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Primary Category: Radiation Oncology and Radiobiology

Secondary Category: Head and Neck

Mon Nov 27 2017 10:50AM - 11:00AM ROOM S104A

03) Predicting the HPV P16 Status of Oropharyngeal Cancer Patients Using Radiomics and an Ensemble of Random Forests

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PURPOSE

Recent data demonstrate that human papillomavirus (HPV)-associated oropharyngeal cancers (OPC) have discrete biology and clinical behavior as compared to HPV-negative OPC. We hypothesize that some phenotypic image features can be correlated to tumor biology in a non-invasive fashion.

METHOD AND MATERIALS

Data for biopsy-proven oropharyngeal squamous cell carcinoma patients dispositioned to definitive (chemo)radiotherapy at a single institution between 2005-2012 were scanned (n=465). Pretreatment contrast-enhanced CT (CE-CT) images and contours of the gross primary tumor were extracted in DICOM-RT format for patients with known p16 status and uniform CT slice thickness of 1 mm (n=248). Radiomics-based analysis was performed using IBEX which utilizes the Matlab platform. A total of 60 radiomics features were selected from the categories intensity direct (n = 11), neighborhood intensity difference (NID; n = 5), grey-level co-occurrence matrix (GLCM; n = 22), grey-level run length (GLRL; n =9), and shape (n = 13). The contribution of each feature toward the classification of the patients was estimated using the mean accuracy decrease. To further examine the performance of the model, the receiver operating characteristics (ROC) were plotted and the area under the curve (AUC) was calculated using pROC package for R.

RESULTS

The final cohort included a total of 248 patients with known p16 status, categorized into: p16-positive (83.1%) and p16-negative (16.9%). The most discriminating feature, based on Mean Accuracy Decrease for 1000 Random Forests was the shape feature sphericity, $((36\pi \sqrt[3]{\text{Volume}})^2 / \text{Area})^{1/3}$. The other discriminating features were the GLCM feature Information Measure Correlation 2, the shape features convex and roundness, and volume. Figure 1 shows the ROC curve for the ensemble of random forests. The area under the curve for the ensemble was 75.0 with a 95% confidence interval of 67.8 to 82.3. The confidence interval was calculated using the DeLong method.

CONCLUSION

Some imaging features, specifically shape and intensity features can make a distinction between HPV-associated and HPV-negative OPC.

CLINICAL RELEVANCE/APPLICATION

Quantitative information from pretreatment imaging of intact tumor can give a better idea on tumor biology. Further studies are needed to validate the correlation between these radiomic biomarkers and other intrinsic tumor characteristics.

FIGURE (OPTIONAL)

Uploaded Image

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Disclosures:

Nothing to disclose:

Dennis Mackin

Nothing to disclose:

Hesham Elhalawani

Nothing to disclose:

Abdallah Mohamed

Nothing to disclose:

Crosby Rock

Nothing to disclose:

Pei Yang

Nothing to disclose:

Aubrey White

Nothing to disclose:

James Zafereo

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Nothing to disclose:

Joel Berends

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