

Canon

画論
27th
The Best Image

Best Image Awards Compilation
MRI Category

Judging Panel

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[Grand Prize Award]

Clinical value of DWI using an ultra-high b-factor and minimized TE for the differential diagnosis of benign and malignant hepatic tumors using a 3 T MRI scanner with a high gradient field strength

Kyorin University Hospital, Japan _____ 10

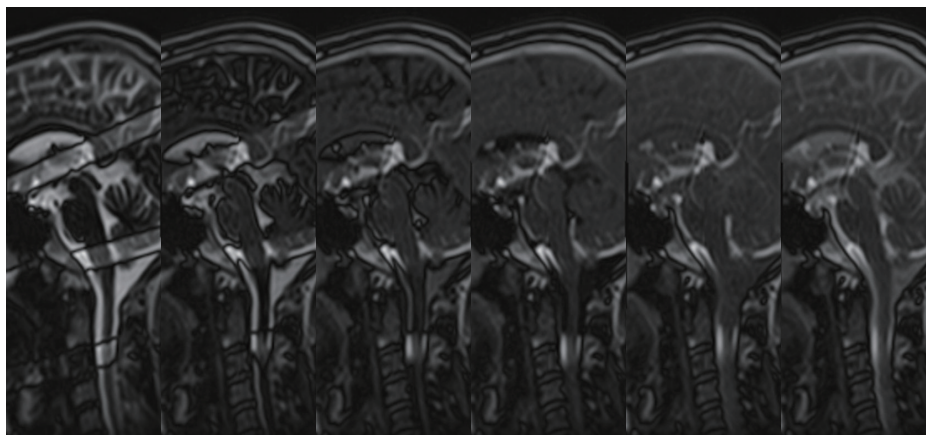
[Technical Award]

Case in which gated acquisition for a hepatic tumor was difficult – From dynamic to hepatocellular phase –

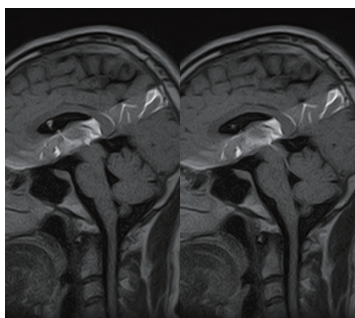
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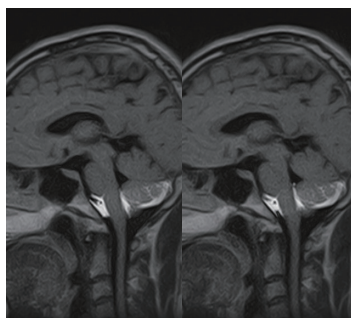
Scan the whole page, including an image with the "medicalAR" icon, and the linked content will be displayed.



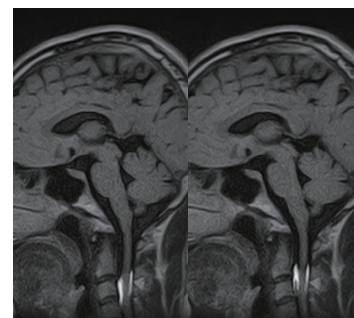
(a) SSFP CSF Time-SLIP scan



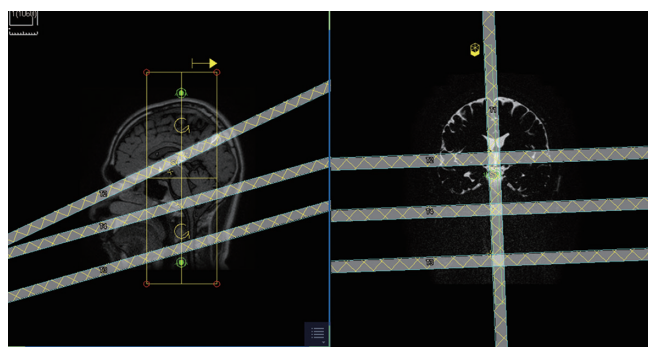
(b) FASE CSF Time-SLIP method (third ventricle)



(c) FASE CSF Time-SLIP method (fourth ventricle)



(d) FASE CSF Time-SLIP method (cervical spine level)



(e) Scan plan for SSFP CSF Time-SLIP scanning

Neurosurgery

Observation of cerebrospinal fluid dynamics

Kouwakai Kugayama Hospital, Japan

System used: Vantage Titan

Reason for examination: Observation of cerebrospinal fluid dynamics in multiple sections in a single phase.

Clinical comments: In the past, it was necessary to perform scanning while moving the tag from one target region to the next because only one tag was available in conventional FASE CSF Time-SLIP scanning, but by using the multi-tag feature in SSFP CSF Time-SLIP scanning, multiple sections can be observed in the same phase in a single scan. This allows the scan time to be significantly reduced

and also permits the basic physiological characteristics of cerebrospinal fluid flow to be directly observed and clearly understood. Cerebrospinal fluid dynamics can be observed under physiological conditions, making it clear that pulsation in the thalamic and choroidal arteries is not the driving force for pulsatile flow of the cerebrospinal fluid.

Technical comments: This method allows dynamic, real-time imaging of the cerebrospinal fluid in multiple sections at the same time. However, if the temporal resolution is prioritized, a reduction in the in-plane resolution is unavoidable because a larger FOV must be set in order to avoid aliasing. To address this problem, the basic principles of SPEEDER1 and a smaller FOV were combined in order to improve the temporal resolution without reducing the in-plane resolution. Image acquisition for 40 phases was completed in only 7 seconds, allowing both breath-holding and additional scanning to be performed easily.

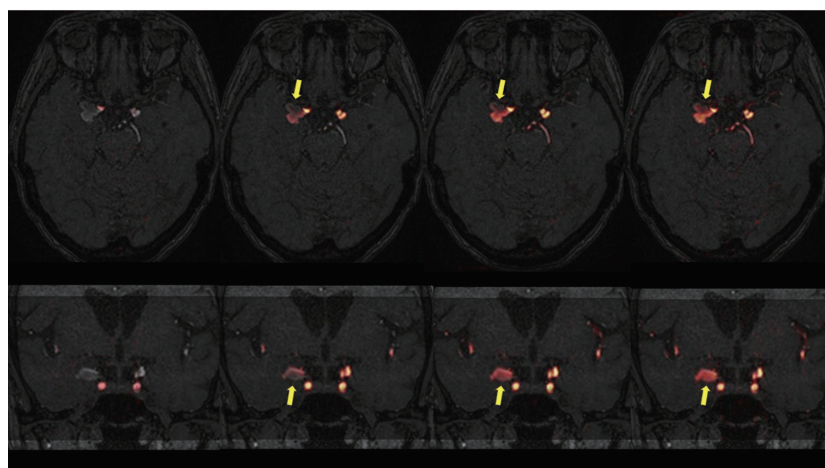
Comments on images: (a) High-resolution SSFP CSF Time-SLIP multi-tag images. Forty phases were acquired in 7 seconds (153 ms/phase). Thanks to the Expand function provided in SPEEDER1, the per-phase acquisition time can be reduced without aliasing. (b) FASE CSF Time-SLIP images of the same section as tag1 in SSFP acquisition (15 phases / 2 min 42 sec). (c) FASE CSF Time-SLIP images of the same section as tag2 in SSFP acquisition (15 phases / 2 min 42 sec). (d) FASE CSF Time-SLIP images of the same section as tag3 in SSFP acquisition (15 phases / 2 min 42 sec). (e) Locator images.

Comments of judges: Superior images are obtained because real-time dynamic imaging of the CSF is possible in a short scan time. Such images are considered to be extremely useful as reference images before performing FASE CSF Time-SLIP scanning. The method employed here can serve as an example for other medical institutions.

