Diffusion weighted imaging in Stage 1 cervical cancer: potential value in differentiating tumour from post biopsy granulation tissue using an endovaginal technique

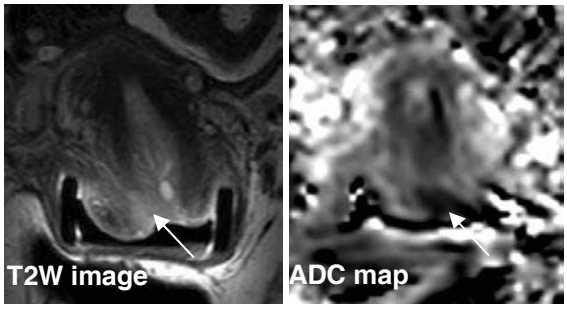
E. M. Charles-Edwards[1], S. S. De Silva[1], V. A. Morgan[1], N. McWhinney[2], M. Katesmark[2], and N. M. deSouza[1]

[1]Royal Marsden NHS Foundation Trust and The Institute of Cancer Research, CRUK Clinical Magnetic Resonance Research Group, Sutton, Surrey, United Kingdom, [2]Dept of Gynaecology, Epsom and St. Helier NHS Trust, Surrey, United Kingdom

Introduction In early cervical cancer, T2-weighted (T2W) MRI is now the gold-standard for preoperative assessment with endovaginal MRI (in-plane resolution ~0.2 mm) allowing precise location of small tumours and lending greater confidence to the selection of women for conservative surgical fertility-sparing procedures. However, patients are often referred following positive cone biopsies when distortion of the cervix, local haematoma or granulation tissue makes T2W image interpretation difficult. Diffusion-weighted MRI (DW-MRI) is showing potential in detection of cancer vs. non-tumour cancer tissues because of the reduced diffusivity of water in tumours [1]. The purpose of this study, therefore, was to determine the apparent diffusion coefficients (ADCs) of tumour compared to non-tumour cervical epithelium and to evaluate the additional information afforded by DW-MRI in detecting residual tumour in a pilot group of patients with stage 1a or small volume 1b1 disease following cone biopsy.

Methods: *Patients:* Cohort 1 consisted of 6 patients (aged 32-64) with clinically obvious (stage 1b2) cervical tumours, confirmed at surgery and 8 patients (aged 24-35) with CIN detected on a screening Pap smear. Cohort 2 consisted of 7 patients (aged 25-46) with stage 1a or small volume 1b1 disease in whom tumour had been detected by previous cone biopsy following an abnormal smear.
Scanning methods: MRI was performed on a 1.5T Philips Intera using an endovaginal coil [2]. T2W fast spin-echo 4500/80 msec [TR/TE] sagittal, coronal and transverse images of the cervix were obtained with a 256 matrix, an 11cm FOV and a 3mm slice thickness. Single shot diffusion-weighted echo-planar images 2500/69 msec [TR/TE] were acquired with a 96 matrix reconstructed to 128, 20cm FOV and 4mm slice thickness. 4 b-values 0,300,500 and 800 s/mm^2 were used. In one patient, diffusion weighted imaging was acquired axially, the remainder acquired coronally. ADC maps were generated using manufacturer's software.
Data analysis: In cohort 1 regions of interest of 10mm^2 were drawn within tumour (if observed) and normal-appearing epithelium on the ADC map by visual correlation of the ADC maps with anatomical information on the corresponding T2W image. Mean values of ADC from tumour, epithelium adjacent to tumour and epithelium in CIN patients were compared using tests for paired and unpaired non-parametric data. In cohort 2 T2W images alone followed by T2W images plus ADC maps were examined by a consultant radiologist as shown in figure 1, scored positive for the presence of residual tumour and the findings compared with those on the surgical specimen.

Figure 1: T2W image and ADC map of the cervix.
Small area of diffuse abnormal signal in T2W image, indicated by arrow is associated with area of restricted diffusion in ADC map, lending greater confidence to diagnosis of tumour.



Results: Cohort 1: There was a statistical difference ($p < 0.05$, Wilcoxon signed ranks) in ADC values from tumour (mean value = 784+/-98 mm^2/s) and epithelium adjacent to tumour (mean value = 1399 +/- 179 mm^2/s) for the 6 patients with stage 1b2 tumours. No significant difference p=0.093 (Mann-Whitney U test) was seen between ADC arising from epithelium adjacent to tumour (n=6) and epithelium in CIN patients (mean value= 1290+/-138 mm^2/s, n=8). Cohort 2: As shown in tables 1a and 1b below, of 7 patients, 3 had residual tumour detected via histopathology of the surgical specimen. In one case tumour was detected solely by addition of ADC maps, but the diagnostic confidence of tumour presence or absence was greater with a combined use of T2W and ADC data in 6 of 7 cases.

Table 1a: Diagnosis of tumour using T2W images

	Histopathology positive	Histopathology negative
T2W positive	2	0
T2W negative	1	4

Table 1b: Diagnosis of tumour using T2W images and ADC maps

	Histopathology positive	Histopathology negative
T2W + ADC positive	3	0
T2W + ADC negative	0	4

Conclusion: ADC values from cervical cancer are significantly lower than from non-tumour bearing epithelium. This pilot study indicates that DW-MRI is a potentially useful tool for detecting or confirming the absence of residual tumour following cone biopsy in early stage disease.

References: 1. Naganawa S et al. Eur Radiol. 2005 15(1):71-8
2. Gilderdale DJ et al. Br. J. Radiol. 1999 72:1-11

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