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VALUE OF RADIOLOGY MODALITIES IN DIAGNOSING BENIGN AND MALIGNANT TUMOURS OF BREAST: AN OBSERVATIONAL STUDY

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DCE
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DWI
Diffusion-weighted imaging
FAMS
Faculty of applied medical sciences
KAU
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MRI
Magnetic resonance imaging
WE
Weighted enhanced.

ABSTRACT

Breast cancer is the most common malignant tumor among women. The objective of this research is to evaluate the specificity, sensitivity, and accuracy of BSGI, DC, and WE-MRI in the diagnosis of breast benign and malignant breast tumors. 228 female patients have participated in this observational research. The age was ranged from 31-68 years (mean age 42.37± 8.14 years) with suspicious breast lesions according to physical and imaging examination (mammography and/or ultrasonography). Moreover, women, who have suspected local regional recurrence after resection of malignant breast tumor and who were suspected to have tumor residual following chemotherapy or radiotherapy were also included. All patients underwent breast specific gamma imaging, DW-MRI, and DCE-MRI examination, and the results of breast MRI were compared with the histopathological results that were used as the standard diagnostic method. In this research, 111 women were found to have breast lesion. All breast lesions were undergone histopathological analysis using needle biopsy and/or excisional biopsy. Also, the results of the pathological analysis were correlated and confirmed with ultrasonography and mammography. The pathologic analysis confirmed that 76 (68.5%) of 111 lesions were benign breast lesions and 35 (31.5 %) of 111 were malignant breast lesions. The results proved that BSGI had the best results for the detection of breast lesions (sensitivity 96.7%, specificity 93.6 % and accuracy 94.8%) as compared with DCE-MRI (sensitivity 92.3%, specificity 85.6% and accuracy 88.2%) and diffusion weighted imaging (sensitivity 94.1%, specificity 88.5% and accuracy 91.4%). The research stated that BSGI is the most appropriate diagnostic tool for breast lesions.

Contribution/Originality: This study documents that Breast Specific Gamma Imaging (BSGI) is the most suitable diagnostic tool for benign and malignant breast tumors. Specifically, the study has contributed in identifying the specificity, sensitivity, and accuracy of BSGI in the diagnosis of breast lesions and tumors.

1. INTRODUCTION

The most common malignant tumor among women is breast cancer (Invasive Ductal Carcinoma), and it is the 2nd most common cause of mortality related to cancer in women [1]. Mammography is an effective tool in diagnosing breast cancer, with sensitivity ranged from 70–90 [2]. Ultrasonography can also diagnose benign to malignant lesions, if their criteria of diagnosis are fulfilled [3]. The value of sensitivity and specificity of MRI is 91% and 88% respectively [4]. DCE-MRI sensitivity in detecting breast cancer is relatively higher, ranging from

88% to 100% for invasive breast malignancies [5]. DCE MRI specificity is variable depending on lesion criteria that were used to recognize breast benign tumors from malignant ones [6].

DWI is considered as a safe technique, which measures the free water protons random motion and evaluates the exchange (diffusion) of water molecules among compartments of breast tissues. The rate of diffusion is varying between pathologic and non-pathologic breast tissues [7]. Many studies proved the value of breast DWI in recognizing breast benign lesions from malignant lesions; the sensitivity of breast DWI was 80% to 96% and specificity was 46% to 91% [8].

Breast Specific Gamma Imaging is also used in case of more information is needed due to miss information in other radiological examinations [9]. The pupose of this research is to find out the specificity, sensitivity, and accuracy of BSGI, DC, and WE-MRI in the diagnosis of breast tumors, whether it is benign or malignant.

2. METHODOLOGY

2.1. Subjects

From May 2013 to April 2015, 228 female patients were recruited in this observational study, with age, ranged from 31-68 years (mean age 42.37± 8.14 years) with suspected breast lesions according to physical and imaging examination (mammography and/or ultrasonography). Similarly, women, having suspected local regional recurrence after resection of malignant breast tumor; in addition to female patients, who were suspected to have tumor residual following chemotherapy or radiotherapy were also included in the study. Exclusion criteria included pregnant and lactating women; patients with no histopathological confirmation of the lesion; patients undergone breast biopsy within one month; patients with negative result of lesion on MRI in regards to clinically or mammographic defined lesion; and patients with any contraindication to perform MRI examination as cardiac pacemaker or metallic aneurysm clips. A detailed history was taken, and general/local examination was done among each patient. All patients underwent Breast Specific Gamma Imaging, DWMRI and DCE-MRI examination, and the results of breast MRI were compared with the histopathological results that were used as the standard diagnostic method. This research was approved by the Ethics Committee at FAMS, KAU.

