Characterization of lesions of the Breast by using diagnostic imagining Technique: Ultrasound Elastography

Hina Baig[1], Tabassum Begum[1], Rabia Akram[2], Mati-Ul-Haq[3], Sara Qadir Afridi[1]

ABSTRACT

Objective: To measure the diagnostic accuracy of Ultrasound Elastography in the differentiation of benign and malignant breast lesions from each other by simultaneously doing confirmation through histopathology of breast lesions.
Study Design: Cross-Sectional study.
Place and Duration: Department of Radiology, Mardan Medical Complex Hospital from June 1st, 2020 to December 1st, 2020.
Methodology: Patients who presented with breast lumps were included. Patients with cystic breast lesions, those who had had surgery or chemotherapy, and those who had signs of infection were all excluded from the study. After Ultrasound elastography evaluation of lesion, the results were compared with the histopathology of the lesion post-operatively. The diagnostic accuracy of ultrasound elastography were analyzed.
Results: The total f 165 women studies, with an average age of 45.4+10.5 years (range 34-56). The mean elastography value for benign lesions was 48.96kPa+42.32 and for malignant lesions was 132.78kPa+42.32 (P 0.001). Malignant lesions found on ultrasound elastography were 117 among 165 (71%) patients. Benign lesions of the breast were 48 among 165 patients (29%). When confirmed with histopathology, 122 patients (73.93%) were found to have malignant breast lesions in 165 patients while 43 had benign lesions (26.06%) which proved breast elastography has high diagnostic accuracy. The mean elastography value for benign lesions was 48.96kPa+42.32 and for malignant lesions was 132.78kPa+42.32 (P0.001).
Conclusion: Breast elastography imaging method minimize the frequency of biopsies of breast lesions conducted by pathologists saving cost and decrease suffering of patients and high diagnostic accuracy for breast elastography was observed.
Keywords: Breast, Benign Lesion, Malignant Lesion, Mammography, Ultrasound Ultrasonography, Histopathology

How to Cite This:
Baiq H, Begum T, Akram R, Haq MU, Afridi SQ. Characterization of lesions of the Breast using diagnostic imagining Technique Ultrasound Elastography. Isra Med J. 2022; 14(3): 117-120.DOI: https://doi.org/10.55282/imj.oa1315

INTRODUCTION

Breast cancer is the most common cancer in the world, contributing 12.5% of the total number of new cases diagnosed in 2020.[1] The most often used diagnostic methods in breast cancer are mammography and ultrasonography.[2]Cancer tissue is stiffer than normal breast tissue, and it is believed that the stiffening process begins in the early stage of cancer.[3] The idea of using this stiffness information for diagnosis evolved into a new diagnostic imaging method for detecting tissue elasticity (stiffness) and evaluating it noninvasively and objectively using ultrasound. Although both mammography and ultrasonography have a high sensitivity but both diagnostic tools have considerable drawbacks.[4] in thick breasts, mammography can produce false negative findings, while ultrasound's specificity in solid breast lesions is weak.[5] BIRADS criteria provide a large number of false positive outcomes, increasing the number of biopsies with a cancer detection rate of just 10%-30%. In benign lesions, several biopsies are conducted; thus, increasing the suffering of patients.[6]it is also time consuming and have financial implications. Ultrasound elastography was developed to address these constraints. Current elastography systems differentiate not only between benign and malignant tissue but also evaluate histological information by depicting the distribution of tissue stiffness, which may have the potential to evaluate the therapeutic effect of treatment with anti-cancer agents.[7] Ultrasound elastography is a non-invasive technique that assesses tissue deformation by measuring elasticity. Ultrasound elastography methods may be divided broadly into two categories: Quasi-static or strain based and dynamic or sheer

1. Assistant Professor of Radiology, Mardan Medical Complex, Mardan
2. Assistant Professor of Radiology, Pakistan Aeronautical Complex (PAC) Kamra
3. Trainee Medical Officer, Department of Radiology, Mardan Medical Complex, Mardan

Correspondence:
Hina Baig
Assistant Professor of Radiology,
Mardan Medical Complex, Mardan
Email: hinabg@gmail.com

Received for Publication: January20, 2022
1st Revision of Manuscript: June 23, 2022
2nd Revision of Manuscript: August24, 2022
3rd Revision of Manuscript: October 05, 2022
4th Revision of Manuscript: December 08, 2022
Accepted for Publication: December 26, 2022

wave based. The nature of external mechanical stimulus defines these methods.[8]The prevalence of malignant breast lesions was found to be 46 percent among breast lesions. Ultrasound elastography have sensitivity and specificity of 86 percent and 76 percent, respectively, in distinguishing benign and malignant breast lesions from each other with promising results.[9] so, this study was conducted with an objective to measure the diagnostic accuracy of Ultrasound Elastography in the differentiation of benign and malignant breast lesions from each other by simultaneously doing confirmation through histopathology of breast lesions.

