10th International Conference on

Otolarngology: ENT Surgery

May 15, 2023 | Webinar

Received Date: 22-03-2023| Accepted Date: 26-03-2023 | Publication Date: 30-05-2023

Artificial Intelligence in a machine learning model for predicting residual and Recurrent Head and Neck Cancer

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Introduction: Artificial intelligence (AI) is rapidly gaining traction in the treatment of head and neck squamous cell carcinoma (HNSCC). Combining AI with a convolutional neural network (CNN) may offer increased accuracy when evaluating HNSCC patients. This study aimed to investigate the use of artificial intelligence with neural networks in a machine learning model for the detection of residual and/or recurrent disease in patients treated for HNSCC.

Methods: Subjects were identified by retrospective radiology review at our center from 2010-2019. We included adult patients who have undergone treatment for oropharyngeal HNSCC. Peri-treatment PET-CT images for 60 patients (30 with tumor recurrence and 30 without) were collected and split into two balanced datasets: a 45-patient training set and a 15-patient test set. A neural network was employed to test convolutional layers, Long-Short-Term Memory (LSTM) cells, and fully connected (mixed) layers models. Accuracies were computed and the results of the machine models were compared to the radiologist's interpretations.

Results: Mixed and convolutional layers methods demonstrated similar sensitivity, specificity, and accuracy (0.71, 0.88 and 0.80 respectively), while the LSTM model demonstrated higher sensitivity (0.86) and lower specificity (0.50) and accuracy (0.67). The mixed model yielded a higher area under the curve (AUC) than the convolutional or LSTM models (0.73, 0.70, and 0.48, respectively). Confusion matrices indicated identical classification rates for convolutional and mixed models. The radiologist interpretations were more sensitive (0.90) and had a higher negative predictive value (0.86). Similar F-scores were noted for the mixed model, convolutional model, and radiologist interpretations.

Conclusion: Artificial Intelligence in conjunction with CNN in a machine learning model has a promising future for detecting residual or recurrent disease in HNSCC patients. Further study is underway implementing a larger data set to make the machine learning model more robust, check calibration against a larger cohort of patients, and validate the presented method.

Biography

Justin M. Pyne is an Otolaryngology–Head and Neck Surgery Resident at the University of Alberta in Edmonton, Alberta, Canada. He completed undergraduate degrees in science and medicine at Dalhousie University in Halifax, Nova Scotia, Canada. He will be embarking on a head and neck oncologic and microvascular surgery fellowship at the University of Texas Southwestern in Dallas, Texas, USA this June. He plans to practice as an academic head and neck oncologist following the completion of his training.

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