Evaluation of Morphological Changes in Breast Cancer: Influence of Fractal Meta-Analysis

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Dear Editor

Breast cancer is the most common cancer among women in developed countries, and the National Cancer Institute has predicted that more than two million women would be diagnosed with breast cancer from 1990 to 2010 in the United States [1,2]. Some researchers believe that the incidence of breast cancer is increasing in many countries, although in some cases the mortality rate may be fixed or slightly reduced [3]. Due to its increasing incidence all over the world and being a medical concern globally, finding predictive methods for its diagnosis as well as its prognosis are of great importance [4].

Studying breast cancer, many researchers currently use a novel method known as fractal geometry [5,6]. Fractals were complex geometrical structures. Developed in 1975, science of fractal images not only is applied in engineering but also has gained importance in medical sciences [7]. Fractals were used for diagnosis of bone diseases, modeling of bone structures, and analysis of bone changes, as well as analysis of heart rhythm and rate and diagnosis of heart diseases. Nevertheless, fractal geometry can be a good diagnostic and prognostic tool wherever structural disorders and malfunctions exist [7]. Since cancer is considered as a type of cellular and histological anarchy, the dimensions of these irregularities can be shown through their quantification and reporting in the form of fractal numbers [8]. This study has investigated the relationship between the fractal numbers in patients with breast cancer and the histopathological grade.

This cross-sectional study was performed on 60 women that were selected through convenient sampling from 1000 women with ductal carcinoma of the breast that referred to Boo-Ali hospital in Tehran, Iran, from June 2010 to October 2013. All patients underwent local anaesthesia and the biopsy was taken from both breasts and underwent histopathological analyses. After being kept in buffered formaldehyde (pH=7.2) and creating paraffin blocks, three 5 µm sections were prepared from each sample and the slides were stained with hematoxylin-eosin (H&E) and examined by light microscope. In addition to their pathology slides, photographs were taken to assess the fractal number by special software. To this end, the Box-Counting method was used in MATLAB-R2007a software.

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Analysis was done by using independent t-test, ANOVA, Fisher’s exact test, and chi-square in SPSS 15.0. The significant difference was set at P<0.05.

The mean age of the studied women was 52.48 ± 10.83 years. The grade of the carcinoma was 2 in 38 women (63.3%) and 3 in 22 women (36.7%). The mean size of the tumor was 2.8 ± 1.48 cm and the mean fractal number was 1.95±0.03 in all cases. A significant difference existed between the mean fractal numbers of grade 2 (1.94 ± 0.03) and grade 3 (1.98 ± 0.004) (P= 0.001).

Fractal is a multi-component geometrical image which can be divided into patches each patch being similar to the “whole” image [7]. It is hard to believe that fractal as a highly complicated and difficult concept which is applied at the highest levels of mathematics can be easily used in a study [8]. In general, despite its complexity, fractal can easily be used in medical sciences [9]. Previous studies have shown that the fractal number can differentiate benign or malignant tumors [8, 9]; but the present study sought to use fractal number to realize the grade of malignancy and obtained interesting results; the higher the fractal number, the increased tumor grade. Geometrically, fractal is an object with three features, self-similarity, high complexity in micro scale, and with dimension not an integer [7,8]. Like many studies, we did not find an association between the risk factors and the fractal number [10,11].

The findings of this study indicated a significant relationship between the fractal number and the histopathological grade of the tumor, for example the fractal number was significantly increased by increasing the histopathological grade of the breast cancer. Thus, a fractal number could be a quantitative concept of tumor grade and can be measured as a predictor of breast cancer prognosis.

References