Cureus

Clinical Considerations of Switching to LBTE Dose Calculation for Lung SBRT

Open Access
Abstract
Published 02/11/2022

Brett Erickson [1] , Brad Ackerson [2] , Christopher Kelsey [3] , Fang-Fang Yin [4] , Justus Adamson [2] , Yunfeng Cui [5]

1. Medical Physics, Duke University, Durham, USA 2. Radiation Oncology, Duke University Medical Center, Durham, USA 3. Department of Radiation Oncology, Duke University Hospital, Durham, USA 4. Department of Radiation Oncology, Duke University Health System, Durham, USA 5. Medical Physics, Duke University Medical Center, Durham, USA

Corresponding author: Brett Erickson, brett.erickson@duke.edu

Categories: Medical Physics, Radiation Oncology
Keywords: normalization, dose-fractionation, lung sbrt

How to cite this abstract
Erickson B, Ackerson B, Kelsey C, et al. (February 11, 2022) Clinical Considerations of Switching to LBTE Dose Calculation for Lung SBRT. Cureus 14(2): a701

Abstract

Objective: To quantify the clinical implications of various dose normalization strategies when implementing the Acuros XB (AXB) linear Boltzmann transport equation (LBTE) dose calculation algorithm in lung stereotactic body radiation therapy (SBRT) planning.

Methods: 85 lung SBRT patients treated from 2007-2014 were selected from a retrospective study approved by our institutional review board, yielding a total of 87 lung SBRT plans. Patients were treated with 3-dimensional conformal radiation therapy (3DCRT) or intensity modulated radiation therapy (IMRT) to a dose of 40-60 Gy in 3-8 fractions. Original plan doses were calculated with the Anisotropic Analytical Algorithm (AAA, versions 8117, 8223, 8615, 10028, and 11031) and were recalculated with AXB (version 15603) specified as dose-to-medium (labelled AXBm). After recalculation with AXBm, the dose prescription was normalized in three ways: to the planning target volume (PTV) D95%, to the internal target volume (ITV) D99%, and to the same planned PTV coverage as the original plan. The change in the actual delivered dose between the original and renormalized plans was quantified through the percentage change in total monitor units (MU). Changes in the treatment planning system (TPS) reported dose were quantified by percentage differences between PTV, ITV, and OAR dose metrics for the AAA and AXBm renormalized plans. The ability of the AXBm renormalized plans to meet our institutional planning objectives was investigated.

Results: Upon recalculation with AXBm, normalizing to the PTV D95% or keeping the same planned coverage resulted in a total MU increase of 7.0±8.8% and 7.9±8.6%, respectively, indicating an increase in the actual delivered dose relative to the AAA plan. When normalizing to the ITV D99%, total MU changed by 0.31±5.8%, suggesting a similar delivered dose compared to the AAA plan. The TPS reported doses for the PTV and ITV D1% increased by median 3.4% and 3.2%, respectively, in AXBm plans normalized to the PTV D95% while normalizing to the ITV D99% resulted in a median decrease of 1.9% in the PTV and ITV D1%. TPS reported OAR doses were mostly increased when renormalizing the AXBm plans to the PTV D95% or keeping the same planned coverage (average chest wall V30Gy[cc] increase of 4.7 cc and 5.3 cc, respectively) while normalizing to the ITV D99% typically resulted in decreased TPS reported OAR dose (average chest wall V30Gy[cc] decrease of 1.3 cc). Replanning based on the AXBm calculated dose showed that the higher TPS reported OAR dose in the AXBm plans normalized to the PTV D95% can be further reduced to meet the institutional planning objectives.

Conclusion: When calculating lung SBRT plans with AXBm, normalizing to the PTV D95% or keeping the same original PTV coverage results in a dose increase compared to the dose delivered with AAA while normalizing to the ITV D99% results in similar delivered dose. TPS reported OAR doses were higher for the PTV D95% and planned coverage renormalizations in the AXBm plan but were manageable when replanned. Special consideration for optimal dose normalization may be needed for some extreme cases.