Breast Cancer Screening by Palpation, Ultrasound, and Mammography

Hiroshi Morikubo

Summary. Breast cancer screening was carried out in 3455 subjects living in Tochigi Prefecture during 1999. All subjects underwent palpation, ultrasonic examination and mammography. The detection rate of each method was examined and compared. Breast cancer was discovered in 11 (0.32%) cases, of which 72.7% was early cancer. Three cases were discovered by ultrasonic examination alone, while 4 cases were discovered by mammography alone. No case was discovered by palpation only. Those that were discovered by ultrasonic examination were detected as a mass (two schirrhous carcinoma, one papillotubular carcinoma). Three cases that were discovered by mammography showed microcalcification without forming a mass and all were noninvasive carcinoma. In conclusion, mammography and ultrasonic examination were considered complementary to each other for the detection of breast cancer in mass screenings.

Key words. Breast cancer screening, Ultrasound, Mammography

Introduction

The Tochigi Public Health Service Association has conducted breast cancer screening on citizens, partly using ultrasound in combination with palpation, since 1988. Since 1997, ultrasound examination has been performed on all examinees, a total of about 20 000 persons a year, which has improved the detection and early detection rates of breast cancer (Table 1). In 1999, as part of a research project conducted in Tochigi Prefecture, the Association performed breast cancer screening using three independent modalities concomitantly, including mammography, ultrasound, and palpation. Furthermore, we conducted a follow-up study on examinees who joined the research project in 2000 to evaluate the sensitivity and specificity of each modality. Currently, the Tochigi Public Health Service Association is performing breast cancer screening by combining ultrasound and palpation or ultrasound and mammography, depending on the selection of local authorities.

Department of Radiology, Rosai Hospital for Silicosis, 632 Takatoku, Fujihara-machi, Shioya-gun, Tochigi 321-2523, Japan

Table 1. Implementation overview of breast cancer screening by Tochigi Public Health Service Association

	1988–1996: some cases were examined using ultrasound in combination with palpation	1997: all cases were examined by palpation and ultrasound	1999: all cases were examined by palpation and ultrasound; some cases were examined in combination with mammography	1999: research project on combined use of palpation, ultrasound, and mammography
Total number of examinees	174 521	17 958	27 206	3455
Rate of cases requiring detailed examinations	1.8%	4.0%	5.7%	15.3%
Detection rate of breast cancer	0.06%	0.13%	0.12%	0.32%
Early detection rate of breast cancer	47.7%	69.6%	69.7%	72.7%

Table 2. Examination methods of ultrasound and mammography

	Ultrasound	Mammography
Devices	7.5 MHz mechanical scanner or electronic linear scanner (Aloka SSD-900)	Toshiba MGU-200B
Scanning and imaging direction	Bilateral whole-breast ultrasound using freehand technique by a technician	Mediolateral oblique (MLO) view Unilateral
Image recording media	MO disk for digital still image	Screen-film system (Kodak Min-R2000/Min-R200)
Time required for examination	4 min	3 min
Interpretation and diagnostic method	Interpretation of still images by ultrasound specialists, 200 cases/h	Independent evaluation by two doctors

Methods

In the research project conducted in 1999, the number of examinees who had received breast cancer screening by the combined use of three modalities was 3455 (mean age, 52 years), the rate of cases requiring detailed examinations was 15.3%, the detection rate of breast cancer was 0.32%, and the early detection rate of breast cancer was 72.7%. This high rate of cases requiring detailed examinations was the result of differences in the independent evaluation of two doctors on the mammography results and between modalities. Table 2 shows the ultrasound and mammography examination methods.

Results

Among 11 breast cancer cases detected by screening, no case was detected by palpation alone, 3 cases were detected by ultrasound alone, and 4 cases by mammography alone. These results are shown in Tables 3 and 4.

As shown in Table 3, all the breast cancers detected by ultrasound alone were invasive ductal carcinoma, and a tumor image was demonstrated by ultrasound in these cases. The age of all three examinees was 50 years or older. Also, as shown in Table 4, three of four cases of breast cancer found by mammography alone were noninvasive ductal carcinoma, and microcalcification was detected by mammography in these cases. Three of four examinees were under 50 years old. Table 5 shows the detection rates of breast cancer by modality.

According to the results of the follow-up study on 3455 examinees who joined the research project in 1999, 1842 examinees received mass breast cancer screening or

Table 3. Results in cases detected by ultrasound alone

Case no (age, years)	Ultrasound findings	Mammography findings	TNM stage classification	Pathological diagnosis
Case 1 (50)	Tumor: detailed examination required	Benign calcification	Stage I	Scirrhous carcinoma
Case 2 (55)	Tumor: detailed examination required	Normal lymph nodes	Stage I	Scirrhous carcinoma
Case 3 (68)	Tumor: detailed examination required	Normal	Stage I	Solid tubular carcinoma

Table 4. Results in cases detected by mammography alone

Case no (age, years)	Ultrasound findings	Mammography findings	TNM stage classification	Pathological diagnosis
Case 1 (36)	Cyst	Calcification: detailed examination required	Stage 0	Noninvasive ductal carcinoma
Case 2 (54)	Normal	Calcification: detailed examination required	Stage 0	Noninvasive ductal carcinoma
Case 3 (47)	Normal	Calcification, tumor	Stage II	Papillotubular carcinoma
Case 4 (40)	Normal	Calcification: detailed examination required	Stage 0	Noninvasive ductal carcinoma

Table 5. Detection rate of breast cancer by modality

	Palpation	Ultrasound	Mammography	Concomitant use of the three modalities
Detection rate of breast cancer	0.09%	0.20%	0.20%	0.32%

Table 6. Sensitivity and specificity of each modality and combined methods

	Palpation	Ultrasound	Mammography	Palpation + ultrasound + mammography	Ultrasound + Mammography
Sensitivity	27.3%	63.6%	63.6%	100%	100%
Specificity	95.4%	95.5%	91.1%	84.2%	88.1%

examinations at medical institutions in 2000. We confirmed that none of them was newly diagnosed as having breast cancer. From the results of the research project in 1999, the sensitivity of ultrasound, mammography, and palpation alone was 63.6%, 63.6%, and 27.3%, respectively. The sensitivity of the concomitant use of three modalities and that of two modalities, ultrasound and mammography, were 100% (Table 6).

Discussion

In terms of the ages of examinees in whom breast cancer was detected and the examination modality, contrary to our expectations, mammography was effective for those under 50 years because many cases of microcalcification were found in relatively younger examinees.

As already mentioned, the types of breast cancer detected by ultrasound and mammography are clearly different. The characteristics of each modality affect the types of cancer detected. Ultrasound examination reveals more invasive ductal carcinoma associated with relatively small tumors. On the other hand, mammography tends to detect more noninvasive ductal carcinoma associated with microcalcification. Although it is difficult to accurately determine the actual ratio of these types of cancer, this research project showed the ratio of these types of cancer to be almost equal.

In conclusion, mass screening for breast cancer becomes effective when ultrasound and mammography are concomitantly used. With this method, each modality functions at almost the same level in a complementary way to achieve adequate detection and early detection rates of breast cancer.