International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 24s, 2025
https://www.theaspd.com/ijes.php

To Evaluate The Role Of Shear Wave Sonoelastography In Characterization Of Solid Breast Lesions And To Correlate With Histopathologic Findings

Dr. Neha Vinod Punjabi[1], Dr. Kaliaperumal V. G[2], Dr.Jenikar Paulraj[3], Dr. Charumati Vikram[4*], Dr. Remya[5]
[1]Junior Resident III, Department of Radiology, Shri Sathya Sai Medical College & Research Institute, Sri Balaji Vidyapeeth (Deemed-to-be University).
[2]Professor, Shri Sathya Sai Medical College & Research Institute, Sri Balaji Vidyapeeth (Deemed-to-be University).
[3]HOD & Professor, Shri Sathya Sai Medical College & Research Institute, Sri Balaji Vidyapeeth (Deemed-to-be University).
[4]Assistant Professor, Shri Sathya Sai Medical College & Research Institute, Sri Balaji Vidyapeeth (Deemed-to-be University).
[5]Assistant Professor, Shri Sathya Sai Medical College & Research Institute, Sri Balaji Vidyapeeth (Deemed-to-be University).

Abstract:
Background: *Sonoelastography is increasingly used in the evaluation of breast lesions in recent years. Sonoelastography is a novel technique that allows to categorizing grayscale images obtained in the B-mode US in color scales by elasticity level.*
Aim of the study *: To evaluate the role of shear wave sonoelastography in characterization of solid breast lesions and to correlate with histopathologic findings.*
Materials and methods*: A Cross-sectional study was conducted in the Department of Radiodiagnosis, at Shri Sathya Sai Medical College and Research Institute, Chennai in patients with complains of breast lump, mastalgia, nipple discharge, nipple retraction for duration of 18 months.*
Results : *Age distribution varied from18 years to 60 years. Majority noted among 41-50 years constituting 50.9% and next common age group was 51-60 years accounting 15.4%.On SWE the average Emax in malignant tumors and borderline phyllodes tumor groups was significantly higher than that in benign lesions respectively; dark blue E color noted in 38 cases (34.5%) followed by Red color in 32 cases (29%), very homogenous in 49 cases (44.5%) followed by heterogenous in 37 cases (33.6%). Majority noted are round in shape with 45.4% followed by irregular in 39.0% cases. On Histopathology examination 70.9% cases reported as Benign and 29.0% cases as malignant.****Conclusion:*** *The results of this study demonstrated that the use of elastography improved the sensitivity in differentiating benign from malignant lesions, which increased from 75.5% to 95.8%.*
Keywords: *Breast elastography, SWE*

INTRODUCTION

As a regular screening technique, ultrasound (US) may help distinguish between benign and malignant breast tumors [1,2]. The ACR Breast Imaging-Reporting and Data System (BI-RADS) vocabulary is widely used in clinical practice.[3] Ultrasonic elastography of the breast has emerged as a potential new method for better lesion characterization in recent years. [4,5] Shear wave elastography (SWE) is one of the methods used in elastography today. It is a transversely propagating method of quantitatively measuring stiffness that has shown to be more reliable and less dependent on human operators than strain elastography based on external mechanical compression. [4–6]
Using Young's modulus, sonoelastography evaluates the elasticity (stiffness) of tissues via the use of ultrasound.: $E=\sigma/\varepsilon$, where σ is the applied stress and ε the resultant tissue deformation.
The two main methods of sonoelastography are transient elastography, which involves vibration or shear waves, and static elastography, which involves strain. Static elastography shows strain from transducer-compressed tissue as a color map overlaid on a grayscale sonogram of the tissue in real time. There is a strong correlation between the diagnostic metric used in static elastography—elastographic scoring (ES) or strain ratio (SR)—and the high degree of interobserver variability. As subjective semi-quantitative metrics, ES and SR are similar to one another.[7,8]
Using SWE, one may determine the propagation speed of transverse shear waves by tracking their lateral spread from the tissue. Compared to static elastography, SWE is more repeatable and produces

quantitative data in real time.[9,10] The most reliable way to confirm the diagnosis of suspicious breast lesions is with a breast biopsy. Despite making up a relatively tiny part of the screened population, women use an outsized amount of healthcare resources when they are referred for interventional diagnostic procedures.[11].
Therefore, it would be helpful to have a dependable, non-invasive, and cost-effective way to distinguish benign breast lesions from malignant ones. This would help reduce the amount of needless interventional diagnostic treatments.

AIMS AND OBJECTIVES

Aim of the study: To evaluate the role of shear wave sonoelastography in characterization of solid breast lesions and to correlate with histopathologic findings .

Its objectives

Primary: To evaluate the tissue stiffness in solid breast lesions using shear wave elastography.
Secondary: To correlate the elastographic findings with histopathologic findings.

MATERIALS AND METHODS

Ethical Institutional committee approval was obtained. Informed consent was taken from all the patients. A Cross-sectional study was conducted in the department of Radiodiagnosis,at shri Sathya Sai medical college and research institute, Chennai in patients with complains breast lump, mastalgia, nipple discharge, nipple retraction for duration of 18 months.

Inclusion criteria:

- Age distribution -18 to 60 years.
- Female patients with complaints of lump in breast, mastalgia, nipple retraction
- Female patients having solid breast lesions.

