



Effect of adding screening ultrasonography to screening mammography on patient recall and cancer detection rates: A retrospective study in Japan



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ABSTRACT

Purpose: To determine whether adding screening ultrasonography to screening mammography can reduce patient recall rates and increase cancer detection rates.

Materials and methods: We analyzed the results of mammography and ultrasonography breast screenings performed at the Total Health Evaluation Center Tsukuba, Japan, between April 2011 and March 2012. We also reviewed the modalities and results of diagnostic examinations from women with mammographic abnormalities who visited the Tsukuba Medical Center Hospital for further testing.

Results: Of 11,753 women screened, cancer was diagnosed in 10 (0.22%) of the 4529 participants who underwent mammography alone, 23 (0.37%) of the 6250 participants who underwent ultrasonography alone, and 5 (0.51%) of the 974 participants who underwent mammography and ultrasonography. The recall rate due to mammographic abnormalities was 4.9% for women screened only with mammography and 2.6% for those screened with both modalities. The cancer detection rate was 0.22% for women screened only with mammography (positive predictive value, 4.5%) and 0.31% for those screened with both modalities (positive predictive value, 12.0%).

Of the 211 lesions presenting as mammographic abnormalities investigated further, diagnostic ultrasonography found no abnormalities in 63 (29.9%) and benign findings in 69 (33.7%). The rest 36.4% needed mammography, cytological or histological examinations or follow-up in addition to diagnostic ultrasonography.

Conclusions: It is possible to reduce the recall rate in screening mammography by combining mammography and ultrasonography for breast screening.

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1. Introduction

In Japan, mammography is the basic modality of breast screening for women 40 years of age or older [1]. The age of the peak incidence of breast cancer in Japan is the late 40s, which is younger than that in the United States and many European countries [2]. However, the sensitivity and specificity of mammography are lower in women in their 40s than those of older ages [3]. To address this problem, an on-going randomized controlled trial is evaluating the effectiveness of combining mammography with ultrasonography [4].

Breast screening by ultrasonography is widely used in Japan, mainly in individual-based screening facilities. Mammography and

ultrasonography are complementary in detecting breast cancers such that the combination of both modalities can detect more cases of breast cancer than can either modality alone, particularly when the parenchyma is dense [5–7]. However, one of the problems of adding screening ultrasound to mammography is the increase in the recall rate [8,9]. When both mammography and ultrasonography are performed for screening, it has recently been recommended that the results of each modality be joined together to decide whether the woman needs to be recalled. We have already adopted this system.

The purpose of this study was to determine whether adding screening ultrasonography to screening mammography could reduce recall rates and increasing cancer detection rates.

2. Materials and methods

The study was approved by the Ethical Committee of Tsukuba Medical Center. Informed consent was not required.

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We reviewed the medical records of women who underwent breast screening in the Total Health Evaluation Center Tsukuba, Japan, between April 2011 and March 2012. Screening was individual-based and women could choose the modality. We informed these women that mammography screening was recommended once every two years for women aged 40 years or older by the government.

2.1. Screening mammography

The mammography equipment used in this study was an MGU-1000 D MAMMOREX Pe.ru.ru DIGITAL by Toshiba Medical Systems Co. Two, 5 M-pixel monitors were used to interpret mammograms. Results of mammography were interpreted by the agreement of a radiologist and a breast surgeon, who were both qualified by the Central Committee on Quality Control of Mammographic Screening in Japan.

2.2. Screening ultrasonography

Equipment used for screening ultrasound consisted of four ProSound Alpha 7 ultrasound consoles (Hitachi-Aloka Medical, Ltd.) with high-resolution linear array and broad bandwidth (4–13 MHz) transducers. Both color Doppler and Real-time Tissue Elastography® were available. The ultrasound examination was performed by 1 of 16 sonographers in turns. Ten of the sonographers finished a 2-day educational program by the Educational Committee of the Japan Association of Breast and Thyroid Sonology. At the time of the ultrasound examination, mammograms had not been assessed.

