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Rapid implementation of extreme hypofractionation protocols in prostate cancer using RapidPlan® in response to COVID-19

To the Editor

In Canada, as of July 25, 2020, over 115,000 cases of COVID-19 have been diagnosed. That number is anticipated to grow until between 30% and 70% of the population have been infected (11–26 million people) [1]. This is despite advantages to disease control of having a small population (37 million) spread over a large geographic area (10 million square km with varying population densities) and governments having implemented nationwide social distancing early in the spread of disease.

Within Canada’s largest healthcare system, Alberta Health Services, preparations to accommodate staffing shortages from potential sharp rises in COVID-19 are having an impact on patients receiving multi-fraction courses of radiotherapy. In anticipation of staffing limitations, our academic radiotherapy institution, has implemented greater hypofractionation and increased automation in prostate cancer.

At the Tom Baker Cancer Centre, prostate irradiation accounts for over 500 courses of radiotherapy per year (approximately 20% of all treatment courses). The most common courses of radiotherapy delivered include 15 Gy high-dose-rate brachytherapy boost with either 37.5 Gy in 15 fractions or 46 Gy in 23 fractions external beam radiotherapy, 78 Gy in 39 fractions, 60 Gy in 20 fractions or 66 Gy in 33 fractions (prostate bed). Additionally, 30–40 prostate only treatment courses per year are delivered to elderly patients, patients with significant comorbidities, or patients with metastatic disease [2]. Given the anticipated impact on resources posed by COVID-19, the genitourinary tumor group implemented hypofractionation protocols for prostate cancer patients including extreme hypofractionation of 36 Gy in 6 weekly fractions (according to the STAMPEDE protocol) for elderly, frail or metastatic patients [2].

To expedite the implementation of these new protocols, automation including RapidPlan® modelling was used. A total of 20 treatment plans, originally treated with either 50, 55 or 60 Gy in 20 fractions to the prostate and seminal vesicles were re-planned to 36 Gy in 6 weekly fractions with the Varian RapidPlan® software within the Varian Eclipse v15.6 environment (Varian Inc., Palo Alto, CA, USA) [2,3]. In all cases, the clinical target volume (CTV) included the prostate and proximal seminal vesicles and the planning target volume (PTV) was a 1 cm margin about the CTV in all directions except posteriorly (0.7 cm). A summary of dose constraints adopted for these treatments are available in Supplementary Table 1.

The 36 Gy in 6 fraction model was constructed from the institution’s previous prostate RapidPlan® model that optimized 60 Gy in 20 fractions. It contains a total of 89 representative patient cases where careful consideration and patient selection provided adequate representation of variation in patient anatomy. This was re-compiled, where the PTV was prescribed a dose coverage criterion of 36 Gy dose to 100% volume, and the organs at risk of bladder, rectum, femoral heads, bowel and penile bulb were assigned generated line objectives with priority towards target coverage. An automatic normal tissue objective was utilized for geometrical dose drop off beyond the PTV. Eclipse’s Photon Optimizer v 15.6 (Varian Inc., Palo Alto, CA, USA) was utilized to optimize treatment plans with RapidPlan® dose-volume constraints. Photon dose calculation was performed using Analytical Anisotropic Algorithm (v15.6.23). The anonymized RapidPlan model is available on request for expedited use by other cancer centers who may be evaluating this approach.

A functional clinical workflow using the above methods took 4 h to implement. Twenty plans were generated with an average planning time of 5 min per plan. All plans passed the dosimetric planning criteria without further modification. On radiation oncologist review, all coverage, dose homogeneity, organ at risk sparing, and plan quality was deemed acceptable for clinical treatment with the exception of one plan where a posterior hot spot was 117% (in all other plans hot spots were limited to <108%). On physics quality assurance, arc variability, modulation, jaw limitations were all within acceptable parameters.

All plans had reasonable coverage. Median PTV D95% was 36.21 (35.96–36.48) Gy. In 19 of 20 plans dose heterogeneity was acceptable. Median PTV D2cc was 38.48 (37.96–42.12) Gy. In terms of organ-at-risk sparing, doses to bladder, rectum, femoral heads and bowel space were well below accepted tolerances (Table 1).

Given the above, the rapid implementation of 36 Gy in 6 fractions as a replacement for 20 fraction radiotherapy courses for patients with prostate cancer and either metastatic disease, advanced age or frailty/comorbid conditions was deemed successful using the Varian RapidPlan® solution. Nineteen of 20 plans were acceptable and passed both local quality assurance protocols that adhered to national standards [4]. This may be a viable option for other centers as healthcare resources available to patients with cancer become limited.

Although the presented implementation was for a 36 Gy in 6 fractions regimen, this methodology could be used to efficiently implement any dose and fractionation regimen. For example, at the research institution, the genitourinary tumor site group has adopted hypofractionation for all radiotherapy courses (Supplementary Table 2). Unfortunately, due to COVID-19 related resource limitations, there is no ability to insert fiducial markers. Because of this, extreme hypofractionation was not adopted for young, healthy patients with curative intent treatment.

Although implementing extreme hypofractionation and automated planning can greatly reduce planning, radiotherapy nursing,
and radiation therapist resource utilization in an era of necessary attrition, it should be intended to supplement other strategies such as remote access and work from home solutions, social distancing, appropriate use of personal protective equipment and staffing reallocation as necessary. Furthermore, these measures should generally be considered temporary until they can be fully integrated into clinical practice with appropriate quality assurance and clinical training to all staff involved.

Conflicts of interest

No conflicts to declare.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.radonc.2020.08.031.

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