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

Role of Shear Wave Elastography in Evaluation of Breast Masses with Fnac/Hpe Correlation

Dr. Kushal M[1*], Dr. Pradeep K[2], Dr. Shashikumar M R[3], Dr. Pooja M[4], Dr. Dhananjaya V R[1], Dr. Tamanna Babbar[1]

[1]Junior Resident, Department of Radiodiagnosis, Adichunchanagiri Institute of Medical Sciences, Adichunchanagiri University, B G Nagara, 571448, Karnataka, India

[2]Associate Professor, Department of Radiodiagnosis, Adichunchanagiri Institute of Medical Sciences, Adichunchanagiri University, B G Nagara, 571448, Karnataka, India.

[3]Professor and head of the department, Department of Radiodiagnosis, Adichunchanagiri Institute of Medical Sciences, Adichunchanagiri University, B G Nagara, 571448, Karnataka, India.

[4]Assistant Professor, Department of Radiodiagnosis, Adichunchanagiri Institute of Medical Sciences, Adichunchanagiri University, B G Nagara, 571448, Karnataka, India.

[*]**Corresponding author:** kushal113034@gmail.com

ABSTRACT

BACKGROUND: *Breast cancer globally is the commonest cancer among women. Early detection plays an essential role in improving the prognosis and overall outcome for patients with breast cancer. The present study attempts to understand role of elastography to differentiate benign and malignant pathologies of the breast and its ability to downgrade the BI-RADS staging of the lesion, which may be helpful to reduce the need for unnecessary biopsies of probably benign masses (BI-RADS 3) and the subset of low-suspicion masses (BI-RADS 4a).*

OBJECTIVE: *To evaluate the sensitivity and specificity of ultrasound shear wave elastography in characterization of benign and malignant breast masses with fine needle aspiration cytology (FNAC) and/or histopathological correlation.*

METHODS: *A hospital-based cross-sectional observational research carried out over a period of 18 months (June 2023 - December 2024) on patients referred to the Department of Radiodiagnosis, Adichunchanagiri Hospital and Research Centre, B G Nagara. US elastography was performed and the measurements were expressed in kiloPascals (kPa). Statistical analysis was performed to correlate elastography findings with HPE/FNAC results.*

RESULTS:

1. *USG BIRADS had a sensitivity and specificity of 93.7 % and 70 % for detecting malignant lesions.*
2. *Elastography had a sensitivity and specificity of 87.5 % and 90 % for detecting malignant lesions.*

CONCLUSION: *Imaging plays an important role in the management of palpable masses of the breast. The grayscale ultrasound had a high sensitivity for detecting malignant lesions. When it came to identifying cancerous lesions, elastography demonstrated both high sensitivity and good specificity. The combined use of grayscale ultrasound and elastography is useful in most instances to better characterize palpable lesions and arrive at a diagnosis. These imaging modalities help reduce the patient's anxiety and avoid unnecessary interventions in those cases in which imaging findings are benign.*

Keywords: *: BI-RADS: Breast Imaging-Reporting and Data System, BSE: Breast self-examination, DCIS: Ductal carcinoma in situ, FNAC: Fine Needle Aspiration Cytology, kPa: kilo Pascals, HPE: Histopathological examination, USG: Ultrasound, UE: Ultrasound elastography*

INTRODUCTION

Globally, breast cancer is the commonest cancer among women. It has surpassed lung cancer as the leading cause of global cancer incidence in 2020, representing 11.7% of all cancer cases [1]. Invasive ductal carcinomas are the commonest malignant lesions, and fibroadenoma is by far the commonest benign lesion [2]

The survival rate and prognosis of patients with breast cancer are poor in India as compared to Western countries due to earlier age at onset, late stage of disease at presentation, delayed initiation of definitive management and inadequate /fragmented treatment [3].

