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Value of Ultrasound Elastography in Combined with Mammography in Evaluation of Indeterminate Breast Lesions

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Abstract

Background: Breast cancer is both the most commonly identified life-threatening cancer in women and the top cause of cancer mortality in women worldwide. The best line of protection against breast cancer is still an early diagnosis. Examples of screening methods are as follows: Self-examination, the clinical inspection, and mammography altogether with Ultra-sonography. Aim of the work: The aim of the work is to evaluate the role of breast elasto-graphy combined with mammography as a diagnostic method in indeterminate breast lesions. Patient and methods: This prospective cohort study was conducted upon 50 female patients with breast mass/masses at Radiology Department of Tanta Cancer Center referred from Surgery Department & early detection unit. The present study demonstrated in correlation with other studies that breast ultrasound elastrography is sensitive in diagnosis of indeterminate breast lesions however not reliable without other modalities. Results: The overall sensitivity of breast elasto-graphy in diagnosis of indeterminate breast lesions was about 66%.Conclusion:Elastography substantially improves the US capability in differentiating benign from malignant breast lesions, thus reducing the number of breast biopsies in benign nodule. Elastography is a useful complementary tool for undetermined breast lesions but cannot avoid fine needle aspiration or core biopsy if ultrasound features are clearly suspicious.

Keywords: Breast Lesions, Elasto-Graphy and Ultrasound.

1. Introduction

Breast cancer is both the most commonly identified life-threatening cancer in women and the top cause of cancer mortality in women worldwide. The best line of protection against breast cancer is still an early diagnosis. Examples of screening methods are as follows: Self-examination, the clinical inspection, and mammography altogether with Ultra-sonography [1].

The results of breast imaging procedures [mammography, ultrasound, and magnetic resonance imaging; MRI] are described using a standardized vocabulary created by the American College of Radiography [ACR] called BI-RADS. Imaging has been given a prominent position in the diagnostic strategy by virtue of a 7-level positive predictive value [PPV] of malignancy categorization scheme based on this nomenclature [ranging from BI-RADS category 0 to category 6]. Mammography is the benchmark for breast imaging, but it isn't the best screening instrument, particularly for women who have dense breast parenchyma. Its accuracy is between 69% and 90% even when carried out perfectly [3].

Indeterminate breast lesions are considered to be breast lesions falling in-between BIRADS III & BIRADS IV [4].

The abbreviation BI-RADS stands for the Breast Imaging-Reporting and Data System, a quality assurance instrument developed specifically for mammography. For this reason, women with dense breast tissue are ideal candidates for monitoring with breast ultrasound because it has a greater sensitivity for spotting breast cancer [6]. Elastography is an emerging noninvasive imaging method that employs ultrasound [US] to measure muscle rigidity. Reviewers may come to different conclusions about the meaning of similar elastographic pictures. Because breast lesions are typically recorded using the ACR Breast Imaging and Data System [BI-RADS] lexicons and final category, we attempted to evaluate observer difference between lexicons and final classification of US BI-RADS and the elasticity score of US elastography [7].

Breast biopsies in innocuous lumps can be avoided thanks to elastography, which greatly enhances the US's ability to distinguish between benign and malignant breast tumors [8].

Elastography is a useful complementary tool for undetermined breast lesions but cannot avoid fine needle aspiration or core biopsy if ultrasound features are clearly suspicious [9].

2. Patients and Methods

This prospective cohort study was conducted upon 50 female patients with breast mass/masses at Radiology Department of Tanta Cancer Center referred from Surgery Department& early detection unit at period from July 2020 to January 2022 .

Criteria of patient selection

Inclusion criteria

Female patients with solid indeterminate breast lesion [BIRADS 3&4 A] diagnosed by mammography & complementary ultrasound.

Exclusion criteria

- Breast lesions proved to be cystic in nature by ultrasound
- Pregnancy.
- Lactation: the exam will be postponed till 6 months after cessation of lactation.
- Painful breast conditions.

All patients were subjected to the followings

Clinical evaluation

- Complete history and physical examination.
- Local examination: including breast and axillae.

