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Role of Breast Ultrasound in Detection and Differentiation of Breast Lesions

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Abstract

Background: Breast lesion is an abnormal growth or mass in the breast tissue that can be found by imaging tests such as MRI, ultrasound, or mammography images. Lesions might show up as anomalies, calcifications, or lumps. Benign lesions can be identified by ultrasonography as pure, noticeably hyperechoic masses that represent interlobular stromal fibrous tissue. The lesions can also be shaped like an ellipse, wider than tall lesion, totally encapsulated by a thin, echogenic capsule that shows three or fewer gentle lobulations

Objective: The main purpose of this study is to assess the role of breast ultrasound for detection and differentiation of breast lesions.

Methodology: Cross sectional analytical study was conducted with 100 female's patients from Department of Radiology at Madina Teaching Hospital Faisalabad and Allied Hospital Faisalabad. The breast assessment has been done using ultrasound Toshiba xario, linear probe which have frequency of 7-15 MHZ. A statistical relationship was calculated of variables.

Results: The findings of these study showed relative differences between age and classification of lesion. In total patients, the minimum age was 18 and the maximum age was 69 years with an average age of 37.81 (SD=12.19). Total number of female patients ware 100. Normal ultrasound findings present in patients were 15 while abnormal were 85. In BI-RADS classification, it showed that a majority of the patients were classified in categories II and then in III. Categories IV, V and VI were represented in smaller proportions.

Conclusion: The study of ultrasound for screening breast lesions reveals significant insights into their respective efficacy in detecting pathologies. Ultrasound has a high diagnostic yield in differentiating malignant from benign lesions. Within the study multiple types of breast lesions were identified in the study. Majority of the females were identified with fibroadenoma. Secondly, simple cyst was present among females, however mainly the females were identified at a safe place with no lesion at all. Several other types of lesion are also present among ladies.

Keywords: Breast Cancer, Screening, benign and malignant lesions, Ultrasound

Introduction:

Breast lesion is an abnormal growth or mass in the breast tissue that can be found by imaging tests such as MRI, ultrasound, or mammography images. Usually, they are either malignant (cancerous) or benign (non-cancerous). Lesions might show up as anomalies, calcifications, or lumps. Benign lesions can be identified by ultrasonography as pure, noticeably hyperechoic masses that represent interlobular stromal fibrous tissue. The lesions can also be shaped like an ellipse, wider than tall lesion, totally encapsulated by a thin, echogenic capsule that shows three or fewer gentle lobulations.1 Spiculation and an echogenic halo are two ultrasound criteria for

malignant lesions. Greater anteroposterior than transverse dimensions, taller than wide, angular edges, significantly hypoechoic (in relation to fat), shadowing, calcifications, duct ectasia, branch pattern, and microlobulation. Factors like age, genetics, lifestyle, and geography can all affect the type of breast lesions. Up to 50% of women are estimated to have breast lesions at some time in their life. Breast lesions are rather prevalent. In 2020, 685 000 people died worldwide from breast cancer, accounting for 2.3 million new diagnoses. One crucial type of breast imaging is breast ultrasonography2.

In many countries, it is the standard first modality of breast imaging for people under 30. Breast situated with in superficial pectoral fascia. The anterior and posterior lamella are formed when the superficial fascia separates and encloses. From the upper clavicle to the seventh or eighth rib, or from the second to the sixth ribs, the breast expands vertically. The midline/lateral boundary of the sternum to the mid-axillary line is the measurement of the breast's length taken horizontally. The breast floor is formed by the deep pectoral fascia. The upper medial, upper lateral, lower medial, lower lateral, and center are the four quadrants of the breast. Superolateral quadrant extends somewhat along lower pectoralis major margin, extending toward the axilla.3 Cancers detected in women with dense breasts are larger and more often node positive. Interval cancers, which have a worse prognosis than screen-detected cancers, are 18 times more likely to occur in women with dense breasts. Given the prevalence of dense breast tissue and the challenges of identifying cancer in dense breasts with mammography, additional imaging modalities to detect mammographically occult breast cancer are needed. As of January 2018 in the United States, 30 states have “density notification” laws requiring women to be informed of their breast density, many mandating that women be informed that additional screening can detect cancer not visible with mammography. The concept of individualized, risk-based screening is increasingly taking hold. Breast Ultrasound performs a crucial part within the detection and differentiation of breast lesions, offering valuable insight into their characteristics and aiding in accurate diagnosis. Our study will identify breast lesions that increase the chances of successful treatment, particularly in case of breast abnormalities. Early detection leads to less invasive treatment and better prognosis.27

