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# Leading the way in breast and pelvic imaging with SIGNA Hero

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Keiyu Hospital in Yokohama, Japan, was originally established in 1934 to serve police officers and firefighters. Today, the hospital is known for its cutting-edge medical equipment and capacity to care for domestic and international dignitaries. It operates as a core hospital in the region with 410 beds for acute care, emergency patients, day surgery and short-term hospitalizations. It's also designated as a Kanagawa Prefecture Cancer Treatment Cooperation Hospital, providing patients with access to advanced, specialized cancer care.

The hospital is equipped with two MR systems from GE Healthcare, including the SIGNA™ Hero with MR30.1 software, which offers AIR™ Recon DL. Since the hospital installed the SIGNA Hero with AIR Recon DL, we've experienced an improvement in image quality with a reduction in scan times. Now we can see sharper, clearer images with improved SNR, making it easier to detect and diagnose a wide range of conditions.

## Enhancing breast cancer detection and treatment

At the Breast Center at Keiyu Hospital, we handle everything from screening and diagnostic mammograms to breast cancer treatment and post-treatment care, including rehabilitation. The hospital performs two to four breast MR exams per day. In 2023, clinicians diagnosed 226 cases of breast cancer and 19 cases of benign breast diseases. Each year, we perform more than 200 breast surgeries.

Breast MR plays an important role in our ability to diagnose and stage breast cancer, alongside mammography and ultrasound. In

addition, preoperative breast MR is performed in almost all cases of tumors, unless there are contraindications such as contrast agent allergies or asthma.

## Expanding the role of MR in pelvic studies

MR is useful in referrals from the urology department to evaluate the prostate and bladder.

In our institution, the role of MR extends beyond the detection of prostate cancer; it is essential for the local staging of disease to guide treatment selection, including surgery, radiation therapy and hormone therapy. It plays a crucial role in assessing the depth of bladder cancer invasion, which is important for determining treatment options such as radical cystectomy or Transurethral Resection of Bladder Tumor (TUR-BT), a surgical procedure to diagnose and treat bladder cancer.

In gynecology, MR is widely used by our clinicians to diagnose a wide range of pelvic conditions, from benign diseases such as uterine fibroids, endometriosis, benign ovarian tumors and pelvic peritonitis, to malignant tumors such as uterine and ovarian cancers. MR plays a significant role in assessing the depth of invasion in endometrial and cervical cancers, as well as evaluating the malignancy of ovarian tumors.

In addition, Keiyu Hospital has long been dedicated to perinatal care, with MR examinations performed relatively frequently for fetal imaging and to investigate ectopic pregnancies.

## Case 1: Breast cancer

### Patient history

A female patient in her 50s was referred for an assessment of tumor extent and presence of multiple lesions in her right breast.

### Results

A 12 mm round mass with slightly irregular margins was observed in the D region of the right breast. The time-intensity curve in dynamic contrast-enhanced (DCE) imaging showed a rapid-plateau pattern, which is consistent with breast cancer. Linear contrast enhancement was noted toward the nipple, suggesting possible intraductal extension.

No significant lymph node enlargement was observed. Background parenchymal enhancement (BPE) was minimal.