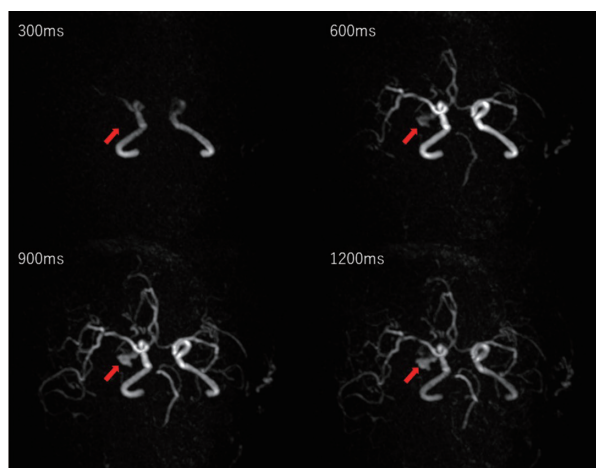
Sex	Age	Weight	Software version	Fasting	Contrast medium
Male	30-40 years	60-70 kg	V2.31	No	
Dose	Injection rate	Administration method	Workstation		

Acquisition conditions for (a)	FFE1.9_ssfp_330k, TR: 3.7, TE: 1.9, FA: 82, fat suppression: none, gating: peripheral pulse gating, SPEEDER factor: 1, FOV / No Wrap: 10×30 / 1, matrix: 40×128, slice thickness / number of slices: 8 mm / 1, number of segments: 1, number of acquisitions: 1, scan time: 0:07
Acquisition conditions for (b), (c), and (d)	FASE+5, TR: 10000, TE: 80, FA/Flop: 90/160, BBTI: 2000, fat suppression: none, gating: peripheral pulse gating, SPEEDER factor: 2, FOV / No Wrap: 23×23 / 1, matrix: 224×256, slice thickness / number of slices: 5 mm / 1, number of shots: 1, number of acquisitions: 1, scan time: 2:24
Coil used for (a), (b), (c), and (d)	Atlas SPEEDER Head

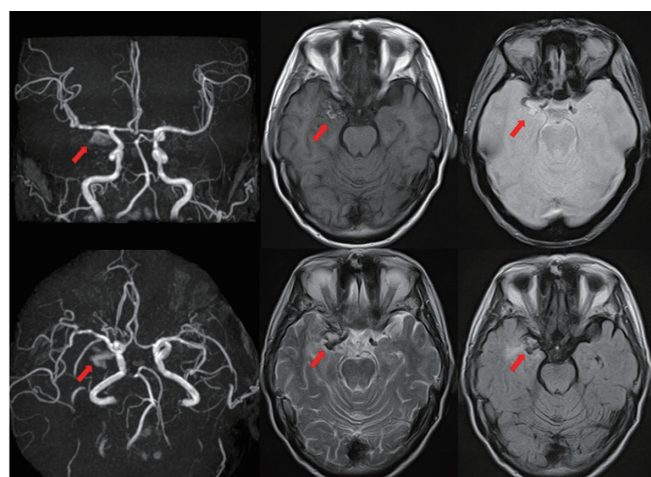




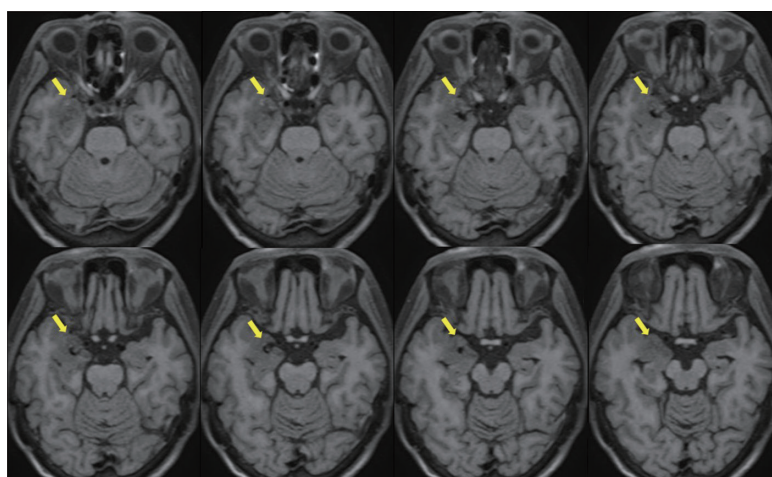
(a) Fusion images



(b) mASTAR images



(c) TOF-MRA images and axial images



(d) Evaluation of thrombus in aneurysm using Fast 3D mode

Neurosurgery

Bilateral internal carotid artery aneurysms

Jichi Medical University Saitama Medical Center, Japan

System used: Vantage Titan

Reason for examination: This patient was referred to Jichi Medical University Saitama Medical Center for suspected bilateral internal carotid artery aneurysms. MRI was performed for detailed evaluation before treatment.

Clinical comments: To determine whether an aneurysm requires treatment and to formulate an effective treatment plan, it is essential to obtain detailed information concerning the shape of the aneurysm and its internal characteristics, such as the presence of thrombus. In this patient, the use of Fast 3D mode in combination with the mASTAR

method was found to be extremely helpful because it allowed the bilateral aneurysms to be evaluated based on detailed analysis of their internal characteristics, including thrombus formation and blood flow. Such information cannot be obtained using TOF-MRA alone. Based on the findings shown in these MRI/MRA images, the lesions were judged to have a high risk of rupture, which could lead to severe complications such as a stroke.

Technical comments: For the detection of thrombus formation inside the aneurysms, plaque imaging was performed using Fast 3D mode. In these examinations, scanning was performed with a smaller flop angle to maximize the BB effect. Because there was some mismatch in the signal intensity inside the aneurysm between the TOF-MRA original images and the plaque images, the mASTAR method was also employed because this method is known to be useful for evaluating blood flow inside aneurysms. Fusion images of the TOF-MRA and mASTAR images were generated for each phase. These fusion images demon-

strated partial thrombus formation in the aneurysms as well as the presence of areas of slow blood flow.

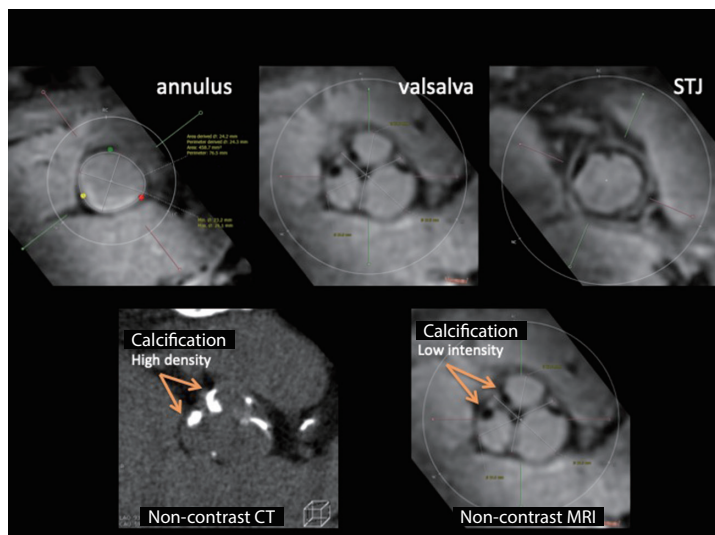
Comments on images: (a) Fusion images. Fusion images of the TOF-MRA and mASTAR images were generated for each phase. These fusion images show areas of slow blood flow inside the aneurysms and the presence of thrombus (yellow arrows). (b) mASTAR images. As in the TOF-MRA images, an irregularly shaped aneurysm is also observed in the mASTAR images (red arrows). (c) TOF-MRA images. An irregularly shaped aneurysm is seen in the right IC-PC (red arrows). (d) Fast 3D mode. Because the aneurysm had an extremely irregular shape, scanning was performed using Fast 3D mode to evaluate thrombus formation. Flow voids are seen in some areas inside the aneurysm, but these areas do not match the signal intensity observed in the TOF-MRA images (yellow arrows).

