by a radiologist blinded to patient response with the aid of the corresponding T2-weighted series. Average pretreatment ADC values of all four response groups were compared: first individually and second grouped as responders (either CR or PR) and non-responders (either SD or PD).
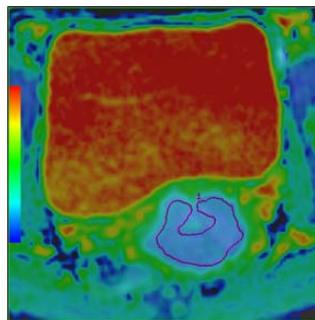
Results

Figure 1 illustrates an ADC map and whole tumour ROI. Average pretreatment whole tumor ADC value for all patients and for the different response groups are given in Table 1. Individual whole tumor ADC results for the different response groups are presented (see Figure 2). There was no significant difference between average ADC in the group of responders (both CR and PR) and non-responders (both SD and PD) ($p= 0.06$). ADC values in the two patients with CR are higher compared to PD and SD. Mean group ADC values increased systematically with response improvement

	ADC ($10^{-3} mm^2/s$)	SD ($10^{-3} mm^2/s$)
All Patients (n=14)	0.89	0.1
PD (n=4)	0.81	0.07
SD (n=2)	0.84	0.07
PR (n=6)	0.92	0.14
CR (n=2)	0.99	0.06

Table 1: pretreatment whole tumor ADC values and standard deviations for the different response groups.

Conclusion

ADC values in whole tumor were in the range of literature values for cervical carcinoma [3, 4]. Although DWI at 3T did not allow a straightforward prediction of response to combined chemoradiation therapy in our small cohort of advanced squamous cell carcinoma patients, average group ADC values increased with response improvement. Veigh et al. [3] found no difference in average ADC between response groups and only found a difference between responders and PD in the 90th percentile using histogram analysis. Our findings are discordant to the results of Liu et al. [4], who reported a significant difference between ADC values of CR and PR in a cohort with positive response to chemotherapy (only one SD and no PD included) and who found a negative correlation between pretreatment ADCs and percentage size reduction after 2 months of chemoradiation as well. We conclude that this result supports further study in a larger cohort to explore whether pretreatment high tumor ADC values are suggestive of good response to chemoradiotherapy.

Figure 1: pretherapy ADC map with tumor ROI in a 34-year old with progressive disease. Scaling ranges from 0.2 [blue] to 3.5 10^{-3} mm²/s [red].

Figure 2: pretreatment ADC values in the four response groups [blue diamonds] and group average [pink squares].
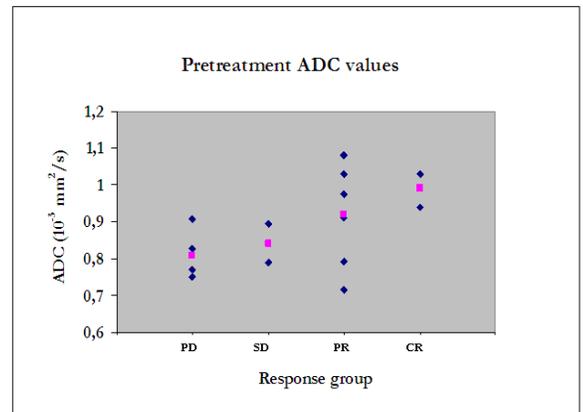
References

[1] Monk et al (2009) J Clin Oncol 27: 1069-1074
[2] Harry et al (2009) Obst Gynecol Surv 64(8): 548-60
[3] McVeigh et al (2008) Eur Radiol 18: 1058-1064
[4] Liu et al (2009) Clin Radiol 64: 1067-1074
[5] Eisenhauer et al (2009) EJC 45: 228-247