Editors' Pick

Real world dosimetric comparison between Cyberknife-SBRT and HDR-brachytherapy for the treatment of prostate cancer

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What was your motivation for initiating this study?

At the University Hospital of the Goethe University in Frankfurt, Germany, we have the technology to offer two forms of extreme hypofractionation, namely transrectal ultrasound (TRUS)-based high-dose-rate (HDR) brachytherapy (BRT) and robotic-based stereotactic body radiotherapy (SBRT), for the radical treatment of low-risk and favourable intermediate-risk prostate cancer. Our motivation for the initiation of this study was to compare these two modalities dosimetrically through the study of imaging data from the same patient for treatment planning (computed tomography (CT)/magnetic resonance imaging (MRI) for SBRT and trans-rectal ultrasound (TRUS) for HDR-BRT). Our comparison differs from that in published work from other groups because it provides patient-specific dosimetry data for two different techniques. Of course, in our cohort, SBRT was the modality that was applied and HDR-BRT was performed virtually, but we believe that our approach reflects a real-world situation since we applied the individual anatomy of every patient for both treatment options.

What were the main challenges during your work?

The challenges we encountered encompassed practical as well as treatment-specific aspects. From the practical point of view, fiducial marker implantation for robot-based SBRT and acquisition of three-dimensional TRUS images for virtual HDR-BRT were performed consecutively in one interventional setting with the patient in the lithotomy position. Fiducial implantation was performed under local anaesthesia using the TRUS-stepper/template system for HDR-BRT, yet the acquisition of the image data set proved to be uncomfortable for some patients who had large prostate volumes (>60 cm^3), given the need to perform a deep rectal TRUS-probe insertion in order to cover the full extent of the prostate base and the bladder while the template was attached to the perineal region. From a treatment-specific point of view, our analysis for HDR-BRT was based on a virtual pre-plan and not on a post-implantation treatment plan but HDR-BRT has high reproducibility between pre- and post-planning which was considered suitable for our methodology.

What are the most important findings of your work?

In our study we showed that the sparing of the rectum and bladder can be improved with HDR-brachytherapy treatment, whereas robotic SBRT showed potential to offer superior urethra-sparing. With regard to rectum sparing, HDR-BRT proved superior in the high-dose levels (V36 and V29) even though there was no difference in the low-dose levels (V18). Likewise, bladder exposure was significantly lower during HDR-BRT treatment at all evaluated dose-levels compared with SBRT.

What are the implications of this research?

Our data corroborate the excellent conformity of HDR-BRT for prostate cancer in a patient-specific dosimetric comparison with SBRT. Since the dosimetry of both modalities is superior to that of any other radiotherapy technique, a clinical study that focuses on oncological outcomes is warranted. The superiority of HDR-BRT, at least from a dosimetric point of view, has been proven, and there is growing evidence of its high effectiveness. The role of SBRT as a non-invasive modality is currently being explored. Both techniques demonstrate very high conformity while they generate biological dose escalation through extreme hypofractionation.

For those who believe in the principle of dose-response, the choice of treatment seems currently to be based on the availability of each modality.

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