Quantitative Analysis of Breast Density Morphology Based on MRI

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BRIEF DESCRIPTION

Breast density has been shown to predict the individual woman's risk of developing breast cancer, We have developed a new method to analyze breast density based on Magnetic Resonance Imaging (MRI). A similar system for analyzing breast density based on 2-dimensional mammogram is commercially available. Our new method is based on MRI, which acquires 3-dimensional images and can be used to analyze not only the amount of dense tissue, but also the morphological distribution of the dense tissue.

This invention allows for the analysis of the density of breast. This information may be used to provide a better management plan for patients receiving breast MRI.

FULL DESCRIPTION

Mammographic density and breast parenchymal patterns (the relative distribution of fatty and fibroglandular tissue) have been shown to be associated with the risk of developing breast cancer. Percent breast density as determined by mammography is a well-established risk factor, but on the other hand, studies on parenchymal pattern have been scarce, possibly due to the lack of reliable quantitative parameters that can be used to analyze parenchymal tissue distribution. In this study the morphology of fibroglandular tissue distribution was analyzed using three-dimensional breast MRI, which is not subject to the tissue overlapping problem.

Methods: Four parameters, circularity, convexity, irregularity, and compactness, which are sensitive to the shape and margin of segmented fibroglandular tissue, were analyzed for 230 patients. Cases were assigned to one of two distinct parenchymal breast patterns: Intermingled pattern with intermixed fatty and fibroglandular tissue (Type I, N=141), and central pattern with confined fibroglandular tissue inside surrounded by fatty tissue outside (Type C, N=89). For each analyzed parameter, the differentiation between these two patterns was analyzed using a two-tailed t-test based on transformed parameters to normal distribution, as well as distribution histograms and ROC analysis.

Results: These two groups of patients were well matched both in age (50±11 vs 50±11) and in fibroglandular tissue volume (Type I: 104±62 cm3 vs Type C: 112±73 cm3). Between Type I and Type C breasts, all four morphological parameters showed significant differences that could be used to differentiate between the two breast types. In the ROC analysis, among all four parameters, the "compactness" could achieve the highest area under the curve of 0.84, and when all four parameters were combined, the AUC could be further increased to 0.94.

Conclussions: The results suggest that these morphological parameters analyzed from 3D MRI can be used to distinguish between intermingled and central dense tissue distribution patterns, and hence may be used to characterize breast parenchymal pattern quantitatively. The availability of these quantitative morphological parameters may facilitate the investigation of the relationship between parenchymal pattern and breast cancer risk.

SUGGESTED USES

A new method to analyze breast density based on Magnetic Resonance Imaging (MRI) is presented. Morphological parameters analyzed from 3D MRI can be used to distinguish between intermingled and

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OTHER INFORMATION

KEYWORDS

breast density, parenchymal pattern, MRI

CATEGORIZED AS

- **Optics and Photonics**
  - All Optics and Photonics
- **Imaging**
  - 3D/Immersive
  - Medical
  - Other
- **Medical**
  - Diagnostics
  - Disease: Cancer
  - Disease: Women's Health
  - Imaging

central dense tissue distribution patterns, and hence may be used to characterize breast parenchymal pattern quantitatively.

ADVANTAGES

This invention allows for the analysis of the density of breast. This information may be used to provide a better management plan for patients receiving breast MRI. The advantage of is that it can perform the entire procedures, starting from raw MR images. It will perform breast segmentation, dense tissue segmentation, and complete the analysis of dense tissue volume, percent density, as well as the morphological analysis.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	8,582,858	11/12/2013	2010-421

» Screening

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» Medical

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