An initial evaluation of the role of Diffusion Weighted Imaging in the nodal staging of rectal MRI

G. Macnaught[1], F-W. Poon[1], S. Viswanathan[1], Y-T. Sim[2], and M. Digby[2]
[1]Radiology Department, Glasgow Royal Infirmary, NHS Greater Glasgow and Clyde, Glasgow, Scotland, United Kingdom, [2]Radiology Department, Stobhill Ambulatory Care Hospital, NHS Greater Glasgow and Clyde, Glasgow, Scotland, United Kingdom

Introduction and aims

Currently in the UK all rectal cancers are staged by both CT and Magnetic Resonance Imaging (MRI). MRI is useful in identifying any local tumour spread and has a strong influence on patient management. However current standard MRI sequences do not have high specificity for evaluating nodal disease. Despite various criteria for nodal characteristics (e.g. size, shape and peri-nodal fat) there is still discrepancy and difficulty in determining malignant lymph nodes versus non-diseased nodes using MRI. Diffusion Weighted Imaging (DWI) is a relatively new MRI technique for abdominal and pelvis imaging [1]. It has the potential to provide information regarding disease at the cellular level and could help determine whether lymph nodes are involved in the disease. This would mean that treatment could be better tailored to the individual patient. In this initial assessment we aimed to highlight both the subjective nature of T_2 weighted Turbo Spin Echo (TSE) images and the potential use of DWI in determining whether lymph nodes in rectal cancer patients are involved in the disease.

Method/results

Two radiologists independently determined whether or not 32 lymph nodes of rectal cancer patients appeared suspicious of malignancy on the routine T_2 TSE images. They each used the criteria that a suspicious lymph node would have an irregular shape and would have an inhomogeneous signal [2]. Each node visualised on the T_2 TSE images was correlated with the corresponding area on the DW images (b values 0, 400, 800 and 1000 s/mm^2) and Apparent Diffusion Coefficient (ADC) maps. The diffusion of each node was quantified by calculating the ADC value in units of mm^2/s. Two sets of ADC values were calculated for each radiologist's assessment: one set for benign nodes and another for suspicious nodes. The mean ADC values for benign and malignant nodes, for each radiologist's independent assessment of all the observed nodes, are given in the left hand portion of Table 1. The mean ADC values for benign and suspicious nodes were recalculated, this time only including those nodes that the radiologists had both agreed were benign or suspicious of malignancy. These ADC values are given in the right hand portion of Table 1. Unpaired t-tests (using 95% confidence intervals) were carried out to determine whether there is a significant difference between the ADC values of suspicious and benign nodes. This was carried out for the ADC values based on the assessment of each radiologist and also the values that both radiologists agreed on. The p-values are also quoted in Table 1.

	Including all nodes independently assessed by the radiologists		Including only the nodes that both radiologists agree are benign or suspicious
	Radiologist 1	**Radiologist 2**	**For Radiologists 1 and 2**
Benign node mean ADC values	0.87 ± 0.19	0.66 ± 0.34	0.97 ± 0.17
Suspicious nodes mean ADC values	0.80 ± 0.13	0.86 ± 0.19	0.77 ± 0.08
Unpaired t-test p-values	0.36	0.08	0.04

Table 1: The mean ADC values (in units of $\times 10^{-3}$ mm^2/s) of nodes independently assigned as either benign or suspicious of malignancy by two experienced radiologists reviewing T_2 TSE images. Unpaired t-test p-values (with 95% confidence intervals) used to test for significant differences between the mean ADC values of benign and suspicious nodes are also quoted.

Discussion/conclusion

No significant difference was found between the mean ADC values of nodes independently assigned by radiologist 1 or radiologist 2 to be benign or suspicious of malignancy. This is probably due to the fact that the radiologists disagreed on whether a node was benign or suspicious in 25% of cases. This highlights the subjective nature of making this assessment based on T_2 TSE images.

A significant difference in the mean ADC values of benign and suspicious nodes was found when including only those nodes that both radiologists had agreed were benign or suspicious of malignancy. This suggests that the DWI technique could be a potentially useful tool in assessing the malignancy of nodes in rectal cancer patients. Having received ethics approval we have now started the next stage of this study. This involves comparing the ADC values of lymph nodes in rectal cancer patients with the "gold standard" of the post-resection pathology results. The literature on this specific topic is limited. However Yasui et al [3] found that the ADC values of benign nodes in colorectal cancer patients were significantly higher than those of malignant nodes (1.85 vs. 1.36 $\times 10^{-3}$ mm^2/s respectively). Our initial results (shown on the right hand side of Table 1) agree with this trend, although our mean ADC values for benign and malignant nodes are both lower than those quoted in reference 3. Several factors, such as differences in the DWI sequence parameters used and that Yasui et al included both colon and rectal cancer patients in their study, may account for this discrepancy.

References: **[1]** T. C. Kwee et al, European Radiology (2008) 18: pp1937-1952 **[2]** D-M Koh et al, Radiology (2004) 231 (1): pp91-99 **[3]** Yasui et al, Journal of Experimental Medicine (2009) 218: pp177-183