ROLE OF ULTRASOUND ELASTOGRAPHY IN THE ASSESSMENT OF INFLAMMATORY BREAST LESIONS

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Received: 5/4/2022
Accepted: 4/5/2022

Online ISSN: 2735-3540

ABSTRACT:

Background*: Benign and malignant breast inflammatory conditions must be differentiated from each other as they have different prognosis and management. Ultrasound Elastography can be used in combination with B-mode conventional ultrasound for assessing inflammatory breast lesions. Strain Elastography can help pickup malignant inflammatory breast lesions and avoid unnecessary biopsy from benign inflammatory lesions.*

Aim of our Study: *is to assess the diagnostic performance of strain ultrasound elastography added to the conventional B-mode ultrasound in evaluating inflammatory breast lesions.*

Patient and method: *This study includes 40 female patients presenting with mastitis. All breast lesions were assessed by Conventional B-mode ultrasound and Strain Elastography. Qualitative color-coded E-scoring and Semiquantitative SR (strain ratio) evaluation of the sonoelastographic images were performed. The results were compared to histopathological diagnoses or follow-up for 2 weeks after antibiotic therapy.*

Results *In our study combined conventional ultrasound and elastography shows higher accuracy 84.2% and specificity 81.8% comparing to using conventional ultrasound alone 80%, 77.1% respectively. Both types of elastography shows the same accuracy 85% and specificity 82.8%.* ***Conclusion:*** *by assessment of tissue stiffness; it was found that ultrasound elastography play an important role in differentiating benign and malignant inflammatory disorders.*

Key words: *Inflammatory breast disorders-conventional ultrasound-elastography.*

INTRODUCTION:

Inflammatory breast disorders include a wide range of underlying causes that may be benign infectious, non-infectious inflammation and inflammation resulting from underlying breast malignancy. Unfortunately, there are a difficulty to distinguish between benign mastitis and breast malignancy because of the overlap of their clinical and radiological features, which lead to major diagnostic dilemma[(1)].

Mastitis is a non-malignant inflammatory breast disease, which may affect any anatomical structure of the mammary gland that often presents with pain, swelling, warmth, erythema and fever. It may lead to debilitating illness with prolonged morbidity[(2)]. Sometimes it present with nonspecific symptoms, that may lead to delayed diagnosis and inappropriate treatment.

Inflammatory breast cancer is a type of breast malignancies that must be ruled out and differentiated from benign mastitis because of its poorer prognosis and the great difference in the management between them[(3)].

The Breast Imaging Reporting and Data System (BI-RADS) lexicon was developed by the American College of Radiology**.** The distinct BI-RADS assessment category implies which further clinical action should be taken. It has been established that probably benign (BI-RADS category 3) lesions having a malignancy rate of less than 2% require short-term imaging follow-up rather than immediate biopsy[(4)]**.**

BI-RADS 4 lesions have a low to moderate probability of malignancy (2–94%) and biopsy/fine-needle aspiration cytology (FNAC) should be considered. Among BI-RADS category 4 A lesions, approximately only 2–9% turn out to be histologically malignant, and a much larger proportion of patients undergo invasive diagnostic proceduresthat might not be necessary if a better noninvasive imaging methods were available for accurate diagnosis[(5)]**.**

Early detection of inflammatory malignant lesions is critical for the successful management as it is very aggressive type of cancer with poor prognosis. Today, conventional ultrasound (US) plays a decisive role in the diagnostic pathways using the standardized Breast Imaging Reporting and Data System (BI-RADS) lexicon. Intrinsic elastic features of the tissues may be changed in certain circumstances; neoplasm is one of the pathophysiologic process influencing the elasticity of the tissues[(6)]**.**

Generally, stiffer and immobile breast lesions suggest malignancy. On the basis of this principle, ultrasound elastography (UE) as an objective method to estimate tissue stiffness. It has been shown beneficial in diagnosis of breast lesions[(6)]**.**

Studies and a meta-analysis indicated that ultrasound elastography provides higher image quality compared to US or mammography during breast cancer diagnosis, which can increase specificity and reduce false-positive results, making it useful for avoiding unnecessary breast biopsy[(7)]**.**

Strain elastography allows evaluation of the elastography score (ES) as a qualitative parameter of relative stiffness of the lesion using a color map and the strain ratio (SR, fat/ lesion ratio [FLR]) as a semi quantitative ratio of the stiffness of the lesion to that of the adjacent fat[(5)]**.**

According to the World Federation for Ultrasound in Medicine and Biology (WFUMB) guidelines and recommendations for clinical use of ultrasound elastography, SR is a semi quantitative method for numerically evaluating how many times stiffer a target mass is compared with subcutaneous fat[(8)]**.** Although some studies have reported that the SR is a highly valuable and more objective parameter for differentiating malignant and benign breast lesions than the ES[(9)], some other studies reported that ES is more sensitive objective parameter for differentiating malignant and benign breast lesions than the SR, other studies have showed that the SR has poor reliability[(10)]**.**

AIM OF THE WORK:

The aim of our study: to assess the diagnostic performance of strain ultrasound elastography added to the conventional B-mode ultrasound in evaluating inflammatory breast lesions.