Comments of judges: New imaging techniques were skillfully employed to evaluate the internal characteristics of aneurysms.

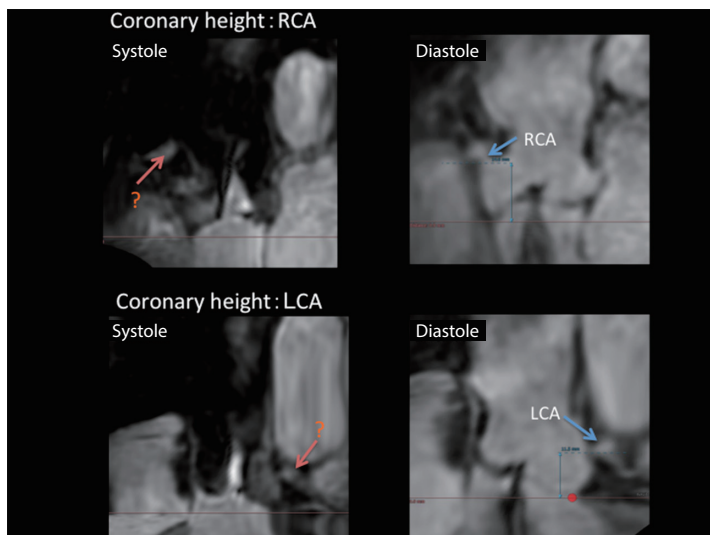
Sex	Age	Weight	Software version	Fasting	Contrast medium
Female	70+ years	40-50 kg	V4.0	No	
Dose	Injection rate	Administration method	Workstation		
			Ziostation2		

Acquisition conditions for (a)	Fat suppression: none, gating: none
Acquisition conditions for (b)	FFE3D ASTR, TR: 5.6, TE: 1.9, FA: 8, TI: 300, fat suppression: none, gating: none, SPEEDER factor: 2, FOV / No Wrap: 22×22 / 1, matrix: 160×160, slice thickness / number of slices: 3 mm / 30, number of segments: 2, number of acquisitions: 2, scan time: 3:04
Acquisition conditions for (c)	MRA3D-ic, TR: 19, TE: 6.8, FA: 18, fat suppression: none, gating: none, SPEEDER factor: 2, FOV / No Wrap: 20×20 / 1, matrix: 192×256, slice thickness / number of slices: 1 mm / 102, number of acquisitions: 1, scan time: 4:36
Acquisition conditions for (d)	FASE3D Fast 3D mode, TR: 500, TE: 13.5, FA/Flop: 90/50, fat suppression: FatSAT, gating: none, SPEEDER factor: 1.5, FOV / No Wrap: 25×25 / 1, matrix: 256×256, slice thickness / number of slices: 1.5 mm / 95, number of shots: 5, number of acquisitions: 2, scan time 4:35
Coil used for (b), (c), and (d)	Atlas SPEEDER Head/Neck

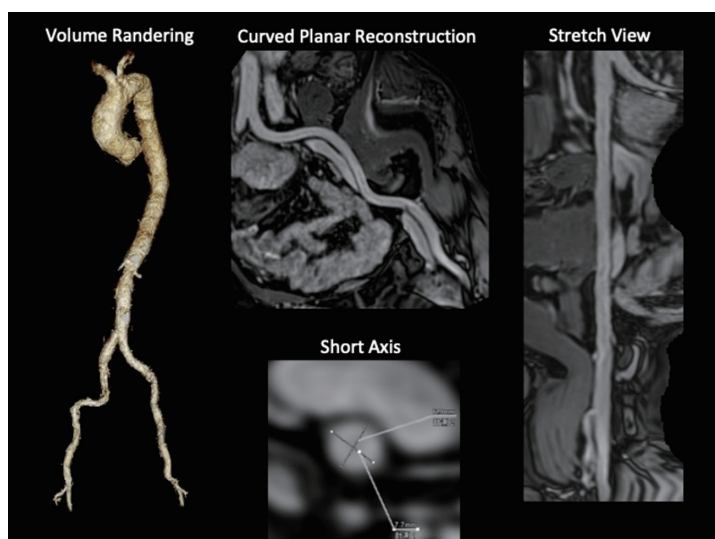




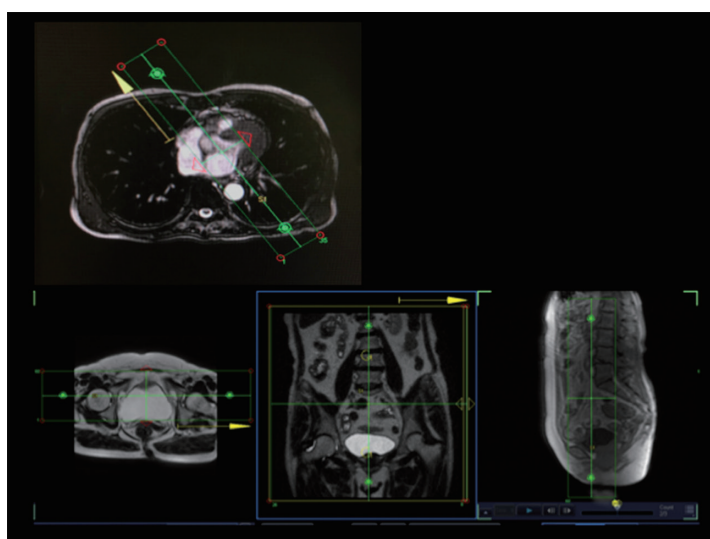
(a) Valve measurement and evaluation using 3mensio



(b) Evaluation of coronary artery height (comparison between systole and diastole)



(c) Evaluation of access route based on VR and CPR images



(d) Scan plan

Thoracic vessels / great vessels

Evaluation of a patient with CKD prior to TAVI

Mitsui Memorial Hospital, Japan

System used: Vantage Titan

Reason for examination: This 87-year-old woman was admitted for exertional dyspnea and syncope. Examination showed that she had severe aortic valve stenosis. Due to the patient's advanced age, TAVI was considered. The guidelines for patients undergoing TAVI include the recommendation that contrast CT examination should be performed before the procedure. However, contrast CT was contraindicated in this patient because she had severe kidney dysfunction due to nephrosclerosis (eGFR: 23.5 mL/min / 1.73 m²). Non-contrast MRI was therefore used for preprocedural evaluation.

Clinical comments: Non-contrast MRI was used to examine the aortic valve (annulus, sinuses of Valsalva, height of the coronary arteries, etc.) and to evaluate the access route (diameter and tortuosity of the vessel). Non-contrast CT was used to evaluate calcification. The valve measurements obtained showed good alignment with the findings

of transesophageal echocardiography performed during the procedure. The results of calcification evaluation also aligned with the low-signal areas seen in MRI and the high-absorption areas seen in CT. The diameter and tortuosity of the vessel were checked to evaluate the access route. Ultimately, the patient was judged to be a good candidate for TAVI.

Technical comments: Because patients undergoing TAVI are often elderly, special efforts must be made to minimize the scan time. Compared to the scan time for the entire heart, the scan time could be significantly reduced by tilting the imaging table to scan the valve. The imaging table was set to coronal for evaluation of the access route, permitting a wide range to be scanned in a short time. It is generally recommended that data acquired during systole should be used to evaluate the aortic valve, but due to the rapid blood flow in patients with AS, the presence of extensive flow voids may interfere with evaluation. To avoid this problem, images were also acquired during diastole to permit evaluation of the sinuses of Valsalva and the height of the coronary arteries.

