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Role of ultrasound in detection of breast cancer: Current status

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Abstract
Breast Ultrasonography (US) is now a days considered the first line examination in the Screening of breast for detection of early breast lesions including cancer. Yet only few single center cohort studies analyzing breast US as screening tool could be found in literature. In spite of the fact that mammography is considered as the primary method for screening for its ability to detect microcalcifications, US is good in mass or mass like lesion detection, especially in the dense breast population as proved by the study of ACRIN 6666 (American College Of Radiology Imaging Network). A lobular hypoechoic area, lesion with ductal extension and dilatation, and a hypoechoic nodular lesion with a dilated lactiferous duct leading to the retroareolar region, were the common ultrasound findings in Ductal carcinoma in situ (DCIS) have been found. Recent introduction of Computer programmes have been developed and approved for use in clinical practice, like CAD (computer aided/assisted detection/ diagnosis), ABUS (Automated breast US), elastography and microbubbles in contrast-enhanced ultrasound. The standardized scanning, with addition of computer technology implementation and finding the picture of DCIS may prove an important radiation free modality for detecting early breast cancer. Results: Out of 176 cases in which we analysed US data and compared with histocytological findings sensitivity and specificity were 94.5% and 92.3% respectively. It was concluded that conventional USG examination can very well complement the diagnosis of breast lesions including cancer. Moreover, this method has the lowest cost/efficiency ratio and it is also the most non-invasive and easily accessible imaging method, with an accuracy comparable to MRI.

Keywords: Breast lesions; DCIS; ultrasound elastography; CAD; ABUS

Introduction
Improved breast screening methods has led to reduced mortality and the extent of surgery necessary for local and systemic control of breast lesions including breast cancer. Mammography has been established as the primary method for screening. Some 45% of nonpalpable cancers are detected as microcalcifications in mammographic studies [2]. These microcalcifications can also sometimes be visualized by modern ultrasound (US) equipment also without the potential risk of radiation exposure [1]. The high incidence of breast cancer and its slow evolution before diagnosis have led to research on new diagnostic techniques for earliest possible detection. The recent introduction of elastography has increased the specificity of USG and enabled earlier diagnosis of breast cancer. The use of quantitative elastography with strain ratio (SR) has tremendously improved the diagnostic accuracy in cases with equivocal Stavros criteria (stages 3 and 4 BIRADS). USG elastography differentiates between benign and malignant lesions on the basis of their elasticity: benign lesions have an elasticity similar to the surrounding tissue, while malignant lesions are harder than adjacent tissue of breast lesions. Malignant tumors have reduced elasticity and also display larger dimensions on elastography due to the accompanying desmoplastic reaction. Only a few single center cohort studies analysing breast US in for breast cancer screening are found in literature. Screening for breast cancer focuses on detecting occult cancer at an early stage with tumor size preferably less than 1 cm, negative lymph node status, and without evidence of distant spread. Ductal carcinoma in situ (DCIS) is a noninvasive form of breast cancer comprised of a heterogeneous group of lesions with diverse malignant potential. US is currently considered the first-line examination in the detection and characterization of breast lesions including the evaluation of breast cancer. The purpose of this study was to assess the role of US in the early detection. Although US is generally considered to be a highly operator dependent modality requiring a skilled sinologist equipped with state-of-the-art equipment and is considered less sensitive to find mammographically detected DCIS or early

cancer, a multicenter trial of combined screening with mammography and US (ACRIN 6666) reported higher cancer detection in high risk women who underwent annual ultrasound screening in addition to mammography compared to those that underwent mammography alone.

Aims and Objectives

The purpose of this study was to assess the role of USG in the early detection and differential diagnosis of breast lesions with the help of various parameters including elastography so that early and timely curative treatments may be instituted. A prospective study was conducted at Peerless hospital & B.K. Roy Research Center, Kolkata in the department of General Surgery with active involvement of department of Radiodiagnosis.

Materials and Methods

176 patients diagnosed as breast lesions between September 2017 and August 2019 were included in the present study. All the patients underwent thorough clinical examination in the supine as well as sitting positions. Consecutive patients presenting with breast symptoms or palpable breast lesions were assessed with conventional B-mode USG by single sinologist in radiodiagnosis department. Those confirmed to have a breast lesion were then assessed with US guided FNAC[3] or Core biopsy to get tissue disgnosis. Sonologist was requested in each case to localize the lesion first and then was requested to obtain the elastography strain image. For obtaining the elastography images 6.5-MHz linear probe was used by them. The elastography strain images were scored according to the Tsukuba elasticity score. Statistical analysis were performed for assessment of the role of USG elastography in the diagnosis of breast lesions.