PATIENTS AND METHODS

Patients*:*

The present study was a prospective research work, which performed at the Radiology Department, Women imaging unit referred from breast surgery clinic and outpatient clinic at Ain-Shams University (Dmerdash) hospital. It included 40 patients with inflammatory breast pathology for whom, Ultrasound Elastography was performed in combination with conventional breast ultrasound to evaluate its possible impact on accurate diagnosis and avoid the unnecessary biopsy.

Inclusion Criteria:

- Patients presenting with clinical signs of mastitis such as pain, redness, focal or diffuse swelling of the breast with or without palpable breast masses.
- Patients presenting on ultrasound examination with suspected inflamematory breast conditions.

Exclusion Criteria:

- Patients with non-inflammatory presentation of breast disease.

Image Analysis:

Imaging analysis including ultrasound performance (both gray scale and elastographic ultrasound) was performed under the guidance of two experienced consultants of radiology. Imaging-guided biopsy for the detected masses was performed. At the stage of final evaluation, there was a multidisciplinary discussion of cases with the referring physician.

Methods:

Ultrasound Examination:

All patients were examined with B-mode ultrasound. Examinations were performed using a high-end ultrasound system General Electric (GE) Logic, those include a multi-frequency linear probe operating at 6 to 15 MHz software and a combined autocorrelation method.

The scanning protocol included transverse and longitudinal real-time imaging of masses of concern. A split-screen imaging mode (twin images) was used for conventional US and US elastography so as to obtain identical images optimal for accurate application for region of interest (ROI) and strain ratio (SR) measurement later on.

Ultrasound reports should confirm (+ve finding) or exclude (-ve finding) the presence of: Echogenic edematous fat lobules, Interstitial edema, Ill- defined collections, Retro areolar duct system dilatation, Thickened skin (>2mm) and its measurement, Mass lesions and confirm their cystic or solid nature, Abscess cavities and Lymph node enlargement and their status.

Each Lesion was evaluated regarding, shape, boundary, orientation, margin, echo pattern, ± calcifications. Assessment of the surrounding tissue condition was also included.

Lesions were classified according to the American College of Radiology Breast Imaging Reporting and Data System (BI-RADS) for B-mode ultrasonography as follows: *category 2* lesionswere classified as benign; *category 3* as probably benign; *category 4* as suspicious for malignancy; *category 5* as highly suggestive of malignancy.

Sonoelastography:

All patients were examined with ultrasound elastography. *Sonoelastographic images* were obtained by placing the transducer with coupling gel on the skin and then the considered mass is focused upon.

After activating the sonoelastographic function, images were obtained by applying repeated compression and decompression in a sustained frequency. Color-coding is superimposed on the translucent B-mode images. To get a correct sonoelastographic map, the process was repeated until a stable image was obtained. The sonoelastographic images were obtained in a 256-color scale ranging from red to blue. The softest component of the lesion was depicted in red, showing the greatest strain, whereas the hardest component with no strain was depicted in blue; green indicated intermediate elasticity. We selected an image obtained in the early phase of compression because these images provide the best contrast according to[(11)].

- ***In the qualitative (color-coded)*** *evaluation* of the Sonoelastographic images, lesion classification was

performed on the basis of a 5-point scoring method **(Tsukuba scoring system**) proposed by ***Itoh et al.,*[(12)]**.**

- ***In the semiquantitative*** evaluation of the sonoelastographic images, the strain indices of the lesions were calculated. For each case, normal-appearing breast region approximately at the same level of the concerned lesion was elicited as an internal reference (ROI 1) and the region of interest including the lesion was selected as (ROI 2), to correctly determine the difference in hardness of the lesion compared with the surrounding normal area. The strain ratio was automatically obtained as the strain measured via channel 1/ the strain measured via channel 2 ratio.

Final Diagnosis:

Final diagnosis was made upon the follow up of responsiveness to antibiotic treatment or on the histopathological diagnosis of surgical specimens or biopsy specimens were obtained and served as reference standards.

Diagnosis from elasticity scoring and the strain ratios were compared with the histopathologic diagnoses or follow up for 2 weeks after antibiotic therapy, further adding to thedifferentiation criteria of benign and malignant inflammatory lesions.