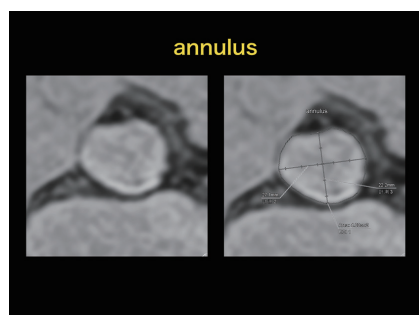
Comments on images: (a) Valve measurement and evaluation were performed using 3mensio. Measurement and evaluation of the valve annulus, sinuses of Valsalva, and STJ was possible. Calcification seen as high-absorption areas in non-contrast CT aligned with the low-signal areas seen in

MRI, and the locations also matched closely. (b) The use of data acquired during systole is recommended for evaluation of the valve annulus, but it was difficult to evaluate the height of the coronary arteries in this case due to the presence of flow voids. To address this issue, additional images were acquired during diastole. This minimized flow void effects, permitting the height of the coronary arteries to be evaluated. (c) It was possible to acquire images with sufficiently high signal intensity for generating VR images in order to evaluate the access route. The diameter of the blood vessel was judged to be acceptable based on diameter measurements in short-axis images obtained from the CPR image. Tortuosity of the right external iliac artery was also observed in the VR image. (d) Patients undergoing TAVI are often elderly, and it is therefore important to minimize the scan time. For scanning the aortic complex, the scan range was narrowed by tilting the imaging table. The access route was scanned by setting a coronal imaging table, permitting a wide range to be scanned in a short time. The scan time was approximately 11 minutes.

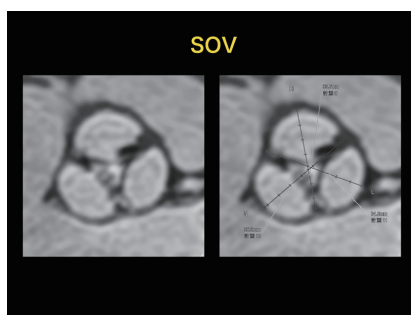
Comments of judges: Despite the short scanning time, both the valve and the access route could be evaluated. The methods employed in this case are judged to be of great practical value.

Sex	Age	Weight	Software version	Fasting	Contrast medium
Female	70+ years	40-50 kg	V3.1		
Dose	Injection rate	Administration method	Workstation		
			3mensio, Ziostation2		

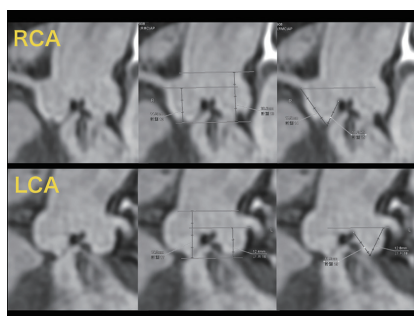
Acquisition conditions for (a) and (b)	FFE3D2.3_ssf200k, TR: 4.5, TE: 2.3, FA: 115, fat suppression: FatSAT, gating: ECG-gated RMC, SPEEDER factor: 2.4, FOV: 32×38, matrix: 196×240, slice thickness / number of slices: 1.6 mm / 40, number of segments: 4, number of acquisitions: 1, scan time: 3:12
Acquisition conditions for (c)	FFE3D2.6_ssf200k, TR: 5.2, TE: 2.6, FA: 120, fat suppression: FatSAT, gating: respiratory gating, SPEEDER factor: 2, FOV: 38×38, matrix: 256×256, slice thickness / number of slices: 1.5 mm / 60, number of segments: 1, number of acquisitions: 1, scan time: 4:02
Coils used for (a), (b), and (c)	Atlas SPEEDER Body and Atlas SPEEDER Spine



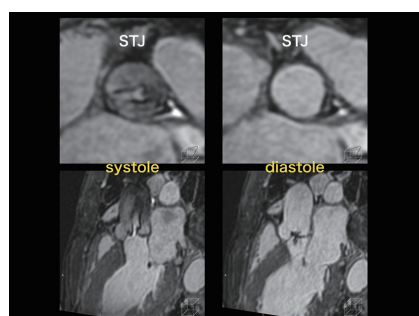
(a) Evaluation of valve annulus (short-axis diameter, long-axis diameter, and valve ring area)



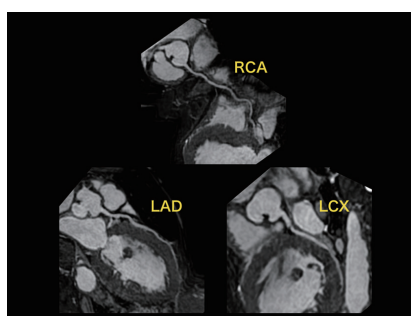
(b) Evaluation of SOV (RCC, LCC, and NCC diameters)



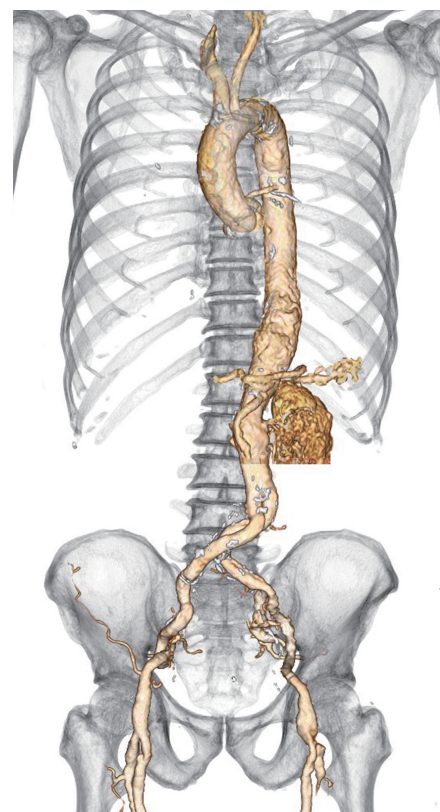
(c) Evaluation of height of coronary arteries and valve leaflets



(d) Evaluation of STJ (left: systole, right: diastole)



(e) Evaluation of coronary arteries using images acquired during diastole



(f) Fusion image of CT and MRI

Thoracic vessels/great vessels.

Evaluation using non-contrast MRI prior to TAVI

Sendai Kousei Hospital, Japan

System used: Vantage Orian

Reason for examination: This patient was referred to our hospital to receive treatment for heart failure. The patient was found to have severe AS by TEE and was scheduled to undergo TAVI. The patient was initially scheduled to undergo preprocedural contrast CT examination, but the results of blood tests obtained before the examination showed impaired renal function (Cre: 2.72 mg/dL, eGFR: 18.7 mL / min / 1.73 m²). Non-contrast MRI was therefore used to evaluate the aortic valve complex, coronary arteries, great vessels, etc. before the TAVI procedure.

Clinical comments: The aortic valve complex and the coronary arteries (which are important structures for determining the size of the artificial valve to be implanted) could be clearly visualized without blurring. The patient had previously undergone surgery for AAA, and it was therefore expected that evaluation of the abdominal aorta would be

difficult. Nevertheless, the MRI images were sufficiently clear to permit the characteristics of the abdominal aorta to be evaluated. With the accuracy of preprocedural evaluation by non-contrast MRI considered to be comparable to that of contrast CT, it was possible to perform TAVI as scheduled, and the procedure was completed without any serious complications.

Technical comments: To allow scanning of the heart and abdominal aorta in a single acquisition, sagittal-oblique scanning using the SSFP3D method was employed. Images were acquired during systole and diastole for evaluation of the aortic valve complex. To compensate for the loss of signal information due to the rapid blood flow through the aortic valve during systole which is characteristic of AS, analysis was performed using images acquired during diastole. For abdominal scanning, coronal-oblique acquisition was performed using the 3D FS-FBI method along the course of the blood vessels from the CIA to the CFA, allowing the number of images to be minimized and reducing the acquisition time to approximately 5 minutes.

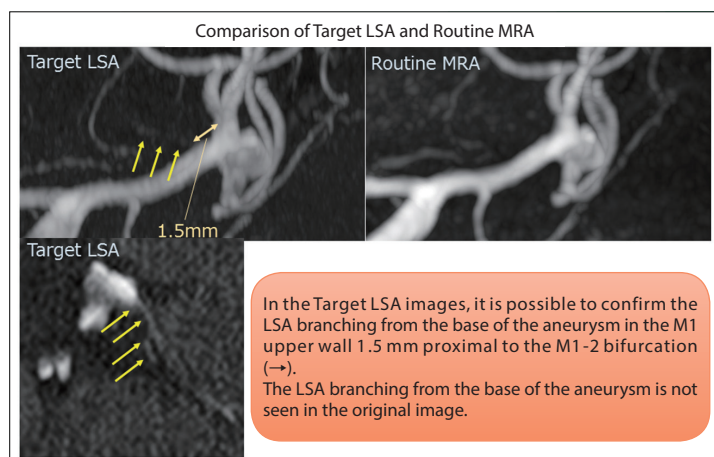
Comments on images: (a) Evaluation of the valve annulus (short-axis diameter, long-axis diameter, and valve ring area) using a non-contrast MRI image acquired during systole. (b) Evaluation of the SOV (RCC, LCC, and NCC diameters) using a non-contrast MRI image acquired during

diastole. (c) Determination of the height of the coronary arteries and evaluation of the valve leaflets using non-contrast MRI images acquired during diastole. (d) Evaluation of the STJ using non-contrast MRI images acquired during systole. It can be seen that there is loss of signal information caused by the rapid blood flow through the aortic valve during systole which is characteristic of AS (left). By using an image acquired during diastole (right) in combination, clear images without loss of signal information could be obtained, making it possible to perform analysis. (e) Evaluation of the coronary arteries using non-contrast MRI images acquired during diastole. Clear images without blurring could be obtained. Stenosis is seen in the RCA-mid and LCX-prox. CAG was performed in addition to TAVI, and moderate stenosis is seen in the same segments. (f) A CT-like image could be obtained by generating a fusion image using an image of the thoracic aorta acquired using the SSFP3D method, an image of the abdominal aorta acquired using the 3D FS-FBI method, and a non-contrast CT image of the bones and the calcifications in the large arteries.

Comments of judges: It is judged that the lesions in the coronary arteries are clearly visualized and that the image quality is extremely high.

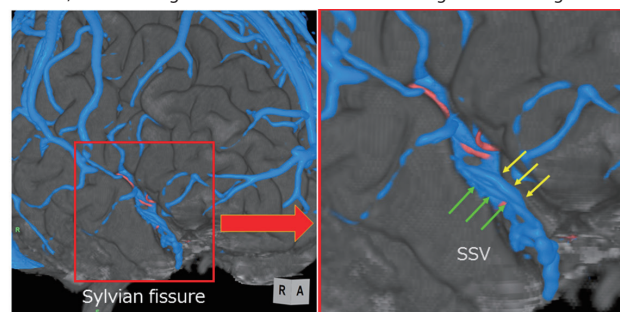
Sex	Age	Weight	Software version	Fasting	Contrast medium
Male	70+ years	50-60 kg	V4.5	Yes	
Dose	Injection rate	Administration method	Workstation		
			Ziostation2		

Acquisition conditions for (a) and (d) (left)	SSFP3D, TR: 4, TE: 2, FA: 105, fat suppression: FatSAT, gating: ECG gating RMC, SPEEDER factor: 2, FOV / No Wrap: 31.3×36 / 1, matrix: 200×224, slice thickness / number of slices: 1.6 mm / 80, number of segments: 4, number of acquisitions: 1, scan time: 6:01
Acquisition conditions for (b), (c), and (d) (right) and for (e) and (f) (chest)	SSFP3D, TR: 4, TE: 2, FA: 105, fat suppression: FatSAT, gating: ECG gating RMC, SPEEDER factor: 2, FOV / No Wrap: 31.3×36 / 1, matrix: 212×224, slice thickness / number of slices: 1.6 mm / 110, number of segments: 4, number of acquisitions: 1, scan time: 8:16
Scan conditions for (f) (abdomen)	FASE3D+5-FBI:FS, TR: 3138, TE: 80, FA/Flop: 90/180, TI: 130, fat suppression: none, gating: ECG gating, SPEEDER factor: 2, FOV / No Wrap: 40×40 / 1, matrix: 256×272, slice thickness / number of slices: 3 mm / 80, number of shots: 1, number of acquisitions: 1, scan time: 4:37
Coils used	Atlas SPEEDER Body and Atlas SPEEDER Spine



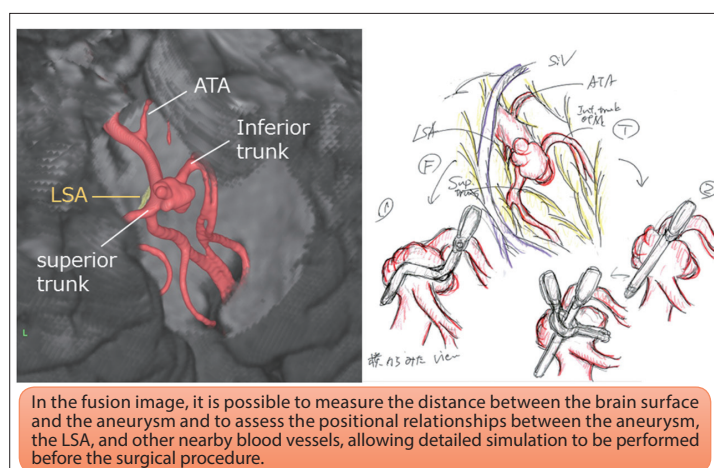
(a) Preoperative MRA images (Target LSA, Routine MRA)

In addition, a fusion image of the brain surface and MRV is generated using 3D FLAIR.

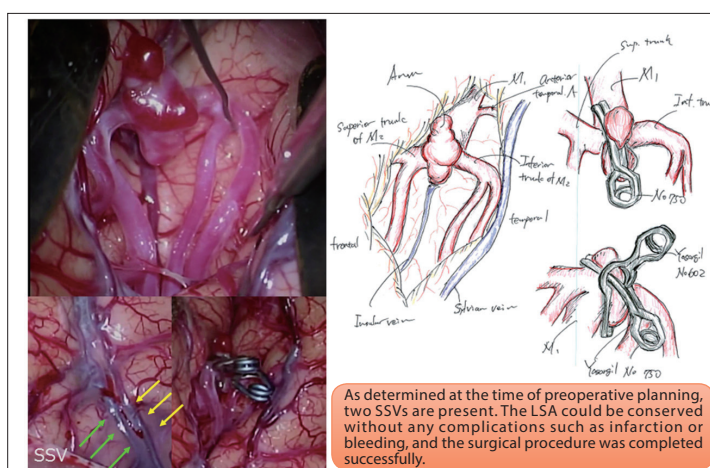


In the fusion image of the brain surface and MRV, it is seen that there are two SSVs on the brain surface of the temporal lobe (→).