METHODOLOGY

In this Cross-Sectional validation study, females presented with breast lumps were studied in the department of radiology, Mardan Medical Complex Hospital from June 1, 2020 to December 1, 2020. Non-probability sampling was used to select the samples. For sample collection, with a 95% confidence level, a sample size of 165 instances was computed, with a sensitivity of 91.8 percent and a 10% margin of error for ultrasound elastography, and a specificity of 88.37 percent and a 9 percent margin of error for elastography.

Informed consent was obtained, as well as demographic information (name, age, marital status, and several breast masses). Female patients having breast lumps/lesions and who were willing to participate in the study were included. Patients with cystic breast lesions, those who had had surgery or chemotherapy, and those who had signs of infection were all excluded from the study.

The patient was then screened for breast cancer by three radiologists utilizing an Aplio 300 ultrasound machine and an SWE with a high-frequency probe. Patients were labeled as positive having breast lesions and negative having no breast lesions.

Data Analysis: SPSS version 21 was used to enter and analyze all of the data. The quantitative data, such as age and the number of breast lesions, were expressed as mean and standard deviation. The qualitative characteristics, such as malignant breast mass (as determined by elastography), were provided as a percentage and frequency. To quantify the sensitivity, specificity, PPV, NPV, and diagnostic accuracy of elastography USG, a 2x2 table was created.

RESULTS

The total number of 165 females, with an average age of 45.4+10.5 years (range 34-56) were studied. Malignant lesions found on ultrasound elastography were 117 among 165 (71%) patients. Benign lesions of the breast were found to be 29%.

When confirmed with histopathology, 122 patients (73.93%) were found to have malignant breast lesions among 165 patients while 43 had benign lesions (26.06%) which proved breast elastography has high diagnostic accuracy. The mean elastography value for benign lesions was 48.96kPa+42.32 and for malignant lesions was 132.78kPa+42.32 (P0.001).

Shear wave elastography (SWE) had sensitivity of 91.8%, specificity 88.37%, PPV 95.72% and NPV 86% with overall diagnostic accuracy of 90.9%.

Table – I: Statistical analysis of breast elastography and histopathological diagnosis of positive and negative malignant cases in the study group. (N=165)

	Histopathology Diagnosis			p-Value	Kappa value
Elastography	Positive	Negative	Total	0.001	0.79
Positive (malignant)	112 (68%)	5 (3%)	117 (71%)		
Negative (benign)	10 (6%)	38 (23%)	48 (29%)		
Total	122 (74.2%)	43 (26%)	165% (100%)		

DISCUSSION

In the study, 165 patients with breast lesions were made to undergo ultrasound elastography. Later confirmatory histopathology biopsies were done. Results were compared to see false positive and false negative cases. Malignant lesions found on ultrasound elastography among 165 patients were found to be 71% but on confirmatory histopathology, malignant lesions were found to be 73.93%. Ultrasound elastography found 29.06% patients having benign lesions but on histopathology, the number of benign lesions was found to be 26%. This clarified in this study, the high accuracy of breast elastography for characterization of benign lesions from malignant breast lesions.

In another study sensitivity and specificity of ultrasound were 80% and 76% respectively and while ultrasound elastography showed higher sensitivity and specificity of 86.6% and 90.4% respectively in differentiation of malignant and benign breast lesions.[7]

In a meta-analysis, different studies were evaluated and compared among each other to find the role of breast elastograpy. In the study of Zhou et al, 193 women with 193 breast lesions were included to find the diagnostic performance of breast elastography. E_{max}, E_{mean}, and E_{min} were adopted to represent tissue stiffness. However, the diagnostic sensitivity (0.52, 0.55 and 0.77) and specificity (0.86, 0.78, and 0.78) of these three parameters were all low compared with other studies. Meanwhile, Youk et al reported high detection sensitivity (0.92) and specificity (0.92) of elastography, in which E_{max} represent tissue elasticity. Evans et al (2012) found that the detection sensitivity of elastography was 0.97 (0.92–0.99), whereas specificity was only 0.69 (0.56–0.80). On the contrary, Evans et al (2010) reported 0.53 detection sensitivity and 0.83 detection specificity. The variances in results might be attributed to the differences in characters of patients, ethnicity or elastography parameters.[8]

Similarly in another meta-analysis, which was confined to a total of 9 studies evaluated the diagnostic performance of elastography and conventional ultrasound, the area under the curve was 0.96 (95% CI, 0.94–0.97), yielding a sensitivity of 0.971 (95% CI, 0.941–0.986) and specificity of 0.801 (95% CI, 0.733–0.856). Breast elastography imaging methods seems to be a good quantitative method for differentiating breast lesions,

