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Original research article

Diagnostic performance in detecting breast cancer on combined mammography and ultrasound

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Abstract

Studies have also shown that the sensitivity for combined mammography-ultrasound ranges from 80 to 95% while mammography alone ranges from 56 to 89%, with a 3.2-28% added sensitivity from an adjunct ultrasound. Sensitivity with ultrasound as an adjunct to mammography is especially increased in dense breasts. 460 women underwent screening mammogram and adjunct ultrasounds were examined. 18 patients underwent tissue biopsies and histopathological correlation. The radiological data of all the patients for screening were retrieved from the Columbia Asia hospital data base prospectively. Women had both ultrasound and mammography were part of the study. The combined mammography and ultrasound showed a sensitivity of 100% age in detecting breast cancer, 81.2% in detecting breast pathology, 100% in detecting breast pathologies in dense breasts, 75% in detecting breast pathologies in fat breasts. Mammography alone had a sensitivity of 66.6% in detecting breast cancer, 31.2% in detecting breast pathology, 25% in detecting breast pathologies in dense breasts, 25% in detecting breast pathologies in fat breasts.
Keywords: Breast cancer, mammography and ultrasound

Introduction

Breast cancer is the most common cancer occurring in women worldwide with incidence rates of 80 per 100,000 in developed countries and 40 per 100,000 in developing countries. Many studies have proven that regular mammography screening reduces the breast cancer death rate by more than 30%.[1]

Studies have also shown that the sensitivity for combined mammography-ultrasound ranges from 80 to 95% while mammography alone ranges from 56 to 89%, with a 3.2-28% added sensitivity from an adjunct ultrasound. Sensitivity with ultrasound as an adjunct to mammography is especially increased in dense breasts. Ultrasound, however, has been associated with increased false positive diagnoses.[2]

Despite many Western studies demonstrating that the addition of ultrasound to screening mammography significantly increases the detection of breast cancer, it is not a current guideline under American College of Radiology recommendation for breast cancer screening.[3, 4]

There are no studies defining the additional value of routine ultrasound to screening mammography in an Indian population. The purpose of this study is to evaluate the role of routine ultrasound as an adjunct to screening mammography in the detection of breast cancer in an Indian population with a view to influencing local and national screening guidelines.

Methodology

This study was approved by the Institutional Review Board and Ethics Committee.

Study design: Prospective, observational study.
Study Population: 460.

460 women underwent screening mammogram and adjunct ultrasounds were examined. 18 patients underwent tissue biopsies and histopathological correlation. The radiological data of all the patients for screening were retrieved from hospital data base prospectively. Women had both ultrasound and mammography were part of the study. Mammography was performed with standard craniocaudal and medial lateral oblique views and a consultant radiologist would review the Images on 5 MP Barco monitor and then perform the ultrasound. A combined BIRADS was given at the end of both studies and

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retrospectively separate BIRADS were given on mammography and ultrasound with BIRADS 1 being normal, BIRADS 2 benign disease, BIRADS 3 atypical or intermediate but probably benign, grade 4 suspicious for malignancy and Grade 5 high suspicious for malignancy. Clinical and histopathological data was collected by reviewing the care 21 software and recorded on the excel sheet. Fine Needle Aspiration Cytology and excision biopsies were performed. For the purpose of the study any lesion which was given BIRADS 4 and 5 were taken as probability of cancer, BIRADS 3, 4 and 5 were considered as pathology, Lesions with BIRADS 3 were subjected to short interval follow up and few lesions had surgical excision. For easy understating of the data we have divided the radiological imaging according to the type of investigation (M= Mammography and U= ultrasound) and BIRADS grade (0 to 5). These were compared with follow up and final histopathological diagnosis. Statistical analysis was performed with 2 x 2 contingency table. Fisher's exact positivity test was used to know the association between mammography and ultrasound in breast cancer screening by using 2 x 2 contingency table.
Participants were women with no risk for breast cancer who presented for routine mammography and provided written informed consent. Each participant underwent mammography followed by ultrasound, both studies performed by the same Radiologist.

Inclusion criteria: Asymptomatic women 40 years of age and above coming for breast cancer screening.
Exclusion criteria: Males, women < 40 years of age, symptomatic women with swelling/ discharge from the nipple, women unable to provide informed consent, women who cannot undergo adequate mammography, women unable to undergo a breast ultrasound, pregnant or breast-feeding women, women with known breast cancer or any other malignancy.
The proforma was filled after both mammogram and ultrasound reports were validated. Final histopathological diagnosis was obtained in 18 patients.

