MRI directed diagnosis and radiotherapy response assessment for bladder cancer

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Quantitative MRI can provide biological information of tissue characteristics complementary to conventional anatomical imaging. The ability to characterise the biological features of bladder cancer supports further exploration as a prognostic and predictive tool. This PhD project will investigate the quantitative application of MRI to inform diagnosis, radiotherapy adaption, and radiotherapy response.

The current diagnostic pathway for bladder cancer is dominated by patients having a transurethral resection of the bladder tumour (TURBT). This highly invasive technique has significant disadvantages for those with muscle invasive bladder cancer. We hypothesise that MRI can successfully replace TURBT and this is being tested in the BladderPath Trial (ISRCTN 35296862). Using data from the BladderPath Trial and IDEAL MRI substudy (NCT01124682) we will develop MRI-derived quantitative risk stratification to inform standardised reporting criterion for bladder cancer.

Of particular relevance, diffusion-weighted MRI (DW-MRI) can identify early change both in tumour and normal tissue during radiotherapy. It provides a completely non-invasive measurement of the apparent diffusion coefficient (ADC) of water within tissues, a surrogate imaging biomarker of cell kill following treatment. Monitoring DW-MRI changes during treatment may provide early identification of non-responders and those most likely to experience radiotherapy related toxicity.

We will use longitudinal MRI data acquired during radiotherapy on both the diagnostic scanners (RADIO ISRCTN43698103 and IDEAL Trials) and on the MR-Linac (PERMIT NCT03727698, PRIMER NCT02973828, and MOMENTUM NCT04075305 Trials) to identify biological signal change to support decision making tools for intervention and inform radiotherapy adaption based on both tumour and normal tissue change.

Follow-up after radiotherapy is reliant on cystoscopy. We aim to demonstrate that imaging biomarkers can identify effective treatment response correlated to pathological outcomes, survival and long-term bladder preservation rates. This information will be used personalise non-invasive patient follow-up schedules. A linked PhD is studying DNA based biomarkers in urine.

The above experimental work will serve as basis for prospective evaluation within multi-centre clinical trials to be set up during the course of the PhD.

This PhD will be based at the ICR, Sutton. No specific clinical speciality is required although the project lends itself to those from either clinical oncology or radiology.