Though breast self-examination is not accepted as an early detection method for breast cancer, this technique, if used diligently and skillfully, can serve as a useful adjunct to making the woman aware of her normal breast. [4]

Imaging modalities that help in the assessment of the breast tissue are mammography, ultrasound, and MR mammography [5]. X-Ray mammogram reveals early signs like microcalcifications. Mammography

has several limitations, including false-negative results in dense breasts, and there is the risk of radiation-induced breast cancer, especially exposure in young patients.

An MR mammogram is more sensitive for even small lesions, and it is recommended for screening women with a high risk for malignancy of the breast, such as those with a strong family history and/or mutation genes, including BRCA1/BRCA2. Ultrasound has been proven to improve diagnostic sensitivity when added to screening mammography in high-risk women with dense breasts. [6,7] Ultrasound is also useful as the primary imaging modality to guide interventional breast procedures.

Ultrasound elastography differentiates between the benign and the malignant lesions based on their elasticity component: the benign lesions have elasticity, which is similar to the surrounding tissues, while the malignant lesions have elasticity harder than the surrounding tissues.[8,9] Histopathology is the gold standard for the characterization of breast lesions.

The present study attempts to understand the role of elastography to differentiate benign and malignant pathologies of the breast.

MATERIALS AND METHODS:

Place of study: The study was conducted in the Department of Radiodiagnosis, Adichunchanagiri Hospital and Research Centre, B G Nagara-571448, Mandya District, Karnataka.

Ethical considerations: This study was approved by the ethics committee of Adichunchanagiri Institute of Medical Sciences (approval number: AIMS/IEC/091/2023) dated 13-05-2023.

Study Design: A hospital based cross sectional study

Duration of the Study: 18 months (June 2023 - December 2024).

Study group: Group of 52 Patients with palpable breast lump.

INCLUSION CRITERIA:

Patients of AIMS B.G. Nagara above the age of 25 years who are referred to our department with a physical examination suggestive of a palpable lump in the breast which was diagnosed by gray scale ultrasound classified as BI-RADS 3–6.

EXCLUSION CRITERIA:

1.Patients with normal findings on ultrasonography of the breast.
2. Simple cystic lesions.
3. Masses where pathological correlation is not possible.

SAMPLE SIZE ESTIMATION:

The sample size (n) is calculated according to the formula:

$n = z^2 * p * (1 - p) / e^2$

Where: z = 1.645 for a confidence level (α) of 90%,

p = proportion (expressed as a decimal) (0.26), e = margin of error (0.1),

$n = 1.645^2 * 0.26 * (1 - 0.26) / 0.1^2$

$n = 0.5206 / 0.01 = 52.064$

$n \approx 52$ (Sample Size)

The minimum required sample size as per the above-mentioned calculation is 52

METHOD OF DATA COLLECTION:

This cross-sectional study was conducted at the Department of Radiodiagnosis, Adichunchanagiri Institute of Medical Sciences, B.G. Nagara, Mandya, Karnataka, over 18 months. All the participants were given written informed consent in their native language. The clinical history required was obtained, and examination findings were recorded. If the patient had undergone any USG scanning previously, the findings were tabulated. Each breast mass was analysed with standard ultrasound descriptors like shape, orientation, margins, lesion boundary, echo texture and posterior acoustic features, calcification and presence of necrosis. Each lesion was given a BIRADS score. Shear wave elastography was performed on patients who fulfilled inclusion criteria, and quantitative shear wave elastography parameters (mean elasticity) will be obtained and recorded. Results were confirmed by pathological correlation as the standard reference.

STATISTICAL ANALYSIS

The data were entered into **Microsoft Excel** and analysed using **SPSS 26.0**. **Qualitative** and **quantitative variables** were summarized using **mean** and **standard deviation**.

RESULTS

Table 1: Representing the different age groups (in years) involved in this study

AGE (IN YEARS)	NUMBER	PERCENTAGE
25-35	7	13.5
36-45	14	27
46-55	12	23
56-65	12	23
> 66	7	13.5
TOTAL	52	

Minimum age of patient included in the study was 25 years and the mean age of participants of the study being 50.5 years.