Ethical Considerations:

Official permission was obtained from the Radio-Diagnosis Department, Faculty of Medicine, Ain shams University. The study was approved by the Research Ethics committee of Ain shams University Hospitals and a written informed consent was obtained from all subjects prior to study procedure.

Statistical Analysis:

Data were coded and entered using the statistical package SPSS (Statistical Package for the Social Sciences) version 28 (IBM Corp., Armonk, NY, USA). Data was summarized using mean, standard deviation, median, minimum and maximumin quantitative data and using frequency (count) and relative frequency (percentage) for categorical data. Standard diagnostic indices including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic efficacy were calculated as described by ***Galen,*[(13)]**. ROC curve was constructed with area under curve analysis performed to detect best cutoff value of elastography for detection of malignancy. Comparisons between quantitative variables were done using the non-parametric Mann-Whitney test [(14)]. For comparing categorical data, Chi-square ($\chi 2$) test was performed. Exact test was used instead when the expected frequency is less than 5[(15)]. Kappa test was used to evaluate agreement between two diagnostic methods, P value less than 0.05 was considered as statistically significant.

RESULTS:

Our study was a prospective research work that included 40 patients. Ultrasound Elastography was performed in combination with conventional breast ultrasound for all of them at the Radiology Department, Womenimaging unit referred from breast surgery clinic and outpatient clinic at Ain-Shams University (Demerdash) hospital.

Table (1): Symptoms distribution of the patients participating in this study.

Symptom (n=40)	N (%)
Diffuse breast swelling	32 (80.0%)
Breast lump	27 (67.5%)
Breast redness	37 (92.5%)
Breast pain	40 100.0%)

All the examined patients (100%) complained from mastalgia. Twenty seven patients (67.5%) presented with a breast lump. Thirty two patients (80%) presented with diffuse breast swelling. Thirty seven patients (92.5%) gave history of breast redness (Table 2).

Table (2): Shows skin thickening regarding the final diagnosis.

	Final diagnosis										
	Malignant					Benign					P value
	Mean	SD	Median	Mini.	Maxi.	Mean	SD	Median	Mini.	Maxi.	
Skin thickness in mm (US)	7.96	2.32	7.00	5.90	14.00	3.59	2.32	4.00	1.20	11.90	< 0.001

Skin thickness of the examined malignant cases ranged between 5.9 and 14mm with mean ±SD of 7.96±2.32, while for benign cases ranged between 1.2 and 11.9 with mean±SD of 3.59±2.32 (Table 2).

Table (3): US breast finding according to final diagnosis of the patients participating in this study

		Final diagnosis				
		Malignant (n=5)		Benign (n=35)		P value
		Count	%	Count	%	
Doppler application (US)	Normal	0	0.0%	7	20.0%	0.565
	Hypervascular	5	100.0%	28	80.0%	
Echogenic fat lobules (US)	Echogenic	5	100.0%	33	94.3%	1
	Absent	0	0.0%	2	5.7%	
Interstitial edema	Present	5	100.0%	34	97.14%	1
	Abscent	0	0.0%	1	2.86%	
lactiferous ducts (US)	Dilated	0	0.0%	8	22.9%	0.563
	Normal	5	100.0%	27	77.1%	
Parenchymal distortion (US)	Present	3	60.0%	8	22.9%	0.117
	Absent	2	40.0%	27	77.1%	
Ill defined collections (US)	Present	3	60.0%	12	34.3%	0.345
	Absent	2	40.0%	23	65.7%	

Most of our patients had echogenic fat lobules (all malignant cases and 94.3% of benign cases), and interstitial edema (all malignant cases and 97.14% of benign cases) (Table 3).

Table (4): Diagnosis of patients according to U/S descriptors of breast masses.

		Final diagnosis				
		Malignant		Benign		P value
		Count	%	Count	%	
Mass (US)	Present	5	100.0%	22	62.9%	0.154
	Absent	0	0.0%	13	37.1%	
Shape of mass (US)	No mass	0	0.0%	13	37.1%	0.058
	Oval	0	0.0%	5	14.3%	
	Lobulated	1	20.0%	2	5.7%	
	Irregular(speculated)	4	80.0%	9	25.7%	
	Rounded	0	0.0%	6	17.1%	
Margin of mass (US)	No mass	0	0.0%	13	37.1%	0.066
	Well defined	1	20.0%	13	37.1%	
	Ill defined	4	80.0%	9	25.7%	
Echopattern (US)	No mass	0	0.0%	13	37.1%	0.082
	Hypoechoic	5	100.0%	12	34.3%	
	Heterogenous	0	0.0%	6	17.1%	
	Complex cystic and solid	0	0.0%	4	11.4%	

