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Comparision of different image-guided adaptive treatment strategies for radiation therapy

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To determine potential dosimetric benefits of image-guided adaptive radiation therapy treatment (IGART) strategies for intermediate-risk prostate cancer. A 19 patient cohort with 8-13 CT-images was used to compare different IGART strategies. The IMRT prescription was 46 Gy/23 fractions to the prostate and seminal vesicle PTVs, followed by a 40 Gy/20 fractions prostate boost. For each patient, daily IGART imaging was simulated by random selection from available images. The three different IGART-IMRT strategies are simuated; (A0) initial planning only with 5 mm PTV margins; (A1) daily re-planning without considering prior dose; and (A2) online daily re-planning for each fraction considering prior dose obtained via deformable dose mapping (A1 and A2, no PTV margin). For each strategy, daily dose was deformably mapped using Demons-based displacement vector fields and accumulated to estimate the treatment dose. Strategies were compared via dosimetric adherence to constraints and objectives. Results show A0 had larger doses to 20, 30, and 50% rectal (30±20%) and bladder (40±20%) volumes than A1 and A2 ($p<0.001$). Rectal and bladder D_2's were also respectively higher in A0 by 15±13% and 24±14% ($p=0.002$ and 0.00001 respectively). Comparing A1 and A2, no significant differences were found in prostate D98 ($p=0.4$) or bladder D_2 ($p=0.33$). Significant differences were found for the rectum ($D_{5,A2}>D_{5A1}$, $p=0.02$). IGART utilizing daily re-planning (A1 and A2) has dosimetric advantages over conventional-IMRT for critical structures, particularly high-dose regions, without compromising PTV-coverage. Due to inherent deformation vector field inaccuracies, daily re-planning based on prior dose (A2) showed poor rectal sparing than A1.

Biography

Manju Sharma completed her Ph.D. in Physics in 2006 from Panjab University, India. After the completion of her Ph.D., she worked at Roswell Park Cancer Center on the development of nanocomposites for cancer detection. She did her postdoctoral studies at the University of Minnesota, Minneapolis. The main focus was to study the impact of radiation treatment on bone health of cancer patients. Since 2010, she is working as a postdoctoral fellow at the Virginia Commonwealth University on the development of image-guided adaptive radiation treatment techniques.

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