### Discussion

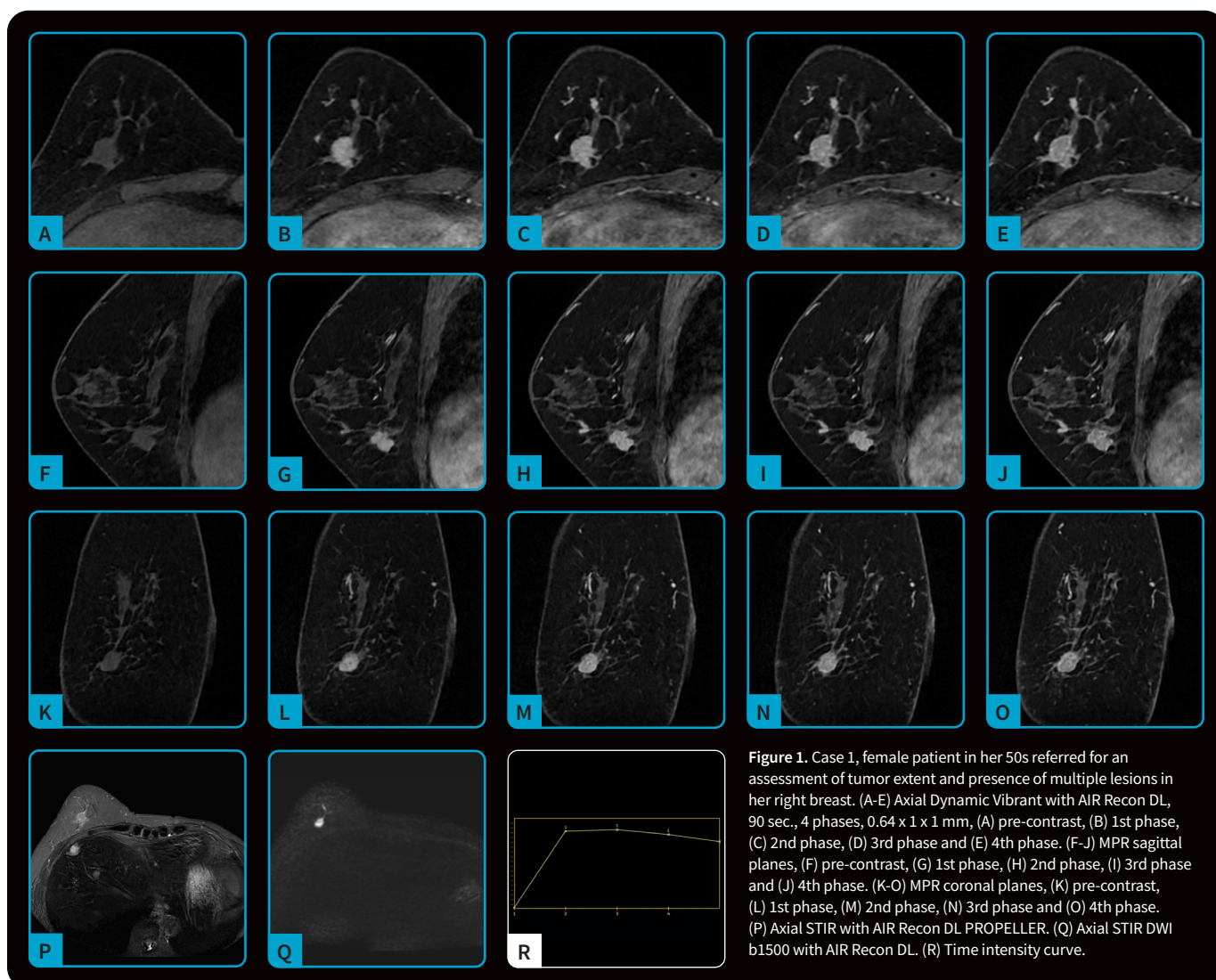
Since we installed SIGNA Hero, we've benefited from various advantages, including AIR Recon DL. Overall image quality of 2D non-contrast sequences has improved. For fat-suppressed

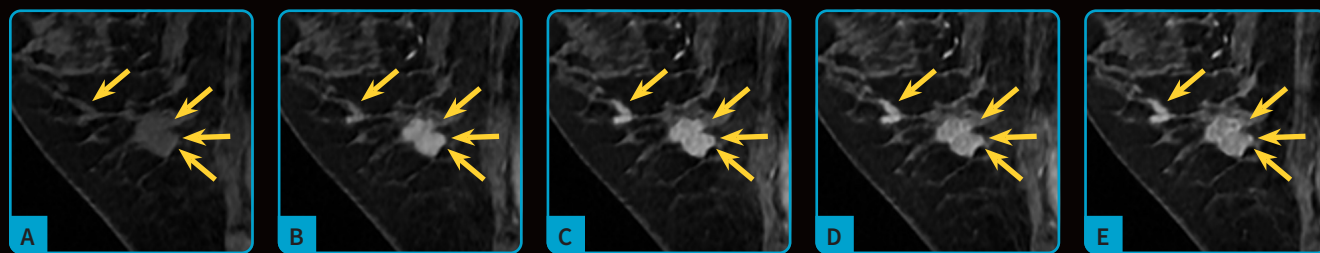
T2-weighted and T1-weighted sequences, we employ PROPELLER for sufficient motion correction. The robust imaging against physiological movements, such as heartbeat and respiration, has resulted in images with no motion artifacts, even in areas like the axilla.