2.2. Imaging Procedures

The following imaging techniques were applied to all participants in the request of referring physician; and all radiological examinations were performed by the same radiologist.

2.3. Breast Specific Gamma Imaging (BSGI)

A dose of 25 mCi of 99mTcsestamibi was given to each patient. Gamma camera protocol was also applied to perform BSGI.

2.4. MR Imaging

A 1.5-T magnetic resonance machine was used to examine all participants in prone position with optimum MRI protocol including Localizing Sagittal View (scout view) and Axial Nonfat Saturated T1WI. The results obtained by FSE are as follows:

- TR = 450 ms
- TE =14 ms
- Slice thickness = 3 mm
- Field of View (FOV) = 300–360 mm
- Matrix = 307.512

Short TI inversion recovery (STIR) is as follows

- TR = 7000–9000 ms

- TE 70 ms and inversion time (TI) = 150 ms
- Slice thickness = 3–4 mm with inter slice gap 1 mm
- Field of view (FOV) = 300–360 mm
- Matrix = 307.512.

DCE-MRI was made in the axial plane with fat suppression by applying fat saturated pulse. The sequence used was FLASH 3D GRE-T1W1 with the following parameters:

- TR = 4–8 ms
- TE = 2 ms
- Flip angle = 20, 25
- Slice thickness = 2 mm with no inter-slice gap,
- Field of View (FOV) = 300–360 mm
- Matrix = 307.512.

DC enhanced MRI was performed after the injection of a bolus of gadopentetate dimeglumine, in a dose of 0.1 mmol/kg using an automated injector at a rate of 3–5 ml/s through an 18–20 gauge intravenous cannula inserted into an antecubital vein. Contrast injection was followed by a bolus injection of saline (total of 20 ml at 3–5 ml/s). The dynamic study consists of one pre-contrast and five post-contrast series; each of them took about 1.16 min with a break between the pre-contrast and post-contrast study about 20s. Firstly, weighted images were obtained, followed by dynamic images through using a diffusion-weighted echo-planar imaging (EPI) sequence with parallel imaging.

3. RESULTS

In this research, 111 women were diagnosed with breast lesions. All breast lesions had undergone histopathological analysis using needle biopsy and/or excisional biopsy. The results of pathological analysis were correlated and confirmed with ultrasonography and mammography. The pathologic analysis confirmed that 76 (68.5%) of 111 lesions were benign breast lesions and 35 (31.5 %) of 111 were malignant breast lesions. The detailed histological diagnosis is presented in table (1):

Table-1. Histopathological diagnosis of the benign and malignant breast lesions.

Type of breast lesion		Number	Percentage
Benign breast lesion	Fibroadenoma	29	38.15%
	Mucous adenoma	18	23.7%
	Papilloma	15	19.7%
	Postoperative scar	9	11.8%
	Hyperplasia	6	6.65%
Malignant breast lesions	Invasive ductal carcinoma	19	54.3%
	Ductal carcinoma in situ	5	14.3%
	Invasive lobular carcinoma	4	11.4%
	Medullary carcinoma	3	8.6%
	Mucinous carcinoma	2	5.7%
	Papillocarcinoma	2	5.7%

