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RADIOMICS IN BREAST CANCER

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Abstract

Introduction: Breast cancer is the most common tumour in women. It accounts for nearly 29% of all female cancers and represents the first cause of oncologic death; genetic and environmental factors are involved. Early detection is mandatory. Digital tomography represents the gold standard for early diagnosis. Tomosintesys 3D (DBT), ultrasound (US) and breast MRI are used to help diagnosis, in patient who have dense breast. Recent studies have elaborated mathematical algorithms able to create radiomics features, which represent the intrinsically characteristics of the tumour, using morphological imaging parameters of lesion. Aim of this study is to apply these MRI features in order to classify benign and malignant lesions, and their histological type.

Methods and materials: We retrospectively included patients who came to the UOC of Senology of Sassari AOU between January 2018 and September 2018 and underwent a breast MRI C.E. after a digital tomography, DBT and echography, were included.

Results: 51 patients were enrolled. A radiomics analysis was performed on enhanced MRI breast imaging.

Discussion: This study demonstrate a potential role of radiomic in order to distinguish not just between malignant and benign lesion, but also between different histological pattern, confirming their high potential in early diagnosis and therapy.

Keywords: *breast cancer, early diagnosis, radiomics, MRI*

Introduction

Breast cancer is the most common tumour in women. It accounts for nearly 29% of all female cancers and represents the first cause of oncologic death; genetic and environmental factors are involved. (Table 1) [1-4] Early detection is mandatory to reduce mortality, metastasis and increase survival rate [5-9], leading to an improvement in the patient's quality of life. [1] There are two main histological type of breast cancer: ductal and lobular and ductal is the most common.

Digital tomography represents the gold standard for early diagnosis. [9] Furthermore, Tomosintesys 3D (DBT), ultrasound (US) and breast MRI are used to help diagnosis, in patient who have dense breast [10-15]. Indeed, digital breast tomosynthesis can reduce the overlap between normal tissues and lesions as the X-ray tube can be moved at any angle, and breast MRI enable radiologist to better identify the lesions through many parameters, such as contrast enhancement or perfusion data [15-16].

Recent studies have elaborated mathematical algorithms able to create radiomics features, which represent the intrinsically characteristics of the tumour, using morphological imaging parameters of lesion.

Therefore, "radiomic" is defined as conversion of radiological images in data, useful for clinical and therapeutical decisions [16].

Specific dedicated software can elaborate these radiomics characteristics, and the process of identification and selection of the most significant features is called "radiomic signature". According to recent literature, the most relevant breast cancer MRI features seem entropia, 90° percentile and skewness, which offers an excellent capability for identification of malignant lesions [16], confirmed by biopsy [17]

Aim of this study is to apply these MRI features in order to classify benign and malignant lesions, and their histological type.

Methods

We performed a 9 months retrospective study. All patients who came to the UOC of Senology of Sassari AOU between January 2018 and September 2018 and underwent a breast MRI C.E. after a digital tomography, DBT and echography, were included.

All patients with following parameters have been excluded: age<18 years, pregnant women, women with absolute contraindications for MRI (pacemaker or metallic surgical-aids) and absolute contraindications to contrast enhancement (high FGE or allergies).

Philips Achieva High-fields Magnetic Resonance (1,5 Tesla) was used.

Pre- and post-contrast axial scan were performed with Gadolinium (0,1 mmol/kg in 2ml/s followed by 20 ml of saline solution).

Images were obtained with MRI system using the following sequences: T2 weighted sequences STIR (3 mm slice thickness), axial DWI sequences (3 mm slice thickness) and T1 weighted sequences 1 pre - contrast and 5 post C.E. (1 mm slice thickness).

T1 weighted sequences resulted the best for analyse volume of interest on the tumour. 3D slicer software was used to extract first and second-order radiomic features. In according to current literature, the three most significant features were used.

Patient information were obtained by reviewing medical records.

Quantitative variables were analysed by using average rate and standard deviation (SD) in parametric distribution, or median and interquartile range (IQR) in non-parametric distribution. Qualitative variable was described as absolute frequencies and rates.

Statistical analysis was obtained by using statistic software Stata 14.0 (StataCorp, College Station, TX, USA).

Results

We enrolled 51 women. Medium age was 55 years old (+/-11). Tumour was located in left breast in 26 units (51%). In 6 patients (12%) it was located behind the areola, in 7 (13%) in the superior-external quadrant, in 3 (6%) in the internal superior quadrant, in 5 (10%) in the lower-external quadrant and in 5 (10%) in the lower-internal quadrant. In 7 patients (13%) the tumour location was in the upper quadrants, in 1 (2%) in the lower quadrants, in 7 (14%) in the external quadrants and in 10 units (20%) in the internal quadrants.

Histological study pointed out in situ ductal carcinoma in 7 patients (14%), infiltrative ductal carcinoma in 36 (70%), infiltrative lobular carcinoma in 4 (8%) and benign papilloma in other 4 (8%). 3 (8%) of infiltrative ductal carcinoma were I grading, 24 (67%) were II grading and 9 (25%) were III grading.

