A COMPARATIVE STUDY OF STRAIN ELASTOGRAPHY WITH HISTOPATHOLOGICAL EXAMINATION FOR AXILLARY LYMPH NODE ASSESSMENT IN BREAST CANCER PATIENTS

Abstract

Background: Breast cancer is the most prevalent malignancy among women globally, with axillary lymph node status playing a pivotal role in determining prognosis and treatment. Traditional methods for evaluating lymph node involvement, such as axillary lymph node dissection (ALND) and sentinel lymph node biopsy (SLNB), are invasive and associated with significant morbidity, including lymphedema.

Materials and methods: This hospital-based prospective observational study was conducted at Assam Medical College and Hospital from February 2023 to January 2024 and included breast cancer patients with both palpable and non-palpable lymph nodes. The diagnostic performance of strain elastography was compared to histopathological results. Sensitivity, specificity, and accuracy of strain elastography were analyzed.

Results: A total of 42 female breast cancer patients were included in the study of which 32 patients had clinically palpable lymph nodes. On performing strain elastography of the lymph nodes, 26 patients (61.9%) showed hard consistency, 5 showed soft consistency and rest of the 11 patients had the indicator of strain elastography mode pointed in the intermediate zone. Comparing with histopathological examination of lymph nodes, strain elastography was found to have 80% sensitivity and a specificity of 64.71%.

Conclusion: Strain elastography shows promise as a non-invasive diagnostic tool for assessing axillary lymph node involvement in breast cancer, potentially reducing the need for invasive surgical procedures. This method could enhance patient comfort, reduce healthcare costs, and improve early diagnosis and treatment outcomes.

Keywords:
Breast cancer, axillary lymph nodes, strain elastography

Introduction

Breast malignancy is found to be the most frequently occurring malignancy in the world, among all females.[1,2] For a disease like breast cancer that is so prevalent worldwide, it is utmost essential to search for techniques that will utilise resources economically without

compromising the diagnostic accuracy. Furthermore, early diagnosis is the only way to increase the survival of breast cancer patients.

The common man is always more apprehensive of surgery and biopsy. Cancer still means death to a lot many people. The most common metastatic site in breast cancer is the axillary lymph node which is very important for deciding treatment.[2] Therefore, axillary lymph node metastasis in breast cancer must be detected at an early stage.

The breast is an integral part of the human body, especially in females. Apart from being the only major source of nourishment for a newborn, this organ is a primary way of identification of a female body. Hence, any sort of mutilation to the breast results in conflicts in the patient's mind regarding self-image. Thus, breast surgery has psychosocial implications which cannot be fairly understood by anyone except the patient.

Hence, in this study, I would like to compare the diagnostic accuracy of the non- invasive technique of strain elastography with that of lymph node histopathology so that patients with breast cancer, in at least the initial stages, who do not have metastatic axillary lymph node involvement are spared from invasive surgery. With more use of non-invasive techniques to assess axillary lymph nodes, breast cancer patients will be encouraged to take medical consultation as soon as they are aware of any symptom, which in turn will lead to earlier diagnosis.

This current study is done on confirmed cases of breast cancer with both clinically palpable as well as nonpalpable lymph nodes. The results of strain elastography mode of ultrasound are compared with the results of histopathological evaluation of lymph nodes in these patients.

Materials and Methods:

PLACE OF STUDY: Department of General Surgery,

Assam Medical College and Hospital, Dibrugarh

TYPE OF STUDY: Hospital-based Observational study

DURATION OF STUDY: From February, 2023 to January 2024

STUDY POPULATION: All confirmed cases of carcinoma breast in Assam Medical College And Hospital, Dibrugarh

SAMPLE SIZE: Considering the sensitivity of ultrasound elastography in diagnosing axillary lymph nodes in breast cancer to be 97.22%, sample size for the present study was calculated to be **42** with 95% confidence and margin of error of 5%.

SAMPLING TECHNIQUE: Consecutive sampling technique

INCLUSION CRITERIA: 1. All confirmed cases of carcinoma breast

EXCLUSION CRITERIA: 1. Patients unwilling to participate in the study

ETHICAL CLEARANCE: Ethical clearance was obtained from the Institutional Ethics Committee (Human studies) of Assam Medical College and Hospital, Dibrugarh, prior to commencement of the study.

METHODOLOGY:

The patient as well as the patient's relative were first asked for informed consent to participate in the study as per the informed consent in annexure 1 after the inclusion criteria had been fulfilled. Detailed history was taken with special emphasis on any swelling in and around the breast. After carrying out a detailed general and physical examination, an elaborate local examination of the breast and axilla was performed. After carrying out the routine blood investigations, while performing ultrasonography of the breast, the Strain Elastography mode was used for detailed imaging of the axilla. Next, after the pre-operative investigations were done, the patient was prepared

for the proposed surgery. The specimen obtained during axillary dissection was sent for histopathological evaluation. The results of lymph node biopsy were then compared with those of clinical and radiological methods.