TABLE 2: Represents various FNAC findings:

	NUMBER	PERCENTAGE
Lipoma	1	1.9
Abscess	3	5.8
Galactocele	3	5.8
Fibroadenoma	13	25
Phyllodes	0	0
Inflammatory breast cancer	1	1.9
Papillary carcinoma	1	1.9
Infiltrating ductal carcinoma	30	57.7
Total	52	

Of the 52 cases, based on FNAC, 20 cases were benign, of which fibroadenoma comprised the majority of cases (13 cases) (25%), followed by breast abscess and galactocele, comprising 3 cases each (5.8% each), and 1 case (1.9%) of lipoma. Of the 32 malignant cases, the majority of cases were of ductal carcinoma (30 cases) (57.7%) and 1 case of papillary and inflammatory breast carcinoma (1.9% each).

Table 3: Showing Age distribution of benign and malignant lesions based on FNAC/HPE:

AGE (IN YEARS)	BENIGN	MALIGNANT	TOTAL
25-35	7	0	7
36-45	9	5	14
46-55	2	10	12
56-65	1	11	12
> 66	1	6	7
TOTAL	20	32	52

Of 20 benign cases, maximum numbers (9 cases) were seen in the 36-45 years of age. Similarly, out of 32 malignant cases, the maximum number (11 cases) was found in the 56-65 years of age.

Table 4: Table representing detection of lesion by grayscale ultrasound with respect to FNAC/HPE:

	FNAC/HPE (MALIGNANT)	FNAC/HPE (BENIGN)	TOTAL
USG (MALIGNANT)	30	6	36

USG (BENIGN)	2	14	16
TOTAL	32	20	

Of the 52 subjects, based on USG, 36 patients showed features of malignancy, corresponding FNAC when performed on these patients, 30 patients showed malignant features. Based on USG, 16 patients showed benign features, and corresponding FNAC when performed on these patients, 14 patients showed benign features.

Table 5: Table representing detection of lesion by ultrasound elastography with respect to FNAC/HPE:

	FNAC/HPE (MALIGNANT)	FNAC/HPE (BENIGN)	TOTAL
ELASTOGRAPHY (MALIGNANT)	28	2	30
ELASTOGRAPHY (BENIGN)	4	18	22
TOTAL	32	20	

Of the 52 subjects, based on elastography, 30 patients showed features of malignancy. Corresponding FNAC when performed on these patients, 28 patients showed malignant features. Based on the elastography, 22 patients had benign lesions. Corresponding FNAC when performed on these patients, 18 patients had benign features.

Table 6: Mean SWE velocity for different BIRADS category lesions in the study

BIRADS	MEAN ELASTICITY (in kPa)
3	49
4	123
5	170
6	156

Mean tissue elasticity of BIRADS 3 lesions was 49kPa, BIRADS 4 lesions was 123kPa, BIRADS 5 was 170 kPa and BIRADS 6 lesions were 156kPa.