Additionally, we use a b-value of 1500 s/mm<sup>2</sup> for breast DWI. This is a high b-value for DWI, which makes it challenging to maintain an adequate SNR with this parameter setting. However, with AIR Recon DL we can reduce noise and obtain images with improved SNR in just 2 minutes.

Furthermore, we can acquire thinner slices in DCE, resulting in more detailed images. After imaging, we use MPR and MIP to assist our diagnoses, and we have noticed that smaller lesions are now much easier to detect.

This patient first received an MR examination on our SIGNA™ Explorer system. Although we were satisfied with the exam, we wanted an even more accurate assessment of the extent of breast cancer, which is why we subsequently imaged her on the SIGNA Hero. AIR Recon DL can now be applied to both 2D and 3D sequences,





**Figure 2.** Same patient as Figure 1. (A-E) MPR Sagittal planes Dynamic Vibrant acquisition with AIR Recon DL, 90 sec. x 4 phases, 0.64 x 1 x 1 mm, (A) pre-contrast, (B) 1st phase, (C) 2nd phase, (D) 3rd phase and (E) 4th phase.

SIGNA Hero 3.0T			
Case 1: Breast cancer	STIR	STIR DWI b1500	DCE
TR (ms):	8719	5000	5.2
TE (ms):	102	79	2.4
FOV (cm):	36	36	36
Slice thickness (mm):	4	4	1 (0.5)
Frequency:	300	128	500
Phase:	300	160	320
NEX:	1.63	4	0.71
Scan time (min.):	2:20	2:30	1:31
Options/other:	AIR Recon DL, PROPELLER, Acc	AIR Recon DL, Acc	AIR Recon DL, HyperSense

significantly enhancing the image quality of most breast imaging. Additionally, the use of PROPELLER with AIR Recon DL enables the acquisition of images with minimal motion artifacts caused by heartbeat and respiration.

The enhancement of contrast in dynamic studies has improved with the SIGNA Hero 3.0T MR system, allowing for better visualization of intraductal extension in breast cancer. This result has improved our ability to determine a treatment plan after the examination.

## Case 2: Female pelvis

### Patient history

A female in her 30s with an ectopic pregnancy and caesarean section scar.

### Results

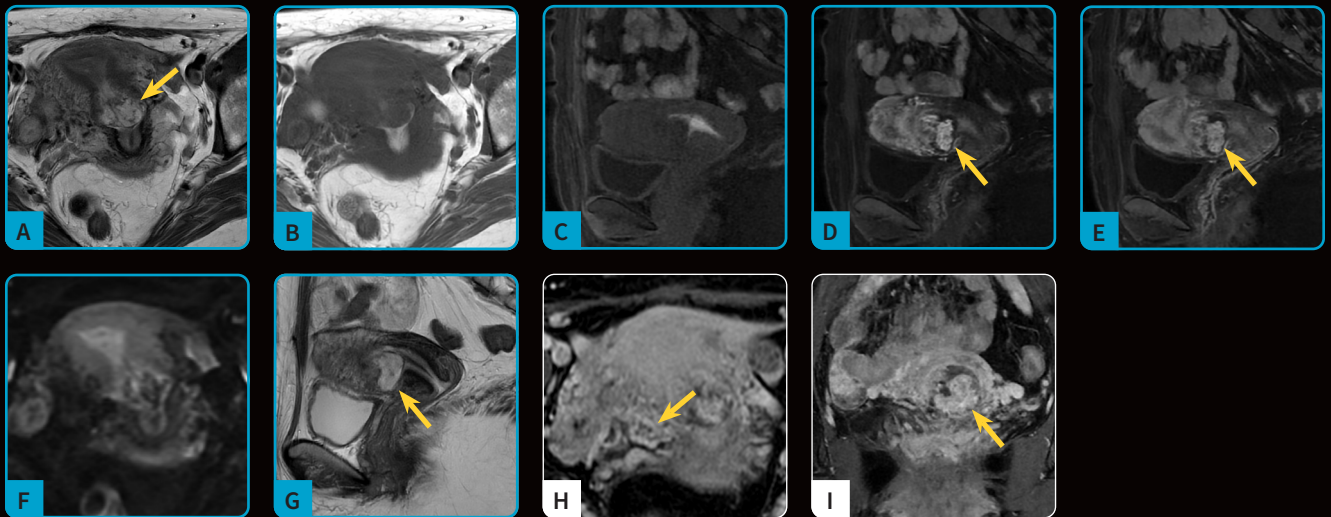
A 2 cm soft-tissue mass with high T2 signal was observed in the lower uterine segment at the caesarean section scar, extending into the uterine cavity. Dynamic imaging revealed significant early enhancement. A small amount of blood was present in the uterine cavity. The patient was diagnosed with caesarean section scar pregnancy in the lower uterine segment.

