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Validation of Treatment Planning and Lung Dose Estimation for Total Body Irradiation Using Eclipse Treatment Planning System

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Abstract

The lungs are a primary dose limiting organ in high dose total body irradiation (TBI). Accurate prediction of lung dose can dictate treatment success by preventing pulmonary toxicity. Normal treatment planning consists of basic hand calculations and in vivo dosimetry. The use of a treatment planning system (TPS) is an unverified method at the extended treatment distance required by TBI. Our aim is to analyze the Eclipse TPS as a viable method to determine required monitor units (MU) to meet a prescription and estimate dose to the lungs during blocked treatment fractions.

For standard hand calculations, MU's are solely dependent on patient thickness at the umbilicus. The Eclipse TPS uses the Acuros algorithm to calculate MU's using patient specific anatomy information. The TPS allows for evaluation of a mean lung dose as well as a standard point dose estimate of the mid lung. The MU's calculated by the Acuros algorithm were used to deliver radiation to a basic phantom made of solid water and dried cedar planks. The phantom mimics the densities in the human trunk with sections specific to the lungs and abdomen. Dosimetry measurements were made within both sections for a variety of different treatment plans for a comparison to both hand calculations and the Acuros algorithm.

The TPS has produced promising results for mid body dose estimate with all measurements within 2% of the treatment plan. Early measurements have shown mean lung dose can be on average 14% higher than mid lung dose suggesting a point dose measurement may be an underestimate. Current methods to predict lung dose behind blocks have shown large over estimation possibly due to required placement of compensators. With a change in procedure, there is promise that the Eclipse Acuros algorithm could be a useful tool for TBI dose calculations.