This table showed twenty seven patients (67.5%) showed a breast mass while thirteen patients (32.5%) had no masses on ultrasound. Out of 27 patients, 22 patients

were diagnosed benign in nature while 5patients were diagnosed malignant in nature. Regarding shape and margin; Out of evaluable 27 patients, 13 patients (32.5%) showed irregular mass with ill-defined margin, 4 of them diagnosed malignant by histopathology. Regarding echogenicity, 17 patients showed hypoechoic mass, five of them finally diagnosed as malignant (Table 4)**.**

Table (5): Description of LNs according to the final diagnosis.

		Final diagnosis				
		Malignant		Benign		P value
		Count	%	Count	%	
LNs	Absent	0	0.0%	6	17.1%	< 0.001
	Non specific	0	0.0%	22	62.9%	
	Indeterminate	0	0.0%	7	20.0%	
	Suspicious (malignant)	5	100.0%	0	0.0%	
Shape	Oval	0	0.0%	28	96.6%	< 0.001
	Rounded	5	100.0%	1	3.4%	
Fatty hilum	Preserved	0	0.0%	23	79.3%	0.002
	Effaced	5	100.0%	6	20.7%	

Thirty four patients (85%) presented with lymph node on US, twenty twoofthem (64.7%) showed nonspecific LNs, seven patients (20.5%) showed indeterminate LNs (were benign on follow up) and five patient (14.7%) showed malignant looking LNs (proved to be malignant by histopathology) (Table 5).

Shape: Out of 34 evaluable patients, 6 patients (17.6%) had rounded LN, one of them was benign and the other 5 patient were malignant (Table 6).

Fatty hilum: Out of 34 evaluable patients, 11 patients (32.4%) presented with effaced fatty hilum and five of them finally diagnosed malignant (Table 6).

Table (6): Accuracy of conventional ultrasound

Statistic	Value	95% CI
Sensitivity	100.00%	47.82% to 100.00%
Specificity	77.14%	59.86% to 89.58%
Positive Predictive Value	38.46%	25.38% to 53.46%
Negative Predictive Value	100.00%	
Accuracy	80.00%	64.35% to 90.95%

The calculated sensitivity of conventional US was 100%, specifity was 77.14%, and the total accuracy was 80%. The PPV and NPV were 38.46%, and 100% respectively (Table 6).

Table (7): Accuracy of Elastography.

Statistic	Value	95% CI
Sensitivity	100.00%	47.82% to 100.00%
Specificity	82.86%	66.35% to 93.44%
Positive Predictive Value	45.45%	28.69% to 63.32%
Negative Predictive Value	100.00%	
Accuracy	85.00%	70.16% to 94.29%

The calculated sensitivity of Elastography was 100%, specifity was 82.86%, and the total accuracy was 85%. The PPV and NPV were 45.45%, and 100% respectively (Table 7).

Table (8): Diagnostic performance of the conventional US and US Elastography: 5-point scoring (E-Score) and Strain Ratio methods.

Method	Sensitivity	Specificity	Accuracy	PPV	NPV
Conventional US	100%	77,14%	80%	38.46%	100%
Elastography (E-Score and Strain ratio)	100%	82.86%	85 %	45.45%	100%
Combined US and Elastography	100%	81.8%	84.2%	45.5%	100%

After exclusion of two cases with difference between BIRADs and elasto-graphy, regarding the remaining 38 patients, 27 lesions of them (71.05%) were diagnosed as benign by combined US/Elastography, all of which turned out to be benign by pathology (100%; true negative = Sensitivity). Eleven patients (28.95%) were diagnosed as malignant by US/Elastography, 5/11 (45.5%; true positive) were diagnosed with malignant pathology, while the remaining 6/11 patients were diagnosed as benign by pathology.

The calculated sensitivity of CombinedUS/Elastography was 100%, specifity was 81.8%, and the total accuracy was 84.2%. The PPV and NPV were 45.5%, and 100% respectively **(Table 8)**.

Case 1

Clinical background: A 28 year old female patient, presented with left breast enlargement and reedness with palpated lump and mastalgia for 3weeks in duration with no response to antibiotic therapy.

Elastography revealed :

1- Qualitative Elastography revealed:
The E score was 4.

