

Oral contrast improves soft tissue matching in image-guided radiotherapy for gastrointestinal (GI) tumors

Purpose/Objectives:

The lack of soft tissue contrast and artifacts due to variable gas filling make image guidance in precision radiotherapy for GI tract challenging. Anatomical structures in the tumor proximity can be used as surrogates as bony landmarks may be some distance from the target and inappropriate for target localization. We propose that oral contrast may aid in reproducible soft tissue visualization at treatment delivery and it is less invasive than fiducial marker insertion. This may be more useful in patients undergoing radiotherapy for hepatobiliary tract tumors where duodenal identification will aid in safe treatment delivery.

Material/Methods:

Patients undergoing image-guided radiotherapy (IGRT) to the upper abdomen received dilute oral contrast (3-10 mL Gastrografin® in 50-200 mL H₂O) 10-15 minutes prior to daily online CBCT imaging. For all CBCTs, offline soft tissue image registrations using the gross tumor volume (GTV) (where visible) and adjacent organs at risk were completed. Separate automatic bony registrations were performed and the results compared with those obtained from the soft tissue matches. To determine intra-user variability, repeat soft tissue image registrations (n=3) were performed for three patients.

Results:

Ten consecutive patients undergoing abdominal IGRT with abdominal compression from June 2015 – January 2016 were reviewed. 72 CBCTs were analysed from patients undergoing stereotactic body RT 36-60Gy/3-10# (n=9) and 29 CBCTs from those receiving fractionated RT 60Gy/30# (n=1) for upper abdominal malignancies. Qualitatively, duodenum was visualized in all patients. Oral contrast-enhanced soft tissue image guidance differed from bony registration by a population mean (range) of 2mm in the right-left (RL) (8mm R, 12mm L), 2mm superior-inferior (SI) (11mm S, 6mm I), and 1mm anterior-posterior (AP) (7mm A, 6mm P) directions. There was some variability in direction of greatest difference in bony vs soft-tissue alignment depending on tumor site. In the liver patients the greatest variations were seen in the SI direction with a mean of 4±3mm. Variations were smaller in all other tumor sites, with mean differences of 2±3mm for both the RL and SI directions in the pancreas patients and differences of ≤ 3mm in all directions for patients undergoing nodal RT. Intra-user variability was minimal (0.6mm).

Conclusion:

Through the use of oral contrast during CBCT, it is possible to visualize normal tissues either surrounding or adjacent to GTVs in the upper abdomen for IGRT. Additional soft tissue information provided by oral contrast can improve image matching and thus treatment accuracy in the upper abdomen, particularly in the liver and pancreas. Further work is underway to validate these findings.