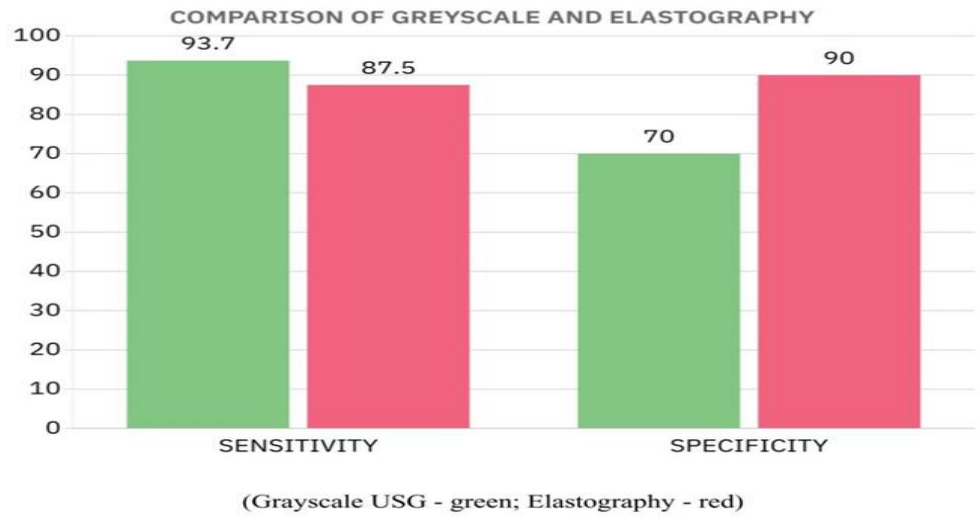

Figure 1: Showing a comparison of various techniques used in our study in the detection of breast lesions

DISCUSSION

Out of the total 52 patients, the highest number of the patients were in the 36-45 years age group (27 %), followed by the 46-55 and 56-65 years age groups (23 % each) and the 25-35 years age group (13.5 %), > 66 years (13.5 %). The mean age in our study was 50.5 years, which was comparable to the study by Marukatat N et al. (2024), in which the mean age group was 52.18 years. [10]

In our study, USG BIRADS had a sensitivity and specificity of 93.7 % and 70 % for detecting malignant lesions. This was in conformity with the study conducted by S. Hari et al. [11] (2018), who reported a sensitivity of 96.8% and a specificity of 70.2% for ultrasound for detecting malignant pathology.

In our study, USG Elastography had a sensitivity and specificity of 87.5 % and 90 % for detecting malignant lesions. Similarly, a study conducted by Chang et al. reported a similar sensitivity of 89.0 % and specificity of 85.0 % for elastography in the detection of malignant lesions [12].

In our study, the mean tissue stiffness for benign and malignant lesions was 49 kPa and 140.6 kPa respectively. This yielded results comparable to the study by Choi HY et al. who reported maximum tissue stiffness of 52.6 kPa for benign lesions and 141.8 kPa for malignant lesions. [13]

The most significant factor influencing image quality during US elastography was the thickness of the breast at the lesion's location. In a study conducted by Thomas et al., both observers independently determined that elastography cannot provide a comprehensive evaluation of breast lesions that are situated deeper than 1 cm [14].

In an additional report by Raza et al., false-positive and false-negative lesions were discovered to be situated at a greater depth than those that were accurately identified through US elastography [15]. The accuracy of US elastography was found to decrease when breast lesions were located deeper than 12 mm. Breast stiffness measurement becomes challenging due to the fact that thicker tissue attenuates both elastic waves and ultrasound waves.

LIMITATIONS:

1. Our study had a small sample size of 52, hence it may not represent the larger population.
2. Additionally, our study is limited by its single-centre design, which may introduce biases related to the specific patient population and healthcare practices at our institution.
3. Interobserver variability can occur during data acquisition and interpretation.
4. Furthermore, the image quality of US elastography can greatly influence overall reader performance for tumour characterization.

CONCLUSION

Imaging plays an important role in the management of palpable masses of the breast. The grayscale ultrasound had a high sensitivity for detecting malignant lesions. Elastography had good sensitivity and high specificity for detecting malignant lesions. The combined use of grayscale ultrasound and elastography is useful in most instances to better characterize palpable lesions and arrive at a diagnosis. These imaging modalities help to reduce the patient's anxiety and avoid unnecessary interventions in those cases in which imaging findings are benign.

REFERENCES

1.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 May;71(3):209-249. doi: 10.3322/caac.21660. Epub 2021 Feb 4. PMID: 33538338.

2.Malich,T.Boehm, M.Facius, M.G.Freesmeyer, M.Fleck, R.Anderson. 2000. Differentiation of mammographically suspicious lesions.clinical radiology; 56:278283

3.Maurya AP, Brahmachari S. Current status of breast cancer management in India. Indian Journal of Surgery. 2021 Jun;83(Suppl 2):316-21.

