Predicting Post Neoadjuvant Axillary Response Using A Novel Convolutional Neural Network Algorithm

Abstract# 403976

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Objectives:

In the post neoadjuvant chemotherapy (NAC) setting, conventional radiographic complete response (rCR) is a poor predictor of pathologic complete response (pCR) of the axilla. We developed a convolutional neural network (CNN) algorithm to better predict post NAC axillary response using a breast MRI dataset.

Materials and Methods:

An IRB approved retrospective review of our database from 1/2009 to 6/2016 identified 127 breast cancer patients who: 1) underwent breast MRI prior to the initiation of NAC; 2) successfully completed Adriamycin/Taxane-based NAC; and 3) underwent surgery including sentinel lymph node evaluation/axillary lymph node dissection with available final surgical pathology data. Patients were classified into 2 groups based on their NAC response confirmed on final surgical pathology: Pathologic complete response (pCR) of the axilla (group 1), and non-pCR of the axilla (group 2). Breast MRI performed prior to NAC was used. Tumor identified on first T1 post contrast images underwent 3D segmentation. A total of 2811 volumetric slices of 127 tumors were evaluated. CNN consisted of 10 convolutional layers, 4 max-pooling layers and dropout of 50% after a fully connected layer. Dropout, augmentation and L2 regularization were implemented to prevent over-fitting of data. Code was implemented in open source software Keras with TensorFlow on a Linux workstation with NVIDIA GTX 1070 Pascal GPU.

Results:

On final surgical pathology, 38.6% (49/127) of the patients achieved pCR of the axilla (group 1) and 61.4% (78/127) of the patients did not with residual metastasis detected (group 2). For predicting axillary pCR, our CNN algorithm achieved an overall accuracy of 83% (95% CI, +/-5) with sensitivity of 93% (95% CI, +/-6) and specificity of 77% (95% CI, +/-4). Area under the ROC curve (0.93, 95% CI, +/-0.04).

Conclusions:

Current deep CNN architecture can be used to predict post NAC axillary pCR. Larger data set will likely improve our prediction model.