Study Sample
A total of 460 women who came for annual health screening and who satisfied both inclusion and exclusion criteria were enrolled.

Results

Table 1: Diagnostic performance in detecting breast cancer on combined mammography and ultrasound

	Patients with breast Cancer	**Patient without breast cancer**	**Total**
Breast cancer detected on combined mammography and ultrasound	A=3=TP	B=4=FP	A+B=7
Breast cancer not detected on mammography and ultrasound	C=0=FN	D=41=TN	C+D=41
Total	A+C=3	B+D=45	A+B+C+D=48

Sensitivity = A/ (A+C) =3/3=100% (95% confidence interval: 0.30 -1).
Specificity =D/ (B+D) =41/45= 91% (95% confidence interval: 0.77-0.97).
PPV = A/ (A+B) = 3/7=42.8% (95% confidence interval: 0.11-0.79).
NPV= D/D+C= (41/41) =100% (95% confidence interval: 0.89-1).
Accuracy=A+D/ (A+B+C+D) =44/48=91.6. The two-tailed p value equals 0.00210.
The association between rows (groups) and columns (outcomes) is considered to be very statistically significant.

Table 2: Summaries of Salient Findings

	Sensitivity (U+M)	**Sensitivity M**	**Specificity (U+M)**	**Specificity M**
Breast Cancer	100	66.6	91	95.5
Breast Pathology	81.2	31.2	93.7	96.8
Dense Breast (Breast Pathology)	100	25	87.5	100
Fatty Breast (Breast Pathology)	75	25	85.7	85.7

The combined mammography and ultrasound showed a sensitivity of 100% age in detecting breast cancer, 81.2% in detecting breast pathology, 100% in detecting breast pathologies in dense breasts, 75% in detecting breast pathologies in fat breasts. Mammography alone had a sensitivity of 66.6% in detecting breast cancer, 31.2% in detecting breast pathology, 25% in detecting breast pathologies in dense breasts, 25% in detecting breast pathologies in fat breasts.
The combined mammography and ultrasound showed a specificity of 91% in detecting breast cancer, 93.7% in detecting breast pathology, 87.5% in detecting breast pathologies in dense breasts, 85.7% in detecting breast pathologies in fat breasts. Mammography alone had a specificity of 95.5% in detecting breast cancer, 96.8% in detecting breast pathology, 100% in detecting breast pathologies in dense breasts, 85.7 % in detecting breast pathologies in fat breasts.

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Table 3: Cancer detection rates

Modality	Cancers detected
Mammography	2
Combined ultrasound and mammography	3

Cancer detection rate for mammography = 1000x2/460=4.3.
Cancer detection rate for combined ultrasound and mammography = 1000x3/460=6.5.

Table 4: False positive rates

Modality	False positives
Mammography	2
Combine ultrasound and mammography	4

False positive rates for mammography= 100 x FP/ (FP +TN) = 100 x 2 /45= 4.4.
False positive rates for combined ultrasound and mammography = 100 x FP/ (FP +TN)=100 x 4/45= 8.8

Discussion

In our study, when evaluating breast density in 460 women who presented for breast cancer screening, we found 99 had fatty breast tissue (22%), 234 (51%) had scattered fibroglandular breast tissue, 118 (25.6%) had heterogeneously dense breast tissue, 7 (1.5%) had extremely dense breast tissue and 2 (0.43%) had implants in situ. According to the American College of Radiology, 10% women have fatty breasts, 10% have extremely dense breasts, 40% have scattered fibroglandular breast tissue and 40% have heterogeneously dense breasts [5]. In our study, more than half the number of women had scattered fibroglandular breast tissues, which might explain why all our breast cancers were detected in scattered fibrogalndular breast tissue.

Sudheer *et al*., suggested that the ultrasound characteristics of benign breast lesions are smooth and well circumscribed, hyperechoic, isoechoic or mildly hypoechoic lesions with a thin echogenic capsule, ellipsoid shape and minimal lobulations [6]. In our study, we found that these classic ultrasound appearances of breast pathologies were useful in making specific diagnoses. We encountered smooth, well-circumscribed anechoic, thin-walled cysts most commonly, followed by well-defined, laterally shadowing solid fibroadenomas, complex cysts containing internal echoes, fluid-filled tubular ectatic ducts, superficial echogenic sebaceous cysts, deeper well-defined echogenic lipomas. 4 benign lesions that were incorrectly reported on ultrasound as being suspicious for malignancy were proven on histopathology as proliferative breast tissue, fibroadenoma, lipoma and papilloma.