Methodology

A cross-sectional analytical study was conducted in the Department of Radiology at Madina Teaching Hospital and Allied Hospital, Faisalabad, over a period of four months. A total of 100 female participants aged 15–60 years were included through a defined sampling procedure. Participants included those with normal breast findings as well as those presenting with breast lesions, associated masses, nipple discharge, or nipple retraction. Females with a history of breast surgery or breast implants were excluded. Breast assessment was performed using ultrasonography with a Toshiba Xario ultrasound system equipped with a linear probe operating at a frequency range of 7–15 MHz. Ethical approval was obtained from the relevant institutional ethical committee, and written informed consent was taken from all participants. Confidentiality and anonymity of participant information were maintained, and participants were informed about their right to withdraw at any stage of the study. Data were collected through bilateral breast ultrasonography using systematic scanning techniques, including examination of all four breast quadrants (upper outer, upper inner, lower outer, and lower inner) along with axillary, parasternal, and clavicular regions. Data were entered and analyzed using Microsoft Excel and SPSS version 20. Quantitative variables were expressed as mean ± standard deviation, while qualitative variables were presented as frequencies and percentages.

Results:

Table 5.1: Statistics of Age

The descriptive statistics is used in summarization of dataset. It also helps in exportation of data and helps in further statistical findings. The following analysis of descriptive statistics gives information about age of participants.

Descriptive Statistics

N		Minimum	Maximum	Mean	Std. Deviation
Age	100	18.00	69.00	37.8100	12.19430

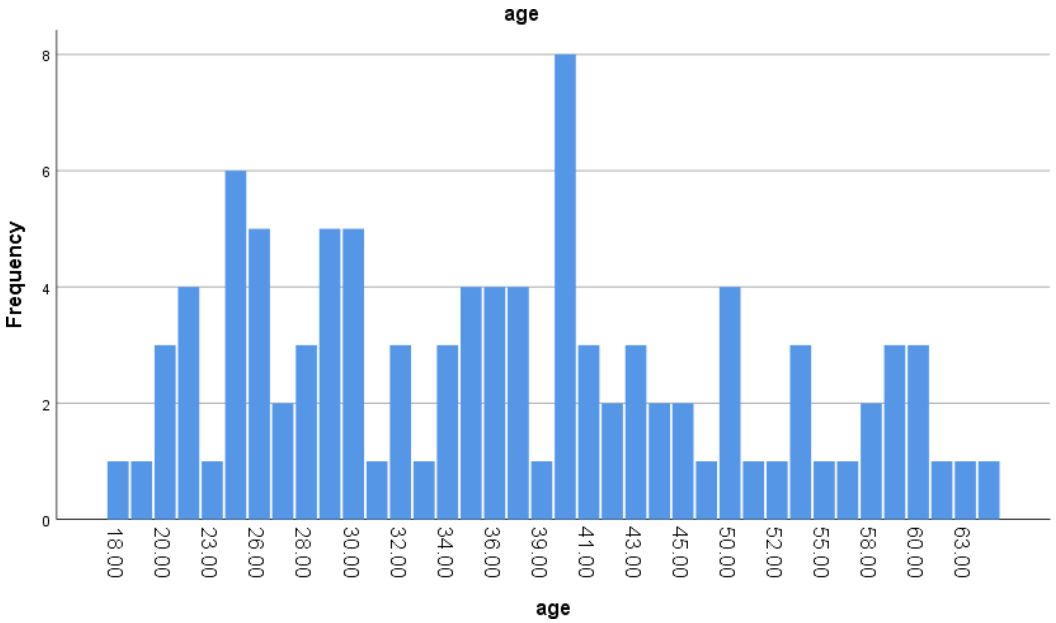
Table 5.1 Shows the statistics of age of patients reveals a mean age of 37.81 years with a standard deviation of 12.19430, indicating moderate variability within the sample.