(b) Preoperative MRI images (fusion of MRV and 3D FLAIR)



(c) Preoperative fusion image and simulation



(d) Intraoperative photographs and postoperative notes

Neurosurgery

Aneurysm at the bifurcation of the right MCA

Kyorin University Hospital, Japan

System used: Vantage Galan 3T

Reason for examination: This patient was receiving treatment for polycystic kidney disease. An aneurysm at the bifurcation of the right MCA (which was not seen in a previous brain MRA examination performed in 2015) was found in a follow-up MRA examination performed in 2018. Due to the patient's impaired renal function, it was not possible to perform CTA or DSA, and the decision to perform craniotomy and clipping was based solely on the findings of MRI and MRA.

Clinical comments: Conservation of the penetrating branches is essential when performing clipping procedures for cerebral aneurysms. It is therefore extremely important to obtain a clear understanding of the positional relationships between the base of the aneurysm and the origins of the penetrating branches. Target LSA for visualizing the lenticulostriate arteries (LSAs), which are penetrating branches of the MCA, is a useful sequence in non-

contrast MRA that can clearly depict the positional relationships between the origins of the penetrating branches and the aneurysm. In addition, by fusing the MRV and a brain surface image acquired using 3D FLAIR, it was possible to simulate a safe access route based only on non-contrast imaging. This method is of great clinical value.

Technical comments: The in-plane resolution required for visualization of the LSAs was confirmed using a phantom with simulated LSAs, and the optimal FOV and matrix were determined. In addition, based on assessment of the visualization capabilities of this method using images obtained from a volunteer, the Target LSA method has been developed to achieve a clinically acceptable scan time in relation to Slice No Wrap and the number of acquisitions. In addition, it was possible to obtain a non-contrast MRI image for preoperative support by fusing the veins on the brain surface in the MRV image with an image of the brain surface acquired using 3D FLAIR.

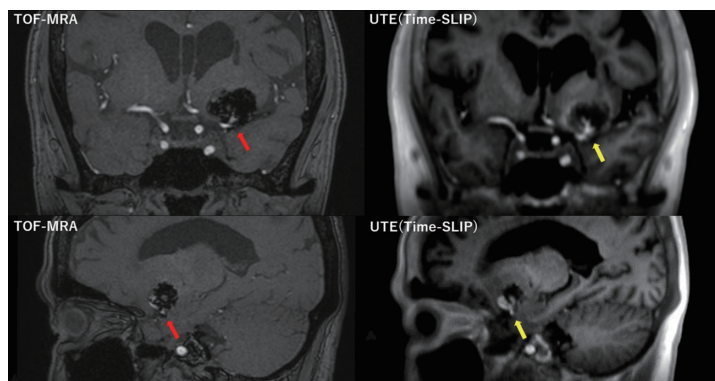
Comments on images: (a) An LSA that could not be depicted by routine MRI was clearly visualized by Target LSA, and it was possible to confirm that the LSA branched from the upper wall of M1 approximately 1.5 mm proximal to the M1/2 bifurcation at the base of the aneurysm. (b)

Based on the fusion image of MRV and 3D FLAIR, it was determined that two superficial Sylvian veins (SSVs) were present on the brain surface of the temporal lobe. (c) By fusing Target LSA, MRV, and 3D FLAIR images of the brain surface, it was possible to obtain an image that could be used for preoperative simulation from the surgeon's perspective by performing only non-contrast MRI and MRA. (d) Intraoperative photographs were also obtained. As shown in the image obtained before surgery, two SSVs were present on the brain surface and no LSA branched directly from the base of the aneurysm. As a result, the procedure was performed safely and the LSA near the base of the aneurysm was successfully conserved in accordance with the preoperative simulation.

Comments of judges: The penetrating branches were clearly visualized with high resolution. Because it is essential to perform clipping procedures without interrupting blood flow in the penetrating branches, detailed information concerning the orientation of the aneurysm is extremely important. Fusion images generated from FLAIR and MRV were therefore very useful during the actual surgical procedure. The high-quality data obtained provided ideal preoperative information.

Sex	Age	Weight	Software version	Fasting	Contrast medium
Female	40-50 years		V5.0		
Dose	Injection rate	Administration method	Workstation		
			Ziostation		

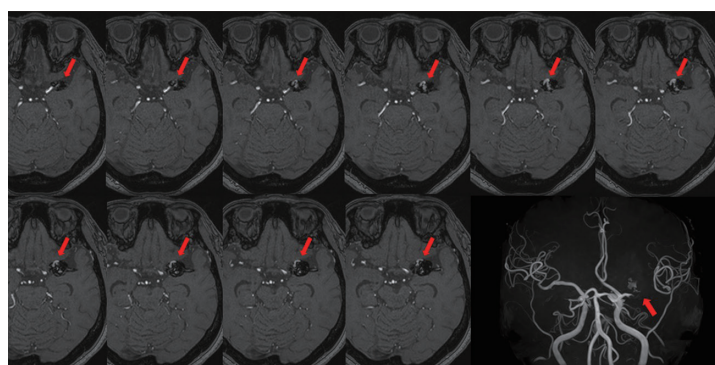
Acquisition conditions for (a) and (c)	Target LSA (Highreso TOF MRA), TR: 19, TE: 3.9, FA: 15, fat suppression: none, gating: none, FOV / No Wrap: 8 × 8 / 1.5, matrix: 224 × 224, slice thickness / number of slices: 0.8 mm / 30, number of acquisitions: 1.5, scan time: 5:07
Acquisition conditions for (b)	3D FLAIR, TR: 6000, TE: 352, FA/Flop: 90/180, Ti: 2000, fat suppression: none, gating: none, FOV / No Wrap: 23 × 23 / 1.2, matrix: 208 × 208, slice thickness / number of slices: 1.2 mm / 150, number of acquisitions: 1, scan time: 6:48
Coil used	32ch Head SPEEDER



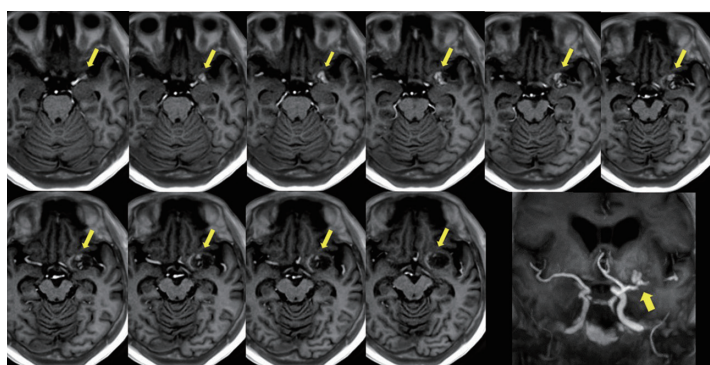
(a) Comparison of MPR images
TOF-MRA (left) UTE and Time-SLIP used in combination (right)



(b) Comparison of MIP images
TOF-MRA (left) UTE and Time-SLIP used in combination (right)



(c) TOF-MRA



(d) UTE and Time-SLIP used in combination

Neurosurgery

Follow-up examination after left MCA aneurysm embolization combined with stenting (suspected recanalization)

Jichi Medical University Saitama Medical Center, Japan

System used: Vantage Titan 3T

Reason for examination: The patient had undergone left MCA aneurysm embolization combined with stenting at another hospital. An MRI examination was performed for follow-up.

Clinical comments: UTE is known to be useful for suppressing metal artifacts. However, one disadvantage of UTE is that it requires a relatively long scanning time. The method employed in this case allowed the scanning time to be reduced while retaining the advantages of UTE. This is clinically useful for improving workflow and for examining patients with claustrophobia. In addition, because

background structures are visualized to some degree, it is easier to obtain a clear understanding of positional relationships as compared to the TOF method.