Diagnostic work up

All patients were subjected to radiological and imagining studies as follows:

- Mammography.
- B-mode breast ultra-sonography.
- Breast sonoelastagraphy.
- Pathological analysis.

Mammographic examinations

While most cases only required the usual cranio-caudal and medio-lateral oblique projections of each breast, some cases needed extra views.

B-mode ultrasonography

Equipment

Conventional US was performed by using Toshiba Aplio500 ultrasound systems, with a 7.5 MHz superficial liner small parts transducer. Neither traditional US nor elastography resulted in any unwanted side effects for any of the participants in this research.

Imaging methods

First, the standard ultrasound pictures of the breast were taken. We got B-mode images as part of our standard evaluation. The extent of a lesion was determined by measuring its circumference using B-mode ultrasound.

On B-mode images, bulbous or fatty-appearing lesions were disqualified.

Breast Imaging, Reporting, and Data System [BI-RADS] standards for US were used to categorise the identified lesions.

It was determined that lesions were likely innocuous if they exhibited characteristics such as an ovoid or round form, parallel alignment to the epidermis, a confined border, and an abrupt interface to the normal parenchyma [BI-RADS category 3].

Malignant characteristics include an atypical appearance [an irregular form, an asymmetrical alignment, an undefined border], a dense echogenic halo, complex echotexture, a posterior auditory shadowing or combined pattern, and the presence of microcalcifications. It was considered suspect for malignancy if it met even a single malignant condition [BI-RADS category 4]. It was considered extremely suspect for malignancy if multiple criteria were met [BI-RADS category 5].

The statistical analysis did not take into account the existence of BI-RADS US-specific exceptions, such as masses under or on the skin, foreign bodies, and the presence or absence of lymph nodes.

Elastography

Under the close watch of an experienced radiologist, we then acquired elasticity pictures of the patient lying supine and perpendicular to the chest wall. A breast probe was used to capture elasticity pictures by being placed on the breast and shifted slightly inferior and superior.

Our definition of light pressure was enough to keep the probe in touch with the skin and create imaging circumstances in which the relationship between pressure and strain was basically proportional.

The pectoral muscles and subcutaneous fat were included in the region of interest [ROI] for getting elasticity images, and the side boundaries of the ROI were chosen to be more than 5 millimetres from the limit of the lesion. It was important to make sure that the region of interest [ROI] included enough of the nearby breast tissues because the strain ratio displays elasticity in typical breast tissue in relation to the average strain inside the ROI.

Based on the strain value, we gave each elasticity picture pixel one of 256 distinct hues. Components under the most stress [red] were rated as delicate, while those under no stress [blue] were rated as strong [i.e., hardest components]. The average stretch in the ROI was represented by the colour green.

Using a suggested five-point measure, we analysed the colour pattern within the identified lesions to categorise elasticity pictures [10]

- For the complete hypoechoic lesion, a value of 1 showed even strain [i.e., the entire lesion was evenly shaded in green].
- The majority of the tumour showed strain with a value of 2, while some spots showed no strain at all [i.e., the lesion had a mosaic pattern of green and blue].
- A score of 3 showed that the hypoechoic lesion was strained only around its edges, while its interior remained unaffected [i.e., the peripheral part of lesion was green, and the central part was blue].
- A total hypoechoic lesion value of 4 showed no strain [i.e., the entire lesion was blue, but its surrounding area was not included].
- There was no stress in the complete hypoechoic tumour and its surroundings at score 5. [i.e., both the entire hypoechoic lesion and its surrounding area were blue].

The strain ratio [SR] was calculated by first hand drawing a region of interest [ROI] [A] for the lesion's strain that was circumscribed by the mass's interior margin. To counteract stress loss with depth, the second ROI [B] for the fat strain was positioned as deep as feasible in the fat tissue. It was determined that the fat tissue encoded in green best reflected middle stiffness in the region, so this is where the second ROI for the fat strain was put. In order to determine the mass rigidity, the ultrasound machine's software computed the strain index, which is the ratio of the strain in fat to that in mass [B/A].