Table 5.2: Frequency of Age

Age		Frequency	Percent
	18-20	5	**5.0**
	21-25	11	**11.0**
	26-30	20	**20.0**
	31-35	12	**12.0**
	36-40	17	**17.0**
	41-45	12	**12.0**
	46-50	5	**5.0**
	51-55	6	**6.0**
	56-60	9	**9.0**
	61-65	2	**2.0**
	66-70	1	**1.0**
	Total	**100**	**100.0**

Table 5.2 Display the frequency along percentage of age distribution of data collection. The age ranges from 18 to 70. The highest frequency ranges from 26-30 of age which is 20 and lowest ranges from 66-70 of which is 1.

Graph 5.1: Age Frequency



Graph 5.1 Shows the distribution of age among individuals. The y-axis categorizes the number of individual fall in respective age, while the x-axis displays the age of individual.

Ultrasound Findings / Lesion Characteristics	Category	Frequency (n)	Percentage (%)
Overall Ultrasound Findings	Normal	15	15.0
	Abnormal	85	85.0
Cyst	No cyst	77	77.0
	Simple cyst	15	15.0
	Complex cyst	8	8.0
Fibroadenoma	Present	45	45.0
	Absent	55	55.0
Galactocele	Present	1	1.0
	Absent	99	99.0
Mastitis	Present	3	3.0
	Absent	97	97.0
Fibrocystic Changes	Present	3	3.0
	Absent	97	97.0
Duct Ectasia	Present	7	7.0
	Absent	93	93.0
Intraductal Carcinoma	Present	4	4.0
	Absent	96	96.0
Lesion Location: Upper Outer Quadrant	Present	31	31.0
	Absent	69	69.0
Lesion Location: Upper Inner Quadrant	Present	15	15.0
	Absent	85	85.0
Lesion Location: Lower Outer Quadrant	Present	11	11.0
	Absent	89	89.0
Lesion Location: Lower Inner Quadrant	Present	11	11.0
	Absent	89	89.0

Calcifications	Present	7	7.0
	Absent	93	93.0
Lymph Nodes	Enlarged	26	26.0
	Normal	74	74.0

Among the 100 female participants, abnormal ultrasound findings were observed in 85% of cases, while 15% showed normal breast findings. Fibroadenoma was the most frequently detected benign lesion (45%), followed by cystic changes (23% including simple and complex cysts). Other findings included enlarged lymph nodes (26%), duct ectasia (7%), calcifications (7%), intraductal carcinoma (4%), mastitis (3%), and fibrocystic changes (3%). Lesions were most commonly located in the upper outer quadrant of the breast (31%)..

BI-RADS Category	0	10	10.0
	I	9	9.0
	II	56	56.0
	III	17	17.0
	IV	4	4.0
	V	3	3.0
	VI	1	1.0

According to BI-RADS classification, the majority of participants were categorized as BI-RADS II (56%), followed by BI-RADS III (17%), while malignant categories IV–VI represented smaller

Discussion:

The present research explored the role of breast ultrasound in detection and differentiation of breast lesions. A detailed evaluation of the retroareolar space was also conducted; visibility posterior to its surface is limited by posterior acoustic shadowing caused by the dense tissue. Ultrasound has a high diagnostic yield in differentiating malignant from benign lesions, in preoperative assessment and even in the detection of early cancers that are mammographically and clinically occult. The advantage of breast ultrasound increases with higher breast density and in young women where the sensitivity of mammography is low. In this study, the mean age of patients is 37.81 years, with a standard deviation of 12.19430, indicating moderate variability. The reported variation in age lines up with global epidemiological trends, highlighting the importance of targeted preventive and screening programs in this age range for early detection of carcinoma of the breast and better results. Studies such as those by A. and Di Loreto, et al (2017), titled "Role of mammography, ultrasound and large core biopsy in the diagnostic evaluation of papillary breast lesions" reported the imaging findings of papillary lesions of the breast. Differentiation of benign from malignant papillary lesions usually poses significant diagnostic problems because of the absence of distinctive clinical and radiological signs. Recent works have emphasized that diagnostic accuracy can be improved by evaluating the cytological or core biopsy features of the lesions. However, the management of papillary lesions is still controversial. Recently, Hoda and Rosen suggested that all papillary lesions diagnosed with core biopsy should be surgically excised regardless of their cytological and/or architectural characteristics. The main reason for this recommendation is the potential risk of sampling errors by core biopsy. In addition, the authors underline the fact that there are no long-term studies on papillary lesions diagnosed by core biopsy. Furthermore, the three largest series on the use of core biopsy for the diagnosis of papillary lesions are retrospective in their design and have a limited sample size. Nevertheless, data from these studies are encouraging and indicate that distinguishing benign from malignant papillary lesions on core biopsy samples should be possible with a careful histopathological evaluation. Some important points were emphasized