2- Quantitative Elastography revealed:
The yielded SR was 4.7

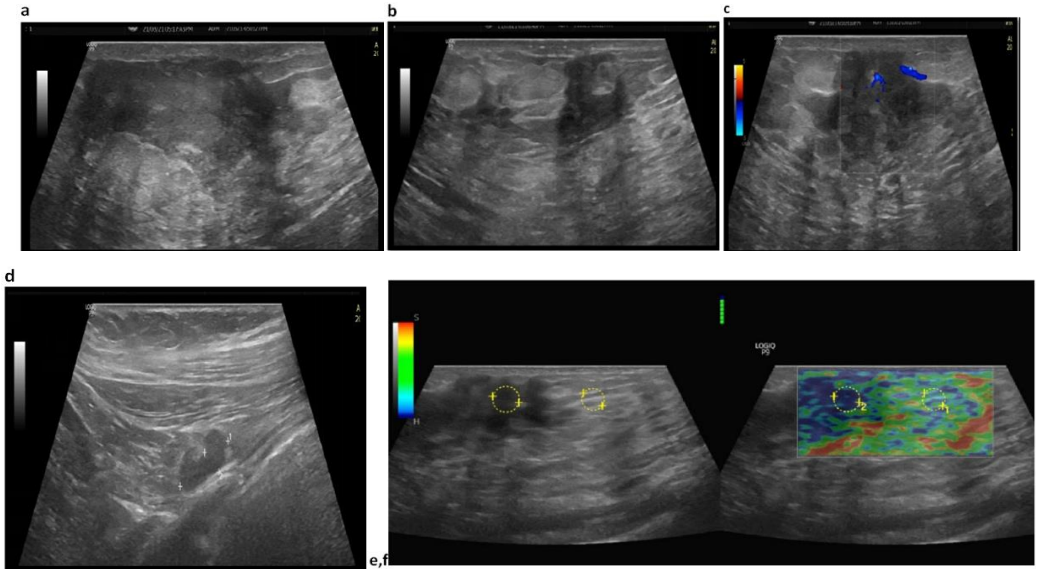

Figure1: (a) (b) Left breast showed diffuse edema with large illdefinedhypoechoicretroareolar lesion with echogenic fat lobules and intercommunicating collections associated with diffuse mild skin thickening measuring 6mm. (c) On color Doppler shows increase vascularity. (d) Left axillary lymph nodes are seen enlarged with one showing cortical thickening reaching 5mm with relatively effaced fatty hilum. (e) Left breast quantitative elastography SR 4.7. (f) Left breast qualitative elastographyEscore 4.

Diagnosis: Suspicious left breast lesion associated with inflammatory process **(BIRADS IV).** *US guided core needle biopsy* was done after non resolution by long course of antibiotic therapy showed Granulomatis mastitis. B-mode US,

qualitative and quantitative elastography suggested suspicious process which was discordant with histopathology results which revealed granulomatious mastitis.

Case 2

Clinical background: A 52 years old female, presented with left breast diffuse swelling with palpated mass at upper outer quadrant associated with diffuse skin redness and severe mastalgia of a month duration that did not respond to medical treatment.

Elastographyrevealed:

1- Qualitative Elastography revealed:
The E-score was 4.

2- Quantitative Elastography revealed:
The yielded SR was 6.

