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Dosimetric Comparison of Analytical Anisotropic Algorithm (AAA) and Acuros XB (AXB) in Radiotherapy Planning for Esophageal Cancers: A Treatment Planning Study

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Abstract

Background

Calculation of right dose in radiotherapy for esophageal cancer is very difficult because of the large differences in tissue types. These include the sharp changes in density between soft tissue, lung tissue, and air spaces. This treatment planning study aims to compare the dosimetric differences between the Analytical Anisotropic Algorithm (AAA) and the Acuros XB dose calculation algorithm in VMAT or IMRT for esophageal cancer.

Methods

Treatment strategies were created for a group of esophageal cancer patients utilizing CT simulation data sets. For every patient, the same beam geometries, target volumes (CTV and PTV), and prescribed doses were kept constant. Plans originally calculated with AAA were re-evaluated using AXB in two different reporting modes: Dose-to-Medium (D_m) and Dose-to-Water (D_w). Coverage goals ($D_{95\%}$, $D_{2\%}$, $D_{98\%}$, and Homogeneity/Conformity Indices) as well as dose-volume histogram (DVH) metrics for organs at risk (OARs)—like the lungs (V_5 , V_{20} ,

Mean Lung Dose), heart (V_{30} , Mean Heart Dose), and spinal cord ($D_{\max}$)—were assessed and analyzed through paired t-tests.

Results

Initial dosimetric evaluation showed significant differences between the AAA and AXB algorithms. AAA usually overvalued the target dose coverage within the Planning Target Volume (PTV) and varied pulmonary interfaces in contrast to AXB. The AXB (D_m) algorithm showed reduced $D_{95\%}$ coverage for PTV near low-density lung areas. For OARs, AXB forecasted slightly reduced or similar lung volumes receiving low-to-moderate doses (V_5 , V_{20}), while spinal cord $D_{\max}$ and heart doses exhibited minor differences, indicating AXB's enhanced management.

Conclusion

Acuros XB offers a more precise physical prediction of dose distribution than AAA in planning treatment for esophageal cancer, especially close to low-density tissue boundaries such as the lungs. Although AAA is still clinically acceptable, AXB is preferable for enhanced accuracy in target coverage and dependable OAR risk evaluation in complex thoracic settings.

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