

Pathomic topology-based predictive models of radiation treatment response in patients with non-small cell lung cancer

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<Abstract> (294/300)

Aims

Radiation therapy (RT), one of the first-line treatments for inoperative early-stage patients with non-small cell lung cancer (NSCLC), exhibits wide variations in the treatment response [1]. We hypothesized that tumour cells associated with the radiation treatment response could harbour inherent geometrical phenotypes as well as genotypes [2]. The aim of this study was to explore pathomic predictive models of the radiation response in patients with NSCLC via cell topology.

Materials & Methods

We collected 108 NSCLC patients who underwent RT from The Cancer Genome Atlas (TCGA), including adenocarcinoma (TCGA-LUAD) and squamous cell carcinoma (TCGA-LUSC). Patients were divided into training (n=54), validation (n=27), and test (n=27) datasets to establish predictive models. After colour normalisation and channel decomposition, cell topological features with Betti numbers (BNs) were extracted from the pathology images. Zero- and one-dimensional BNs were defined, which indicated the number of connected components (B0) and holes (B1). The Cox proportional hazard (CPH) model, which provides the time-to-event risks (death risks after RT) for each feature with hazard ratios and p-values, was leveraged to select significant features. Logistic regression (LR) was deployed to build the predictive models with a 4-fold cross-validation. The model performance was evaluated by the area under the receiver operating characteristic curve (AUC), accuracy, specificity, and sensitivity. The prognostic power on the overall survival after RT was evaluated using the p-value obtained from a log-rank test in Kaplan-Meier curve analysis.

Results

Five significant topological features were chosen among 6912 features. The proposed model achieved a mean AUC of 0.707 and indicated the prognostic power with p-values ranging from 4.27×10^{-9} to 0.007 for 4 folds.

Conclusions

The pathomic features based on the cell topology with Betti numbers could harbour the potential for prediction of the radiation response after RT for lung cancer patients.

Reference:

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[2] Deschavanne PJ, Fertil B. A review of human cell radiosensitivity in vitro. *Int J Radiat Oncol Biol Phys.* 1996;34(1):251-266. doi:10.1016/0360-3016(95)02029-2