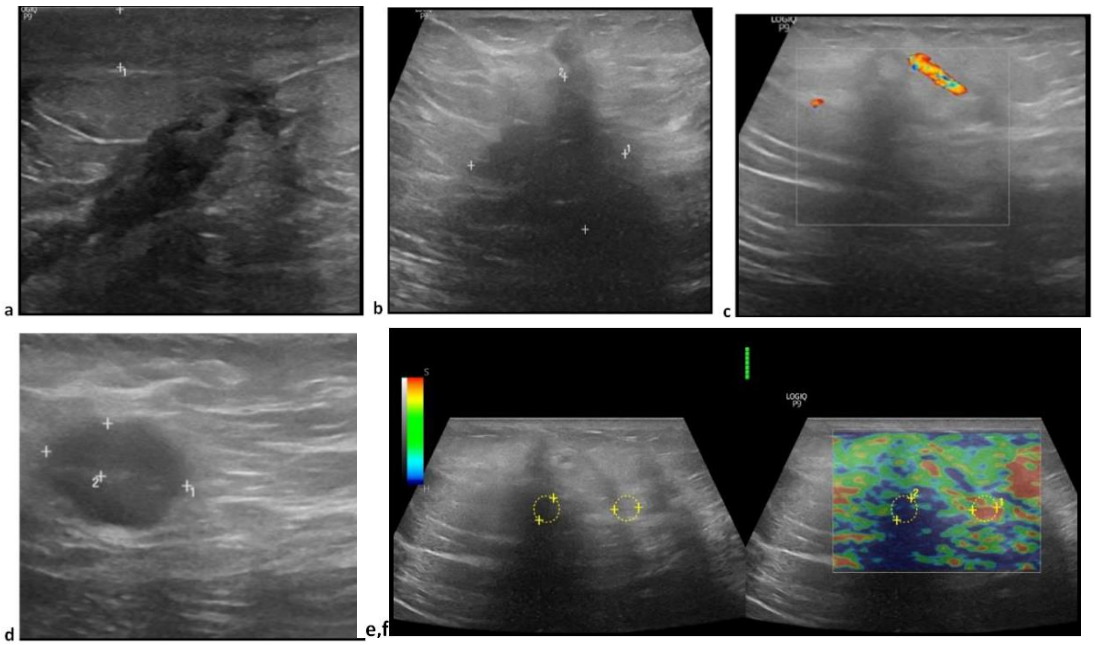

Figure2: (a) Left breast diffuse increased skin thickness associated with subcutaneous and interstitial edema and echogenic fat lobule. (b) Leftilldefined speculated hypoechoic lesion posterior shadowing. (c) On color Doppler shows increase vascularity. (d) Left axilla shows suspicious looking lymph nodes globular in shaped with effaced central fatty hilum. (e) Left breast quantitative elastography shows SR 6. (f) Left breast qualitative elastography shows E score 4.

Diagnosis: Left breast malignant lesion with surrounding inflammatory changes (Inflammatory carcinoma) with ipsilateral suspicious looking axillary lymphadeno-pathy **(BIRADS V)**. *US guided needle biopsy* was done and yielded invasive duct carcinoma grade II. Qualitative & Quantitative elastography confirmed the data supplied by the conventional US and were concordant with histopathology results.

DISCUSSION:

Mastitis is inflammation of the breast which is very common condition that can be infectious or noninfectious inflammation. It can occur in all population at any age and whether or not breastfeeding. The reported incidence varies from a few to 20% of all women within 6 months period after delivery [(16)] and in other studies up to 33% of lactating women, and less than 10% in non lactating ones. Till now there is a dilemma and challenge to distinguish acute mastitis from malignancy, especially from inflammatory breast carcinoma (IBC), by clinical or imaging features[(1)].

Conventional ultrasound (US) is an interactive, dynamic modality that proved to play a decisive role in the diagnostic pathways using the standardized (BI-RADS) lexicon**.** As

Subtle irregular or indistinct margins, artifacts, and architectural distortions may be difficult to capture on static images[17].

In the Current study we evaluated 40 female patients with inflammatory breast disorders. Their age ranged from 23 to 53 years with mean ± SD 37.25 ± 8.72**.** All patients underwent diagnostic Ultrasound and Elastography (Quantitative & Qualitative) assessment in AIN-shams university hospitals.

In our study, five patients (12.5%) were diagnosed as malignant disease (all of them had IDC) and 35 were diagnosed as benign cases (25.7% of them had a breast abscess). Eleven of 35 patients with benign lesions (31.4%) in our study underwent complete resolution with antibiotic treatment but the remaining 24 patients (68.57%) that didn't respond to antibiotics or lesions with BIRADS IV were diagnosed either histologically by means of true cut biopsy or fine needle aspiration cytology**.**

Regarding the US findings of mastitis in the form of echogenic fat lobules, interstitial edema, ill-defined collection, also hypervascularity by Doppler showed no significant difference between benign and malignant lesions with P-value more than 0.05 yet skin thickness shows significant difference with P- value less than 0.001.

Both ***Kamal et al.,***[18] and ***El-Naggar et al.*** [1] were similar to our study in the significant difference regarding the skin thickness. They showed that thickened skin was significantly higher in malignant than in benign inflammatory cases.

Regarding the ultrasound descriptors of lesions with breast masses, twenty seven patients (67.5%) showed a breast mass while thirteen patients (32.5%) show no masses on ultrasound. Out of 27 patients, 22 patients were diagnosed benign in nature while 5patients were diagnosed malignant in nature. We found that there was no significant difference between benign and malignant cases of mastitis regarding the shape, margin and echogenicty of mass lesions with Pvalue slightly more than 0.05.

In concordant to our study, the study done by ***Kamal et al.***[18] and ***El-Naggar et al.***[1]**,** as they reported alot of the examined inflammatory disorders shows no masses with significant difference between examined benign and malignant masses. Our study included 37.1% of cases that had no masses with the majority of cases had mass lesions (62.9%). Also, this inconcordance could be attributed that cases diagnosed as fat necrosis by histopathology showed irregular hypoechoic lesion with speculated margin as that of the malignant lesions.

