

APPLICATION OF TEXTURAL RADIOMICS AND KINETIC PARAMETERS TO QUANTIFY EARLY PHASE NEOADJUVANT CHEMOTHERAPY TREATMENT RESPONSE ON BREAST DYNAMIC CONTRAST ENHANCED MAGNETIC RESONANCE IMAGES

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ABSTRACT

Breast cancer is the most commonly diagnosed disease in women as well as the leading cause of cancer death. Neoadjuvant chemotherapy (NAC) is a standard treatment technique for locally advanced breast tumors, with the goal of clinical downstaging. Dynamic contrast enhanced magnetic resonance imaging (DCE-MRI) is used to diagnose breast cancer and could be used to access the NAC treatment response. However, the assessment of treatment response at the early phase is crucial and challenging. Previous studies show that radiomic features have the potential in quantifying the pathological changes due to NAC. In this work, an attempt has been made to objectively quantify the early phase changes observed on the DCE-MRI due to NAC using radiomic features. Different radiomic features are extracted from DCE-MR images of Visit 1 (pre-treatment) & 2 (post-treatment) to quantify the treatment response and are statistically analyzed. Further, kinetic features from the images are also extracted and associated with the radiomic features and are tested using Spearman's correlation test. Results demonstrate that radiomic features such as energy, homogeneity, entropy, kurtosis have shown a highly significant difference between the two visits ($p \leq 0.05$). Similarly, the association between significant radiomic features and kinetic parameters shown a positive correlation with $r = (0.48 - 0.66)$, $p = (0.00029 - 0.016)$ respectively. Hence it appears that the association of radiomic and kinetic parameters would be used as an adjunct measure in differentiating the NAC treatment visits at early stages.

Keywords: Breast Cancer, DCE-MRI, Kinetic Features, Neoadjuvant Chemotherapy, Radiomic Features, Treatment Response

INTRODUCTION

The first most cancer death worldwide is breast cancer [1]. In locally advanced breast cancers, the downstaging of tumor growth and breast conserving treatment rates have been recommended by Neoadjuvant chemotherapy (NAC) treatment [2], [3]. The status of the NAC treatment is assessed by the pathological complete response (pCR) of the patient, such as overall and progression-free survival (PFS) [4].

Breast DCE-MRI is one of the non-invasive imaging modalities that measures the tissue microvascular structure which is used predominantly in breast NAC treatment response with high spatial resolution. It is the most extensively used and clinically recognized imaging modality in the detection of breast tumors with its high sensitivity [5], [6]. The anatomical and hemodynamic information is provided with high spatial resolution. Previous investigations on breast DCE-MRI showed that there is a correlation between geometric, kinetic parameters and NAC response, histopathological factors, and benign/malignant tumors [7].