Report

Breast cancer measurements with magnetic resonance imaging, ultrasonography, and mammography

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Summary

Background: Accurate measurement of the size of breast cancers becomes more important as breast cancer therapy advances. This study reports the accuracy of magnetic resonance imaging (MRI), ultrasonography and mammography for measuring the largest breast cancer diameter in comparison to the pathology measurement.

Materials and methods: Fourteen breast cancers were examined in 13 women with MRI, ultrasonography and mammography. The age range was 31-73 (mean 56). Six of the cancers were in premenopausal women. The MRI was performed with the intravenous injection of gadolinium based contrast agent and a three dimensional fast spoiled gradient echo sequence with fat suppression. The largest cancer diameter was measured with each imaging technique and compared to the largest cancer diameter measured at pathology.

Results: At pathological examination cancers ranged from 0.6 to 6 cm (mean 2.2) in largest diameter. MRI measurements had the highest correlation coefficient (r = 0.98) and the smallest standard error (0.34). Ultrasoundography measurements had a correlation coefficient of r = 0.45 and a standard error of 0.78. Mammography measurements had a correlation coefficient of r = 0.46 and a standard error of 1.04.

Conclusions: MRI was more accurate than ultrasonography and mammography in measuring the largest cancer diameters in this group of women. This was particularly evident for several larger cancers, and a post-chemotherapy cancer.

Introduction

There have been progressive changes in breast cancer therapy including breast conservation (segmental breast resection) in conjunction with various radiation and chemotherapeutic protocols. Several therapeutic trials have not included any surgery [1, 2]. Accurate measurements of the size of the breast cancer becomes important in treatment planning with these new therapies.

Cancer size is a prognostic factor as well as a major factor in determining if a woman is a suitable candidate for the various treatment modalities including mastectomy versus partial resection and/or...
chemotherapy [1]. Change in cancer size is the primary factor in determining response to chemotherapy, and in the case of lack of response, changing therapeutic regimen [2-4]. As more trials of different treatment protocols are developed and compared, there is a need for more accurate noninvasive cancer measurements: first, to determine surgical and/or medical oncologic approaches; second, to compare rate and degree of response of the different treatments; and third, to determine when a cancer is not responding to a particular therapy in order to allow more rapid change to a potentially more effective therapy.

Studies are underway to improve detection of initial and recurrent breast cancers using magnetic resonance imaging (MRI) [5-12]. This study will compare MRI’s accuracy to measure breast cancer size compared to the already established methods of measurement by mammography and ultrasonography. These results will be compared to other breast cancer measurements reported in the literature.

Methods and materials

The study group consisted of fourteen women who were suspected of having carcinoma based on clinical, mammographic, and/or sonographic findings. All had fine needle aspiration cytologic proof of carcinoma prior to the MRI. All were scheduled for segmental resection or mastectomy within three weeks. Permission of the treating physician was obtained before recruiting the subject. Informed consent was obtained prior to performing the MRI. Segmental resection or mastectomy was then performed. All the resected cancers were measured by a pathologist.

Mammography was performed with dedicated mammographic equipment (GE DMR, GE 600T, Siemens, LoRad). Mammograms consisting of both craniocaudal and mediolateral oblique projections were routinely obtained. Occasionally 90 degree mediolateral views were also acquired. The largest cancer diameter obtained from the different films was used. Magnification views were not used.

Ultrasonography was performed by board certified radiologists with considerable breast imaging experience using realtime ultrasound equipment operating at 7.5 or 10 MHz (Toshiba, Acuson, Aloca, Dianonics). Sagittal and transverse views were obtained of each mass, and the largest diameter was obtained for each transducer position. When possible, the largest diameter was obtained collinear to the ultrasound beam. The diameter was measured with electronic calipers and recorded on the static images.

The MRI examinations were performed on 1.5 Tesla General Electric (GE) (Milwaukee, WI) Signa MRI imagers. All were equipped with software version 4.8. Two breast coils were utilized: either a prototype Medrad (Pittsburgh, PA) receive/transmit breast coil, or a GE receive only dual phase array coil system. When the latter was used, except in one case, only one breast was examined. When the Medrad coil was used, the woman was positioned in an anterior oblique position. When the GE phase array system was used, the woman was positioned in the prone position. The breast was placed as close to the magnetic field isocenter as possible.

Images were acquired before and immediately after the rapid intravenous bolus administration of either gadoteridol (ProHance™, Bracco Diagnostics Inc., Princeton, NJ) or gadopentetate dimeglumine (Magnevist™, Berlex Imaging, Cedar Knolls, NJ). Several different doses were administered. Gadopentetate dimeglumine was administered to 2 patients at a dose of 0.1 mmol/kg. Gadoteridol was administered to 4 patients at a dose of 0.1 mmole/kg, 3 patients at 0.2 mmole/kg, and 4 patients (one with two cancers) at 0.3 mmole/kg.

The imaging pulse sequence was a standard fast three dimensional spoiled gradient refocused echo with fat suppression. The TR was approximately 19.5 msec. The echo was a fractional echo with a TE of 2.2 msec. Sixty images covering the entire breast were obtained in 3.5 minutes. Data acquisition matrix was 128 x 256. The field of view and slice thickness were adjusted to image the entire breast. Therefore, voxel dimensions ranged from 0.7 to 1.2 mm by 1.4 to 2.3 mm by 1.3 to 2.5 mm thick. The average voxel dimensions were 0.9 mm by 1.8 mm by 1.8 mm thick. The images were acquired in the sagittal or a sagittal-coronal oblique plane depending on the woman’s position.