The chorionic tissue of an ectopic pregnancy was clearly visualized with the improved image quality of DCE. This patient subsequently underwent angiography, followed by bilateral uterine artery embolization. Even the fine uterine arteries were clearly depicted on DCE, which was helpful in the preoperative planning for catheter selection. The day after the uterine artery embolization, dilation and curettage was performed.

### Discussion

In traditional female pelvic examinations, PROPELLER has been used for both T2-weighted and T1-weighted sequences. PROPELLER is a useful application for suppressing artifacts caused by respiratory motion effect, but it can increase exam length. This

SIGNA Hero 3.0T							
Case 2: Female pelvis	Axial T2w	Axial T1w	Sagittal T2w	DWI b1000	Sagittal DCE T1w FatSat	Axial CE T1w FatSat	Coronal CE T1w FatSat
TR (ms):	4097	505	4532	4421	4.9	6.6	6.4
TE (ms):	122	11.2	94.6	77.3	1.9	1.9	2.4
FOV (cm):	24	24	24	32	24	26	26
Slice thickness (mm):	5	5	5	5	2.3 (1.2)	2.9 (1.5)	2.4 (1.2)
Frequency:	400	308	400	160	300	200	384
Phase:	400	308	400	256	256	288	320
NEX:	1.54	1.55	2.03	5	0.72	2	0.7
Scan time (min.):	1:02	1:54	2:07	1:15	0:28	1:22	1:20
Options/other:	AIR Recon DL, Acc, NPW1.5	AIR Recon DL, Acc, NPW1.5	AIR Recon DL, Acc, NPW1.6	AIR Recon DL, Acc	AIR Recon DL, HyperSense	LAVA Flex, HyperSense	AIR Recon DL, HyperSense



**Figure 3.** Female patient with ectopic pregnancy and caesarean section scar pregnancy. All acquisitions acquired with AIR Recon DL except LAVA Flex. (A) Axial T2w, 0.6 x 0.6 x 5 mm, 1:02 min. (B) axial T1w, 0.77 x 0.77 x 5 mm, 1:54 min. (C-E) T1w LAVA DCE FatSat, 28 sec. x 2 phases, 0.86 x 1 x 2.3(1.2) mm, (C) pre-contrast, (D) 1st phase and (E) 2nd phase. (F) Axial DWI, 2 x 1.25 x 5 mm, 1:15 min. (G) Sagittal T2w PROPELLER, 0.6 x 0.6 x 5 mm 2:07 min. (H) Axial contrast-enhanced LAVA Flex water, 1.2 x 0.9 x 2.9(1.5) mm, 1:22 min. (I) Coronal contrast-enhanced LAVA Flex water, 0.67 x 0.81 x 2.4(1.2) mm, 1:20 min.

isn't usually an issue in routine exams, but in emergency cases such as ectopic pregnancy, rapid MR examinations are required.

AIR Recon DL helps reduce the scan time without compromising image quality. It's compatible with PROPELLER and LAVA sequences, allowing PROPELLER imaging to be completed in a shorter time and making it easier to handle emergency exams. Additionally, the image quality of LAVA has improved, with excellent contrast enhancement.

Since some cases involve abdominal pain, lightweight and flexible coils, like the AIR™ Coil, help reduce patient discomfort and contribute to a more comfortable examination.

While improving image quality is crucial for diagnosis, the enhanced quality of DCE LAVA provides clear contrast effects, resulting in very high-quality images. The improved image quality from the combination of AIR Recon DL and the SIGNA Hero resulted in clearer contrast enhancement in DCE. This facilitated the diagnosis

of ectopic pregnancy and was useful for the preoperative uterine artery embolization.

### Case 3: Prostate

#### Patient history

A male in his 70s with a PSA level of 7.3.

#### Results

The prostate was enlarged, measuring 4.8 x 3.2 x 4.3 cm (34.3 mL). A 15 mm indistinct lesion with signal changes was observed in the mid-to-base transition zone (TZ) of the right lobe. It appeared as a homogeneous low signal on T2-weighted imaging, high signal on DWI (with low ADC), and showed early enhancement on DCE, suggesting prostate cancer with a Prostate Imaging-Reporting and Data System (PI-RADS) of 5.