Exclusion criteria:

- Asymptomatic women less than 18yrs of age.
- Women with known case of carcinoma.
- Pregnant and lactating women.

Sample size calculation:

Based on the previous study 22the prevalence of benign lesion for histopathology in 53 % level of significance.

n = 4pq / L x L. , Where p = 53 % , q = 100 - 53 = 47 , precision error 10%
= 4 X 53 X 46 / 10 X 10
= 9964/100 = 99.64 + 10% non response rate
= 99.64 = 9.96
= 109.6D
= 110

METHODOLOGY

ELASTOGRAPHIC TECHNIQUE

After explaining the procedure to the patient and getting informed consent breast examination was done using Mindray DC 80 ultrasound machine with a linear array transducer L 12-3E. We standardized our SWE techniques on the basis of findings in the literature, including published guidelines from the World Federation for Ultrasound in Medicine and Biology and the European Federation of Societies for Ultrasound in Medicine and Biology; prior research.1-4, training, and tips provided by the vendor's applications specialist and engineers; and considerations for the practicality and efficiency of routine clinical SWE acquisition before ultrasound-guided biopsy. Our default elastography setting was a side-by-side dual-panel display of B-mode ultrasound and SWE images.
The main purpose of the side-by-side B-mode display was to allow real-time visualization of the target lesion, which often was obscured by the color overlay on the SWE display. The default quantitative SWE scale showed the Young modulus elasticity measurements (expressed as kilopascals), with the color red indicating hard elasticity, the color blue indicating soft elasticity, and the maximum color scale set at 175 kPa
Following the World Federation for Ultrasound in Medicine and Biology guidelines and the research by Barr [5] and Zhang [6] on the effects of precompression, the radiologists attempted to apply minimal precompression during SWE acquisition by keeping the probe touching the skin lightly and instructing

patients to suspend respiration as necessary. The FOV box encompassed the target lesion and adjacent surrounding normal breast tissue. The radiologists allowed several SWE frames to complete until the color overlay appeared to stabilize, and they then selected the size and placement of a circular ROI over a representative portion of the lesion, which should include the stiffest part of the lesion as per the color overlay. The ultrasound system then automatically calculated the Emean (displayed as E), ESD, Emax, and Emin on the basis of shear-wave speeds generated within the ROI. The elasticity measurements Emean, ESD, and Emax were then recorded for each acquired SWE image.

SHEAR-WAVE ELASTOGRAPHY QUALITY PARAMETER ASSESSMENT

On the basis of a review of the published literature, including the World Federation for Ultrasound in Medicine and Biology and European Federation of Societies for Ultrasound in Medicine and Biology guidelines on breast ultrasound elastography, we defined and categorized five specific SWE image quality parameters.128

Lesion visualization on the B-mode image of the dual panel is used to aid in the verification of lesion inclusion and appropriate placement of the FOV box and ROI circle on the SWE image. The SWE red pattern (denoting high stiffness) in the near field of the FOV indicates the amount of applied precompression, which should be essentially no manual compression, during SWE acquisition. The appearance of surrounding tissue, including color heterogeneity, vertical streaks, and absence of color overlay, is used to assess quality, with the tissue surrounding the lesion serving as the reference. Normal breast tissue, particularly fat lobules, should show relatively homogeneously soft elasticity. Red vertical streaks represent artifacts of comb-push shear elastography technique, and absence of color overlay indicates insufficient shear-wave generation or signal.

The purpose of FOV placement is to appropriately include the lesion and an adequate amount of normal tissue surrounding the lesion. ROI placement is used for elasticity measurement. Areas of maximum elasticity and representative portions of the lesion are included to appropriately calculate the distribution of SWE values.

A scoring system for these quality parameters is presented in table 4 with a score of 0 indicating low quality and a score of 1 denoting high quality. Scoring of the appearance of the surrounding tissue was based on subcategorized features of surrounding tissue heterogeneity, the presence of vertical streaks, and the absence of color overlay. In brief, the parameters were considered high quality when there was lesion visualization on the B-mode image panel, absence of a SWE red pattern (denoting high stiffness) in the FOV near field, homogeneous color overlay of the surrounding normal tissue, appropriate inclusion of surrounding normal tissue in the FOV, and inclusion of the representative and stiffest portions of the lesion by the ROI circle.

TABLE 4: DESCRIPTION OF SCORING SYSTEM FOR SHEAR-WAVE ELASTOGRAPHY TECHNICAL IMAGE QUALITY PARAMETERS

Quality Parameters

Quality Parameter	Score and Description
B-mode visualization	1: Distinct lesion can be visualized 0: Lesion cannot be easily visualized
Red pattern in near field	1: Red pattern NOT visualized in the majority of the near field 0: Red pattern visualized in the majority of the near field
Appearance of surrounding tissue Surrounding tissue heterogeneity	1: The surrounding tissue is homogeneously colored blue 0: The surrounding tissue is NOT homogeneously colored blue
Vertical streaks	1: No vertical streaks present 0: Vertical streaks visualized

International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 24s, 2025
https://www.theaspd.com/ijes.php

Colorless areas	1: No considerable colorless area present 0: Considerable colorless area visualized
FOV placement	1: FOV box is centered on the lesion AND covers ≥ 1-cm span of the surrounding tissue 0: FOV box is not centered on the lesion OR covers < 1-cm span of the surrounding tissue
ROI placement	1: ROI size and location are appropriate, BOTH are representative of whole lesion, & the stiffest area is included 0: ROI does not include the area with the highest elasticity (darkest red area) OR the ROI area is NOT representative of the whole lesion.

