Simulation-free radiotherapy: A novel technique to expedite treatment

Vikneswary Batumalai[1,2], Madeline Carr[1,3], Maddison Picton[1], David Crawford[1], Michael Jameson[1,2,3], Tania Twentyman[1], Urszula Jelen[1], Jeremy de Leon[1]

[1]GenesisCare, New South Wales, Australia
[2]School of Clinical Medicine, Medicine and Health, University of New South Wales, Australia
[3]Centre for Medical Radiation Physics, University of Wollongong, Wollongong, Australia

Introduction

- Standard radiotherapy workflow involves simulation computed tomography (CT), followed by treatment planning & radiotherapy.
- There is a possibility to reduce patient burden by eliminating the need for simulation-CT appointment.
- This can be achieved through the adoption of simulation-free radiotherapy, where radiotherapy treatment plans are generated from pre-existing diagnostic imaging.

Objective

To investigate the feasibility of simulation-free radiotherapy by leveraging the use of diagnostic prostate specific membrane antigen - positron emission tomography CT (PSMA-PET/CT) scans.

Methods

- Six prostate cancer patients scheduled to receive treatment on the magnetic-resonance linear accelerator (MR-Linac) were selected. Figure 1 shows the 2 workflows used in the study.
- All patients underwent the standard practice of simulation-CT & simulation MR (time taken at each step was recorded).
- Two radiotherapy treatment plans were generated:
  1) standard plan based on simulation-CT, &
  2) simulation-free plan based on PSMA-PET/CT
- Time taken at each step was recorded & both plans underwent quality assurance (QA) checks.
- During treatment delivery, the simulation-free plan was utilised as the reference plan instead of the standard simulation-CT plan.
- The total time for day 1 treatment was recorded & compared to previous prostate cancer patients (treated within the past 6 months).

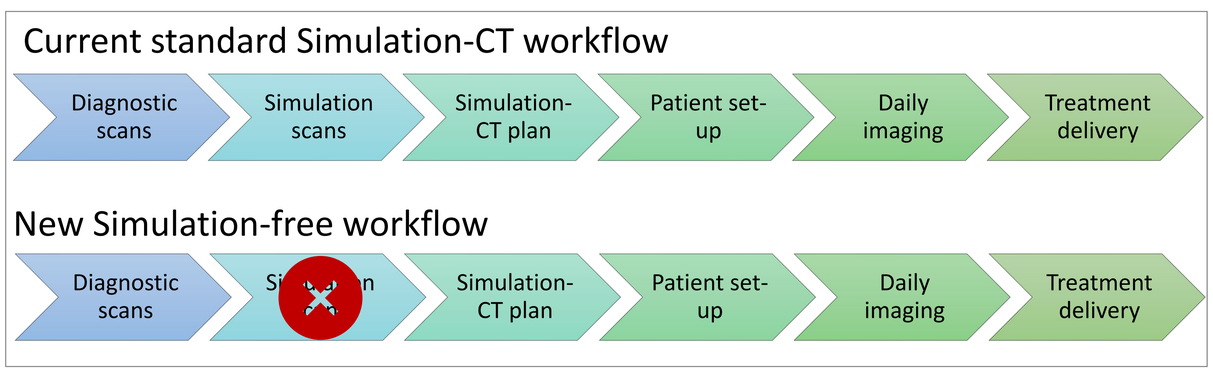

Figure 1: Current standard simulation-CT (above) and new simulation-free (below) workflows

Results

- The simulation-free plans were clinically comparable to simulation-CT plans & passed QA checks for all 6 patients, therefore deemed clinically acceptable.
- Figure 2 shows the average time for simulation-CT & MR scans, plan generation for simulation-CT & simulation-free plans, & overall time for both pre-treatment workflows.
- The average time for the pre-treatment simulation-CT workflow was 94 minutes, while the average time for the simulation-free workflow was 122 minutes.
- On the first day of treatment, the deformable image registration successfully registered the PSMA-PET/CT scan with the daily T2-weighted MR-Linac scan (Figure 3).
- The total treatment time (51 minutes) was comparable to the average treatment time of previous patients (58 minutes).