Documentation of all relevant data, which include identification, history, clinical findings, diagnostic tests, operative findings, operative procedures was done for analysis.

TOOLS USED AND TECHNIQUES ADOPTED:

1) Detailed History
2) Clinical Examination-Local and Systemic
3) Strain Elastography
4) Histopathological examination of lymph nodes

DATA ANALYSIS:

Categorical data were presented as **frequency (percentage)** and continuous data as **mean ± standard deviation.** Sensitivity, specificity and accuracy of clinical and radiological methods of assessing axillary lymph nodes in breast cancer patients were calculated considering lymph node biopsy as gold standard. Chi-square test / Fisher's exact test was used to assess the statistical significance. Kappa statistics was also calculated to assess the agreement between the methods. A p-value of less than 0.05 was considered statistically significant.

RESULTS AND OBSERVATIONS:

Table 1. Age Distribution:

Age Group *(in years)*	Number *(n)*	Percentage *(%)*
18–30	3	7.14

31–40	9	21.43
41–50	14	33.33
51–60	12	28.57
61–70	4	9.52
>70	0	0.00
TOTAL	42	100.00
Mean ± S.D.	47.57 ±10.35 *years*	
Range	27–70 years	

Table 2. Results of Strain Elastography of Axillary Lymph Nodes:

Strain Elastography	Number *(n)*	Percentage *(%)*
Soft	5	11.90
Firm	11	26.19
Hard	26	61.90
TOTAL	42	100.00

Table 3. Histopathological Evaluation of Lymph Nodes:

Lymph Node Biopsy	Number *(n)*	Percentage *(%)*

Benign	17	40.48
Malignant	25	59.52
TOTAL	42	100.00

Table 4. Correlation Of Results of Strain Elastography with Histopathological Evaluation of Lymph Nodes:

Physical Examination	Histopathological Evaluation of Lymph Nodes		TOTAL
	Malignant	Benign	

	n	*%*	*n*	*%*	*n*
Malignant	20	80.00	6	35.29	26
Benign	5	20.00	11	64.71	16
TOTAL	25	100.00	17	100.00	42
False Positive Rate (FPR)			35.29%		
False Negative Rate (FNR)			20.00%		
Sensitivity			80.00%		
Specificity			64.71%		
Positive Predictive Value (PPV)			76.92%		
Negative Predictive Value (NPV)			68.75%		

DISCUSSION:

Age Distribution:

In the current study, the most common age group involved was 41-50 years with mean age of 47.57±10.35 years.

Rajbonshi et. al. studied the age distribution pattern of women suffering from breast cancer in Assam, India, using retrospective data from Dr. B. Borooah Cancer Institute, Assam, during the period from 2010 to 2012. 18.6% (majority) of the 1163 cases included in the study were in the age group 38-43 years.[3]

Bhattacharjee et. al. performed a prospective cohort study to find out the age distribution of 313 patients with breast cancer at State Cancer Institute Hospital, Guwahati, Assam, from 2016 to 2018, following up till 2019. The mean age was found to be 47.555 years and the median age was 47 years.[4]

A retrospective study by Reddy et. al. in 2023 across 4 centres in India to understand the epidemiology of breast cancer patients showed that the mean age of the study population was 52.6 (± 12.4) years while the median age was 53 years.[5]

In an Indian prospective observational study done by Chand et. al. in 2020 on 50 female breast cancer patients, there were two peaks in the age distribution, one at 41-50 years of age and the other at 51-60 years of age.[6]

A study was done by Hendrick et. al. in 2021, analysing the SEER 21 database for the incidence of invasive breast cancer between 2014 and 2017, to demonstrate the age distribution of the diagnosis of breast cancer according to race and ethnicity in women of the US. It was found that women from minority groups like Native Americans, Hispanics, non-Hispanic Blacks, and Asian American/Pacific Islanders, together had a 72% greater risk of getting diagnosed before attaining 50 years of age as compared with non-Hispanic White women.[7]

In a study done by **Valente et. al.**(2012) to evaluate the accuracy of predicting axillary lymph node positivity by physical examination, mammography, ultrasonography, and MRI, the mean patient age was 58 years (range 31 – 85 years).[8]

Strain Elastography:

In the current study, the sensitivity of strain elastography with respect to histopathological evaluation of lymph nodes was found to be 80% while the specificity was found to be 64.71%. The positive and negative predictive values were found to be 76.92% and 68.75% respectively. The false positive and false negative rates were 35.29% and 20% respectively.

Zhou et. al. (2022) conducted a study aimed at evaluating the properties of axillary lymph nodes in breast cancer by ultrasound elastography. The sensitivity, specificity and accuracy of UE were 97.22%, 95.45%, and 96.25%, respectively.

Marino et. al. (2019) conducted a study on lymph node imaging in patients with primary breast cancer wherein the sensitivity and specificity of ultrasonography were 87% and 53-97% respectively.