HISTOPATHOLOGIC DIAGNOSIS

All the specimens were received in the Department of Pathology and histopathological examination was done.

STAISTICAL ANALYSIS

Data will be entered in systematically in MS-excel. Statistical analysis will be done by using SPSS 17 software. Both point estimates and 95% confidence intervals (CIs) was used. In all the above tests the "p" value of less than 0.05 was be accepted as indicating statistical significance.

IMAGE GALLERY

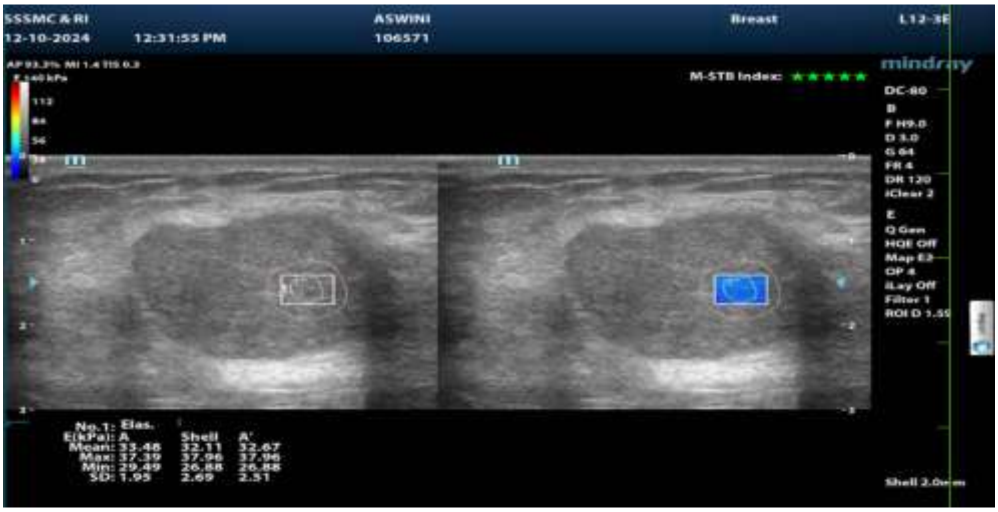


Fig 19: Homogenous breast lesion with mean E(kPa) value of 33 – Benign breast lesion.

Fig 20: Homogenous breast lesion with mean E(kPa) value of 31.1 – Benign breast lesion.

International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 24s, 2025
https://www.theaspd.com/ijes.php

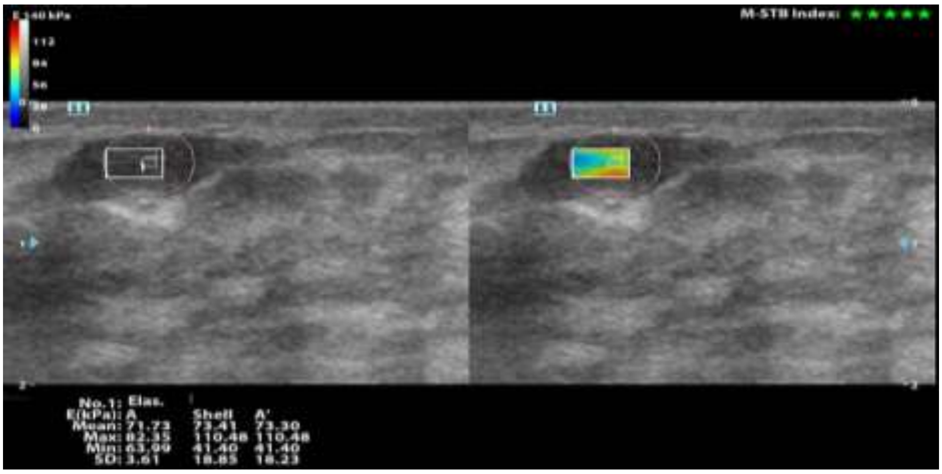


Fig 21: Heterogenous breast lesion with mean E(kPa) value of 71.1 – Intermediate breast lesion.

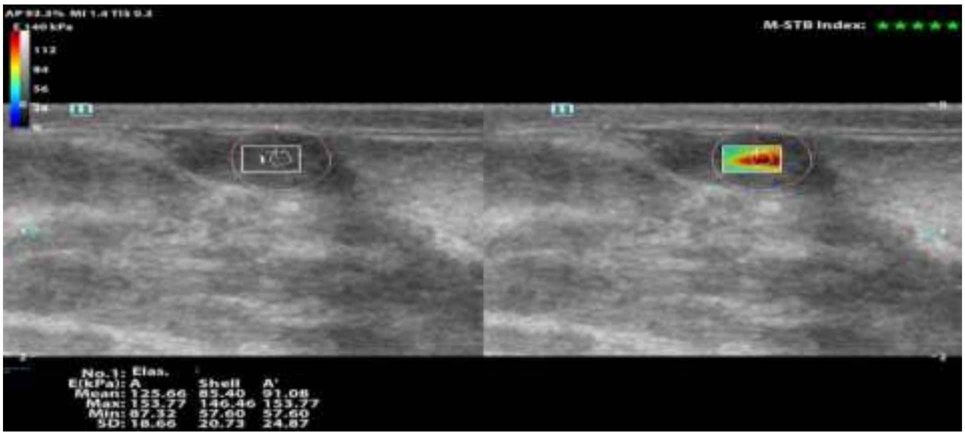


Fig 22: Heterogenous breast lesion with mean E(kPa) value of 125.1 – Malignant breast lesion.