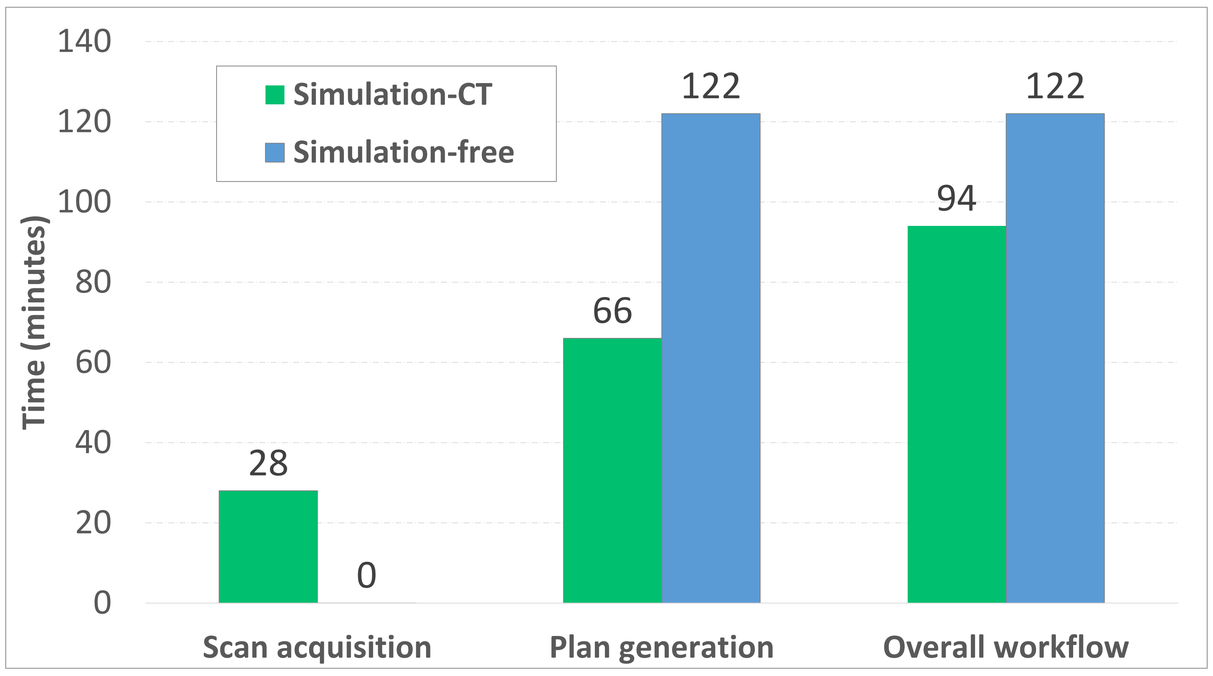

Figure 2: Average time for scan acquisition, plan generation & overall workflow

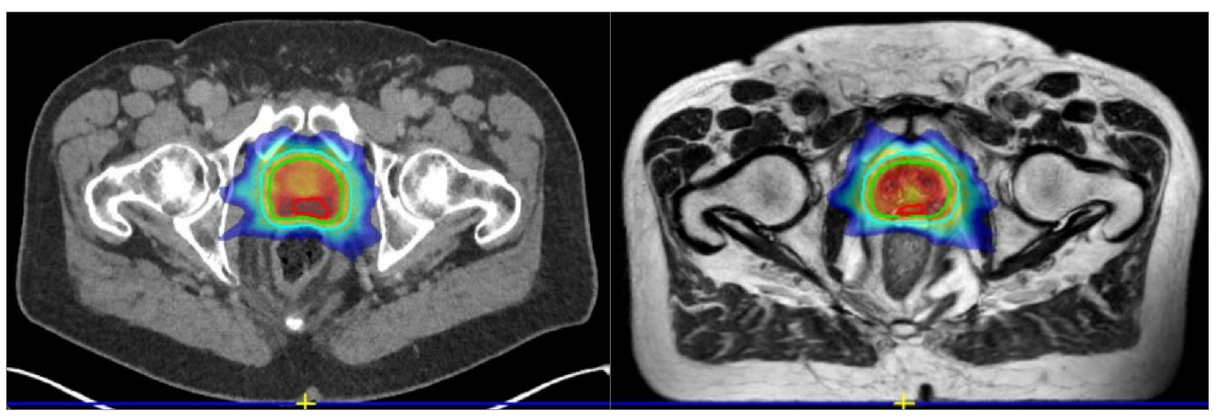

Figure 3: Simulation-free PSMA-PET/CT reference plan (left) & adapted plan on T2-weighted MR (right)

Our analysis demonstrates that simulation-free workflow is feasible

This workflow can be adapted to other types of cancer, benefiting a wide range of patients

Patients can skip the extra travel and waiting time, and have fewer visits to the clinic

These efforts will bring substantial benefits for remote and rural patients

UNSW SYDNEY

ST VINCENT'S HOSPITAL SYDNEY

GenesisCare