PATIENT-SPECIFIC IMMUNE CELL RADIOSENSITIVITY RATIO NECESSARY FOR PREDICTING RADIOTHERAPY OUTCOMES IN LUNG CANCER: A MATHEMATICAL MODELING STUDY

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Background Every tumor presents within a given tumor microenvironment (TME) that may influence response to radiation therapy (RT). The purpose of this study is to use pre-treatment biopsy information to make these predictions with a simple mathematical model.

Methods Using data from the Moffitt Total Cancer Care Protocol (initial tumor cell counts, immune cell counts, radiotherapy treatment information, radiation sensitivity, and locoregional tumor control), a model was created to predict tumor response to radiotherapy. Normalized cell counts were used to calibrate an ODE system of tumor-immune interactions. Response to RT was modeled using the linear-quadratic model with an in vivo correction factor of the survival fraction. Lastly, a patient-specific ratio of the survival fraction of tumor cells to immune cells (R) was necessary to separate patients by locoregional tumor control (LRC).

Results We found that pretreatment cell counts and tumor cell survival fraction were not sufficient to stratify patients by outcome. Furthermore, post-treatment cell counts with uniform R values were also not sufficient to stratify patients. Only post-treatment counts with patient-specific R values were able to separate patients based on LRC.

Conclusions This study revealed the necessity of including patient-specific lymphocyte radiosensitivity for the model used. This value is especially important in two-dimensional systems that only consider tumor and immune cell counts.

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