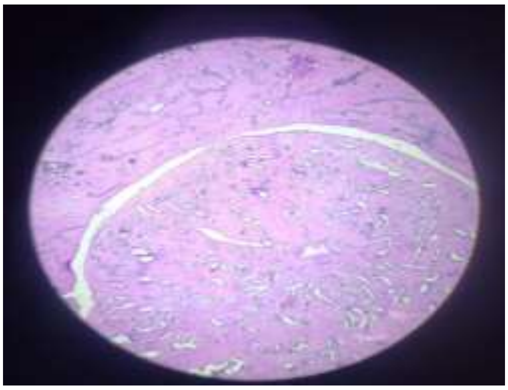


Fig 23: HPE proven Fibroadenoma.

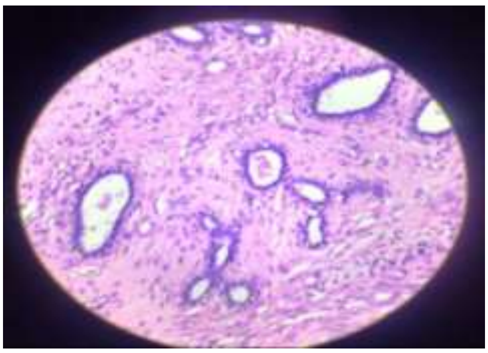


Fig 24: HPE proven Fibroadenoma.

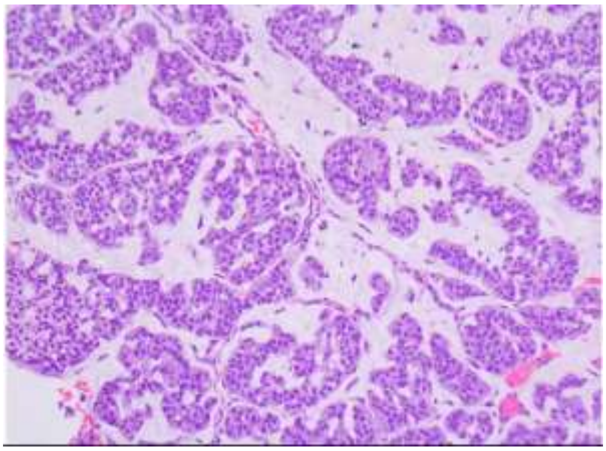


Fig 25: HPE proven intraductal carcinoma.

RESULTS AND OBSERVATION

TABLE 1: DISTRIBUTION OF MASSES BENIGN OR MALIGNANT AS IDENTIFIED ON USG

DISTRIBUTION OF DIAGNOSIS ON USG	NO. OF CASES	PERCENTAGE
BENIGN	**78**	**70.9**
MALIGNANT	32	29.0
Total	110	99.9%

In the present study on USG benign lesions were noted in 70.9% cases and malignant in 29.0% cases.

TABLE 2: DISTRIBUTION OF USG FINDINGS

DISTRIBUTION OF USG FINDINGS	NO. OF CASES	PERCENTAGE
Size		
• <10mm	10	9.09
• 11-20mm	65	59.0
• >21mm	35	31.8
Shape of the lesion		
• Round	30	27.2
• Oval	20	18.1
• Lobular	30	27.2
• Irregular	25	22.7
Margins of the lesion		
• Indistinct	32	29.0
• Well Circumscribed	78	70.9
Echogenicity		
• Hyperechoiec	78	70.9
• Hypoechoic	20	18.1
• Hypo-hyperechoic	12	10.9
Posterior acoustic shadowing		
• Absent	78	70.9
• Present	32	29.0
Surrounding Architectural distortion		
● Absent	98	89.0
● Present	12	10.9
Calcification		
● Absent	95	86.6

• Micro • Macro	10 5	9.09 4.5
Vascularity • Absent • Present	 78 32	 70.9 29.0
Axillary lymphadenopathy • Absent • Present	 95 15	 86.6 13.6
BI-RADS • 2 • 3 • 4A • 4B • 4C • 5 • 6	 50 18 07 08 05 07 15	 45.4 16.3 6.3 7.2 4.4 6.3 13.6
Total	**110**	**100**

In our study Among benign lesions 10 cases <10mm and 65 cases were between [11]-20mm. Among malignant lesions 35 cases were more than 2cm. Circumscribed margins were present in 78 subjects. All of them were benign. Lesions of 27 subjects had indistinct borders 32 of them turned out to be malignant on HPE. All 10 lesions with speculated margins on ultrasonography turned out to be malignant by HPE. 78 of them were hyperechoic lesions and in them all we're benign and 20 lesions were heteroehoeic of which 20 were malignant on HPE. 12 cases were hypo and hyperechoic. All proven to be malignant on HPE. Surrounding architectural distortion was present 12 cases. 32 cases had the presence of vascularity and turned out to be malignant.

QUANTITATIVE ASSESSMENT OF BREAST LESIONS ON SWE

In clinical practice, Emean, Emax, ESD, and E ratio are popular quantitative SWE parameters in the differential diagnosis of breast lesions visible on ultrasonography.

