

# The Usefulness of Contrast-enhanced Ultrasound for the Evaluation of Response to Neoadjuvant Chemotherapy in Breast Cancer

Megumi SATOH<sup>1,2</sup>, Mutsumi NISHIDA<sup>2,3</sup>, Yusuke KUDOU<sup>2,3</sup>, Mamiko INOUE<sup>2,3</sup>,  
Satomi OMOTEHARA<sup>2,3</sup>, Tatsunori HORIE<sup>1,2</sup>, Takahito IWAI<sup>2,3</sup>, Fumi Kato<sup>4</sup>,  
Mitsuchika HOSODA<sup>5</sup>, Kanako HATANAKA<sup>6</sup>, Hiroko YAMASHITA<sup>5</sup>

## Abstract

**Purpose:** To assess the feasibility of contrast-enhanced ultrasound (CEUS) with Sonazoid® for the evaluation of response to neoadjuvant chemotherapy in breast cancer patients.

**Subjects and Methods:** Thirty-three patients (all women, mean age 49.5 years) with 35 histologically confirmed breast cancers were evaluated. The enhancement patterns of the lesions were stored for 1 minute after bolus injection of the micro bubble contrast agent “Sonazoid®”. Time intensity curve (TIC) analysis was performed by placing the region of interest (ROI) at showing the strongest enhancement region. Time to peak (TTP, s) and mean transit time (MTT, s) were calculated. Histological evaluation of treatment response (HE) was graded from 0 to 3 according to the Japanese breast cancer guideline. The HE was further categorized into 2 groups; grade 0 to 2 was for a non-complete responder and grade 3 was for a complete responder. The Response Evaluation Criteria in Solid Tumors (RECIST) by ultrasonography (US) and contrast-enhanced MRI were also performed. Each CEUS value was compared between complete responders and non-complete responders. Statistical analysis was performed by the Mann-Whitney U test and Spearman’s rank correlation ( $p < 0.05$  was considered significant).

**Results and Discussion:** The HE values of responders and non-complete responders were 6 and 29 nodules, respectively. Respective post-treatment evaluation by CEUS of TTP (mean±SD, range) and MTT values were: responders,  $75.7 \pm 72.0$  s, 17.2 to 158.8 s and  $75.7 \pm 72.0$  s, 17.2 to 158.8 s; and non-complete responders,  $6.0 \pm 3.0$  s, 2.9 to 14.1 s and  $15.6 \pm 12.5$  s, 4.3 to 57.7 s. There were significant correlations between TTP and HE ( $\rho = 0.613$ ,  $p < 0.01$ ), and MTT and HE ( $\rho = 0.698$ ,  $p < 0.01$ ). Clinical response (RECIST) by US of PD, SD, PR and CR were 1, 7, 27, and 0, respectively. RECIST by US failed to detect CR. Clinical response (RECIST) by contrast-enhanced MRI of PD, SD, PR and CR were 1, 8, 22, and 4, respectively.

**Conclusion:** CEUS was judged to have a good potential for application to the evaluation of response to neoadjuvant chemotherapy in breast cancer patients.

Vol.40 No. 6 (2015) 637-648

---

<sup>1</sup>Hokkaido University Hospital Department of Radiology, <sup>2</sup>Diagnostic Center for Sonography, <sup>3</sup>Department of Clinical Laboratory and Transfusion, <sup>4</sup>Department of Diagnostic and Interventional Radiology, <sup>5</sup>Department of Breast Surgery, <sup>6</sup>Department of Surgical Pathology

Received on March 31, 2015; Revision accepted on August 12, 2015