

Dosimetric Evaluation of Abdominal Tumor Adaptive Proton Therapy with Image Guidance and Bowel Management

Theme: Physics

Abstract No: PTCOG-AO2025-ABS-0135

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Background / Aims:

Photon radiotherapy for abdominal tumors tends to damage normal tissues. Although proton therapy has dose advantages, it is affected by respiration and intestinal dynamics. This study establishes an "imaging-intestinal management-APT" system, verifies dose reproducibility, determines adaptive thresholds, and provides a dose optimization scheme for proton therapy of abdominal tumors.

Subjects and Methods:

Ten patients with abdominal tumors who received proton therapy in our hospital from December 2024 to May 2025 were selected, using the Mevion S250i system. Adaptive Proton Therapy (APT) was performed: optimization was conducted when target volume displacement exceeded 5 mm, or intestinal volume/intestinal displacement exceeded 10%/5 mm. Intestinal management included three stages: long-term (dietary control, medication intervention, lifestyle adjustment), intensive (fasting, use of laxatives/cleaning enema, before positioning and treatment), and daily (oral simethicone, wearing custom vacuum negative pressure pad, maintaining moderate bladder filling).

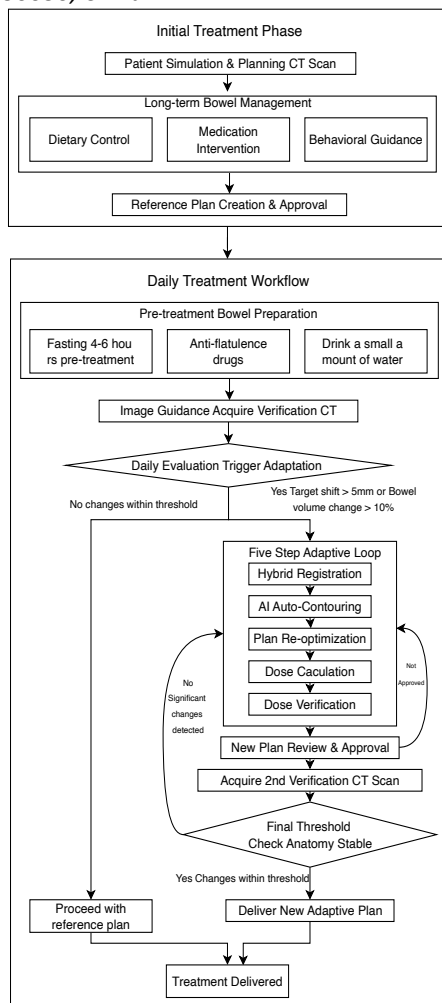


Figure 1: APT workflow

Result:



Figure 2: The dosimetric comparison of the original plan between the original CT and the same-day verification CT

The adaptive plan improved target volume CI and D95, and reduced doses to intestines and other organs at risk ($p < 0.05$). Intestinal management helped stabilize anatomy, and all patients completed treatment without dropout. Offline APT had a bottleneck of approximately 3 hours of duration; in the future, it can be accelerated with AI. Large-sample follow-up and RCT verification of clinical benefits are needed.