TABLE 3: DISTRIBUTION OF Emean BETWEEN BENIGN, BORDERLINE AND MALIGNANT TUMORS OF BREAST

LESIONS	NO.OF CASES	Emean±SD
Benign	78	84.5 ± 44.36
Malignant	32	124.1 ± 7.645

In the present study the average elasticity values of the Benign-98.82 ± 44.36 ,Malignant -134.1 ± 7.645 , ,Borderline phyllodes tumor groups-173.0±115.[3]

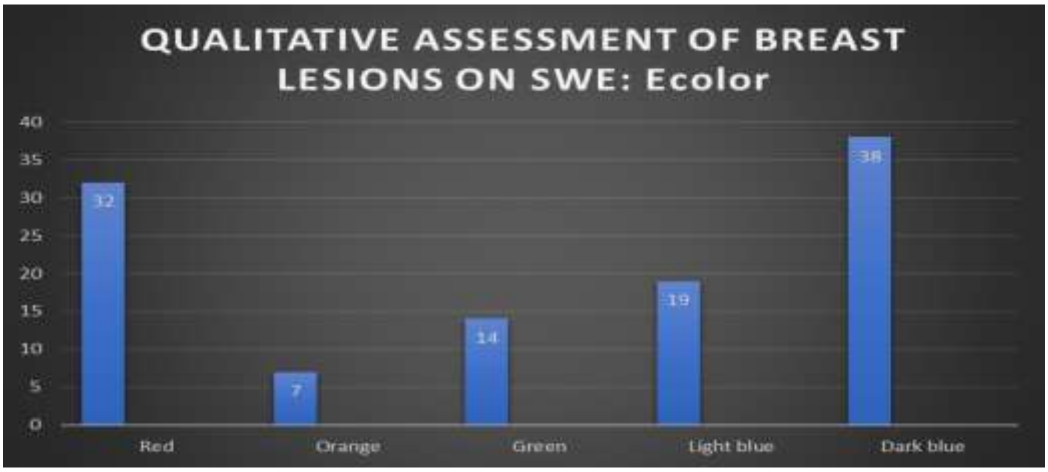
THE QUALITATIVE ASSESSMENT OF BREAST LESIONS ON SWE

TABLE 4 : DISTRIBUTION OF E color

DISTRIBUTION OF E color	NO.OF CASES	PERCENTAGE
Red	**32**	**29**
Orange	7	6.3
Green	14	12.7
Light blue	19	17.2
Dark blue	**38**	**34.5**
Total	110	99.9%

In the present study dark blue Ecolor noted in 38 cases (34.5%) followed by Red color in 32 cases (29%)

International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 24s, 2025
https://www.theaspd.com/ijes.php



Graph 9 : Bar diagram showing Qualitative assessment of breast lesions based on E-color.)

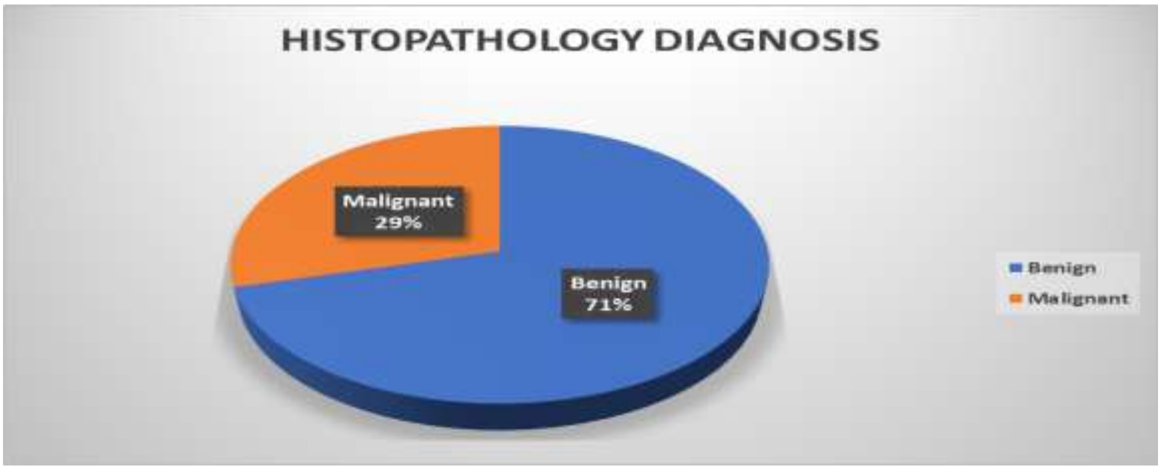
In the present study on Histopathology examination 70.9% cases reported as Benign and 29.0% cases as malignant.

Graph 1 : Bar diagram showing distribution of Histopathology diagnosis.

TABLE 6 : DISTRIBUTION OF LESIONS OF BREAST ON HISTOPATHOLOGY

HISTOPATHOLOGY DISGNOSIS	No. of cases	Percentage
Benign Lesions (78)		
• **Fibroadenoma**	68	61.8
• Intraductal papilloma	8	7.2
• Benign phyllodes tumor	1	0.9
• Borderline phyllodes tumor	1	0.9
Malignant Lesions (32)		
• **Invasive ductal Carcinoma**	14	12.7
• Invasive lobular Carcinoma	2	1.8
• Ductal carcinoma in situ	10	9.09
• Mucinous adenocarcinoma	3	2.7
• Papillary carcinoma	2	1.8
• Medullary carcinoma	1	0.9
Total	**110**	**100**

- In the present study on HPE among benign lesions Fibrodenoma was reported in 61.8% cases followed by Intraductal papilloma in 15.4% cases.
- Among malignant lesions Invasive ductal Carcinoma in 12.7% cases followed by DCIS in 9.09% cases.



