ORIGINAL RESEARCH

The diagnostic performance of mammography in detecting breast cancer

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ABSTRACT
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. Mammography was performed with standard craniocaudal and medial lateral oblique views and a consultant radiologist would review the Images on 5 MP Barco monitor. The sensitivity of mammography alone in detecting breast cancer on histopathological correlation was 66.6% while on adding ultrasound it was statistically more significant in identifying breast cancers with 100%, causing an improvement in sensitivity of 33.4%.
Key words: Mammography, breast cancer, asymptomatic women

Introduction

Ontario Health Technology Assessment Series (OHTAS) studied screening Mammography for Women Aged 40 to 49 years who had an average Risk for Breast Cancer. They found that the breast cancer incidence is lower in women aged40 to 49 years with sensitivity of 75% and specificity of 80% compared to women aged 50 to 69 years with sensitivity of 85% and specificity of 90%. Study concluded that increased density of breast tissue in younger women is mainly responsible for the lower accuracy and also as the proportion of breast cancers that occur before the age of 50 are more likely to be associated with genetic predisposition as compared with those diagnosed in women after the age of 50, mammography may not be an optimal screening method for younger women.[1]

In a study done by Smith *et al* in 2003, mammography was shown to reduce breast cancer related deaths across ages 40 to 70 years in women.[2]

McCavert *et al* in 2009, Mammography was found to be more sensitive in patients over 50 years of age. However, higher sensitivity was found in those screened by combined mammography and ultrasound, especially in patients below 50 years of age.[3]

Sensitivity with ultrasound as an adjunct to mammography is especially increased in dense breasts.

Crystal *et al* in 2003 screened 1517 asymptomatic women with dense breasts and normal mammogram and underwent adjunct ultrasound.7 breast cancers were diagnosed with cancer-detection rate of 0.46% with 4 carcinomas detected in high-risk women 3 in women with baseline risk. The cancer-detection rate in the subgroup of high-risk women was 1.3%, significantly higher than the cancer-detection rate of 0.25% in the baseline risk subgroup.[4]

Corsetti *et al* in 2011 described that one of the predictor of breast cancer risk was breast density and increased breast density is a predictor of breast cancer risk. He reported a cohort of 8865 women in which 19,728 screening examinations which he studied between 2001-2006. However in his study only women with heterogeneously dense and extremely dense breasts which he called as D3 and D4 underwent both mammogram and ultrasound, but fat and scattered breast tissues which he called D1 and D2 underwent mammography alone underwent mammography alone. He observed6.3 cancers per 1000 in his first year of screening in D1-D2 group and 8.3/1000 screens in the D3-D4 group. Cancer detection rate (CDR) was 5.98/1000 in all screening examinations but in D3-D4 breasts which underwent adjunct ultrasound, there was an additional CDR of

4.4/1000 screened women. He identified 21 cancers in first year with 0.95/1000 in women < 50 years and 1.16/1000 screens in women ≥ 50 years. 83.5% was the screening sensitivity for mammography alone in D1-D2 breasts in comparison to86.7% for mammography with ultrasound in D3-D4 breast which had higher sensitivity. He concluded that addition of ultrasound is likely to improve cancer detection in dense breasts.[7,8].

Methodology

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 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 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.

Results

Table 1: Diagnostic performance of mammography alone in detecting breast cancer

	Patients with breast cancer	**Patients without breast cancer**	**Total**
Breast cancer detected on mammography	A=2=TP	B=2=FP	A+B=4
Breast cancer not detected on mammography	C=1=FN	D=43 =TN	C+D=44
Total	A+C=3	B+D=45	A+B+C+D= 48

Sensitivity = A/ (A+C) =2/3=66.6% (95% confidence interval: 0.12- 0.98).
Specificity=D/ (B+D) =43/45=95.5% (95% confidence interval: 0.83-0.99).
PPV= A/ (A+B) = 2/4=50% (95% confidence interval: 0.091-0.90).
NPV = D/(D+C) =43/44=97.7% (95% confidence interval: 0.86-0.99).
Accuracy= A+D/A+B+C+D =45/48=93.7.

Fischer's exact test

The two-tailed p value equals 0.014. The association between rows (groups) and columns (outcomes) is considered to be statistically significant.

The sensitivity of mammography alone in detecting breast cancer on histopathological correlation was 66.6% while on adding ultrasound it was statistically more significant in identifying breast cancers with 100%, causing an improvement in sensitivity of 33.4%. The specificity, positive and negative predictive value, accuracy was 95.5, 50, 97.7%, 93.7 and 91, 42.8, 100%, 91.6 for mammography alone and combined mammography and ultrasound respectively. All were statistically significant differences.

The breast cancer lesion missed on mammography appeared as focal asymmetric breast tissue (fig s); ultrasound however showed this to be an ill-defined irregular hypoechoic mass with posterior accoustic shadowing and a few suspicious microcalcificaitons (fig t).

The two lesions correctly reported as suspicious for malignancy on mammogram demonstrated typical linear branching calcification (fig u) (dilated tortuous ducts were seen on ultrasound (fig v)) in one case and a typical spiculated mass in the other (fig w) (ultrasound: lobulated hypoechoic mass with asymmetric irregular margin, internal vascularity and microcalcification (fig x).