 DOI: https://doi.org/10.55282/imj.oa1315

recommending breast elastography for inclusion into routine imaging protocols.[9]

Breast cancer is the most frequently diagnosed cancer and the chief cause of cancer death among women all over the world, with an estimated 1.7 million cases and 521,900 deaths in 2012.[10] Breast cancers alone accounts for 25% of all cancer cases and 15% of all cancer deaths among females.[11] Its high incidence has led to research on new diagnostic imaging techniques for early diagnosis and to improve patient's mortality rate.[12]Breast ultrasound elastography is an advanced sonographic imaging technique which provides information on breast lesions in addition to conventional ultrasonography (US) and mammography.[13] Ultrasound elastography provides a non-invasive evaluation of a the "stiffness" of a lesion. Elastography is used to characterize a lesion that has already been detected in B mode. It is a characterization tool, not a detection tool. The main interest of breast elastography is to improve the characterization of benign and malignant breast lesion.[14]Another important point to differentiate benign/malignant lesions is that cancers appear larger in elastography than conventional ultrasound.[15]

It is a noninvasive imaging technique in which the local tissue strains are measured directly (e.g., the strain ratio/the young modulus) or indirectly (e.g., shear-wave velocity) after external stress (static or dynamic) is applied to compress the tissue. The addition of strain and shear wave elastography to B-mode ultrasonography has improved diagnostic performance.[16] The combination of strain and shear wave elastography results in a higher diagnostic results than each individual elastography modality.[17] Elastography size appears also better correlated with histological size.[18,19]

Ultrasound elastography has 86.5% sensitivity, 89.8% specificity, and 88.3% diagnostic accuracy in the differentiation of benign from malignant solid breast masses.[20-22]

Breast elastography has been acknowledged as a good diagnostic tool for both palpable and non-palpable breast masses.[23,24] Elastography can also increase the ultra-sonographer's confidence in his/her diagnosis before a biopsy is performed for confirmation.[25,26] It is a cost-effective method. It decreases the requirement for repeated biopsies for histopathology purpose to characterize benign lesions of the breast from malignant lesions.[27,28]

CONCLUSION

Breast elastography imaging method minimize the frequency of biopsies of breast lesions conducted by pathologists saving cost and decrease suffering of patients and high diagnostic accuracy for breast elastography was observed.

AUTHOR'S CONTRIBUTION

Baig H: Conceived idea, Data collection, Literature research, Proof reading and final approval
Begum T: Data collection, Literature research, Designed research methodology
Akram R: Data analysis, Literature research
Haq MU: Data collection, Literature research, Data analysis
Afridi SQ: Data collection, Manuscript Writing, Literature research, Proof reading and final approval

Disclaimer: None.
Conflict of Interest: None.
Source of Funding: None.

REFERENCES

1. Ahmed AT. Diagnostic utility of strain and shear wave ultrasound elastography in differentiation of benign and malignant solid breast lesions. Egyptian J Radiol Nuclear Med.2020; 51(70):1-9. DOI https://doi.org/10.1186/s43055-020-00181-7
2. Barr RG. The Role of sonoelastography in breast lesions. Semin Ultrasound CT MR.2018; 39(1):98-105.
3. Farooq F, Mubarak S, Shaukat S. Value of elastography in differentiating benign from malignant breast lesions keeping histopathology as the gold standard. Cureus 2019; 11(10):1-11
4. Keiteb AS, Lesions SA. Accuracy of elastography for differentiating benign and malignant breast lesions. Biomed J Sci Technical Res.2019; 16(2):11849-11856
5. Kim HJ, Kim SM, Kim B, Yun BL, Jang M, Ko Y et al. Comparison of strain and shear wave elastography for qualitative and quantitative assessment of breast masses in the same population. Sci Reports.2018; 8(6197):1-11 DOI: 10.1038/s41598-018-24377-0
6. Maaly MA, Lattif HA, Elsakhawy MM, Khallaf HM. Role of elastography in characterization of solid breast masses. Menoufia Med J.2019; 32(1):101-105.
7. Zahran MH, Shafei MME, Emara DM, Eshiba SM. Ultrasound elastography: How can it help in differentiating breast lesions? Egypt J Radiol Nuclear Med. 2018; 49(1):249-58.
8. Xue Y, Yao S, Li X, Zhang H. Value of shear wave elastography in discriminating malignant and benign breast lesions: a meta-analysis. Med.2017; 96(42):1-6
9. Liu B, Zheng Y, Huang G, Lin M, Shan Q, Lu Y, et al. Breast lesions: quantitative diagnosis using ultrasound shear wave elastography—a systematic review and meta-analysis. Ultrasound Med Biol. 2016; 42(4):835-847.
10. Shaukat U, Ismail M, Mehmood N. Epidemiology, major risk factors and genetic predisposition for breast cancer in Pakistani population. Asian Pac J Cancer Prev. 2013; 14(10):5625-5629 doi: 10.7314/apjcp.2013.14.10.5625
11. Yilmaz A, Aslan A, Inan I, Evren MC, TekesinK. Real-time elastography for differentiation of breast lesions. Pol J Radiol.2017; 82:664-669. DOI: 10.12659/PJR.902596
12. Yang H, Xu Y, Zhao Y, Yin J, Chen Z, Huang P. The role of tissue elasticity in differential diagnosis of benign and malignant breast lesions using shear wave elastography. BMC Cancer. 2020; 20(930): 1-10 DOI: https://doi.org/10.1186/s12885-020-07423-x
13. Zahran MH, Shafei MME, Emara DM, Eshiba SM. Ultrasound elastography. How can it help in differentiating breast lesions? Egypt J Radiol Nuclear Med. 2018; 49(1):249-258.

