

Stereotactic MR-guided online adaptive radiotherapy (SMART) in the reirradiation of locally recurrent prostate adenocarcinoma: A single center experience

Das, Prantik; Chinherende, Ebison; Carla, Perna; Sabharwal, Ami; Dallas, Nicola; Nash, Adam Camilleri, Philip
GenesisCare UK

Introduction

After definitive radiation treatment of prostate cancer, local recurrence alone occurs in up to 30% cases. Less than 2% of patients undergo some form of local salvage therapy. Most patients receive androgen deprivation therapy (ADT) with attendant side effects. Due to superior radiotherapeutic ratio that allows dose escalation, while meeting the organs at risk (OARs) dose constraints, SMART reirradiation (reRT) is an option to achieve safe local control, avoiding prolonged treatment with ADT. Here we briefly report our experience in the use of SMART in the reirradiation of five prostate cancer patients who had a localized disease relapse.

Methods and materials

Initial management

All five patients included in this study, received SMART reirradiation of the prostate between July 2020 and June 2021. All patients have had a biochemical recurrence at least 18 months after initial external beam radiotherapy determined by the Phoenix definition (PSA nadir +2ng/mL). Patients' eligibilities were assessed against robust institutional inclusion/ exclusion criteria.

Table 1

Patient	Age (years)	Initial staging	Initial Dose Prescription & Date	SMART reRT	SMART reRT EQD2
1	72	T3N0M0 PSA 28 Gleason Score 3+3 = 6	55Gy/20#s (2005)	30Gy/5#s	64.29Gy
2	59	T3bN0M0 PSA 81 Gleason Score 4+3 = 7	74Gy/37#s (2014)	30Gy/5#s	64.29Gy
3	79	T2N0M0 PSA 27.8	64Gy/32#s (1997)	30Gy/5#s	64.29Gy
4	68	T3AN0M0 PSA 0.9 Gleason Score 3+4 = 7	66Gy/33#s (2012 - Prostate Bed)	30Gy/5#s	64.29Gy
5	83	T3N0M0 PSA = 17.7 Gleason Score 3+3 = 6	74Gy/34#s (2014 - Prostate and SVs)	35Gy/5#s	85Gy

Eligibility

Previous definitive prostate radiotherapy > 18 months prior. T1–T3a/b and PSA ≤30ng/mL and Gleason score ≤8 at initial diagnosis of prostate cancer. Recurrence within prostate only with PSMA or Choline PET. Biopsies confirm cancer within the prostate. T1/T2 disease on relapse. T3a/b acceptable if unilateral but spacer insertion mandatory for this PSA <20 at relapse, WHO PS 0-1. No significant LUTS (IPSS <19).

Treatment/Dose

All patients underwent PSMA/ Choline PET and multiparametric MRI to confirm prostate-only recurrence. 80% of patients had biopsy proven recurrence. A rectal spacer, to reduce the risk of significant rectal toxicity was inserted in 4 patients. Patients were simulated in a supine position and included a planning 0.35T MR scan acquired on the MRIdian linac. Prescribed dose was 30Gy in 5# to the whole prostate when there is no visible nodule or bilateral disease is present on biopsy. For patient 5, a partial boost to 35Gy in 5 fractions was given to MR visible lesion within the prostate. All patients were treated on alternate days with daily adaptation and re-optimization of treatment plan onset. Previous RT dose data was obtained to calculate the remaining dose tolerance.

Table 2

OAR	α/β -ratio	Recovery
Bladder	3	25% per year, up to maximum 50%
Rectum	3	25% per year, up to maximum 50%
Bowel	3	25% per year, up to maximum 50%
Femoral heads	2	25% per year, up to maximum 50%
Urethra	3	25% per year, up to maximum 50%

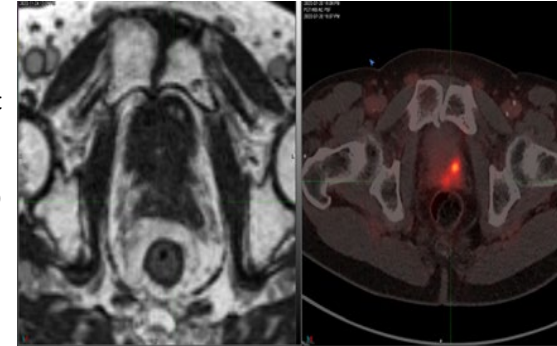


Fig 1 PSMAPET and MR showing recurrence

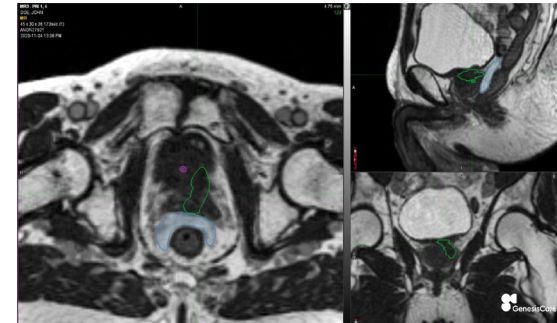


Fig 2: Contouring target including spacer

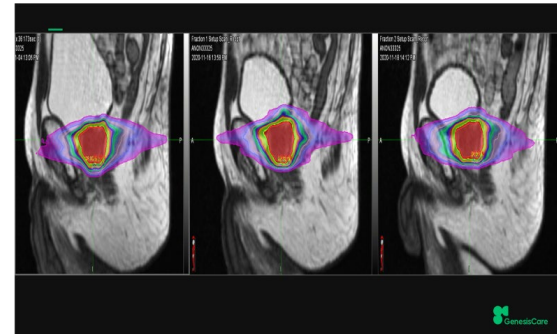


Fig 3 plan in color wash

Structure/Point	Attn	Mean	Max	Dose to Volume
PTVprostate	Attn	33.000	33.000	100%
PTVprostate	ReOptimized	33.000	33.000	100%
PTVnight	Attn	33.000	33.000	100%
PTVnight	ReOptimized	33.000	33.000	100%
PTVprostate	Attn	33.000	33.000	100%
PTVprostate	ReOptimized	33.000	33.000	100%
Rectum3cm	Attn	33.000	33.000	100%
Rectum3cm	ReOptimized	33.000	33.000	100%
Rectum3cm	Attn	33.000	33.000	100%
Rectum3cm	ReOptimized	33.000	33.000	100%
Bladder3cm	Attn	33.000	33.000	100%
Bladder3cm	ReOptimized	33.000	33.000	100%
Bowel3cm	Attn	33.000	33.000	100%
Bowel3cm	ReOptimized	33.000	33.000	100%
Urethra_PTV	Attn	33.000	33.000	100%
Urethra_PTV	ReOptimized	33.000	33.000	100%

Fig 4: 3rd fraction reoptimized plan

Outcome

Table 2 above was used to calculate tissue tolerances. Toxicity following treatment were assessed with PROMs. All patients tolerated treatment well. No grade 3 or 4 toxicities were reported. This is attributed to SMART reirradiation's capability to accurately detect the varying anatomy of each treatment fraction and creating an adapted plan to account for changes.

Conclusion

Our initial experience indicates that re-irradiation can be an attractive and safe option for carefully selected patients.

References

Rudra, Soumon; Jiang, Naomi; Rosenberg, Stephan A; *et al.* Using adaptive magnetic resonance image-guided radiation therapy for treatment of inoperable pancreatic cancer. *Cancer Me.* 8:213-32; 2019. DOI: