

Impact of real-time virtual sonography using magnetic navigation on predicting residual tumor after neoadjuvant chemotherapy for breast cancer

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Authors: S. Nakano, K. Fujii, K. Yorozyua, M. Yoshida, J. Kousaka, T. Fukutomi, J. Kimura, T. Ishiguchi; Aichi-gun/JP
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Purpose

MRI is the most accurate technique for evaluating the extent of residual disease after neoadjuvant chemotherapy (NAC). Limitation in tumor localization may lead to a great incidence of positive resection margins and the need for repeated excision or mastectomy. However, in many cases, sonographic identification of MRI detected residual disease is difficult, because the patient's body is positioned differently than it is during MRI.

Recently, we have developed a real-time virtual sonography (RVS) that synchronizes breast sonography and MRI cutaway images of the same site, displaying these images using magnetic navigation in real time¹⁻³⁾.

The objective of this study was to evaluate the role of RVS for surgical planning in patients with breast cancer who undergo NAC.

Methods and Materials

Materials

Between April 2007 and May 2009, 96 breast conservation therapy were performed for invasive ductal carcinoma (IDC) at our hospital. Fourteen patients with stage IIA-IIIB palpable IDC were enrolled in a study investigating the effects of NAC on tumor imaging. All patients underwent MMG, US, MRI, and RVS before and after NAC. Nine patients received lumpectomy, and 5 received mastectomy.

Methods

MRI

MRI was obtained on a Magnetom 1.5-T imager (Siemens, Germany) using a flexible body surface coil. All patients were examined in the supine position as near as possible to the sonography.

Real-time Virtual Sonography (RVS)

RVS consisted of a magnetic generator, magnetic sensor, and workstation (Fig. 1, 2). The magnetic sensor installed on the tip of the probe sensed the magnetic field and detected the position and motion of the probe while it was scanning (Fig. 2).

Images for this section:

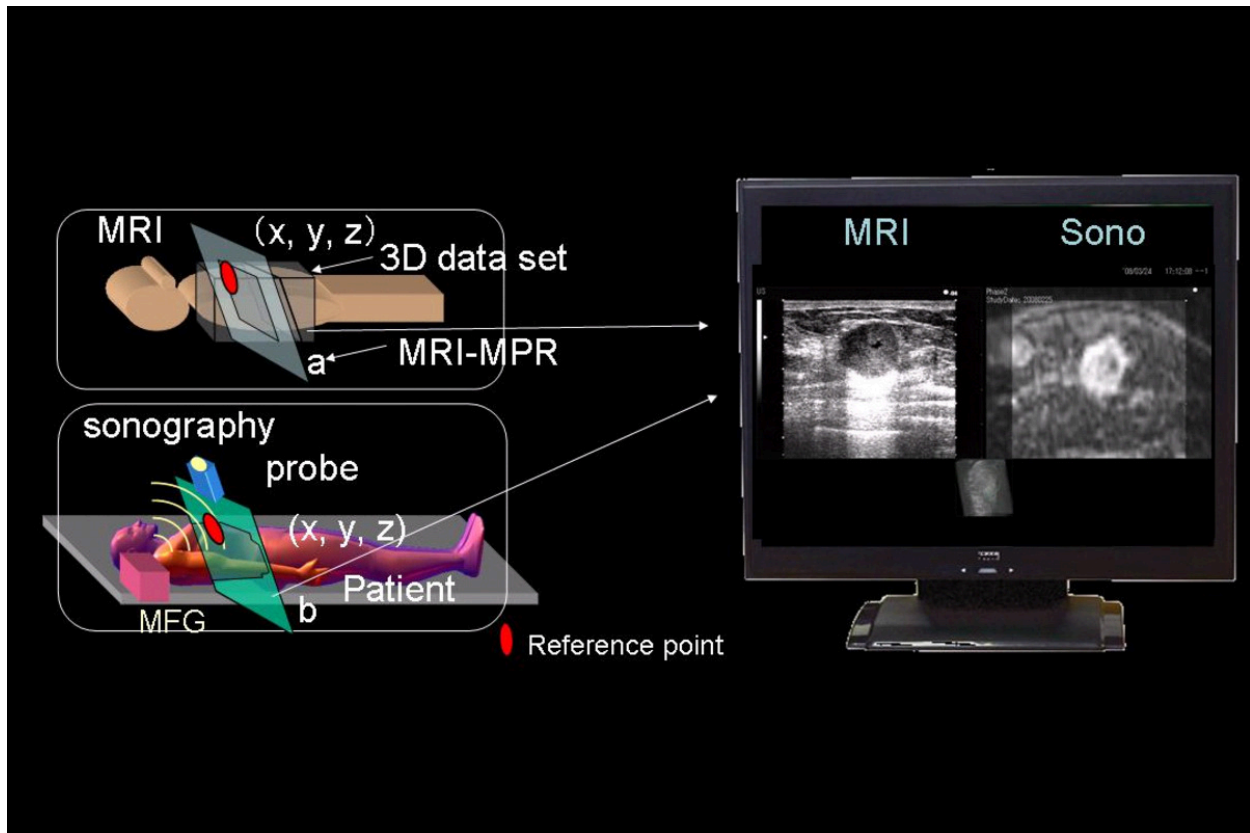


Fig. 0: Synchronization of sonography and MRI with magnetic navigation

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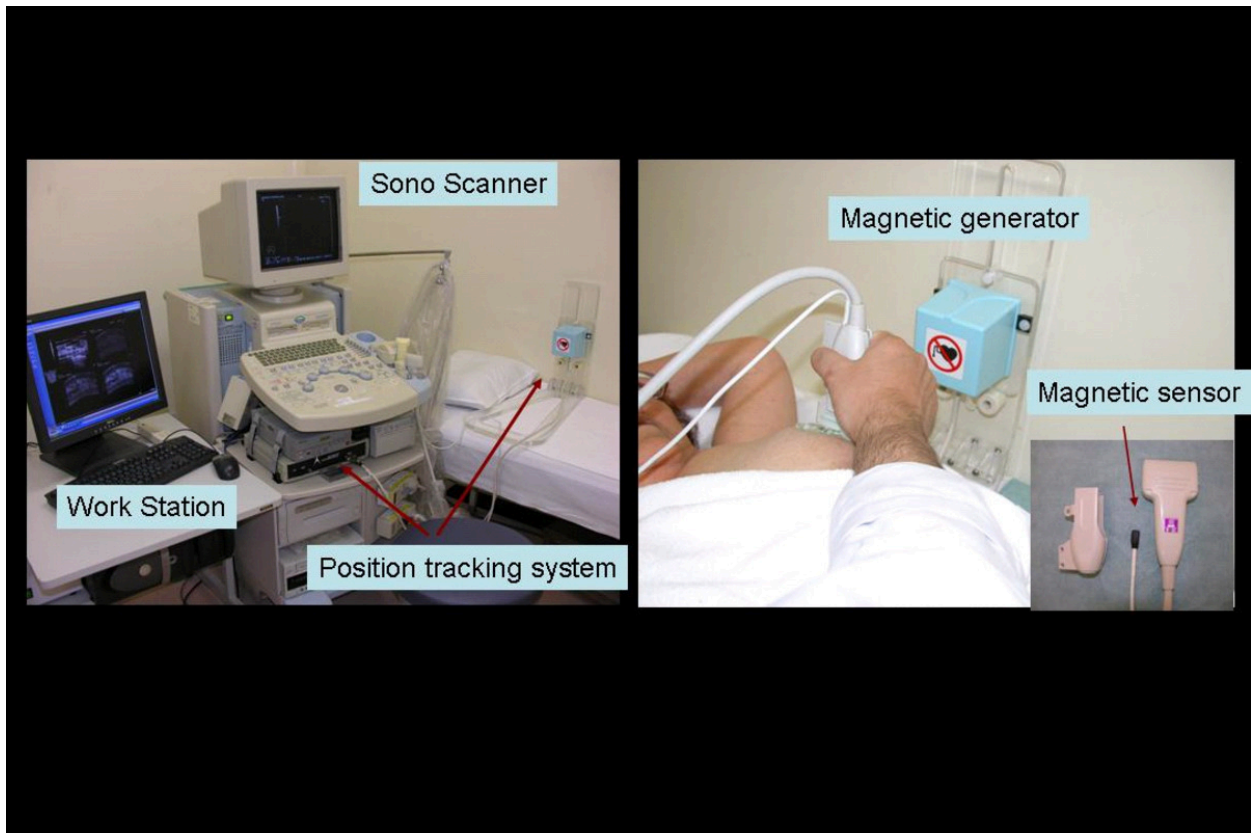


Fig. 0: Operative method for RVS

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Results

All index tumors were detected by sonography and MRI before NAC. After NAC, a cCR was seen in 5 (5 of 14, 36%) patients. MRI correctly diagnosed pCR in 4 (4 of 5, 80%) patients. Detection rate for residual tumors was 9% (1 of 11) for mammography, 33% (3 of 9) for sonography alone, 78% (7 of 9) for MRI, and 89% (8 of 9) for RVS.

It was noteworthy that 5 (5 of 5, 100%) cases with cCR were accurately localized onto the body surface with supplementation using RVS combined with pre- and post-NAC imaging while we were checking sonography (Fig. 1, 2). Although surgical excision was incomplete in 5 (5 of 9, 56%) patients, all positive surgical margins were DCIS (Table. 1).

No	y	Meno	Chem	TNM	Stage	HG	ER/PR	HER2	C-Res	Type	US	MRI/CT	Virtual US	P-Res	Margin
1	46	pre	DTX	#FEC1M0	2	+	-	-	cCR	N	no	no	no*	pCR	-
3	64	post	DTX	#FEC1M0	1	+	-	-	PR	S	y	y	y	non	DCIS
4	54	post	DTX	#FEC1M0	2	+	-	-	PR	S	y	y	y	pCR	-
5	64	post	DTX	#FEC1M0	2	+	-	-	PR	S	no	y	y	non	DCIS
6	31	pre	DTX	#FEC1M0	3	+	-	-	cCR	N	no	no	y*	pCR	-
7	48	pre	DTX	#FEC1M0	2	-	+	+	PR	F	no	y	y	non	DCIS
8	62	post	DTX	#FEC1M0	2	+	-	-	cCR	N	no	no	y*	non	DCIS
12	42	pre	EC	T1N1M0	2	+	-	-	PR	S	no	y	y	non	-
13	38	pre	EC	T1N1M0	1	+	-	-	PR	S	y	y	y	non	DCIS

Table. 1 Results of breast conserving surgery after NAC

N: non enhancement type, S: shrinkage type, F: fragmentation type, cCR: clinical CR, pCR: pathological CR, y: yes,

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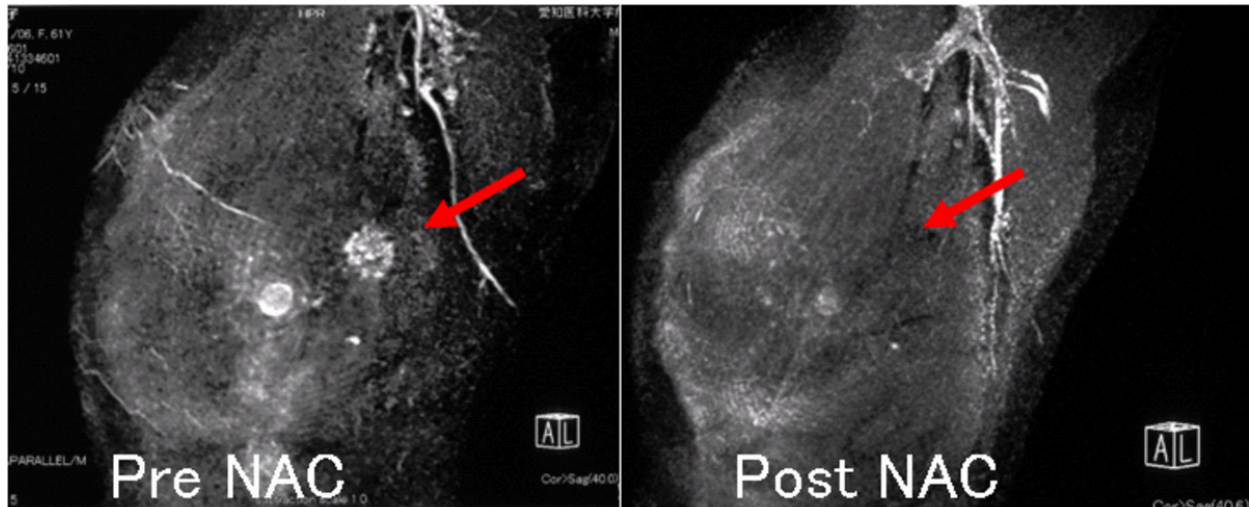


Fig. 0: After NAC, no enhancement is seen in case 8 (cCR).

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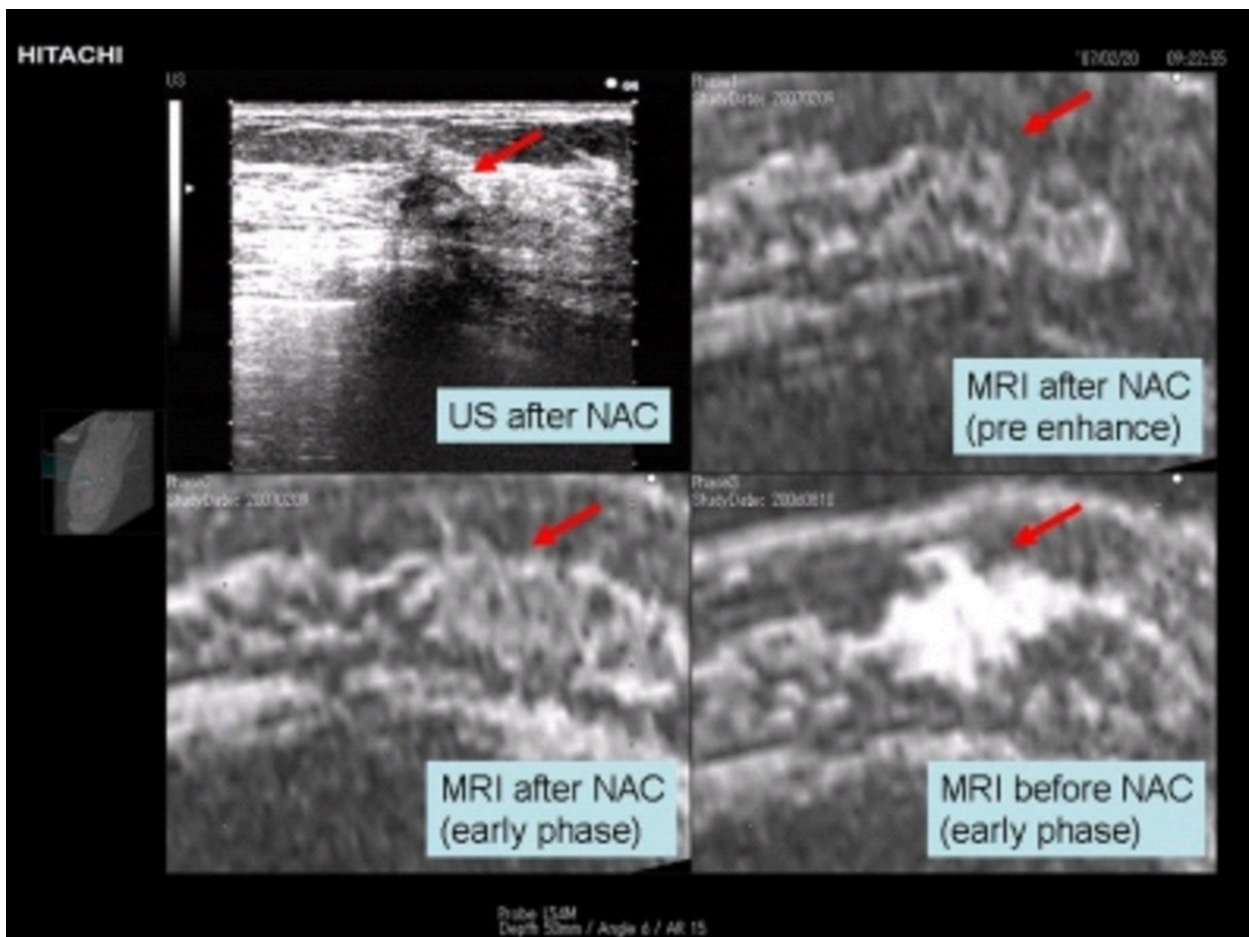


Fig. 0: Enhancing lesion is detectable sonographically by using before NAC MRI-MPR (case 8).

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Conclusion

By using RVS, two different forms of diagnostic imaging can be integrated in real time and thereby complement each other. The present results suggest that RVS is a useful imaging technique for detecting residual tumors that have been associated with local recurrence after NAC.

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Personal Information

E-mail; snakano1@aichi-med-u.ac.jp