Influence of Oral Contrast Agent On Dose Calculation of Radiotherapy Treatment Planning for Pancreatic Cancer a Multi-Factor Systematic Analysis Based On 3D Conformal Radiation Therapy and Volumetric Modulated Arc Therapy

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Purpose

Using positive oral contrast in gastrointestinal CT scan could improve the profile quality of bowel structure display and assist the delineation for pancreatic cancer radiotherapy. However the problem



	5b-CRT	7b-CRT	9b-CRT	VMAT
GTV				
D _{min}	-0.2±1.4%	0.03±1.23%	-0.54±0.58%	-0.18±1.02%
D _{max}	-0.26±1.07%	0.34±0.68%	-0.35±0.76%	-0.34±0.96%
D _{mean}	-0.24±0.28%	-0.15±0.22%	-0.29±0.28%	-0.23±0.15%
D ₉₅	-0.23±0.25%	-0.12±0.33%	-0.21±0.26%	-0.16±0.22%
D ₅	-0.22±0.38%	-0.14±0.32%	-0.25±0.36%	-0.2±0.23%
CI	1.2±3.65%	1.33±3.18%	0.78±2.84%	0.3±2.29%
CTV				
D _{mean}	-0.24±0.27%	-0.2±0.24%	-0.28±0.26%	-0.2±0.13%
D ₉₅	-0.3±0.36%	-0.31±0.35%	-0.25±0.29%	-0.3±0.3%
D ₅	-0.25±0.35%	-0.17±0.32%	-0.22±0.34%	-0.22±0.22%
CI	0.61±1.13%	0.51±0.84%	0.64±1.07%	0.4±0.92%
PTV				
D _{mean}	-0.15±0.14%	-0.16±0.1%	-0.21±0.16%	-0.2±0.12%
D ₉₅	-0.25±0.23%	-0.21±0.15%	-0.27±0.25%	-0.34±0.25%
D ₅	-0.15±0.26%	-0.05±0.18%	-0.11±0.27%	-0.2±0.07%
CI	0.04±0.79%	0.33±0.92%	0.55±0.94%	-0.22±0.92%
Duodenum				
D _{1cc}	-0.21±1.02%	-0.82±1.08%	-0.58±1.65%	-0.92±1.28%
Dmean	-0.99±0.34%	-0.86±0.44%	-1.05±0.37%	-1.06±0.55%
Stomach				
D _{1cc}	-0.54±1.73%	-0.02±1.1%	-0.16±0.7%	-0.21±0.75%
Dmoon	-0.63±0.42%	-0.6±0.58%	-0.78±0.57%	-0.78±0.54%
Intestine				
D ₁₀₀	-0.21±0.99%	-0.31±0.73%	-0.55±1.09%	-0.42±0.64%
Dmoon	-0.25±0.21%	-0.35±0.16%	-0.43±0.31%	-0.53±0.33%
Spinal				
Cord				
D _{1cc}	-0.59±2.7%	0.31±0.93%	-0.13±1.63%	0.51±1.42%
D _{mean}	0.08±0.43%	-0.08±0.63%	-0.18±0.6%	-0.28±0.16%
Left				
Kidney				
Dmean	-0.13±0.30%	0.03±0.19%	-0.03±0.26%	-0.18±0.24%
V ₂₀	0±0.33%	-0.41±1.09%	0.33±1.55%	-0.17±1.65%
Right				
Kidney				
Dmoon	-0.07±0.16%	-0.03±0.13%	-0.09±0.24%	-0.11±0.29%
V	0.05±0.24%	-0.25±0.55%	-0.22±1.14%	-0.31±0.49%

the calculation uncertainty and grid. For the normal tissue, the difference was also smaller than 1.5±1.5%, while the contrast-involved organs like duodenum, stomach and intestine showed a relatively higher difference than non-contrast involved organs like the spinal cord, kidney. Also we observed an nonsignificant relatively lower PDD/PVD of VMAT plan than 5b-CRT plan.

is contrast medium changed the electron density of content and would cause the dose calculation error when planning. In our study, we investigate the dosimetric influence of oral contrast medium used for pancreatic cancer radiotherapy treatment planning, as well as the influence intension correlated to different levels of contrast density and different radiation techniques.

Methods

Firstly we designed a virtual phantom in Monaco system to simulate the photon through the contrast passing beam Hounsfield different with volumes value from different angles. Unite(HU) Secondly 10 patients with locally advanced remote pancreatic cancer and no metastasis were enrolled in our study. Candidates were given 250ml of diluted solution consisting 3% iopamidol 15mins before CT scanning. Target volumes, normal tissue and gastrointestinal contrast volume were countered with precise, using threshold auto-counter function with an appropriate Hounsfield Unit (HU)>80. In our study, we simulated 4 branches of plans as 5-beam conformal radiotherapy (5b-CRT), 7-beam conformal radiotherapy (7b-CRT), Obcom conformal radiatharany (Ob CDT)



HU enhancement

Figure 1. Dose differences with increasing enhanced HU value for different beam energies and gantry angles.

DVH metrics difference



Figure 3 revealed the dose difference of different techniques with different contrast levels. 5b-CRT branch had the most serious underestimation, while VMAT branch had the most slight influence caused by contrast HU percentage averaged The increase. difference of Dmean, D95 and D5 of GTV, CTV and PTV were all smaller than 1% when HU enhancement is smaller than 500. In normal tissue, the percentage difference was larger than in targets. The relatively percentage difference of VMAT branch had less impact from HU enhancement level compared with that of 5b-CRT branch. The impact difference between 7b-CRT and 9b-

and standard doviati

Figure 2. The average and standard deviation of DVH metrics difference between OCCT of HU equals the averaged HU of contrast volume sets and original OCCT sets for different kinds of techniques..



 Table 1. The average results of dose difference between

 unmodified OCCT and modified non-OCCT of HU=0 with

 different techniques



CRT was not significant.

We also investigated the correlation between contrast enhancement level and the average gamma index passing rate of patients under a criterion of 2mm/2% for different techniques. For 5b-CRT plan, when HU is smaller than 300 the passing rate of target volume is higher than 97%. For VMAT plan the passing rate could be higher than 97% even the HU reached to 500. It indicated that the contrast