Technical comments: This follow-up MRI examination showed findings suggestive of recanalization in the segment where coil embolization had been performed. Because the patient had undergone coil embolization combined with stenting, the addition of mUTE[®]-MRA was considered because it is known that this scanning method minimizes the effects of susceptibility artifacts. However, due to the patient's claustrophobia, Time-SLIP was used in combination to minimize the scanning time. This is because Time-SLIP does not require two acquisitions for obtaining a labeling image and a control image. The number of trajectories was set to 19968 taking the spatial resolution and acquisition time into account.

Comments on images: (a) Left: TOF-MRA images, right: UTE images with Time-SLIP used in combination. With the TOF method, the blood flow inside the aneurysm and the continuity of blood flow cannot be clearly visualized (red arrows). In the UTE images, on the other hand, the continuity of the blood flow inside the aneurysm and stent is

clearly visualized (yellow arrows). (b) Left: TOF-MRA image, right: UTE image with Time-SLIP used in combination. Unlike the TOF-MRA image, the blood flow inside the aneurysm and stent is clearly visualized. (c) TOF-MRA images. Areas of higher signal intensity are observed in the aneurysm of the left MCA where coil embolization was performed, which is suggestive of recanalization (red arrows). However, the lesion was treated by coil embolization combined with stenting, and the blood flow inside the stent is not clearly visualized. (d) UTE images with Time-SLIP used in combination. By employing the UTE method, susceptibility artifacts are minimized, allowing the residual blood flow inside the aneurysm to be clearly visualized (yellow arrows).

Comments of judges: The method employed in this case is judged to be extremely useful because the use of Time-SLIP in combination reduces the time required for evaluating blood flow inside an aneurysm by eliminating the need to perform subtraction.

※ mUTE: minimized acoustic noise utilizing Ultrashort TE

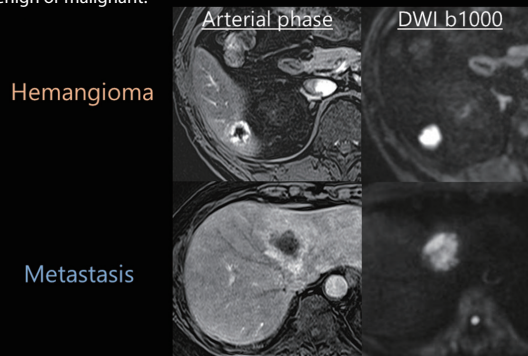
Sex	Age	Weight	Software version	Fasting	Contrast medium
Female	70+ years	60-70 kg	V4.0	No	
Dose	Injection rate	Administration method	Workstation		

Scan conditions for (a) and (b)	Fat suppression: none, gating: none
Acquisition conditions for (c)	MRA3D3.4fc, TR: 21, TE: 3.4, FA: 15, fat suppression: none, gating: none, SPEEDER factor: 2, FOV / No Wrap: 20×20 / 1, matrix: 224×256, slice thickness / number of slices: 0.9 mm / 114, scan time: 5:40
Acquisition conditions for (d)	FFE3D UTE, TR: 3.7, TE: 0.096, FA: 5, BBT: 1000, fat suppression: none, gating: peripheral pulse gating, FOV / No Wrap: 23×23 / 1, matrix: 320×320, slice thickness / number of slices: 1 mm / 200, number of segments: 96, number of acquisitions: 1, scan time: 3:22
Coil used for (c) and (d)	32ch Head SPEEDER



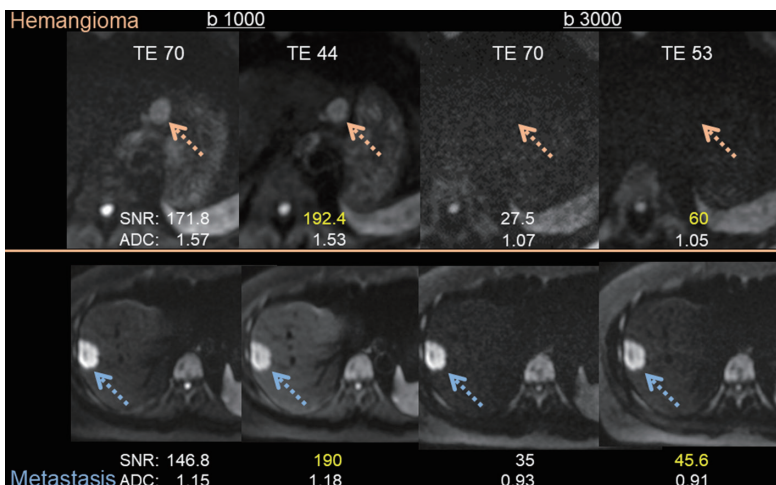
DWI images of hepatic masses

Due to T2 shine-through, it is difficult to determine whether the masses are benign or malignant.



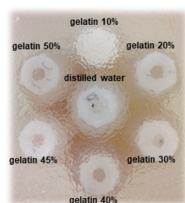
If it were possible to obtain images with a good SNR at a high b-factor...

(a) DWI images of hepatic masses



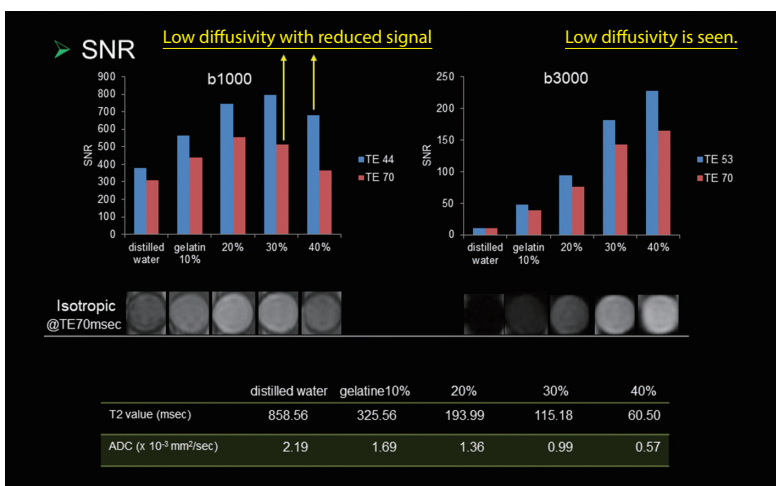
(b) Comparison of DWI images with a b-factor of 1000 or 3000

Original phantom



	T2 value (msec)	ADC (x 10 ⁻³ mm ² /sec)
distilled water	858.56	2.19
gelatin 10%	325.56	1.69
gelatin 20%	193.99	1.36
gelatin 30%	115.18	0.99
gelatin 40%	60.50	0.57
gelatin 45%	N/A	0.30
gelatin 50%	N/A	0.82

(c) T2 values and ADC values of the simulation phantom



(d) Results of tests performed using the phantom (SNR)

Epigastric region

Clinical value of DWI using an ultra-high b-factor and minimized TE for the differential diagnosis of benign and malignant hepatic tumors using a 3T MRI scanner with a high gradient field strength

Kyorin University Hospital, Japan

System used: Vantage Galan 3T

Reason for examination: In the Vantage Galan 3T / ZGO system, the maximum gradient field strength has been significantly improved to 100 mT/m. This makes it possible to select an ultra-high b-factor without the need to extend the TE in DWI scanning. A reduction in the SNR is a concern when an ultra-high b-factor is used, but in this system, the acquisition of tissue images with a certain signal strength is ensured. In this study, both phantom images and actual clinical images were used to evaluate the clinical value of

DWI using an ultra-high b-factor and minimized TE for the differential diagnosis of benign and malignant hepatic tumors.