Table 2: Diagnostic performance of mammography alone in detecting breast pathology

	Patients with breast pathology	**Patients without breast pathology**	**Total**
Breast pathologies detected on mammography alone	A=5=TP	B=1=FP	A+B=6
Breast pathologies notdetected on mammography	C=11=FN	D=31 =TN	C+D=42
Total	A+C=16	B+D=32	A+B+C+D=48

Sensitivity = A/ (A+C) = 5/16=31.2% (95% confidence interval:0.12-0.58).
Specificity=D/ (B+D) =31/32=96.8% (95% confidence interval:0.96-0.82).
PPV = A/ (A+B) = 5/6=83.3% (95% confidence interval:0.36-0.99).
NPV=D/(C+D) =31/42=73.8% (95% confidence interval:0.57-0.85).
Accuracy=A+D/ (A+B+C+D) =36/48=75.

Fisher's exact test

The two-tailed p value equals 0.0120.The association between rows (groups) and columns (outcomes) is considered to be statistically significant.

In identifying all breast pathologies, the sensitivity was 31.2% and 81.2% on mammography alone and combined ultrasound respectively with improvement in sensitivity by 50% on adjunct ultrasound. The specificity, positive and negative predictive value, accuracy was 96.8, 83.3, 73.8%, 75 and 93.7, 86.6, 90.9% and 89.5 for mammography alone and combined mammography and ultrasound respectively for breast pathologies.

Discussion

The sensitivity of mammography alone in detecting breast cancer on histopathological correlation was 66.6% while added ultrasound provided a statistically significant higher sensitivity of 100% with a 33.4% improvement, clearly indicating that ultrasound better identifies characteristics of cancer than mammogram alone. Our findings are higher than other studies reporting 3.2% to 25% improvement in sensitivity. Mc Cavert *et al*studied 999 women in 2009 and found a sensitivity of 56.6% in detecting breast cancers on mammography alone and 80.8% on combined mammography and ultrasound with an improvement of 24%.[3] Zonderland *et al* studied 4811 women in1999 and suggested a sensitivity of 77.4% on mammography alone and 95.4% on combined mammography and ultrasound with an improvement of 18%. [7] Uchida *et al* studied 9082 women in 2008 suggested a sensitivity of 99% on mammography and88.7% on combined mammography and ultrasound there was improvement by 10.3%.[8] Corsetti *et al* studied 9157 women in 2008 and suggested a sensitivity of 83.5% on mammography and 86.7% on combined mammography and ultrasound there was improvement by 3.2%.[5] Leong LC *et al* studied 141 women in 20[12] and suggested a sensitivity of 88.5% on mammography and 100% on combined mammography and ultrasound there was improvement by 11.5%.[6] This relatively higher rate of improvement in our study may be related to the larger number of cancers detected in study, compared to the reported incidence of breast cancer worldwide and in India.

It is known that a normal mammogram does not exclude the presence of breast cancer. The cancer detection rate in our study was 4.34 with mammography and 8 with combined mammography and ultrasound. The adjunct of ultrasound to mammography has improved the cancer detection rate by 2.16 similar to Berg *et al* who showed a cancer detection rate improvement of 3.2. In comparison, the study reported by Crystal *et al* showed a surprisingly low cancer detection rate of 0.46 on combined mammography and ultrasound.[4]

We found a statistically significant drop in specificity of 4.5% when ultrasound is routinely added to screening mammography (mammography alone 95.5% vs. combined 91%), while McCavert *et al* demonstrated a 0.3% improvement in specificity in women over 50 years of age and a 0.5% drop in specificity in women below 50 years of age In their study, there was no statistically significant difference in the specificities of ultrasound and mammography.[3]

Conclusion

The sensitivity of mammography alone in detecting breast cancer on histopathological correlation was 66.6% while on adding ultrasound it was statistically more significant in identifying breast cancers with 100%, causing an improvement in sensitivity of

33.4%. The specificity, positive and negative predictive value, accuracy was 95.5, 50, 97.7%, 93.7 and 91, 42.8, 100%, 91.6 for mammography alone and combined mammography and ultrasound respectively. All were statistically significant differences.

References

1. Ont Health Technol Assess Ser.Screening mammography for women aged40 to 49 years at average risk for breast cancer: an evidence-based analysis. 2007;7(1):1-32. Epub 2007 Jan
2. Smith RA, Saslow D, Sawyer KA, *et al*. American Cancer Society guidelines for breast cancer screening: Update 2003. CA Cancer J Clin. 2003;53:141-169.
3. 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 2009Aug 14.
4. Crystal P, Strano SD, Shcharynski S, Koretz MJ. Using sonography to screen women with mammographically dense breasts. AJR Am J Roentgenol. 2003 Jul;181(1):177-
5. Corsetti V, Houssami N, Ghirardi M, Ferrari A, Speziani M, Bellarosa S,Remida G, Gasparotti C, Galligioni E, Ciatto S. Evidence of the effect of adjunct ultrasound screening in women with mammographically negative dense breasts: interval breast cancers at 1 year follow-up. Eur J Cancer. 2011 May;47(7):1021-6. Epub 2011 Jan 4.
6. Leong LC, *et al*. Supplementary breast ultrasound screening in Asian women with negative but dense mammograms-a pilot study. Ann Acad Med Singapore. 2012 Oct;41(10):432-9.
7. Zonderland HM, Coerkamp EG, Hermans J, van de Vijver MJ, van Voorthuisen The aorta is ectatic. Diagnosis of breast cancer: contribution of US as an adjunct to mammography. Radiology. 1999 Nov;213(2):413-22.
8. Uchida Hida K, Yamashita A, Kawase K, Kamiya K.al. Screening ultrasonography revealed 15% of mammographically occult breast cancers.2008;15(2):165-8. DOI: 10.1007/s12282-007-0024-x. Epub 2008 Jan 26.