Final assessment category of combined B-mode U/S, and ultrasound elastography

Lastly, a scoring system for malignancy risk based on a combination of B-mode U/S and Ultrasound Elastography was developed.

When an elasticity number of 0–2 is attained, the probability of malignancy group drops from BIRADS 4 or 5 [biopsy suggestion] to BIRADS 3 [follow-up recommendation].

With an elastic value of 4 or 5, the probability of malignancy category is upgraded from BIRADS 3 [follow-up suggestion] to BIRADS 4 or 5 [biopsy recommendation].

Histopathological diagnosis [golden standard]:

Histopathologic results of tru-cut and fine needle aspiration cytology [FNAC] under U/S guidance were used as a standard. For each tumour, we recorded the level of concordance between the MRI and histopathologic findings.

Before conducting the research, informed permission was acquired and approved by the Research and Ethical board.

3. Results

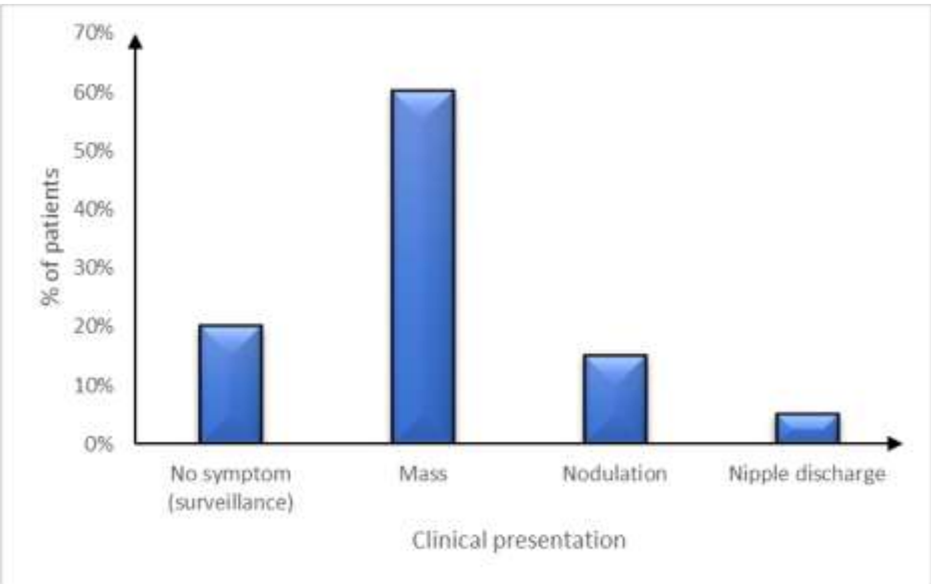
The data was analysed statistically with SPSS version 26. The data is provided in numerical and percentage form. Quantifiable measures of sensitivity, specificity, PPV, NPV, and accuracy were determined.

Distribution of studied cases according to clinical presentation

Regarding clinical presentation, it was no symptom [surveillance] in 10 [20%] patients, mass in 30 [60%] patients, nodulation in 8 [15%] patients and nipple discharge in 3 [5%] patients **Table (1).**

Table (1) Distribution of studied cases according to clinical presentation**.**

Symptoms	No.	%
-No symptom [surveillance]	10	20%
-Mass	30	60%
-Nodulation	8	15%
-Nipple discharge	3	5%
Total	50	100%

