Nonenhanced 3D Breast MRA using FBI and Time-SLIP

M. Miyazaki1,2, P. M. Otto3, H. Kanazawa4, N. Ichinose5, S. Sugiura6, and R. Anderson1

1Toshiba Medical Research Institute, Vernon Hills, Illinois, United States, 2MRI, Toshiba Medical Systems Corp, Otawara, Tochigi, Japan, 3Radiology, University of Texas at San Antonio, San Antonio, Texas, United States, 4MRI, Toshiba Medical Systems Corp., Otawara, Tochigi, Japan

PURPOSE
Angiogenesis plays a critical role in breast cancer progression and metastasis. Early detection could be important for improved treatment. Therefore, Dynamic contrast-enhanced (DCE) breast examinations have become a standard tool for the diagnosis of breast cancer diseases [1,2]. Due to recent concerns about Nephrogenic Systemic Fibrosis (NSF), there is an increasing need to use nonenhanced MRA as an alternative technique [3]. In this study, the potential of nonenhanced fresh blood imaging (FBI) [4] and time-spatial labeling inversion pulse (time-SLIP) sequences [5] are demonstrated for breast imaging.

MATERIALS and METHODS
All studies were performed using a clinical 1.5-T unit (Toshiba, EXCELART Vantage TM powered by Atlas), equipped with a Sentinelle Vanguard T-Series breast coil. Blood in-flow travel time from the mammary arteries was observed by using a variable time tag pulse to a partial Fourier FSE3D time-SLIP technique. Six volunteers underwent both time-SLIP and FBI experiments. Typical time-SLIP acquisition parameters were; TR/TE=4-5RR/80 ms, echo train spacing (ETS)=5 ms, flip/flop= 90/160 deg., matrix=384x346, FOV=320x250 mm, about sixty-five 2.4-mm section slices (interpolated to one hundred forty 1.2-mm thick slices), peripheral pulse gating (PPG) triggering, parallel reduction factor=3.0, a CHESS fats suppression, time-SLIP tag slice thickness=120-180 mm, TI=700, 1000, 1500, 2000, and 2500 ms, fat suppression, and a total scan time of about 3:30 min depending upon a cardiac cycle. The resolution of time-SLIP was about 0.8 mm (PE)x 0.7 mm (RO)x1.1 mm (SE after interpolation). In order to visualize all blood vessels in the breasts, 3D FBI was acquired as a reference in all studies. Typical 3D FBI acquisition parameters were as follows; TR/TE=3RR/76 ms, ETS=6.5 ms, flip/flop= 90/160 deg., matrix=384x346, FOV=320x250 mm, sixty-five 2.4-mm section slices (interpolated to one hundred thirty 1.2-mm thick slices), resolution of 0.8 mm (PE)x0.7 mm (RO)x1.1 mm (SE after interpolation), PPG triggering, parallel reduction factor=3.0, STIR=180 ms, and a total scan time of about 3:0 min, depending upon a cardiac cycle.

RESULTS
Figure 1 shows a typical maximum intensity projection (MIP) results from nonenhanced 3D time-SLIP and 3D FBI images. As TI increased as listed above, blood vessel visualization traveled proximal to distal parts of the breasts. The FBI image shows branching level vessels in the breasts. Similar results were obtained in all volunteers.

DISCUSSION
Since breast blood supply flow is considered slow, the inflow time-SLIP technique was appropriate to apply without extending the scan time. Although the background signal increases at TI higher than 1500 ms, the blood vessels gain signal more rapidly so that blood to background contrast was sufficient. The background signals at shorter TI are suppressed as expected at such inversion times. Both time-SLIP and FBI present bright blood and highlighted lymph nodes. The combined time-SLIP and FBI enable depiction of blood flow in the breasts. The technique has promise; but clinical DCE confirmation studies are required.

In conclusion, visualization of blood vessels in the breasts is excellent with nonenhanced time-SLIP and FBI.

REFERENCES:

Figure 1. Time-SLIP MIP images acquired on a volunteer using TI of 700, 1000, 1500, 2000, and 2500 ms. The yellow rectangular box shows the position of the time-SLIP tag pulse. The FBI MIP image shows all blood vessels in the breasts. Both time-SLIP and FBI images show both blood vessels as well as lymph nodes in bright signals. Note that a small cyst shows increased signal intensity at TI of 2500 ms (red arrow), but not shown at TI of 1000 ms (red arrow).