

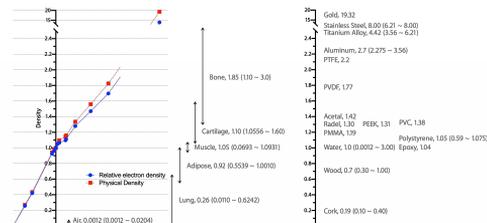
Dosimetric Evaluation of Acuros XB for Treatment Plan on Multiphasic Contrast Enhanced CT

Sang Hoon Jung, Sung Jin Kim, Hyunho Lee, Jeong Il Yu, and Hee Chul Park

Department of Radiation Oncology, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea

Introduction

- In dose calculation using treatment planning system, Hounsfield Unit (HU) from CT scan are historically converted to varying electron densities.
- However, recent advanced algorithms based on Monte-Carlo or grid-based Boltzmann solver convert HU to material density, then assign biological material (lung, adipose tissue, muscle, cartilage, or bone) for voxels.
- Multiphasic contrast-enhanced CT were usually used for treatment planning including target contouring and dose calculation. However, enhanced intensity due to use of contrast agent was not considered to the algorithms.



An Example of the Density Table and Assigned Materials

- Influence of treatment planning with multiphasic contrast enhanced CT for liver cancer on dose calculation using Acuros XB (Varian Medical Systems, Palo Alto, CA), a grid-based technique to solve the linear Boltzmann transport equation was evaluated.

Materials and Methods

- Treatment Plan
 - A single Field with a Size of 10 x 10 cm²
 - Various energies of 6 MV, 10 MV, 6 MV FFF, and 10 MV FFF)
 - A source-to-surface distance of 95 cm
- Homogenous Phantom
 - 20.0 x 20.0 x 20.0 cm³
 - HU of Liver from Multiphasic Contrast Enhanced CT

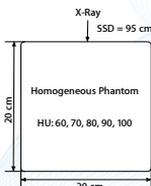


Figure 2. Brief Scheme of a Phantom

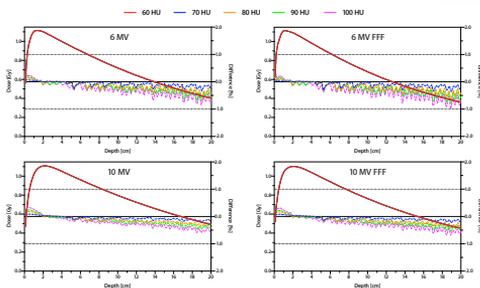
Table 1. Assumed Hounsfield Units of Normal Liver on Multiphasic Contrast Enhanced CT

	Non-contrast	Arterial	Portal	Delayed 1	Delayed 2
HU	60	70	100	90	80
ρ	1.080	1.088	1.104	1.100	1.097
ρ_e	1.059	1.062	1.070	1.067	1.065

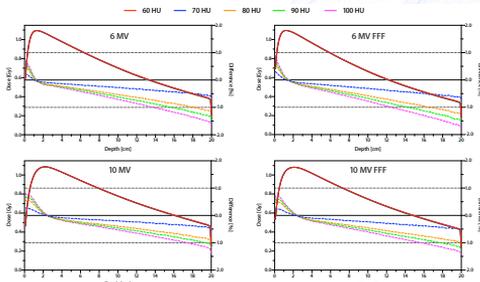
- Dose Calculation and Comparison
 - Depth Doses along a Central Axis
 - Acuros XB (AXB) and AAA (Ver. 15.6)
 - For AXB, Dose Calculation Reported with Dose to Medium (D_m) and Dose to Water (D_w)
 - Depth Dose for 60 HU compared to those for others

Results

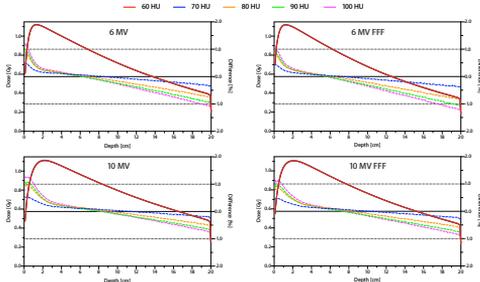
- Depth Doses and differences
- Depth Doses from AAA



- Depth Doses from AXB D_m



- Depth Doses from AXB D_w



Conclusion

- Overall difference upto depth of 20 cm was evaluated to be acceptable clinically with less than 2%.
- However, dose calculation using AXB was influenced by the variation of HU due to the presence of contrast agent, than dose calculation using AAA.
- Physical density of liver from the contrast enhanced CT would be assigned to muscle or cartilage, or mixture of them in treatment planning.
- However, the material composition of the contrast agent could not be defined or modified in the treatment plan using AXB.
- The treatment planning using the contrast enhanced liver CT should be evaluated carefully.

References

Kry SF, Feysgelman V, Balter P, et al. APM Task Group 329: Reference dose specification for dose calculations: Dose-to-water or dose-to-muscle? *Medical Physics*. 2020;47.