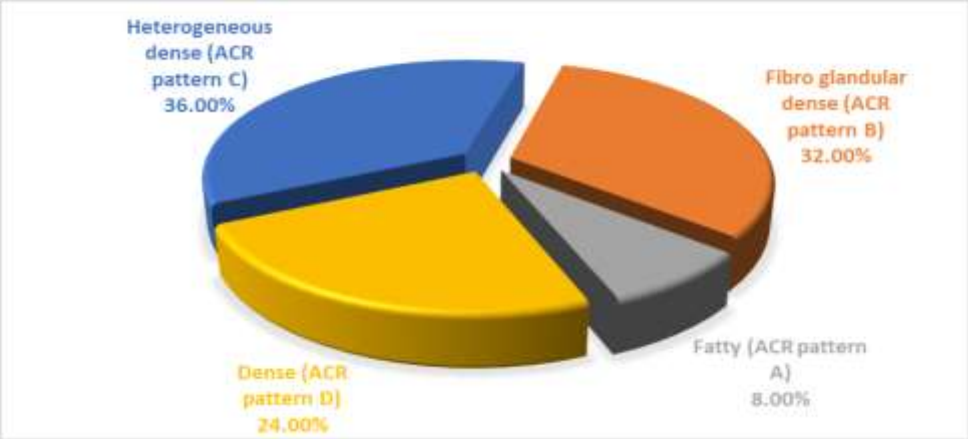


Bar chart (1) Distribution of studied cases according to clinical presentation

Distribution of studied cases according to breast density ACR

Breast density ACR was heterogeneous dense [ACR pattern C] in 18 [36%] patients, fibro glandular dense [ACR pattern B] in 16 [32%] patients, fatty [ACR pattern A] in 4 [8%] patients and dense [ACR pattern D] in 12 [24%] patients**.**

Pie chart (1).



Pie chart (1) Distribution of studied cases according to breast density ACR.

Mammographic finding of the studied cases

Shape was round in 6 [23%] patients, Oval in 15 [58%] patients and irregular in 5 [19%] patients. Margins were circumscribed in 6 [46%] patients and micro -lobulated in 7 [54%] patients.Associated features were calcifications in 6 [55%] patients, axillary adenopathy in 3 [27%] patients and architectural distortion in 2 [18%] patients**.**

Ultrasound findings of the studied cases

Lesions texture was 19 [36%] homogenous and 29 [58.3%] heterogeneous. Echogenicity was 21 [42%] hypoechoic and 29 [58%] hyperechoic. Halo-zone was present in 3 [6%] patients. Associated enlarged lymph nodes were 37 [74%] nonspecific, 10 [20%] reactive and 3[10%] suspicious.

Classification of studied cases according to the U/S BIRADS

U/S BIRADS classification of studied cases was [III] in 35 [82%] patients and [IVA] in 15 [18%] patients **Table (2).**

Table (2): Classification of studied cases according to the U/S BIRADS .

BIRADS	No.	%
-U/S BIRADS [III]	35	82%
-U/S BIRADS [IVA]	15	18%
Total	50	100%

Result of conventional US in the studied cases

There were 13/50 [26%] cases seems to be benign by conventional US, recorded true negative cases were 2/50 [4%] and 11/50 [22%] were falsely detected negative that were histologicalliy proved malignant. On the other hand 37/50 [68%] lesions were diagnosed as malignant by U/S, recorded true positive cases were 4/50 [8%] and falsely detected positive were 33/50 [66%] that were histologicalliy proved benign.Conventional US showed 66.67 % sensitivity, 75%. The PPV and NPV were 26.67% and 94.29 % respectivly. The total accuracy was 74% **Table (3).**

Table (3): Result of conventional US in the studied cases.

Result	N	%
True positive	4	8.0%
False positive	33	66.0%
False negative	11	22.0%
True negative	2	4.0%

Table (3) Continue	
Sensitivity	66.67%
Specificity	75.00%
Positive predictive value	26.67%
Negative predictive value	94.29%
Accuracy	74.00%

Distribution of studied cases according to elastoscoring.

Elastoscoring classification of studied cases at score <4 was 37 [74%] patients and at score ≥4 was 13 [26%] patients**.**

Distribution of studied cases according to elastoscoring

Elastoscore<4 there were 35 cases benign and 2 cases malignant and at score ≥4 there were 9 cases benign and 4 cases malignant. The elastoscoring score [≥4] was significantly higher for malignant lesions than for benign lesions [P < 0.015]. **Table (4)**

Table (4): Distribution of studied cases according to elastoscorin

Score	Group I benign No [%]	Group II malignant No [%]	Total	P value
<4	[35 [79.5%	[2 [33.3%	37	0.015*
≥4	[9 [20.5%	[4 [66.7%	13	
Total	44	6	50	

***:significant P value <0.05**

Final result of elastoscoring in the studied cases.