The detailed pathological types of 76 benign breast lesions included; 29 lesions (38.15%) were fibro-adenoma, 18 lesions (23.7%) were mucous adenoma changes, 15 lesions (19.7%) were papilloma, 9 lesions (11.8%) were postoperative scar, and 6 lesions (6.65%) were hyperplasia. However, the detailed pathological types of 35 malignant breast lesions included; 19 lesions (54.3%) were Invasive Ductal Carcinoma, 5 lesions (14.3%) were Invasive Lobular Carcinoma, 4 lesions (11.4%) were Ductal Carcinoma-In-Situ, 3 lesions (8.6%) were medullary

carcinoma, 2 lesions (5.7%) were mucinous carcinoma, and 2 lesions (5.7%) were papillocarcinoma. Moreover, all participants, involved in this research, underwent BSGI, DCE-MRI, and DW imaging for the suspected breast lesions, which had histopathological reference standard test for their breast lesions. DC Enhanced MRI had sensitivity of 92.3%, specificity of 85.6%, and accuracy of 88.2%; while DWI had sensitivity of 94.1%, specificity of 88.5%, and accuracy of 91.4%. Moreover, BSGI had the best results for the detection of breast lesions (sensitivity 96.7%, specificity 93.6 % and accuracy 94.8%) (Table 2).

Table-2. Sensitivity, specificity, and accuracy of radiology modalities in detecting breast tumors

	DCE-MRI	DWI	BSGI
Sensitivity (%)	92.3%	94.1 %	96.7 %
Specificity (%)	85.6 %	88.5 %	93.6 %
Accuracy (%)	88.2 %	91.4%	94.8 %

%: Percentage, DCE-MRI; Dynamic enhanced magnetic resonance imaging, DWI; Diffusion weighted imaging, BSGI; Breast specific gamma imaging

4. DISCUSSION

BSGI and MRI are excellent radiological techniques for breast lesion detection; although BSGI is more comfortable, less costly, and less time-consuming for image interpretation by the clinician [9]. Weigert, et al. conducted Breast Specific Gamma Imaging up on 1042 patients with breast lesion and stated a sensitivity of 91% and specificity of 77% [10]. Brem, et al. enrolled 146 patients with 167 breast lesions, which were confirmed with biopsy and stated that BSIG sensitivity was 96.4% and 59.5% as moderate specificity [11]. Also, Lee, et al. included 471 patients, who reported that the sensitivity of BSGI was 94.45%, which reflected the significance of Breast Specific Gamma Imaging in the detection breast cancer with high sensitivity [12]. This is validated in a meta-analysis of the available literature on BSGI by Sun et al., in which they stated that BSGI is important to be using as an adjunct to mammography [13].

El Bakry, et al. reported in their study of 71 women with 74 suspicious breast lesions (38 benign lesions and 36 malignant lesions) that DCE-MRI has 91.7% sensitivity, 84.2% specificity, and 87.9% accuracy; while DW imaging had 94.4% sensitivity, 92.1% specificity, and 93.2 % accuracy [14]. Kul, et al. reported that DCE-MRI had 97.9% sensitivity and 75.7% specificity (75.7%); while DW imaging had 91.5% sensitivity and 86.5% specificity [15]. Hetta proved that DCE-MRI had only 80% sensitivity and 73.33% specificity [7]. Moreover, Abdulghaffar and Tag-Aldeen stated that DW imaging had 95.4% sensitivity and 97.5% specificity [16].

Brem, et al. enrolled 26 women in their retrospective study. Mammography, BSGI, and MRI were performed for all participants; they confirmed that the sensitivity of BSGI was 93% in detecting Invasive Lobular Carcinoma; while MRI has a sensitivity of 83% [11]. Also, Kim included 66 patients with dense breasts and already biopsy-confirmed breast cancer. This study reported a percentage of 88.8% sensitivity and 90.1% specificity of BSGI; while MRI sensitivity and specificity were 92.3% and 39.4% respectively [17]. In the other hand, Keto, et al. enrolled only 18 patients, having Ductal Carcinoma-In-Situ, who underwent both breast MRI and BSGI and found that the sensitivity for BSGI was 89% and for MRI was 94% [18].

5. CONCLUSION

The aim of this research was to compare the specificity, sensitivity, and accuracy of BSGI, DC and WE-MRI in the diagnosis of breast tumors. The results proved that BSGI had the best results for the detection of breast lesions (sensitivity 96.7%, specificity 93.6 % and accuracy 94.8%) as compared with DCE-MRI (sensitivity 92.3%, specificity 85.6%, and accuracy 88.2%) and DWI (sensitivity 94.1%, specificity 88.5% and accuracy 91.4%). This research stated that BSGI is the most appropriate investigation tool for diagnosing breast lesions regarding sensitivity, specificity, and accuracy.

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