Sudheer *et al*., suggested that that the ultrasound characteristics of malignant breast lesions are spiculations, height: breadth ratio > 1, angular margins, shadowing, branching patterns, hypoechogenicity, calcifications, duct extensions and microlobulations [6]. In our study, we found similar characterisitcs in the biopsy proven malignant lesions, including ill-defined irregular hypoechoic masses, dilated tortuous ducts containing calcifications, microlobulations and internal vascularity.

Wendie E. Berg *et al*., in 2001 suggested that 43% breast cancers contained calcifications and that the ductal carcinoma calcifications are usually associated with a mass, while invasive breast carcinoma rarely manifested as a mass alone. He suggested that ductal carcinoma in situ manifests as a mass without calcification [7].

Burnside ES *et al*., studied 115 women who underwent image-guided biopsy of microcalcifications. Retrospectively, screening and diagnostic mammograms obtained before biopsy were analyzed in a blinded manner. Coarse heterogeneous, calcification was identified in 7%, amorphous in 13%, fine pleomorphic in 29%, fine linear in 10%. They concluded that microcalcification descriptors and categories in BI-RADS help predict the risk of malignancy for suspicious microcalcifications [8]. In our study, various calcifications were identified on mammography. Scattered round calcification was most commonly seen, followed by punctate calcification, amorphous diffuse bilateral calcification, vascular calcification, egg shell calcification, centrally lucent calcification, dermal calcification, popcorn calcification, fine linear, fine pleomorphic and coarse heterogeneous calcifications. In the 3 biopsy proven malignancies, fine linear branching calcifications and coarse microcalcifications were present.

Conclusion

- We found a significant improvement in the detection and characterization of breast cancer by the addition of ultrasound to the screening mammogram.
- The adjunct ultrasound improved the cancer detection rate by 2.2 similar to Berg *et al*., who showed a cancer detection rate improvement of 3.2.

References

1. Jacques Ferlay, Hai-Rim Shin, Freddie Bray, David Forman, Colin Mathers, Donald Maxwell Parkin. Estimates of worldwide burden of cancer in 2008: GLOBOCAN 2008 17 Jun 2010 Int J Cancer.

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2010 Dec;127(12):2893-917. Doi: 10.1002/ijc.25516

2. Tabar L, Yen MF, Vitak B, Chen HH, Smith RA, Duffy SW. Mammography service screening and mortality in breast cancer patients: 20-year follow-up before and after introduction of screening. Lancet. 2003 Apr;361(9367):1405-10.
3. Hellquist BN, Duffy SW, Abdsaleh S, Björneld L, Bordás P, Tabár L, *et al*. Effectiveness of population-based service screening with mammography for women ages 40 to 49 years: evaluation of the Swedish Mammography Screening in Young Women (SCRY) cohort. Cancer. 2011 Feb;117(4):714-22. Doi: 10.1002/cncr.25650. Epub 2010 Sep 29.
4. McCavert M, O'Donnell ME, Aroori S, Badger SA, Sharif MA, Crothers JG, *et al*. Ultrasound is a useful adjunct to mammography in the assessment of breast tumours in all patients. Int. J Clin. Pract. 2009 Nov;63(11):1589-94. Doi: 10.1111/j.1742-1241.2009.02102.x. Epub 2009 Aug 14.
5. Smith RA, Saslow D, Sawyer KA, *et al*., American Cancer Society guidelines for breast cancer screening: Update. CA Cancer J Clin. 2003;53:141-169.
6. Navneet Kaur, Amit Attam, Sudipta Saha, Bhargava SK. Breast Cancer Risk Factor Profile in Indian Women. JIMSA, 2011 Oct-Dec, 24(4).
7. Berg WA, Arnoldus CL, Teferra E, Bhargavan M. Biopsy of amorphous breast calcifications: pathologic outcome and yield at stereotactic biopsy. Radiology. 2001 Nov;221(2):495-503.
8. Burnside ES, Ochsner JE, Fowler KJ, Fine JP, Salkowski LR, Rubin DL, *et al*. Use of micro-calcification descriptors in BI-RADS 4th edition to stratify risk of malignancy. Radiology. 2007 Feb;242(2):388-95.