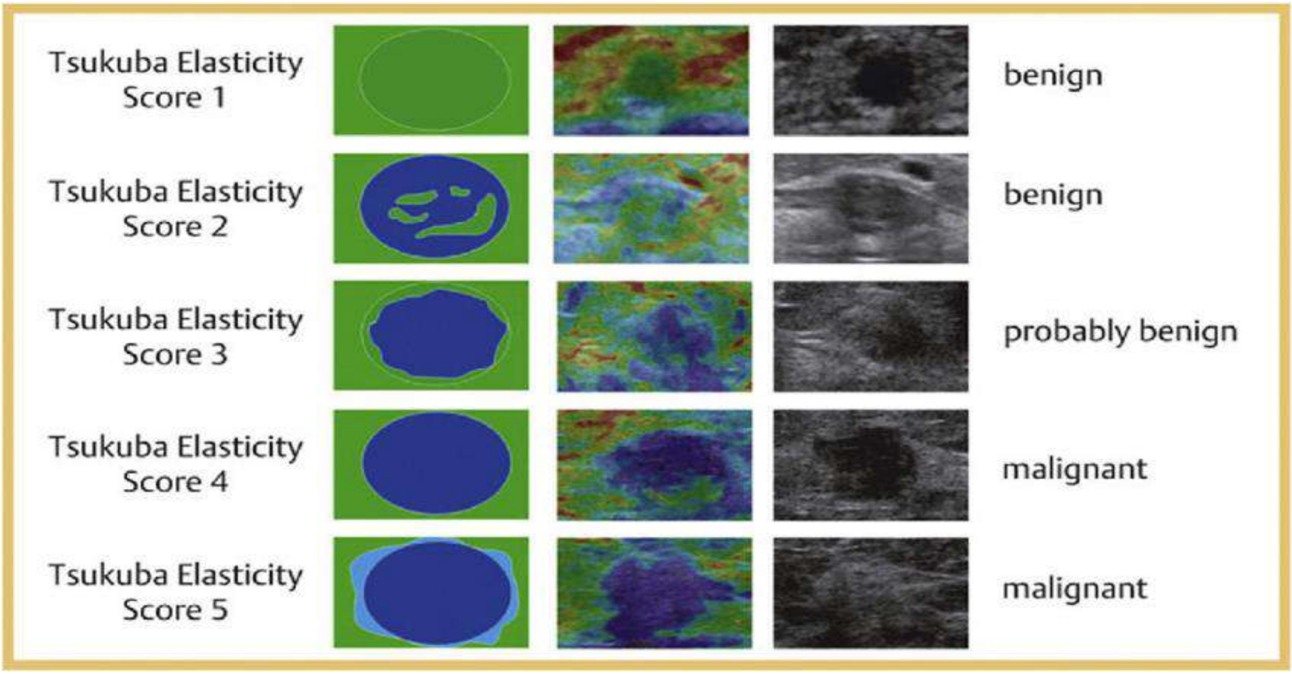

Fig: Type of Tsukuba Elasticity

The scoring system suggested by Itoh *et al*, [25] assigns a score from 1 to 5:
Score 1, Complete deformability of lesion
Score 2, Deformability of large amount of lesion with little stiff areas
Score 3, Presence of stiff area in center with peripheral deformability of lesion
Score 4, Completely stiff lesion.
Score 5, Entire lesion and surrounding area are stiff.
According to this scoring system, the results for elasticity are considered negative (Score 1), equivocal (Scores 2–3) and positive (Score 4–5).

Results

In this study we included 176 patients with breast lesions confirmed on US. The commonest age of the sufferer women was 5th decade (54, 30.7%) [Table 1]. There were 80 (45.5%) benign and 96 (55.5%) malignant lesions. Among the benign nodules the common lesions were fibroadenoma, simple cyst, and fibrocystic change. Among the malignant nodules, the most common lesion was infiltrative ductal carcinoma. In situ carcinoa was diagnosed in 26 cases only [Table 2].

Table 1: Age incidence of patients

Sl. No.	Age Group (Years)	No. of Cases	%
1	11-20	3	1.8
2	21-30	24	13.6
3	31-40	42	23.8
4	41-50	54	30.7
5	51-60	36	20.5
6	>61	17	9.6
Total		176	100

Table 2: Final pathology diagnosis of all lesions

Pathology diagnosis	Number of lesions	(%)
Fibroadenoma	23	13.1
Cysts	26	14.7
Fibrocystic disease	36	20.5
Invasive ductal carcinoma	65	36.9
In situ ductal carcinoma	26	14.8
Total	176	100

US Image interpretation: On Siemens Sonoelastography unit, green indicates medium tissue stiffness, blue indicates soft tissues stiffness, and red indicates harder tissue. The lesions with elastography score of 1, 2, 3 were considered benign and lesions with score of 4 and 5 were considered malignant. All patients underwent histopathological examination using Ultrasound guided Fine needle aspiration cytology (FNAC) (n = 98) or excisional biopsy (n = 78). Sensitivity and specificity of final diagnosis after histocytological confirmations were 94.5% and 92.3% respectively.