In a study conducted by **Choi et. al.**(2011) to evaluate the diagnostic utility of sonographic elastography in differentiating reactive and metastatic axillary lymph nodes in breast cancer,

elastography showed 80.7% sensitivity, 66.7% specificity and 73.4% accuracy, between elasticity scores of 2 and 3. On B-mode sonography, with a cutoff between scores of 1 and 2, the sensitivity and specificity were 74.2% and 78.8% respectively. When B-mode and elastographic sonography were combined, the sensitivity was higher, i.e. 87.1%, compared to B-mode sonography alone.

In a study done by **Esen et. al.** (2005) to evaluate the accuracy of grayscale and power Doppler ultrasound in the preoperative evaluation of axillary metastases in breast cancer patients with no palpable lymph nodes, the sensitivity, specificity,positive predictive value, negative predictive value, and accuracy of US were 86.49, 93.62, 91.43, 89.8 and 90.48%, respectively.

CONCLUSION:

With increasing knowledge and concerns among the common population regarding the outcomes of any operative procedure, it is imperative to explore newer methods and find ways to make any surgery less mutilating. Especially with breast surgeries, preservation of structures can add to the operative outcome by boosting the mental health of patients. As axillary lymph node status is the most important of all the prognostic factors in breast cancer patients, it must be meticulously assessed with all the available diagnostic tools. The advent of sentinel lymph node biopsy was a big step forward in this direction. However, the quest for lesser invasive modalities continues.

This study aimed to compare the clinical and non-invasive modalities of ultrasound and strain elastography with the current gold standard investigation of histopathological evaluation of lymph nodes. The sensitivity and specificity of strain elastography was quite comparable to the previous studies carried out on this front.

Most patients with breast cancer in this part of the world come for consultation pretty late. In my study too, while selecting cases, a lot of patients already had palpable enlarged axillary lymph nodes at presentation. However, with rising awareness of breast cancer, women have resorted to various screening methods, especially self-breast examination and mammography.

In this study, patients with histopathologically confirmed breast cancer were included. The findings of the physical examination of axillary lymph nodes were recorded. In

many patients, no lymph nodes were palpable in the axilla clinically but were found to be involved on performing ultrasonography of both the breasts and axillae. Ultrasonography helped in assessing the size of the lymph nodes, discerning their location, as well as finding out the number of involved lymph nodes, apart from characterizing the breast lump per se. The strain elastography mode of ultrasonography helped to assess the elasticity of the axillary lymph node studied. The harder the lymph node on elastography, the indicator points more towards the blue colour of the spectrum.

It is very important that more such studies are carried out on this front encompassing different non-invasive modalities for evaluating the status of involvement of the axillary lymph nodes in patients of breast cancer. With the advent and popularization of newer and more effective regimens of chemotherapy as well as various techniques of radiotherapy,

However, the study had some limitations. Firstly, in the strain elastography mode, parameters like elasticity score and strain ratio were not taken into account, making the study less objective. Secondly, the study did not include other imaging modalities like MRI and CT scans. Their inclusion would have made the comparison more meaningful. Thirdly, a bigger sample size could have made the study more comprehensive.

REFERENCES:

1. Tao Z, Shi A, Lu C, Song T, Zhang Z, Zhao J. Breast Cancer: Epidemiology and Etiology. Cell Biochem Biophys. 2015 Jun;72(2):333–8.
2. Miller J, Bonafede M, Kalra VB, Fajardo LL. Value analysis of digital breast tomosynthesis for breast cancer screening in a commercially-insured US population. Clin Outcomes Res. 2015 Jan;12:53–63.
3. Rajbongshi N, Nath DC, Mahanta LB. Exploring age distribution pattern of female breast cancer patients in Assam, India using gamma probability distribution model. J Appl Sci. 2016;16(11):496–503.
4. Bhattacharjee S, Deka S. Modeling the age distribution of breast cancer patients of North-East India. J Math Comput Sci. 2022;12:Article-ID.
5. Reddy VA, Sarin R, Panda D, Hanitha RNM, Jain J, Chatterjee S, et al. A Multi-centric retrospective study into the epidemiological distribution of breast cancer patients in India. J Cancer Res Ther [Internet]. 2023 [cited 2024 Aug 4]; Available from: https://journals.lww.com/cancerjournal/_layouts/15/oaks.journals/downloadpdf.aspx?an=01363817-900000000-99461

6. Chand P, Singh S, Singh G, Kundal S, Ravish A. A study correlating the tumor site and size with the level of axillary lymph node involvement in breast cancer. Niger J Surg. 2020;26(1):9–15.

7. Hendrick RE, Monticciolo DL, Biggs KW, Malak SF. Age distributions of breast cancer diagnosis and mortality by race and ethnicity in US women. Cancer. 2021 Dec;127(23):4384–92.

8. Valente SA, Levine GM, Silverstein MJ, Rayhanabad JA, Weng-Grumley JG, Ji L, et al. Accuracy of Predicting Axillary Lymph Node Positivity by Physical Examination, Mammography, Ultrasonography, and Magnetic Resonance Imaging. Ann Surg Oncol. 2012 Jun;19(6):1825–30.