Accuracy of determining preoperative cancer extent measured by automated breast ultrasonography

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Abstract

Purpose. The aim of this study was to determine the accuracy of measuring preoperative cancer extent using automated breast ultrasonography (US).

Materials and methods. This retrospective study consisted of 40 patients with histopathologically confirmed breast cancer. All of the patients underwent automated breast US (ABVS; Siemens Medical Solutions, Mountain View, CA, USA) on the day before the surgery. The sizes of the lesions on US were measured on coronal multiplanar reconstruction images using the ABVS workstation. Histopathological measurement of tumor size included not only the invasive foci but also any in situ component and was used as the gold standard. The discrepancy of the tumor extent between automated breast US and the histological examination was calculated.

Results. Automated breast US enabled visualization of the breast carcinomas in all patients. The mean size of the lesions on US was 12 mm (range 4–62 mm). The histopathological diagnosis was ductal carcinoma in situ (DCIS) in seven patients and invasive ductal carcinoma in 33 patients (18 without an intraductal component, 15 with an intraductal component). Lesions ranged in diameter from 4 to 65 mm (mean 16 mm). The accuracy of determination of the tumor extent with a deviation in length of <2 cm was 98% (39/40).

Conclusion. Automated breast US is thought to be useful for evaluating tumor extent preoperatively.

Key words Breast cancer · Intraductal carcinoma · Ultrasonography · Automated
Materials and methods

Patients

This retrospective study was conducted with the approval by the institutional review board. From January 2010 to April 2010, automated breast US was performed in 40 consecutive patients (ages 31–76 years; mean 54 years) with pathologically proven breast cancer.

Automated breast US

Automated breast US was performed using the ABVS, which consists of the ABVS module with the core components of flexible arms, touch screen monitor, and scanner (transducer, scan box, and screen-membrane for contact). ABVS acquires $15.4 \times 16.8 \times \text{maximum} 6 \text{ cm}$ volume data sets of breast automatically, in one sweep, with a wide-aperture linear array transducer (5- to 14-MHz bandwidth) that utilizes Siemens' proprietary Hanafy lens technology. For the ABVS scanning, customized presets were used to optimize the depth, gain, frequency, and view.

Automated breast US was performed on the day before the surgery. One radiologist and one radiographer obtained one or two views of the affected breast. In this study, the typical scanning time of ABVS was 60 s per scan, and the system captured the volume data at slice intervals of 0.5 mm. The scanning direction was from the periphery of the mammary gland to the nipple; the procedure was stopped after the nipple was scanned completely. After 3D volume data acquisition, the data were automatically sent from the ACUSON S2000 ABVS to the ACUSON S2000 ABVS workstation and reviewed in multiple orientations using an MPR display.

Data evaluation

In the interpretation of automated breast US, ductal dilatation radiating from the main tumor, $^2$ ductal extension, or arborization $^5$ was regarded as positive for intraductal carcinoma (Fig. 1). All 3D volume data were evaluated by a radiologist with 17 years of experience in breast US who was unaware of the mammographic and hand-held US findings. The maximum sizes of the lesions on US were measured on coronal MPR images using the ACUSON S2000 ABVS workstation (Fig. 1).

At our institution, tumors are usually resected with a 2-cm surgical margin. The tumor specimens after breast-conserving surgery were sliced into contiguous 5-mm sections. Cases with cancer foci at the margin were classified as showing a positive surgical margin. Histopathological measurement of tumor size included not only the invasive foci but also the in situ component and was used as the gold standard. The largest dimension of the tumor was taken as that perpendicular to the plane of the section of the specimen. The discrepancy of the tumor extent between automated breast US and the histological examination was calculated.

Fig. 1. A 39-year-old woman had invasive ductal carcinoma with an extensive intraductal component. A Axial reconstruction image of automated ultrasonography (US) shows arborization of the ducts (arrows) in the upper-outer quadrant of the right breast. B Axial reconstruction image of automated US shows ductal extension (arrows) in the subareolar area. C Coronal reconstruction image of automated US shows arborization of the ducts in the upper-outer quadrant of the right breast. N, nipple. The tumor extent was recognized as segmental distribution (triangle). Quadrantectomy specimens revealed an invasive ductal carcinoma measuring 5 mm in diameter with a surrounding extensive intraductal component.