There were 11/50 [22%] cases seems to be benign by elasto scoring, recorded true negative cases were 2/50 [4%] and 9/50 [18%] were falsely detected negative that were histologicalliy proved malignant. On the other hand 39/50 [78%] lesions were diagnosed as malignant by elastography scoring, recorded true positive cases were , 4/50 [8%] and falsely detected positive were 35/50 [70%] that were histologicalliy proved benign.

Elastography scoring showed 66.67% sensitivity, 79.55% specifity. PPV and NPV were 30.77% and 94.59% respectivly, the total accuracy was 78% .

Table (5(4): Distribution of studied cases according **to** elastoscorin

Score	Group I benign No [%]	Group II malignant No [%]	Total	P value
<4	**[35 [79.5%**	**[2 [33.3%**	**37**	**0.015***
≥4	**[9 [20.5%**	**[4 [66.7%**	**13**	
Total	**44**	**6**	**50**	

***:significant P value <0.05**

Distribution of studied cases of according to strain ratio ≥2.7

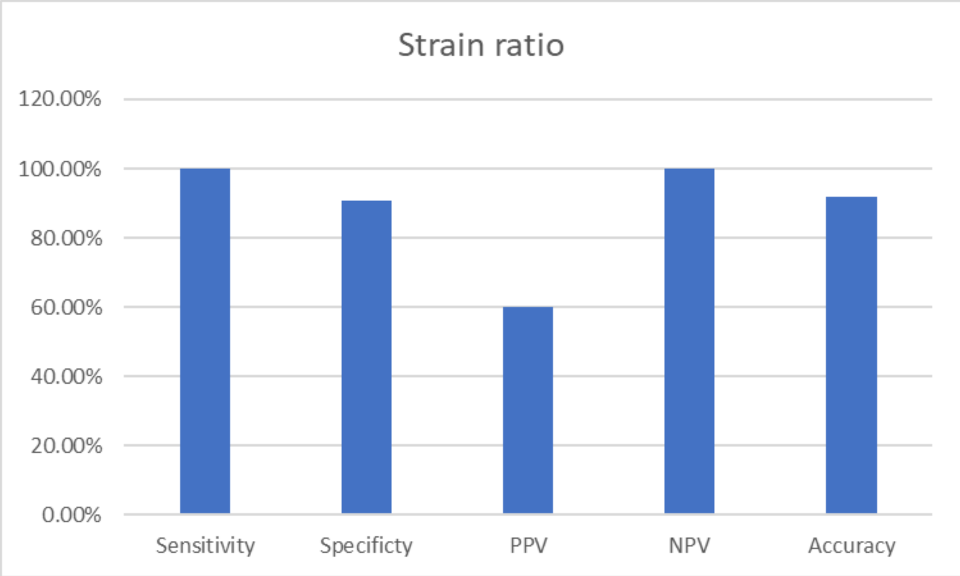
At strain ratio <2.7, there were 40 cases benign and 0 cases malignant and at ≥2.7 there were 4 cases benign and 6 cases malignant. The strain ratio [≥2.7] was significantly higher for malignant lesions than for benign lesions [P < 0.001].

Final result of strain ratio ≥2.7 of the studied cases

There were 4/50 [8%] cases seems to be benign by strain ratio, recorded true negative cases were 0/50 [0%] and 4/50 [8%] were falsely detected negative that were histologicalliy proved malignant. On the other hand 46/50 [92%] lesions were diagnosed as malignant by strain ratio, recorded true positive cases were 6/50 [12%] and falsely detected positive were 40/50 [80%] that were histologicalliy proved benign.