Other study conducted by ***El-Naggar et al.,***[1]**,** proved that the presence of pathological axillary lymph nodes with prominent cortices and muffled hila was strongly indicative of a malignant pathology and there was asignificant difference in LNs between benign and malignant cases.

Similar to our study, the study done by ***Hamed et al.,*** [10]**,** their study included 33 female patients with inflammatory breast diseases. Their study showed that the 27/33 (81.8%) patients showed BIRADS II/III (benign). The remaining 6/33 (18.2%) had BIRADS IV/V (malignant). All patients with BIRADS II/III had benign final diagnosis (100% NPV). And patients with malignant pathology had BIRADS IV/V (sensitivity=100%). Four patients; 2 patients with granulomatous mastitis, one patient with fat necrosis and one patient with breast abscess were classified by US as BIRADS IV (false positive). The specificity and accuracy of US were 87% and 81.8% respectively.

Regarding the study of ***Solyman et al.*** [4] *showed that out of examined 46 breast lesions* when considering US BIRADS categories of 3 as benign and that of 4 as malignant. There were 26 /46 (56.5%) cases diagnosed as benign by conventional US, 20/26 (77%) of them were benign (true negative) by pathology, and 6/26 (23%) were malignant by

pathology (false negative). On the other hand 20/46 (43.5%) lesions were diagnosed as malignant by US, out of which 16/20 (80%) lesions confirmed to be malignant by pathology (true positive) and 4/20 (20%) lesion were benign by pathology (false positive) regarding sensitivity of conventional US it was 72.73%, 83.33% specificity, 80% PPV and 76.9% NPV.

Using a strain ratio of 4.05 as cut-off value, our result showed that the 29/40 (72.5%) patients had a strain ratio below 4.05. The remaining 11/40 (27.5%) were above 4.05 (malignant). All patients with strain ratio below 4.05 had benign final diagnosis (100% NPV). Five patients with malignant pathology had strain ratio >4.05 (sensitivity=100%). The remaining six patients, 4 of them withfat necrosis and 2 with granulomatous mastitis had strain ratio >4.05 (false positive). The specificity and accuracy of quantitative elastography were 82.86% and 85% respectively.

Other studies performed by ***Solyman et al.,***[4] showed also that Strain ratio values had raised the sensitivity and specificity of the elastography beyond the B-mode up to 98.4% and 85.68% compared to 72.73% and 83.33%, respectively.

Also ***Liu et al.***[19] results showed that with strain ratio cut of value 4.15, strain ratio value had raised the sensitivity and accuracy of elastography more than the B-mode up to 92.2% and 86.1% compared to 87% and 81.9% respectively yet the specificity is lower than the B-mode**.**

On the other hand the study done by ***Hamed et al.,***[10]**,** showed that the quantitative elastography (strain ratio) with cut off value 3.85 had the same sensitivity, specificity and accuracy as US; 100%, 87% and 81.8% respectively.

Our study showed lower PPV as our study only includes five patients with malignant disease.

Our results are similar to those reported by ***Hamed et al.,***[10] which showed that ultrasound breast elastography was more specific and more accurate than conventional ultrasound. Sensitivity, specificity, and accuracy were 100%, 90.3% and 90.9% respectively, for elastography, 100%, 87%, and 81.8%, respectively, for conventional ultrasound.

Also Our results are similar to those reported by ***Leong et al.***[3] which showed that ultrasound breast elastography was more specific and more accurate than conventional ultrasound. Sensitivity, specificity, and accuracy were 88.5%, 42.9% and 53.6%, respectively, for conventional ultrasound, 100%, 73.8%, and 80%, respectively, for elastography. They stated that combining elastography with ultrasound improved its specificity and accuracy and it can potentially reduce unnecessary breast biopsies**.**

On the other hand**,** results showed that Qualitative Elastography was more sensitive than conventional ultrasound in the evaluation of the study lesions (92.3%), yet regarding its specificity and accuracy it had shown lower values of 74.1% and 81.4% respectively**.**

Also ***Solyman et al.,*** [4] *results showed that* qualitative elastography was less sensitive comparing to conventional ultrasound with value of 65.45% comparing to 72.73% yet both have the same specificity**.**

In our study, regarding cases of infectious mastitis with/without abscess formation was found to have an elastographic appearance of a soft central area (abscess) and a stiffer outer rim (edema and inflammation) corresponding to E score mostly take score 2 and with strain ratio ranging from 0.8 to 2.7.

Regarding malignant cases in our study, there was five cases that diagnosed Invasive duct carcinoma all showed E-score 4 and strain ratio above the cut off value >4.05 (malignant).