14. Barr RG, Zhang Z. Shear-wave elastography of the breast: value of a quality measure and comparison with strain elastography. Radiol. 2015; 275(1):45-53.
15. Faruk T, Islam MK, Arefin S, Haq MZ. The journey of elastography: background, current status, and future possibilities in breast cancer diagnosis. Clin Breast Cancer. 2015; 15(5):313-324.
16. Youk JH, Gweon HM, Son EJ. Shear-wave elastography in breast ultrasonography the state of the art. Ultrasonography. 2017; 36(4):300.
17. Barr RG. Future of breast elastography. Ultrasonography. 2019; 38(2):93-105.
18. Barr RG, Nakashima K, Amy D, Cosgrove D, Farrokh A, Schafer F et al. WFUMB guidelines and recommendations for clinical use of ultrasound elastography: Part 2 breast. Ultrasound Med Bio. 2015; 41(5):1148-1160.
19. Carlsen J, Ewertsen C, Sletting S, Vejborg I, Schäfer FK, Cosgrove D et al. Ultrasound elastography in breast cancer diagnosis. Ultras Med-Eur J Ultrasound. 2015; 36(06):550-565.
20. Liu B, Zheng Y, Huang G, Lin M, Shan Q, Lu Y et al. Breast lesions quantitative diagnosis using ultrasound shear wave elastography—a systematic review and meta-analysis. Ultrasound Med Bio.2016; 42(4):835-847.
21. Stoian D, Timar B, Craina M, Bernad E, Petre I, Craciunescu M. Qualitative strain elastography–strain ratio evaluation-an important tool in breast cancer diagnostic. Med Ultrasono.2016; 18(2):195-200.
22. Hari S, Paul SB, Vidyasagar R, Dhamija E, Adarsh AD, Thulkar S et al. Breast mass characterization using shear wave elastography and ultrasound. Diagn Interv Imag. 2018; 99(11):699-707.
23. Evans A, Sim YT, Thomson K, Jordan L, Purdie C, Vinnicombe SJ. Shear wave elastography of breast cancer: Sensitivity according to histological type in a large cohort. Breast.2016; 26:115-118. DOI: 10.1016/j.breast.2016.01.009
24. Ng WL, Rahmat K, Fadzli F, Rozalli FI, Mohd-Shah MN, Chandran PA et al. Shearwaveelastography increases diagnostic accuracy in characterization of breast lesions. Med. 2016; 95(12): 3146. DOI: 10.1097/MD.0000000000003146
25. Imtiaz S. Breast elastography: A new paradigm in diagnostic breast imaging. Applied Radiol. 2018; 47(3):14-20.
26. Feldmann A, Langlois C, Dewailly M, Martinez E, Boulanger L, Kerdraon O et al. Shear wave elastography (SWE) an analysis of breast lesion characterization in 83 breast lesions. Ultrasound Med Bio.2015; 41(10):2594-2604.
27. Seo M, Ahn HS, Park SH, Lee JB, Choi BI, Sohn YM et al. Comparison and combination of strain and shear wave elastography of breast masses for differentiation of benign and malignant lesions by quantitative assessment: preliminary study. J Ultrasound Med. 2018; 37(1):99-109.
28. Adel M, Kotb A, Farag O, Darweesh MS, Mostafa H. Breast cancer diagnosis using image processing and machine learning for elastography images. In 2019 8th International Conference on Modern Circuits and Systems Technologies (MOCAST) 2019. Website: [https://ieeexplore.ieee.org/document/8741846] Accessed on June 23, 2022. DOI:10.1109/MOCAST.2019.8741846