in order to improve the preoperative diagnostic accuracy. In particular, Philpotts and Liberman, in two independent reviews about the role of core biopsy, suggest that imaging histopathological agreement and the pathologist judgment should be considered as determining criteria for deciding on whether to remove the lesions surgically.[101] X. and Mao, et al (2020). Clinical value and application of contrast-enhanced ultrasound in the differential diagnosis of malignant and benign breast lesions. Breast cancers rank first among malignancies in females and clinical symptoms are mild at the early stage. At the time-point of diagnosis, breast cancer may have progressed to the intermediate or late stage, which is associated with high mortality. Therefore, early disease detection and diagnosis may provide a marked benefit for breast cancer treatment and prognosis, as well as the survival rate and quality of life of affected patients. At present, the diagnosis of breast cancer mainly depends on imaging methods. Along with the rapid development of imaging technologies in recent years, the ability of clinicians to differentiate between malignant and benign breast lesions has markedly improved.[102]

Jia et al. (2020), who reported that combining automated breast ultrasound (ABUS) or handheld ultrasound (HHUS) with mammography significantly improves breast cancer detection rates in women with dense breasts. The use of ultrasound as a complementary diagnostic tool is validated by these findings, highlighting its effectiveness in characterizing lesions that mammography alone might miss. The identification of indistinct margins and hypoechoic lesions points to the need for advanced imaging techniques to provide more definitive diagnostic information.[103]

The use of ACR and BIRADS classifications in this study provides a standardized way of categorizing breast cancer findings. The progression from lower to higher BIRADS categories, with a majority in categories IV and II, indicates varied levels of concern from benign to highly suspicious lesions. This classification system is integral to the diagnostic workflow, guiding clinical decision-making and management strategies. This aligns with the findings of Lee et al. (2021), who emphasized the importance of standardized classifications in breast cancer diagnostics. The use of BIRADS categories facilitates consistent communication among healthcare providers and ensures that patients receive appropriate follow-up and management based on their diagnostic findings. This standardized approach is crucial in improving the accuracy and efficiency of breast cancer diagnostics. Our research was conducted at Madinah Teaching hospital and Allied Hospital Faisalabad by used ultrasound machine (Toshiba xario) with linear probe of 7Hz for breast scanning test. A sample of 100 women had done in the study duration. Normal ultrasound findings present in patients were 15 while abnormal were 85. In BI-RADS classification, grade II had 56 females affected, grade III had second highest affected females, which is 17 in number and other affected frequencies of females that falls in BIRADS categories were 10 females in grade 0, 9 females in grade I, 4 females in grade IV, 3 females in grade V and grade VI had least affected female that was one.

Conclusion:

Ultrasound proves valuable information in detecting additional lesions, especially in dense breast tissue where mammography may be less effective. Within the study multiple types of breast lesions are identified in the study. Majority of the females are identified with fibroadenoma. Secondly simple cyst is present among females, however mainly the females were identified at a safe place with no lesion at all.

Limitations: Women do not feel comfortable while exposing their breast in front of male sonographers, due to this reason lesions remain undiagnosed.

Recommendations: Women with a family history of breast cancer, may need to start screening earlier and possibly more frequently. Organize events to educate people about breast cancer risks, symptoms and screening method.

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