Graph 2 : Bar Diagram Showing Distribution Of Histopathology Diagnosis Statistical Analysis

DISCUSSION

Morphological criteria are mostly used for the evaluation of localized breast lesions found on x-ray mammography and B-mode ultrasonography. Breast ultrasound elastography may reveal breast lesions with mammography and ultrasonography. To supplement data from conventional anatomical imaging, research into measuring the elasticity of living tissues has gained momentum within the last decade.

By combining the standard B-mode Ultrasonogram with sonoelastography, a cutting-edge sonographic technology, suspicious breast masses may be better evaluated. By applying pressure on tissues, sonoelastography measures their elasticity.When it comes to diagnosing breast cancer, recent studies have shown that ultrasonographic-elastography (USE) is more accurate than B-mode ultrasonography. This means that fewer false-positive findings are produced, which is helpful for preventing needless breast biopsies.

Comparative studies related to age distribution

The ages of the participants in this research ranged from eighteen to sixty.Most people were found to be between the ages of 41 and 50 (50.9% of the total), with those between the ages of 51 and 60 making up 15.4%.The average age of patients with malignant breast lesions was determined to be 45.6 years, and the majority of patients were older than 45 years in the research by Anil Kumar et al. 123. Their ages varied from eighteen to seventy-five, with a mean of 47.72, according to the study129 by Ala otham et al. According to Hari et al., the study comprised 12,011 female participants aged 13 to 87, with an average age of 42.[3] ± 13.6 years (SD).

Comparative studies related to distribution of SIDE of breast lump

Out of the 68 instances that were examined in this research, 46 were found to be benign, while 22 were classified as malignant, all involving the left breast. In 42 instances, the right breast was implicated; 32 of these cases were benign, while 10 were cancerous.In a research performed by Ruby thomas et al121 In two individuals, one had a benign lesion and the other had a malignant one; both breasts were affected. Twelve cases were cancerous and sixteen were benign, involving the left breast in 28 individuals. Of the 43 patients, 20 had cancerous lesions and 23 had benign ones, all located on the right side of the breast. Amelendu kumar et al118 The left breast was the most common site of mass (51.8 percent, n=57).

Comparative studies related to distribution of QUADRANT

A lump was detected in the lower and outer quadrants of 31.8% of the cases in this study, whereas 22.7% of the cases included the upper and outer quadrants. .In Ruby thomas et al121

The higher outside quadrant had 19% to 26% of the lesions, whereas the lower outer quadrant had 17% to 23.[3]%. Amelendu kumar et al 118The top outer quadrant accounted for 42.7% (n=47).

Comparative studies related to distribution of benign and malignant lesions on Histopathology

Based on the histopathology reports, 32 cases were classified as malignant and 78 were classified as benign.In Anil kumar et al123 explore 46 malignant and 44 benign.Hari et al study126 There were 57 benign and 62 malignant breast lesions.Ala otham et al 129 28 breast lesions were determined to be benign, accounting for 67.5% of the total. Nine lesions were found to be malignant, constituting 22.5% of the total, while four lesions had atypia, constituting 10%.Prashanth et al 120 Histopathology revealed that 74 (58.73%) were malignant, whereas 52 (41.72%) were benign.

Table 8: Comparative studies related to distribution of Histopathology diagnosis

Histopathology diagnosis	Hari et al[126]	Prashanth et al[120]	Rasime et al[124]	Present study
Fibroadenoma	33(57.9%	57(77.03%)	-	68(61.8%)
Intraductal papilloma	5(8.8%)	-	1(2/2%)	8(7.2%)
Benign phyllodes tumor	-	1(1.92%)	-	1(0.9%)
Borderline phyllodes tumor	-	1(1.92%)	-	1(0.9%)
Invasive ductal Carcinoma	46(74.2%)	35(67.31%)	38 (86.4%)	14(12.7%)
Invasive lobular Carcinoma	1(1.6%)	-	-	2(1.8%)

DCIS	5(8.1%)	-	-	10(9.09%)
Mucinous adenocarcinoma	1(1.6%)	713.46%),	-	3(2.7%)
Papillary carcinoma	-	1(1.92%),	3(6.8%)	2(1.8%)
Medullary carcinoma	-	1(1.92%),	2(4.5%).	1(0.9%)

In our analysis, IDC was the most prevalent kind of malignant breast tumor. While ultrasonography incorrectly classified 7 IDCs as BIRADS 5 categories and 10 as BI-RADS 4 categories, SWE properly classified 15 IDCs as malignant (E-max > 140 kPa). Unfortunately, SWE missed five IDCs since two masses had a softness limit below 72 kPa and three had an elastic range between 72 and 140 kPa, which is not known. Five DCIS were successfully identified (Emax > 140 kPa), but one exhibited poor elasticity (E-max 41 kPa) and produced false negatives. Ultrasound properly identified a superficial, tiny (1.6 cm) tumor as BI-RADS 4b. The diagnosis accuracy was enhanced by combining SWE with ultrasound since the two methods worked well together in certain cases. A comparable finding has been recorded by Ozsoy et al 135

For this research, With a sensitivity of 100%, E-mean was comparable to E-max among quantitative SWE values; however, its specificity was lower at 70.9% compared to 96.6% for E-max.that is, Hari et al 126 Although E-specific max's sensitivity is 89.5% and E-mean's sensitivity is 93.4%, the latter has lesser specificity.

