Cureus

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Abstract

Feasibility of CBCT-based Online Plan Adaptation for SBRT Pancreatic Cancer Treatment on A Prototype Radiotherapy Delivery Platform ? A Preliminary Case Study with Simulated Online Adaptive Therapy Workflow

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Categories: Radiation Oncology, Gastroenterology
Keywords: online adaptive radiotherapy, stereotactic body radiation therapy, pancreatic cancer

How to cite this abstract
Cai B, Kim H, Hugo G D, et al. (April 02, 2020) Feasibility of CBCT-based Online Plan Adaptation for SBRT Pancreatic Cancer Treatment on A Prototype Radiotherapy Delivery Platform ? A Preliminary Case Study with Simulated Online Adaptive Therapy Workflow. Cureus 12(4): a533

Abstract

Objectives: A novel online adaptive radiotherapy platform, which enables segmentation on daily cone-beam CT, auto-plan adaptation and self-initiated calculation based patient specific QA, is coupled to a ring-gantry treatment device. This work aims to investigate the feasibility of utilization this system for SBRT treatment of pancreatic cancer.

Methods: Three pancreatic cancer cases previously treated with SBRT technique with 50Gy in 5 fractions were included in this study. Simulation images and clinical contour volumes were imported into the new system to generate initial plans. The stomach, duodenum, small bowel and large bowel structures have a hard constraint of V36Gy<0.5cc. For each case, high quality cone-beam CT images previously taken on the same system were used as the "treatment day" images in a simulated online adaptive treatment. Physicians presented to first evaluate and contour on CBCT images, then to review both scheduled and adapted plans to determine the best plan to proceed for treatment. Calculation based patient specific QA were also performed prior to plan approval.

Results: Initial plans were successfully generated satisfying the clinical OAR constraints in the new system. For all three cases, due to the anatomy change on "treatment day", physicians modified OAR contours and evaluated the target volumes in the online segmentation session based on CBCT images. In consequence, the plan adaptations were required for all cases. In case 1, the adapted plan improved the PTV V95% coverage from below 50% to 83% while meeting all OAR constraints; In case 2, the scheduled plan overdosed the duodenum (V36Gy=4.18cc) and small bowel (V36Gy=0.6cc), but the adapted plan were able to meet all OAR constraints; In case 3, all major OAR doses in the scheduled plan exceeded constraints (V36Gy= 13.37cc for duodenum, 7.9 cc for small bowel, 0.61 for stomach, 0.6cc for large bowel), but the all OAR constrains were met in adapted plan. The calculation based QA were also successfully performed with Gamma passing rate>90% (3mm/3% criteria) before plan delivery.

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Published 04/02/2020

Conclusions: The CBCT-based online plan adaptation is feasible for studied pancreatic cases. Physicians were able to review and modify contours on high quality CBCT images acquired on this system. The auto plan adaptation successfully generated plans that met clinical constraints or improved the PTV coverage compared to scheduled plan. More cases will be included into future work to further validate the system.