

Impact of image contrast enhancement on stability of radiomics feature quantification on a 2D mammogram radiograph

ABSTRACT

The present work aimed to evaluate the reproducibility of radiomics features derived from manual delineation and semiautomatic segmentation after enhancement using the Contrast Limited Adaptive Histogram Equalization (CLAHE) and Adaptive Histogram Equalization (AHE) techniques on a benign tumor of two-dimensional (2D) mammography images. Thirty mammogram images with known benign tumors were obtained from The Cancer Imaging Archive (TCIA) datasets and were randomly selected as subjects. The samples were enhanced for semiautomatic segmentation sets using the Active Contour Model in MATLAB 2019a before analysis by two independent observers. Meanwhile, the images without any enhancement were segmented manually. The samples were divided into three categories: (1) CLAHE images, (2) AHE images, and (3) manual segmented images. Radiomics features were extracted using algorithms provided by MATLAB 2019a software and were assessed with a reliable intra-class correlation coefficient (ICC) score. Radiomics features for the CLAHE group ($ICC = 0.890 \pm 0.554$, $p < 0.05$) had the highest reproducibility compared to the features extracted from the AHE group ($ICC = 0.850 \pm 0.933$, $p < 0.05$) and manual delineation ($ICC = 0.673 \pm 0.807$, $p > 0.05$). Features in all three categories were more robust for the CLAHE compared to the AHE and manual groups. This study shows the existence in variation for the radiomics features extracted from tumor region that are segmented using various image enhancement techniques. Semiautomatic segmentation with image enhancement using CLAHE algorithm gave the best result and was a better alternative than manual delineation as the first two techniques yielded reproducible descriptors. This method should be applicable for predicting outcomes in patient with breast cancer.

Keyword: Breast cancer; Radiomics; Contrast limited adaptive histogram equalization (CLAHE); Adaptive histogram equalization (AHE); Semiautomatic segmentation