Strain ratio showed 100% sensitivity, 90.91% specifity, PPV and NPV were 60% and 100%

respectively and total accuracy was 92% **[Error! Reference source not found.; Bar chart (2).**



Bar chart (2) Final result of strain ratio ≥2.7 of the studied cases

Comparison between the BIRADS, elasticity score and strain ratio of the studied cases. Recorded true positive cases were 6 by strain ratio, 4 cases by elastoscoring, 4 [8%] in Conventional. False positive was 4 [8%] in strain ratio, 9 [18%] in elastoscoring, 11 [22%] in BIRADS. False negative was 0 [0%] in strain ratio, 2 [4%] in elastoscoring, 2 [4%] in BIRADS. True negative was 40 [80%] in strain ratio, 35 [70%] in elastoscoring, 33 [66%] in BIRADS.

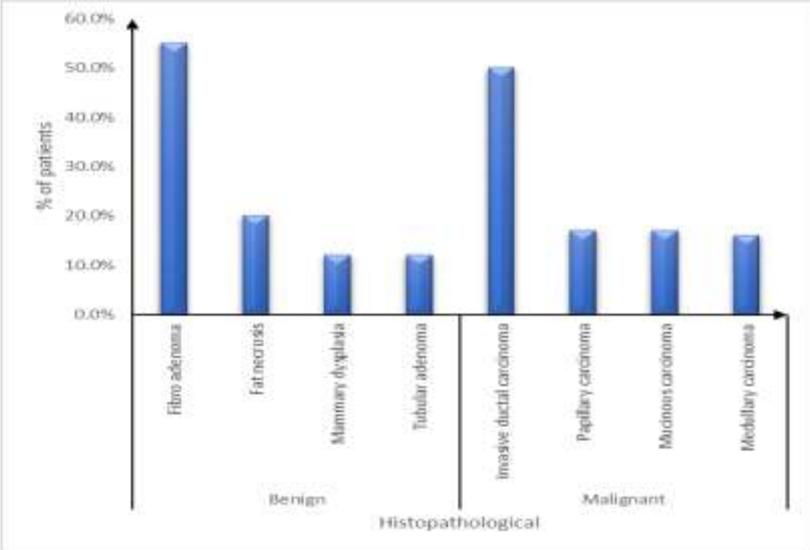
Sensitivity of strain ratio showed 100%, 66.67% of elasto scoring and 66.67% of BIRADS. Specificity of strain ratio showed 90.91%, 79.55% of elasto scoring and 75%of BIRADS. Positive predictive value of strain ratio was 60%, 30.77% of elasto scoring and 26.67% of BIRADS. Negative predictive value of strain ratio was 100%, 94.59% of elasto scoring and 94.29%of BIRADS. Accuracy of strain ratio was 92%, 78% of elasto scoring, 74%of BIRADS**.**

Distribution of studied cases according to histopathological classification

Regarding histopathological classification:Benign breast lesions were 24 [55%] fibro adenoma, 10 [20%] fat necrosis, 5 [12%] mammary dysplasia, 5 [12%] tubular adenoma. Malignant breast lesions were 3 [50%] invasive ductal carcinoma, 1 [17%] papillary carcinoma, 1 [17%] mucinous carcinoma and 1 [16%] medullary carcinoma**. Table (6, Bar chart 3)**.

Table (6) Distribution of studied cases according to histopathological classification [carcinoma. Table

Histopathology	NO	%
A] Benign breast lesions	44	88%
- **Fibro adenoma**	24	55%
- **Fat necrosis**	10	20%
- **Mammary dysplasia**	5	12%
- **Tubular adenoma**	5	12%
B] Malignant breast lesions	6	12%
- **Invasive ductal carcinoma**	3	50%
- **Papillary carcinoma**	1	17%
- **Mucinous carcinoma**	1	17%
- **Medullary carcinoma**	1	16%
Total NO.	50	100%



Bar chart (3) Histopathological classification of our study cases.

4. Discussion

In our study, we included fifty female patients presented with breast lesions. all lesions were subjected to 2-D ultrasound studies and 25 patients had performed mammography which was followed by elastographic evaluation, and scored according to [11] into one of the five elastoscoring categories, then strain ratio was calculated for each lesion and compared with the histological results after radical surgery, excisional, true cut biopsy, or fine needle aspiration cytology.[11]

The current study showed that, the age of the patients in this study ranged from 20 to 70 years with a mean value [± SD] of 44.7 [±11.3] years.