Overall, E-max and E-mean performed similarly well in this investigation, with AUCs of 0.91 and 0.89, respectively. Here, we see that qualitative SWE and E-color are not interchangeable. Color examination alone may generate erroneous negative results for relatively soft conditions such as IDC, DCIS, and necrotic masses. Color stiffness was highly correlated with all quantitative SWE metrics, with E-max yielding the strongest results. Because of this, we deduced that E-color stiffness may stand in for quantitative SWE, which agrees with the findings of Youk et al131

SUMMARY

In the present study age distribution varied from 18 years to 60 years. Majority noted among 41-50 years constituting 50.9% and next common age group was 51-60 years accounting 15.4%.

All the cases included were females (100%)

Majority of the cases presented with lump in breast (100%) followed by retraction of nipple in 18 cases (16.[3]%)

Most of the cases presented with lump breast (27.2%) for duration of 5-6 months . followed by 304 months in 21.8% cases.

Left breast lump noted in majority constituting 59.0% followed by right breast 40.9%.

54.5% cases presented with firm and mobile lump followed by hard and fixed lump in 27.2% cases.

Lump noted in Lower and outer quadrant in 31.8% cases followed by Upper and outer quadrant in 22.7% cases.

USG Benign noted in 70.9% cases and Malignant in 29.0% cases.

In the present study the average elasticity values of the Benign-98.82 ± 44.36 ,Malignant -134.1 ± 7.645, Borderline phyllodes tumor groups-173.0±115.[3].

The average Emax in malignant tumors and borderline phyllodes tumor groups was significantly higher than that in benign lesions respectively;

In the present study dark blue Ecolor noted in 38 cases (34.5%) followed by Red color in 32 cases (29%)

In the present study, very homogenous in 49 cases (44.5%) followed by heterogenous in 37 cases (33.6%)

Majority noted are round in shape with 45.4% . followed by irregular in 39.0% cases.

On Histopathology examination 70.9% cases reported as Benign and 29.0% cases as malignant.

In the present study on HPE among benign lesions fibroadenoma was reported in 61.8% cases followed by Intraductal papilloma in 15.4% cases.

Among malignant lesions Invasive ductal Carcinoma in 12.7% cases followed by DCIS in 9.09% cases.

USG & HPE shows statistical significant correlation in diagnosis of breast lesions with p value <0.0001 ****.

ROC OF BI-RAD SCORE and HPE shows statistical significant correlation in diagnosis of breast lesions with p value <0.0001.

ROC OF E MEAN & HPE shows statistically significant correlation in diagnosis of breast lesions with p value <0.0001.
ROC OF EMAX SCORE & HPE shows statistically significant correlation in diagnosis of breast lesions with p value <0.0001.
In the present study SWE (E MAX) & HPE shows statistical significant correlation in diagnosis of breast lesions with p value <0.0002 ****.
In the present study SWE (E MEAN) & HPE shows statistical significant correlation in diagnosis of breast lesions with p value <0.0001 ****.

CONCLUSION

In conclusion, SWE is a useful technique for characterization of breast masses. E-mean and E-max are the best SWE parameters for characterizing breast masses. SWE, used in addition to ultrasound, improves characterization of BIRADS [3] and 4a masses. Similarly, an additive role of SWE in downgrading BI-RADS [3] masses to 2 may also be explored. Imaging by USG and Shear wave sonoelastography combined has higher sensitivity in the differentiation of benign and malignant lesions, hence guiding management. Among the 2, Sono elastography has higher sensitivity with categorizing lesions as benign and malignant. This helps in avoiding invasive investigations to an extent in breast lesions, by giving them a BI-RADS score.

The high specificity of these investigations combined is helpful to rule out potentially malignant lesions and thus help in reassuring patients. USG and shear wave elastography are helpful and efficient alternatives in the characterization of lesions. The specificity of this study in detecting malignant lesions was comparable with that of histopathological analysis. Thus, it was proved that combining USG and elastography gives a similar accuracy to that of HPE in detecting malignant lesions of the breast.