MRI was performed and radiomic features were obtained using T1-W post-contrast images.

All lesion were studied on imaging; for each lesion were extracted 15 radiomic features (volume, sphericity, surface/volume ratio, spherical disproportionation, external surface area, flatness, skewness, kurtosis, median, standard deviation, entropy, 90° percentile, 10° percentile, energy and dissimilarity).

In according to recent literature, three radiomic features were analysed: entropy, 90° percentile, and skewness, in order to identify a "radiomic signature" for breast cancer lesion.

There is no statistically significative difference in medium values of entropy between malignant and benignant breast tumour (medium value of entropy {DS} 2.7 {0.73} vs. 2.7 {0.4} in benignant and malignant lesions respectively; p=0.75).

There is no statistically significant difference in medium values of 90° percentile between malignant and benign breast tumour (medium value of 90° percentile {DS} 233.7 {70.4}vs 241.1 {35.0}in benignant and malignant lesions respectively; p=0.71).\

The study shows statistically significant difference between average values of skewness in malignant and benign tumour (medium value of skewness {DS} -0.1 {0.2} vs. -0.6 {0.4} in benignant and malignant lesions respectively; p=0.01).

There is no statically significative difference in medium values of entropy between lobular and ductal type (medium value of entropy {DS} 2.9 {0.4} vs. 2.7 {0.4} in lobular and ductal carcinoma respectively; p=0.22).

There is no statistically significant difference in medium values of 90° percentile between lobular and ductal type (medium value of 90° percentile {DS} 227.4 {34.3} vs. 244.5 {36.9} in lobular and ductal carcinoma respectively. p=0.38).

This study shows a statistically significant difference in medium values of skewness between lobular and ductal carcinoma (medium value of skewness {DS} -0.1 {0.2} vs. -0.7 {0.4} in lobular and ductal carcinoma respectively; p=0.01).

There is no statistically significant difference in medium values of entropy of ductal carcinoma between in situ and infiltrative form (medium value of entropy {DS} 2.7 {0.3} vs 2.7{0.4} in in situ and infiltrative form respectively; p=0.99).

There is no statistically significant difference in medium value of 90° percentile of ductal carcinoma between in situ and infiltrative form (medium value of 90° percentile {DS} 231.3 {23.2}vs 244.5 {36.9} of in situ and infiltrative carcinoma respectively; p=0.37).

There is no statistically significant difference in medium values of skewness of ductal carcinoma between in situ and infiltrative form (medium value of skewness {DS} -0.6 {0.4} vs. 0.7 {0.4} in in situ and infiltrative form, respectively; p=0.01).

There is no statistically significant difference in medium values of entropy of ductal carcinoma between grading 1, 2 or 3 (medium value of entropy {DS} 2.9 {0.4} vs 2.7{0.4} vs 2.7{0.5} in grading 1,2 and 3, respectively; p=0.96); in medium value of 90° percentile (medium value of 90° percentile {DS} 213.7 {17.6} 249.3 {35.2} vs 241.8 {43.7} in girding 1,2 and 3, respectively; p=0.40); in medium values of skewness in grading 1, 2 and 3 (medium value of skewness {DS} -0.3 {0.4} vs. 0.7 {0.4} vs. 0.8 {0.4} in grading 1,2 and 3, respectively; p=0.01).

There is no statistically significant difference in medium values of entropy of lobular infiltrative carcinoma between grading 1 and 2 ,according to Elston & Ellis, (medium value of entropy {DS} 3.3 {0.4} vs 2.9 in grading 1,2, respectively); in medium value of 90° percentile (medium value of 90° percentile {DS} 243 vs 211.1 in grading 1 and 3, respectively); in medium values of skewness (medium value of skewness {DS} -0.3 vs. 0.0 in grading 1 and 2, respectively).

Discussion

This study demonstrate a potential role of radiomic in order to distinguish not just between malignant and benign lesion, but also between different histological pattern, confirming their high potential

in early diagnosis and therapy. In particular, skewness seems able to predict malignant nature and histological type of a breast lesion.

Moreover, radiomic enable radiologist to analyse the whole neoplasia, and not a part of the conventional bioptical sample. Recent studies correlate radiomic features, not only to identify different type of lesion, but also to predict therapeutical response.

This study have some limitation: a small simple size and their retrospective nature.

Despite these limitations, this study shows the potential role of radiomic in clinical practice, for diagnosis and management of breast cancer patients [16].

In conclusions, radiomic represents a challenge for radiologist, which could be able to identify on conventional imaging basis the best clinical and diagnostic pathway.

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Table 1. Most frequent cause of oncologic death (Pool AIRTUM 2008-2012): Breast cancer represent the most common cause of death in women.

Men (%)	***Women (%)***	***Population***
Lung (26%)	**Breast (17%)**	Lung (19%)
Colon-rectum(10%)	Colon-rectum(12%)	Colon-rectum (11%)
Prostate (8%)	Lung (11%)	Breast (7%)
Liver (7%)	Pancreas (7%)	Stomach (6%)
Stomach (6%)	Stomach (6%)	Pancreas (6%)

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