Our study showed regarding mammographic finding of the studied cases: Shape was rounded was found in 6 [23%] patients, oval in 15 [58%] patients and irregular in 5 [19%] patients. Margins were circumscribed in 6 [46%] patients and micro - lobulated in 7 [54%] patients. Associated features were calcifications in 6 [55%] patients, axillary adenopathy in 3 [27%] patients and architectural distortion in 2 [18%] patients.

According to **[12]** reported that, out of the total 100 cases mammography showed circumscribed margins in 80 cases, 14 had spiculated margins, 6 had indistinct margins. Out of the total 100 cases, mammography was able to detect calcifications in 8 cases**[12]**.

In our study, regarding ultrasonographic findings **in benign cases**: Shape was 10 [22.2%] rounded and 34 [77.8%] oval. Orientation was 37 [84.8%] parallel to skin and 7 [15.2%] not parallel to skin. The margin was 29 [66.6%] circumscribed and 15 [34.4%] indistinct. The lesion boundary was 39 [88.8%] abrupt interface and 5 [11.2%] anechoic halo The echo pattern was 7 [16.3%] hyperechoic, 34 [78.1%] hypoechoic and 3 [5.6%] isoechoic. Acoustic shadowing was present in 4 [14.2%] patients.

Regarding ultrasonographic findings **in malignant cases**: Shape was 1 [23.4%] rounded and 5 [76.6%] irregular. Orientation was 1 [5.7%] parallel to skin and 5 [94.3%] not parallel to skin. The margin was 1 [8.8%] angular, 2 [26.4%] micro-lobulated and 3 [64.8%] speculated. Lesion boundary was 6 [100%] hypoechoic. Posterior shadowing was 16 [56.7%].

Al-ShymaaZm , Mohamed DM[2018]have studied the shape of a solid breast mass and found that it is an important predictor to malignancy if irregularities is present but a rounded or oval tumor is inconclusive as about 85-86% of fibroadenomas and 29-42% of carcinoma were round or oval.[13]

MasciadriN , Ferranti C. [2011] reported that the characteristic sonographic findings of benign tumor include a round or oval, slightly hypoechoic with smooth borders or pseudo capsule, homogenous internal echoes, no central posterior acousting shadowing and normal surrounding tissue. The typical features of malignancy include irregular shape, irregular margins, hypoechogenicity, a surrounding echogenic rim or halo and posterior acoustic shadowing[14]

In our study, according to U/S BIRADS classification of studied cases was [III] in 35 [82%] patients and [IVA] in 15 [18%] patients.

Sonographic evaluation was 33 [75%] III, 11 [25%] IVA in benign cases and 2 [33.3%] III, 4 [66.7%] IVA in malignant cases. The sonographic evaluation [IVA] was significantly higher in malignant cases than in benign cases.

KeitebAS ,Ibraheem SA. [2019]reported that, Based on BI-RADS analysis of the standard B-mode ultrasound, 7 [14.3%] of the 49 benign lesions and 42 [85.7%] of the malignant breast lesions were classified as BI-RADS 2 and BI-

RADS 3, respectively, while 8 [25.8%] of the malignant breast lesions were classified as BI-RADS 4 and 23 [75.2%] were classified as BI-RADS 5. Chi-square analysis revealed a significant rise in BI-RADS categories among malignant patients [P 0.001] [15].

The current study showed that, there were 13/50 [26%] cases seems to be benign by conventional US, recorded true negative cases were 2/50 [4%] and 11/50 [22%] were falsely detected negative that were histologically proved malignant. On the other hand 37/50 [68%] lesions were diagnosed as malignant by U/S, recorded true positive cases were 4/50 [8%] and falsely detected positive were 33/50 [66%] that were histologically proved benign. Conventional US showed 66.67 % sensitivity, 75%. The PPV and NPV were 26.67% and 94.29 % respectively.The total accuracy was 74%.

