

Case studies

A case study of MRI-guided radiotherapy to treat prostate cancer in a patient who was a main carer of his wife

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■ Case presentation

An 82-year-old man with intermediate risk localised prostate cancer was unable to undergo conventional radiotherapy due to family circumstances.

He was already under the care of a urologist in his hometown of Derby and diagnosed with stage T2cN0M0, a Gleason score 4+3 = 7 (grade group 3) and PSA value of 18. The patient had been started on bicalutamide but was struggling with the side effects of tiredness and painful enlargement of the breast. He also had a previous history of high cholesterol and was being treated with statins.

External beam radiotherapy (EBRT) was now being considered as a next line of treatment by his urologist.

A retired company owner, the gentleman is now a full-time carer for his wife who suffers from a chronic debilitating health condition.

■ Challenges of presentation and choice of treatment

Conventional EBRT radiotherapy for this patient would typically involve 20 to 37 fractions over four to seven and half weeks. The patient had decided against this treatment as he felt that travelling to hospital for several weeks would not be possible with no one to care for his wife. Instead, he had opted for long-term oral endocrine treatment, but this was now affecting his quality of life.

Stereotactic ablative radiotherapy (SABR) was then considered as a recommended treatment for low and intermediate risk prostate cancer. Treatment can be completed in five fractions which would allow the patient to care for his wife.

The option to deliver this SABR on the MRIdian offered additional benefits. The daily adaption can allow for intra and inter fractional movement of the prostate and organs at risk (OARs), improving treatment accuracy and therefore reducing toxicity to healthy tissue. This could help to achieve a better quality of life (QoL) for this patient. It would also allow him to stop long-term endocrine treatment which was also adversely affecting his QoL.

■ MRIdian treatment

The patient was treated with five fractions of SABR using the MRIdian for MRI-guided treatment delivery, with the aim to achieve maximum disease control or be curative. Treatment commenced in December 2019 and was given on alternate days to meet the patient's requested pre-Christmas completion date.

SABR treatment on the MRIdian was prescribed at 36.25 Gy in five fractions. During each treatment session, daily adaptation was performed to account for changes in the position of the prostate due to variable bladder and bowel filling. It has been well recognised that the prostate moves during the course of radiotherapy.

Figure 16 and figure 17 illustrate the typical interfraction movement as seen on the MRI scan. Figure 18 and figure 19 demonstrate the daily changes of the patient's internal anatomy whilst figure 20 and figure 21 show the adaptive radiotherapy plan.