4.Gupta R, Gupta S, Mehrotra R, Sodhani P. Risk factors of breast cancer and breast self-examination in early detection: systematic review of awareness among Indian women in community and health care professionals. J Public Health (Oxf). 2020 Feb 28;42(1):118-131. doi: 10.1093/pubmed/fdy228. PMID: 30608560.

5.F.Odoguardi, A.Cilotti, M.Moretti, D.Mazzotta, A.Vaccaro, F.A.Cardillo, A.Starita.2005. Role of diffusion-weighted imaging (DWI) in magnetic resonance (MR) of the breast. University of Pisa, Italy

6.Lee T. Comparison of Breast Cancer Screening Results in Korean Middle-Aged Women: A Hospital-based Prospective Cohort Study. Osong Public Health Res Perspect. 2013 Aug;4(4):197-202. doi: 10.1016/j.phrp.2013.06.002. Epub 2013 Jun 27. PMID: 24159556; PMCID: PMC3767103.

7.Mo M, Liu GY, Zheng Y, Di LF, Ji YJ, Lv LL, Chen YY, Peng WJ, Zhu JR, Bao PP, Ding JH, Chang C, Luo JF, Cao ZG, Xu WH, Shao ZM. Performance of breast cancer screening methods and modality among Chinese women: a report from a society-based breast screening program (SBSP) in Shanghai. Springerplus. 2013 Jun 24;2(1):276. doi: 10.1186/2193-1801-2-276. PMID: 23961381; PMCID: PMC3724976.

8.Itoh A, Ueno E, Tohno E, et al. Breast disease: clinical application of US elastography for diagnosis. Radiology 2006;239(2): 341–350.
9.Schaefer FK, Heer I, Schaefer PJ, et al. Breast ultrasound elastography: results of 193 breast lesions in a prospective study with histopathologic correlation. Eur J Radiol 2011;77(3):450–456.
10. Marukatat N, Parklug P, Issaragrisil S, Sumanasrethakul C. Shear wave elastography for solid breast masses evaluation: Quantitative measurement of mean elasticity value and elasticity ratio. Eur J Radiol Open. 2024 May 29;12:100573. doi: 10.1016/j.ejro.2024.100573. PMID: 38855720; PMCID: PMC11157203.
11. Hari S, Paul SB, Vidyasagar R, Dhamija E, Adarsh AD, Thulkar S, Mathur S, Sreenivas V, Sharma S, Srivastava A, Seenu V, Prashad R. Breast mass characterization using shear wave elastography and ultrasound. Diagn Interv Imaging. 2018 Nov;99(11):699-707. doi: 10.1016/j.diii.2018.06.002. Epub 2018 Jul 10. PMID: 30006125.
12. J.M. Chang, W.K. Moon, N. Cho, A. Yi, H.R. Koo, W. Han, et al., Clinical application of shear wave elastography (SWE) in the diagnosis of benign and malignant breast diseases, Breast Cancer Res. Treat. 129 (1) (2011) 89–97.
13. Choi HY, Seo M, Sohn YM, Hwang JH, Song EJ, Min SY, Kang HJ, Han DY. Shear wave elastography for the diagnosis of small (≤2 cm) breast lesions: added value and factors associated with false results. Br J Radiol. 2019 May;92(1097):20180341. doi: 10.1259/bjr.20180341. Epub 2019 Mar 26. PMID: 30817169; PMCID: PMC6580903.
14. Thomas A, Fischer T, Frey H, Ohlinger R, Grunwald S, Blohmer JU, Winzer KJ, Weber S, Kristiansen G, Ebert B, Kümmel S. Real-time elastography--an advanced method of ultrasound: first results in 108 patients with breast lesions. Ultrasound in Obstetrics and Gynecology: The Official Journal of the International Society of Ultrasound in Obstetrics and Gynecology. 2006 Sep;28(3):335-40.
15. Raza S, Odulate A, Ong EM, Chikarmane S, Harston CW. Using Real- time Tissue Elastography for Breast Lesion Evaluation: Our Initial Experience. Journal of Ultrasound in Medicine. 2010 Apr; 29(4):551-63.