Ultrasonogram results were evaluated by a single radiologist using the breast cancer screening criteria of the study group from the Japan Association of Breast and Thyroid Sonography [10]. Criteria included only B-mode findings, but information from color Doppler and elastography were added for the evaluation. Judgments were made by looking at ultrasound pictures and movies, when recorded, together with evaluations by sonographers who had performed the examination.

Imaging of previous examinations could be referred to at the time of the assessment of each modality. Mammography and ultrasonography results were compared to each other before deciding whether to recall the woman for more tests.

2.3. Data collection

Women in category 3 or more were recalled and referred to hospitals. Many went to Tsukuba Medical Center Hospital, which is next to the Total Health Evaluation Center Tsukuba. At Tsukuba Medical Center Hospital, images of the screening could be seen using PACS. From the Medical Center Hospital's records, we collected data from women who had been recalled for further testing

as a result of abnormal findings on screening mammograms. We retrospectively evaluated the results of the screening mammograms and of any follow-up examinations.

2.4. Statistical methods

The definitive diagnosis of cancer was made by pathological analysis. Using the cancer diagnosis as the reference standard, we calculated the positive predictive value as the percentage of recalled women who tested positive for cancer. Positive predictive values were calculated for screening mammography alone, screening ultrasonography alone, and for the combination of the two and compared with the Chi-square test.

3. Results

The number of participants, number of participants who were recalled, and number of cancers of each modality according to age are shown in Table 1. Screening mammography is recommended for women 40 years old or older, so most women under the age of 40 years underwent ultrasonography only.

Among 11,753 women screened, 431 women (3.7%) were recalled and 38 cancers (0.32%) were detected. The overall positive predictive value (PPV) was 8.8% (Table 2). The recall rates were 4.5% for mammography and 2.6% for ultrasonography. Of the 5503 women, 13 (0.24%) were diagnosed with cancer by screening mammography and 28 of the 7224 women (0.39%) by screening ultrasonography. Among 5 of the 974 women (0.51%) who had both mammography and ultrasonography and were diagnosed with cancer, 2 cancers not seen on mammography were detected only by ultrasonography. The cancer detection rate was 0.22% for women screened only with mammography (positive predictive value, 4.5%) and 0.31% for those screened with both modalities (positive predictive value, 12.0%; $P < 0.01$).

Among the 248 women recalled because of mammographic abnormalities, 207 visited Tsukuba Medical Center Hospital. Of these, 187 were not screened with ultrasonography, and 20 had been screened with both mammography and ultrasonography. Among the 187 recalled women, 56 (29.9%) underwent diagnostic ultrasonography by a radiologist or breast surgeon at the outpatient clinic and were found to have no abnormalities. They were told to resume their regular screening schedule. An outpatient diagnostic ultrasound examination found benign lesions in another 63 (33.7%) women. They were also told to resume their regular screening schedule. The remaining 68 women (36.4%) underwent additional mammography, ultrasonography, cytological, or histological examination, or other follow-up examination.

The 187 women with abnormal screening mammographic findings had 211 lesions (Table 3). For each lesion diagnostic ultrasound was performed with reference of the screening mammograms to solve the cause of mammographic abnormalities. Among these,

Table 1
Number of breast cancer screening examinations in the study comparing the recall and cancer detection rates of mammography to those of ultrasonography, separately and together, in 11,753 Japanese women, by age group.

Age group, years	Women screened, <i>n</i>		Women recalled, <i>n</i>		Women in whom cancer was diagnosed, <i>n</i>	
	MG	US	MG	US	MG	US
≤29	0	311	0	3	0	0
30–39	80	1853	1	37	0	2
40–49	2102	2105	120	88	1	12
50–59	2171	2020	92	45	5	9
60–69	996	829	28	16	5	3
70≤	154	106	7	2	2	2
All ages	5503 ^a	7224 ^a	248	191	13	28

MG: mammography; US: ultrasonography.

^a 794 women had both MG and US.

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