AbstractID: 8788 Title: Impacts of dose distribution variations in proton therapy according to gastro-intestinal tract air filling and breathing

Purpose: For upper abdominal cancers, the simulation CT represents a snapshot of the possible air distribution and radiological thickness of a patient, both of which impact proton dose distribution. The purpose of this dosimetric study is to analyze the effect of gastro-intestinal tract air filling and breathing on the dose delivered to a superior abdomen target using passive scattering proton therapy.

Method and Materials: We used free-breathing CT (FBCT) and 4D-CT data sets showing the same 3-cm pancreatic tumor. Air distribution was reasonable. We reproduced a situation where proton beam parameters would be calculated on a normal breathing patient with gas (no air override: O^{-}FBCT), and we analyzed the dosimetric impacts if air was replaced by stools (air override: O^{+}FBCT) during treatments and vice-versa. Target coverage for 50.4 CGE in 28 fractions and dose to critical structures were evaluated for different air-filling and breathing-phase scenarios. Four-field plans including 3 incidences going through some gas were compared to 2-posterior-field plans.

Results: For the 4-field plans, beam parameter calculations from the O^{+}FBCT resulted in adequate target coverage when the same beam parameters were applied to the O^{-}FBCT. The converse situation resulted in the need for an additional 1-cm SOBP width to achieve adequate coverage for the antero-posterior and right-lateral beams. The 4-field plans provided insufficient distal target coverage to account for planning uncertainties in the expiration phase, a problem avoided with the 2-field plan.

Conclusion: Our choice of planning margins on O^{+}FBCT for upper abdominal cancer proton therapy is safe for target coverage, even if air filling variations occur during treatments. Planning on an O^{-}FBCT, using a passive scattering technique, results in less conformal plans. The use of posterior incidences for upper abdominal cancers prevents uncertainties, especially in specific clinical situations like ileus or breathing disorders.