REFERENCES

1. Rosen PP, Oberman HA. Tumors of the Mammary Gland. Washington, DC: Armed Forces Institute of Pathology; 1993.
2. Lakhani SR, Ellis IO, Schnitt SJ, Tan PH, van de Vijver MJ, editors. World Health Organization Classification of Tumours of the Breast. Vol 4. Lyon: IARC; 2012.
3. Lenhard MS, Kahlert S, Himsl I, Ditsch N, Untch M, Bauerfeind I. Phyllodes tumour of the breast: clinical follow-up of 33 cases of this rare disease. Eur J Obstet Gynecol Reprod Biol. 2008;138(2):217–21.
4. Choi JS, Ko EY, Kim MJ, Ko ES, Han BK. Combined use of shear wave elastography and Doppler ultrasonography in equivocal fibroepithelial lesions of the breast diagnosed by core needle biopsy. Ultrasonography. 2022;42(1):31–40.
5. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, Bray F. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2021;71([3]):209–49.
6. Gucalp A, Traina TA, Eisner JR, et al. Male breast cancer: a disease distinct from female breast cancer. Breast Cancer Res Treat. 2019;173(1):37–48.
7. Azamjah N, SoltanZadeh Y, Zayeri F. Global trend of breast cancer mortality rate: a 25-year study. Asian Pac J Cancer Prev. 2019;20(7):2015–20.
8. Prat A, Pineda E, Adamo B, et al. Clinical implications of the intrinsic molecular subtypes of breast cancer. Breast. 2015;24(Suppl 2):S26–35.
9. Perou CM, Sørlie T, Eisen MB, et al. Molecular portraits of human breast tumours. Nature. 2000;406(6797):747–52.
10. McCart Reed AE, Kalinowski L, Simpson PT, Lakhani SR. Invasive lobular carcinoma of the breast: the increasing importance of this special subtype. Breast Cancer Res. 2021;23(1):6.
11. Krouskop TA, Dougherty DR, Vinson FS. A pulsed Doppler ultrasonic system for making noninvasive measurements of the mechanical properties of soft tissue. J Rehabil Res Dev. 1987;24(2):1–8.
12. Ophir J, Céspedes I, Ponnekanti H, Yazdi Y, Li X. Elastography: a quantitative method for imaging the elasticity of biological tissues. Ultrason Imaging. 1991;13(2):111–34.
13. Frey H. Real-time elastography. A new ultrasound procedure for the reconstruction of tissue elasticity. Radiologe. 2003;43([11]):850–5.
14. Itoh A, Ueno E, Tohno E, et al. Breast disease: clinical application of US elastography for diagnosis. Radiology. 2006;239(2):341–50.
15. Dietrich CF, Dong Y, Cui XW, et al. Ultrasound elastography: a brief clinical history of an evolving technique. Ultrasound Int Open. 2024;10:a23786926.
16. Barr RG. Sonographic breast elastography: a primer. J Ultrasound Med. 2012;31(5):773–83.
17. Athanasiou A, Tardivon A, Tanter M, et al. Breast lesions: quantitative elastography with supersonic shear imaging—preliminary results. Radiology. 2010;256(2):297–303.
18. Lee SH, Chang JM, Cho N, et al. Practice guideline for the performance of breast ultrasound elastography. Ultrasonography. 2014;33(1):[3]–10.
19. Youk JH, Son EJ, Park AY, Kim JA. Shear-wave elastography for breast masses: local shear wave speed (m/sec) versus Young modulus (kPa). Ultrasonography. 2014;33(1):34–39.
20. Zhou J, Zhan W, Chang C, et al. Breast lesions: evaluation with shear wave elastography, with special emphasis on the "stiff rim" sign. Radiology. 2014;272(1):63–72.

21. Gweon HM, Youk JH, Son EJ, Kim JA. Visually assessed colour overlay features in shear-wave elastography for breast masses: quantification and diagnostic performance. Eur Radiol. 2013;23([3]):658–63.
22. Berg WA, Cosgrove DO, Doré CJ, et al. Shear-wave elastography improves the specificity of breast US: the BE1 multinational study of 939 masses. Radiology. 2012;262(2):435–49.
23. Kumar A, Jha A, Regmi PR, Gurung G. Role of sonoelastography in differentiating benign and malignant breast lesions: a prospective study comparing elasticity contrast index and Tsukuba score. NJR. 2024;14(1):23–?
24. Nirale PM, Balutkar SD, Maniyar SS. Comparative study of elastography and histopathology findings of breast lump at a tertiary hospital. MedPulse Int J Radiol. 2022;21(2):36–39.
25. Thomas R, Das SK, Balasubramanian G, Chandrappa A. Correlation of mammography, ultrasound and sonoelastographic findings with histopathological diagnosis in breast lesions. Cureus. 2022;14(12):e32318.
26. Chang JM, Park IA, Lee SH, et al. Stiffness of tumours measured by shear-wave elastography correlated with subtypes of breast cancer. Eur Radiol. 2013;23([11]):2450–8.
27. Alvarez S, Anorbe E, Alcorta P, et al. Role of sonography in the diagnosis of axillary lymph node metastases in breast cancer: a systematic review. AJR Am J Roentgenol. 2006;186(5):1342–48.
28. Park SY, Choi JS, Han BK, Ko EY, Ko ES. Shear wave elastography in the diagnosis of breast non-mass lesions: factors associated with false negative and false positive results. Eur Radiol. 2017;27(10):3788–97.
29. Berg WA, Bandos AI, Mendelson EB, et al. Ultrasound as the primary screening test for breast cancer: analysis from ACRIN 6666. J Natl Cancer Inst. 2015;108(4):djv367.
30. Taylor KJ, Merritt C, Piccoli C, et al. Ultrasound as a complement to mammography and breast examination to characterize breast masses. Ultrasound Med Biol. 2002;28(1):19–26.
31. Gennisson JL, Deffieux T, Fink M, Tanter M. Ultrasound elastography: principles and techniques. Diagn Interv Imaging. 2013;94(5):487–95.
32. Ng WL, Rahmat K, Fadzli F, et al. Shear-wave elastography increases diagnostic accuracy in characterization of breast lesions. Medicine (Baltimore). 2016;95(12):e3146.