Results in showed that seven cases of infectious mastitis had E score ranging from 2-3, while the six cases of non infectious mastitis had E score ranging from 2-4, two were

granulomatous mastitis with E score 4 and four cases of fat necrosis of E score ranged from 2-3**.**

Results in ***Hamed et al.*** [10], showed that seventeen cases of infectious mastitis had E score ranging from 1-3 and with strain ratio ranging from 0.2 to 3.4 while fourteen cases of non infectious mastitis has E score ranging from 1-4 of which there was three cases with E score 4, two were fat necrosis and one was granulomatis mastitis. As for Strain ratio it ranged from 0.4 to 10 of which there were 4 cases with strain ratio above the cut off value 3.84, all of the 4 turned out to be fat necrosis on pathology.

Many studies like in ***Yağcı et al.,***[6] showed low elastography score and strain value regarding the granulomatious mastitis comparing to the malignant breast lesions as we proved in our study as only two patient with granulomatious mastitis shows high E score or strain ratio.

Our results showed a very good agreement between US and both qualitative and quantitative elastography Only 2 patients showed different results between US and both elastography both classified as malignant by US and benign by both qualitative and quantitative elastography with E score 2 and strain ratio 2, 1.5. After revision of pathology, both lesions turned out to be benign.

Our results were concordant with the findings of other researchers like in ***Liu et al.,***[19]***; Solyman et al.,***[4] ***; Sinha et al.,***[5]***; Hamed et al.***[10] proved that Elastography improves the diagnostic reliability of ultrasonography, increases specificity and allows better differentiation between benign and malignant findings, particularly in BIRADS- 3 and 4 lesions . Therefore, the number of false-positive findings in breast diagnostics was reduced by using Elastography.

Also had stated that ultrasound elastography was superior in detecting breast cancer, since the accuracy (95.8%), sensitivity (98.6%), specificity (96.0%), and positive predictive values (94.5%) were higher than those of B mode sonography (90.6%, 91.4%, 90.0% and 86.5%, respectively)with final conclusion of that ultrasound elastography is superior to B mode sonography in assessing the nature of breast lesions.

Conclusion:

US Elastography play an important role in distinguish benign and malignant inflammatory lesions. This by considering the lesion stiffness. The elastography is better to be done by both qualitative and quantitative method. Our results were concordant with the findings of other researchers that elastography combined with conventional ultrasound potentially increases our level of confidence regarding the final assessment of the breast lesions and helps avoiding the unnecessary benign biopsies and confirm the decision of biopsy in other suspicious inflammatory lesions.

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دور التصوير بالموجات فوق الصوتية elastography في تقييم آفات الثدي الالتهابية

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1 قسم الأشعة التشخيصية بمعهد السكر القومي 2 قسم الأشعة التشخيصية بطب عين شمس

المقدمة: يجب ان يتم التفريق بين حالات الثدي الالتهابية الخبيثة و الحميدة عن بعضها البعض حيث انها تختلف عن بعضها البعض في التنبؤات وطرق العلاج. من الممكن استخدام الموجات الفوق الصوتية المرنة مع الموجات الصوتية العادية و ذلك لتقييم حالات افات الثدي الالتهابية. التصوير الالستوجرافي الانفعالي يساعد في تقييم الافات الالتهابية الخبيثة للثدى لتجنب الخزع الغير ضرورية من الافات الالتهابية الحميدة.

الهدف من البحث: هو تقييم الاداء التشخيصي للتصوير الالستوجرافي الانفعالي مضافة الي الموجات الفوق الصوتية العادية في تقييم افات الثدى الالتهابية.

المرضي وطرق البحث: تتضمن هذه الدراسة 40 سيدة مصابة بالتهابات الثدي. جميع افات الثدي الالتهابية قد تم تقييمها عن طريقة التصوير بالموجات الصوتية العادية و التصوير الالستوجرافي الانفعالي و قد تم تقسيم المجموعات باللون النوعي المشفر و التهديف و النصف كمي و تم تقييم صور الموجات الصوتية المرنة. قد تم مقارنة النتائج علي اساس التشخيص النسيجي او متابعة المرضي بعد تلقي العلاج المناسب.

النتائج: هذه الدراسة اظهرت ان استخدام الموجات الصوتية العادية و الموجات الصوتية المرنة معا دقة بنسبة 84.2 % ونوعية بنسبة 81.8% بالمقارنة باستخدام الموجات الصوتية العادية فقط و التي اظهرت دقة بنسبة 80% و نوعية بنسبة 77.1%.

الاستنتاج: بواسطة تقييم صلابة الانسجة قد توصلنا الي ان الموجات الصوتية المرنة تقوم بدور محوري في التفريق بين الافات الالتهابيه الحميدة و الخبيثة.