Respectively according to the previous results, the calculated sensitivity of conventional U/S was 85.7 %, Specificity was 86.4%, and the total accuracy was 86 %. The PPV, and NPV were 88.9%, and 82.6 %. Our results compared with the study done by **[11]**which reported higher value for sensitivity [96.2%] and lower values for specificity [62.7%] than ours and accuracy was [78.4%] **[11]**. Also the study done by [16] showed higher value for sensitivity [98.2%] and much lower value for specificity [44.1%].

This study showed that, Elastoscoring classification of studied cases at score <4 was 37 [74%] patients and at score ≥4 was 13 [26%]patients.Elastoscore<4 there were 35 cases benign and 2 cases malignant and at score ≥4 there were 9 cases benign and 4 cases malignant. Theelastoscoring score [≥**4**] was significantly higher for malignant lesions than for **benign** lesions [P < 0.015].

Our results are identical to the study done by**[17]** theyreported that the mean elasticity scoring for benign lesions was [2] & for malignant breast lesions was [4].[17] However, the study done by**[18]** reported that the mean elastoscoring for benign lesions was [2] & for malignant lesions was [5][18]. The current study showed that, strain ratio classification of studied cases at ratio <2.7 there were 40 [80%] patients and at score ≥2.7 there were 10 [20%] patients.

At strain ratio <2.7, there were 40 cases benign and 0 cases malignant and at ≥2.7 there were 4 cases benign and 6 cases malignant. The strain ratio [≥2.7] was significantly higher for malignant lesions than for benign lesions [P < 0.001.[[

These findings are consistent with those found by [19], where the mean ratios for normal and malignant tumours were 2.7 and 10.5, respectively [19]. According to the literature [20], normal lesions have a mean strain ratio of 1.6 [SD = 1.0] and cancerous lesions have a mean strain ratio of 5.1 [SD = 4.2][20] .Our study revealed that, there were 4/50 [8%] cases seems to be benign by strain ratio, recorded true negative cases were 0/50 [0%] and 4/50 [8%] were falsely detected negative that were histologically proved malignant. On the other hand 46/50 [92%] lesions were diagnosed as malignant by strain ratio, recorded true positive cases were 6/50 [12%] and falsely detected positive were 40/50 [80%] that were histologically proved benign.

Strain ratio showed 100% sensitivity, 90.91% specifity, PPV and NPV were 60% and 100% respectively and total accuracy was 92%.

In agreement with the findings of [21]'s research of 559 solid lesions, we found that there was a statistically significant difference between the strain ratios of normal lesions [mean: 1.83] and malignant lesions [mean: 8.38] [P 0.001]. The SR method's sensitivity, specificity, and accuracy were all 91.4% when a limit value of 3.05 was used. In comparison to a five-point grading method using ultrasound elastography, diagnostic accuracy using strain ratio analysis was significantly higher [P < 0.05]**[21]**

Regarding histopathological classification: Benign breast lesions were 24 [55%] fibro adenoma, 10 [20%] fat necrosis, 5 [12%] mammary dysplasia, 5 [12%] tubular adenoma. Malignant breast lesions were 3 [50%] invasive ductal carcinoma, 1 [17%] papillary carcinoma, 1 [17%] mucinous carcinoma and 1 [16%] medullary carcinoma.

[22] reported that, fibro adenoma and fat necrosis were found in 10 [25.64%] and 2 [5.12%] respectively in their study. Infiltrating ductal carcinoma, Ductal carcinoma in situ, Inflammatory carcinoma and Medullary carcinoma were found in 4 [10.26%], 2 [5.12%], 1 [2.56%] and 1 [2.56%] respectively.[22]

5. Conclusion

Elastography substantially improves the US capability in differentiating benign from malignant breast lesions, thus reducing the number of breast biopsies in benign nodule. Elastography is a useful complementary tool for undetermined breast lesions but cannot avoid fine needle aspiration or core biopsy if ultrasound features are clearly suspicious.In conclusion, a combined approach using sonography, Elastography and mammography in evaluation of patients presenting with solid indeterminate breast lesions is better than individual modalities.

Conflict of interest: All authors declared that they have no conflict of interest.

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