The lesion slightly extended to the contralateral side and was in broad contact with the capsule, indicating a possibility of microscopic extracapsular extension.

SIGNA Hero 3.0T					
Case 3: Prostate	Axial T2w	Sagittal T2w	Coronal T2w	FOCUS DWI b1000	DCE T1w FatSat
TR (ms):	8125	3435	5090	5000	4.4
TE (ms):	116	99.1	123	79	2
FOV (cm):	22	22	22	36	26
Slice thickness (mm):	2	3	3	4	2 (1.0)
Frequency:	416	384	420	128	260
Phase:	288	384	288	160	260
NEX:	1	1.5	1	4	0.7
Scan time (min.):	3:07	1:16	1:27	2:30	0:32
Options/other:	AIR Recon DL	AIR Recon DL, PROPELLER, Acc	AIR Recon DL, Acc	AIR Recon DL, IR, FOCUS, Acc	AIR Recon DL, Acc



Additionally, a 5 mm lesion was observed in the mid-peripheral zone (PZ) of the right lobe, showing high signal on DWI (with low ADC), early enhancement on DCE and low signal on T2-weighted imaging, suggesting prostate cancer (PI-RADS 4).

No significant lymph node enlargement was observed, and no obvious bone metastases were detected within the imaging range.

### Discussion

With our previous 1.5T system, it was very difficult to perform imaging in compliance with PI-RADS due to insufficient SNR. While parameters were set considering the balance between ensuring SNR and imaging time, it was challenging to obtain sufficient contrast due to the partial volume effect caused by the thickness of the slices.

AIR Recon DL on the SIGNA Hero 3.0T now makes it easier to obtain thin slices with high-resolution images, which was previously challenging to achieve. As a result, T2 contrast in prostate imaging has been significantly improved.

With the previous system's T2-weighted images, we found that contrast was insufficient, making it difficult to detect tumors in the TZ. However, with the introduction of SIGNA Hero, we reassessed the scan parameters. As a result, T2-weighted contrast has improved, making lesion detection easier. Furthermore, the contrast enhancement in DCE imaging is now clearer than before, helping increase our confidence in identifying lesions.

We have now revised our prostate imaging protocol. T2-weighted imaging, a key component in prostate diagnose, now routinely utilizes 2 mm slices, which is thinner than the standard PI-RADS protocol. The thinner slice thickness reduces partial volume effects, improving contrast and providing clearer, more detailed images. This enhancement in T2 contrast has made it easier to identify extracapsular extension. Similarly, for FOCUS DWI, we have also achieved 2 mm slice thickness, similar to the T2-weighted protocol.

Moreover, AIR Recon DL offers great flexibility in parameter settings. For prostate T2-weighted imaging, we maintain high-resolution images for key axial views within the same time frame as before. For sagittal and coronal images, we acquire them as additional images in a short acquisition time of about 1 minute. The ability to flexibly configure protocols, rather than having to choose between high image quality or shorter acquisition times, is a significant benefit of AIR Recon DL. Depending on the clinical need, we prioritize image quality or scan time, ensuring effective imaging within the total examination time.

Compared to the 1.5T MR system we were using previously, prostate imaging on the SIGNA Hero has improved drastically. We can now perform imaging that adheres to PI-RADS guidelines and, with AIR Recon DL, we can maintain sufficient SNR even with thin slices. As a result, detecting tumors in the transition zone on T2-weighted images has become easier compared to the previous system. Currently, we perform all prostate examinations using the SIGNA Hero. **S**

**Figure 4.** Patient with prostate cancer, PI-RADS 5 in TZ and PI-RADS 4 in PZ, all sequences acquired with AIR Recon DL. (A) Axial T2w, 0.52 x 0.76 x 2 mm, 3:04 min. (B) Coronal T2w, 0.52 x 0.676 x 3 mm, 1:15 min. (C) Sagittal T2w with PROPELLER, 0.57 x 0.57 x 3 mm, 1:10 min. (D-G) Axial FOCUS DWI, 2 x 2 x 2 mm, 4:12 min. (D) b1000, (E) synthetic b1500, (F) synthetic b2000 and (G) ADC Map. (H-J) Dynamic T1w LAVA FatSat, 33 sec. x 2 phases, 1 x 1 x 1 mm.