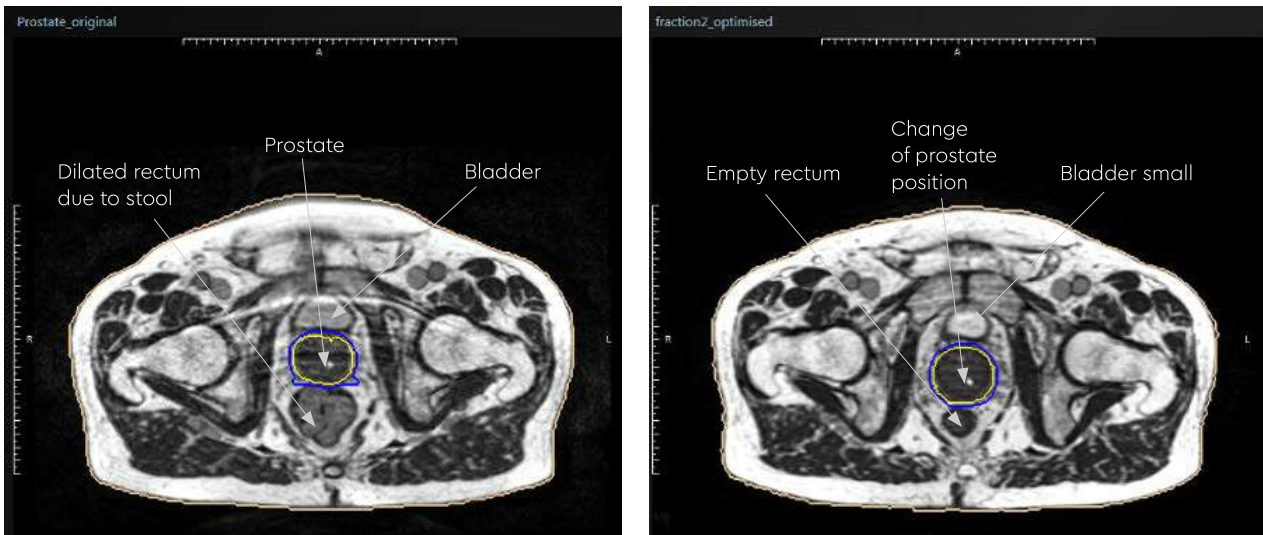


Fig 16: Internal anatomy during the planning MRI

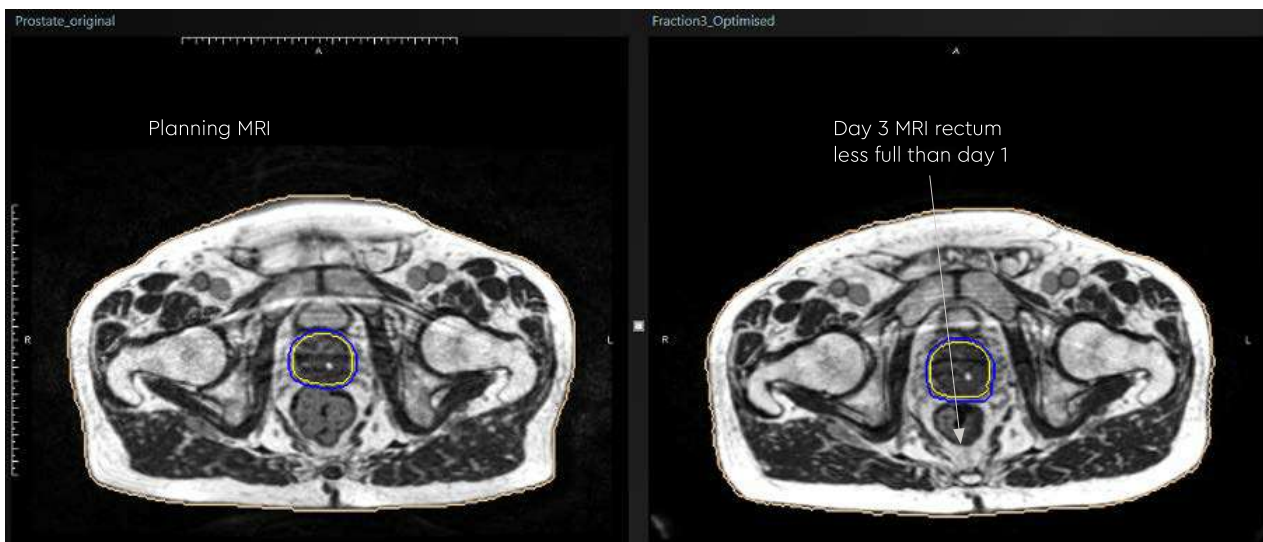


Fig 17: Internal anatomy during first fraction of treatment

Fig 18: Changes in internal anatomy demonstrated by a smaller rectum on day 3 compared to the planning scan