Discussion

The interpretation of breast nodules detected on B-mode US relies mainly on morphological criteria. To improve the accuracy of USG, additional techniques can be used, including Doppler and harmonic imaging. Over the last decade, there has been increasing interest in imaging the elasticity of biological tissues to complement information from standard anatomical US imaging. SE can differentiate between benign and malignant lesions on the basis of their firmness. The lesion's contours, dimensions, color, SR, and appearance on elastography are some of the criteria used for differentiating benign from malignant lesions. The SR represents the relative compliance stiffness of lesions compared with surrounding tissues. Malignant lesions, which are very stiff, deform less and are displayed in blue on the elastography images, whereas benign lesions deform [24]. For characterization of breast lesions, two elasticity scoring systems have been proposed: the Tsukuba score developed by Itoh and Ueno and another designed by the Italian Research Group after Locatelli, Rizzatto *et al*. There is ongoing research for establishing the correct values for better differentiation of benign and malignant lesions. We evaluated scoring system of Itoh and Ueno. Breast cancer in women younger than 40 years is rare and typically presents symptomatically. For symptomatic women, US is the primary modality for the evaluation of palpable masses in younger women. Palpable mass is not always equal to advanced cancer and DCIS may present as a palpable mass. In pathologic nipple discharge, for detection of intraductal mass or hypoechoic irregularly subareolar mass, and differentiating between intraductal papillomas and carcinoma in situ and invasive cancer, US is a useful diagnostic tool superior to mammography and may be worth including in the routine evaluation. DCIS now may account for as much as 30% of breast cancers in the general screening population and approximately 5% of breast carcinomas in symptomatic women. Breast Imaging Reporting and Data System (BIRAD) criteria are not sufficient for discriminating between malignant and benign lesions. Subcategories 4A, 4B, and 4C are useful in predicting the likelihood of malignancy, yet are more difficult for smaller lesions [26]. In the literature, a microlobulated mass with mild hypoechogenicity, ductal extension, and normal acoustic transmission was the most common ultrasound finding in DCIS, and 52% were presented most commonly as a mass. Chiang *et al* proposed three easily recognizable patterns of frequently encountered sonographic findings of DCIS: Cumulus type is usually nonspecific with ovoid or lobular hypoechoic area; Coral type is characterized by angular or irregular shape with ductal extension and dilatation; and Pipe type is characterized by a hypoechoic nodular lesion with a dilated lactiferous duct leading to the retroareolar region. The coral-type group was found in significantly more high-grade DCIS cases than the other types, and color Doppler ultrasound of a high-grade DCIS lesion revealed hypervascularity in the tumor. Several studies in literature have analysed the efficacy of breast ultrasound in Breast Cancers:

Table 3: Type of sensitivity %

	n	Cancers	Breast Ultrasound		Mammography	
			Sensitivity, %	Specificity, %	Sensitivity, %	Specificity, %
Stavros *et al*. 1995 [4]	747	125	98.4	67.8	76.8	–
Moss *et al*. 1999 [18]	559	256	88.9	77.9	78.9	82.7
Rahbar *et al*. 1999 [14]	161	38	95.0	42.0	89.0	42.0
Zonderland *et al*.1999 [19]	4,728	338	91.0	98.0	83.0	97.0
Berg *et al*. 2004 [20]	258	177	83.0	34.0	67.8	75.0

Computer technology implementation in breast imaging has greatly improved the outlook. Computer programs have been developed and approved for use in clinical practice; the application has been termed computer-aided (or assisted) detection, commonly referred to as CAD. CAD is useful in digital mammography for improving the performance of radiologists for decreasing observational oversights [21]. US is technique dependent, in contrast CAD will focus more on lesion diagnosis rather than lesion detection in US. Automated breast US (ABUS) [22] is a promising new technology that might be useful for screening for breast cancer in women with dense breast tissue. US elastography is a relatively newer imaging tool that reflects the stiffness of a lesion [24]. Shear wave elastography allows quantitative measurement of lesion stiffness in kilopascals and has the advantage of reproducibility. By the same notion, microbubbles and contrast-enhanced ultrasound are feasible approaches for sentinel lymph node identify identification in early-stage breast cancer [32], but do not play a screening role for the DCIS lesion itself. In our study too, the elastographic score matched well with our final diagnosis after complete workup of cases.

Conclusion

In conclusion, the sufferers of breast lesions should be subjected to routine breast US. Breast cancer cases can easily be diagnosed even in nonpalpable breast lesions. Rapidly evolving sonographic technology with high-frequency transducers and use of CAD, ABUS etc are likely to become established tool as the preferred radiation free disgnostic imaging tool for breast lesions including differentiation of breast cancer from benign lesion in near future.

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