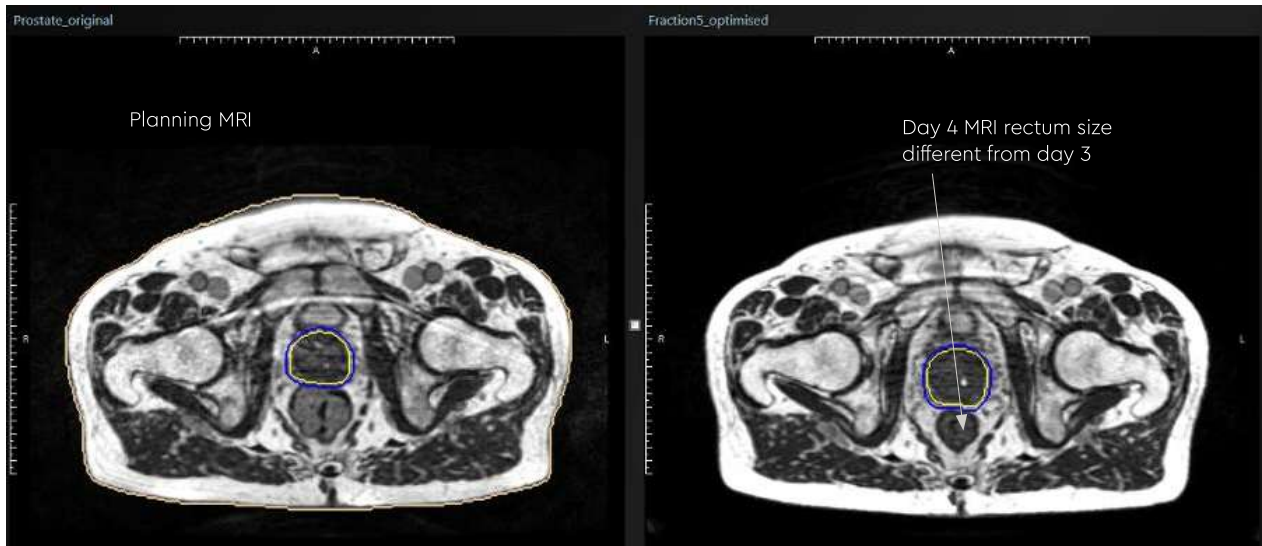


Fig 19: Changes in internal anatomy demonstrated by a different rectum size on day 4



Fig 20: Radiotherapy plan

Fig 21: Plan adaptation. Tight conformity at rectal and prostate boundary is demonstrated by the arrow. Rapid reduction of high dose optimises dose delivery to the prostate and limit dose to the rectum, reducing the risk of long term toxicity

Each treatment session, including set-up and plan adaptation, took 45 to 60 minutes during which time the patient was on the bed.

Although the patient lived in Derby, he was able to travel to the GenesisCare centre in Oxford each day for treatment and private transport was provided as part of his care.

At each session, the target was recontoured by the treating clinical oncologist and the plan adapted daily before treatment. This was found to be necessary due to the degree of movement and shifting of the prostate influenced by bowel and bladder filling.

This daily adaptive process took an average of 54 minutes for each of the five SABR treatment sessions.

■ Results and follow-up

Minimal side effects were recorded, with grade 1 bowel and grade 1 urinary toxicities which settled very quickly after treatment. In fact, these side effects were so minimal that the patient was concerned that treatment might not be effective.

Post-radiotherapy, his endocrine treatment was stopped, the side effects of tiredness had reduced within three weeks and he was feeling significantly better. At five months follow-up, the patient's PSA value had decreased to 1.6 from 18 at the start of radiotherapy treatment.

The patient is continuing to provide patient-reported outcome measures (PROMs) data.

MRI-guided radiotherapy allows technology to be extended for use both in radiotherapy planning and for adaptations during treatment. The advantages of this are numerous – firstly, it can allow greater accuracy in delineating clinical target volumes and organs at risk.^{1,2} This in turn could lead to smaller volumes being irradiated which may reduce both acute and long-term radiation toxicity. Furthermore, rather than having a 'snapshot' of the anatomy, as would be provided by traditional IGRT (image-guided radiotherapy) such as a cone beam CT, this allows direct visualisation of the relevant area during the radiotherapy treatment.

The MRIdian MR linac enabled this patient to undergo curative radiotherapy treatment for prostate cancer with minimum impact on his day-to-day responsibilities as a carer for his wife. This was achieved with minimal short-term toxicities and in doing so, it was possible to reduce the side effects of long-term hormone treatments, greatly impacting the patient's quality of life.

This gentleman was the first patient to be treated on the MRIdian at our GenesisCare centre in Oxford and this was also the first ever MRIdian treatment in the UK. We are delighted we could provide a positive outcome for him and his wife.

References:

1. McPartlin, A., Li, X., Kershaw, L., Heide, U., Kerkmeijer, L., Lawton, C., et al. MRI-guided prostate adaptive radiotherapy – A systematic review. *Radiotherapy and Oncology*. 2016;119(3):371–380.
2. Byrne, TE., A review of prostate motion with considerations for the treatment of prostate cancer. *Med Dosim* 2005;30:155–61.
3. Schild, S., Casale, H., Bellefontaine, L., Movements of the Prostate Due to Rectal and Bladder Distension: Implications for Radiotherapy *Med Dosim* Spring 1993;18(1):13–5.