Clinical comments: In some cases, the differential diagnosis of benign and malignant tumors is difficult using DWI scanning in liver MRI due to the difference in contrast between T2 and diffusion imaging. To address this issue, scanning was performed with the b-factor set to 3000 and with a minimized TE. Contrast with minimal shine-through was obtained, and the SNR was significantly improved as compared to a conventional TE of 70 msec. Using this method, the differential diagnosis of benign and malignant hepatic hemangiomas and hepatic metastases (as in this case) is improved, which may obviate the need to perform other types of examinations, including contrast-enhanced examinations.

Technical comments: A phantom simulating the hepatic parenchyma and tumors in terms of the T2 value and ADC value was fabricated. The phantom was then scanned with the b-factor set to 3000 and with a minimized TE. T2 relaxation effects were minimized by reducing the b-factor, resulting in contrast with more intense diffusion. Compared to the conventional TE of 70 msec, the SNR was significantly

improved. Similar results were also obtained in actual clinical practice. When the b-factor was set to 3000, a reduction in signal was observed in hepatic hemangiomas (in which a reduction in diffusion does not occur), and signals showing a reduction in diffusion were therefore considered to be indicative of hepatic metastases. This permits the differential diagnosis of benign and malignant hepatic tumors.

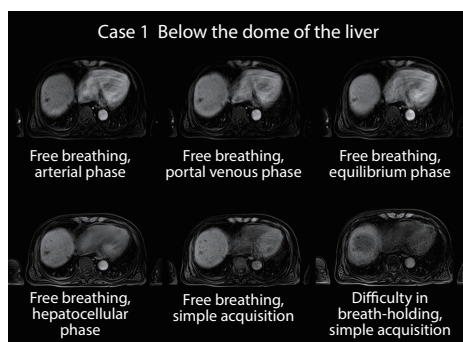
Comments on images: (b) By achieving an ultra-high b-factor with a high SNR, it was possible to distinguish T2 shine-through effects. (c) A phantom simulating the hepatic parenchyma and tumors in terms of the T2 value and ADC value was fabricated using gelatin with different concentrations. (d) When the b-factor was set to 1000, the graph showed a peak, the effect of T2 relaxation was greater than that of low diffusivity, and the image did not reflect low diffusivity. When the b-factor was set to 3000, the slope of the signal value was upward, indicating that signals reflecting low diffusivity were obtained.

Comments of judges: The method described here is clinically very useful because it permits the differential diagnosis of benign and malignant hepatic tumors using DWI with an ultra-high b-factor.

Sex	Age	Weight	Software version	Fasting	Contrast medium
			V5.0		
Dose	Injection rate	Administration method	Workstation		

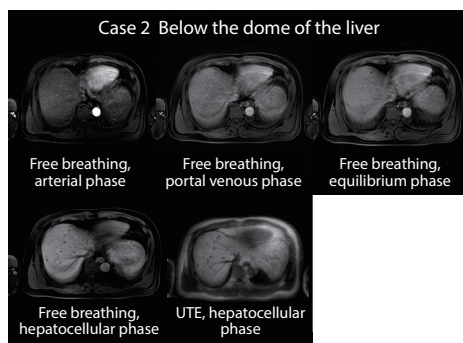
Acquisition conditions for (a)	SSFP3D, TR: 3500, TE: 7, FA/Flop: 90/180, fat suppression: FatSAT, gating: RMC, b-factor: 1000, SPEEDER factor: 2, FOV / No Wrap: 33×36 / 1, matrix 160×160, slice thickness / number of slices: 6 mm / 30, number of shots: 1, number of acquisitions: 3, scan time: 2:06
Acquisition conditions for (b)	SSFP3D, TR: 3500, TE: 7, FA/Flop: 90/180, fat suppression: FatSAT, gating: RMC, b-factor: 3000, SPEEDER factor: 2, FOV / No Wrap: 33×36 / 1, matrix 160×160, slice thickness / number of slices: 6 mm / 30, number of shots: 1, number of acquisitions: 3, scan time: 2:06
Coils used for (a) and (b)	Atlas SPEEDER Body and Atlas SPEEDER Spine

(a) Dynamic3 phase (below the dome of the liver), case 1



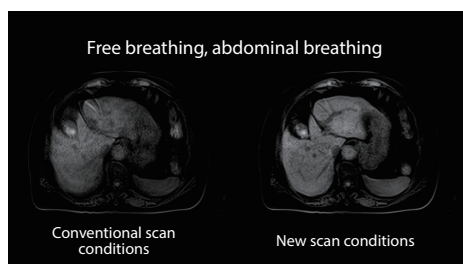
The detection rate is equivalent to that of UTE, hepatocellular phase (even for non-gated, hepatocellular phase).

(c) Dynamic3 phase (below the dome of the liver), case 2

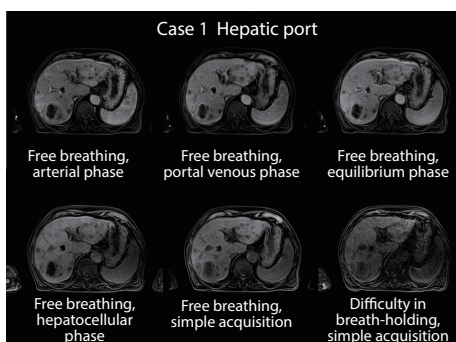


Images acquired using conventional scan conditions under free breathing are degraded by respiratory motion. However, by selecting the optimal SPEEDER factor and slice direction, images of diagnostic quality can be obtained.

(e) Comparison of images obtained under free breathing



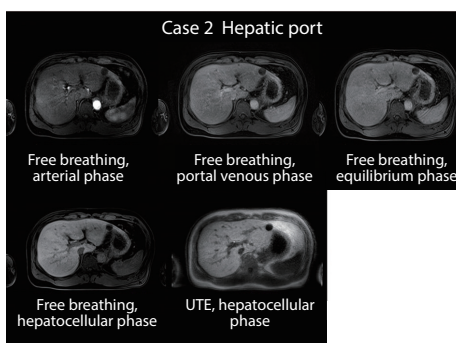
Case 1 Hepatic port



(b) Dynamic3 phase (Hepatic port), case 1

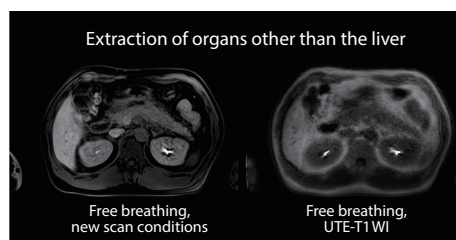
The detection rate is equivalent to that of UTE, hepatocellular phase (even for non-gated, hepatocellular phase).

(d) Dynamic3 phase (Hepatic port), case 2



The detection rate for lesions is improved in UTE-T1 WI due to the shortening of T1 caused by the uptake of contrast medium by the hepatocytes. However, it is not possible to assess lesions in the pancreas or kidney because UTE provides a T1 WI-like image, and fat suppression is ineffective for these organs. Because 3D-T1 WI (which is the method normally used for breath-holding scan) is employed as the basic method, it is also useful for the dynamic assessment of multiple organs.

(f) Extraction of organs other than the liver



Epigastric region

Case in which gated acquisition for a hepatic tumor was difficult – From dynamic to hepatocellular phase –

Jiseikai Tojun Hospital, Japan

System used: Vantage Titan 3T
Reason for examination: Detailed examination of hepatic tumors by contrast-enhanced MRI using EOB Primovist is sometimes required in patients who have difficulty holding their breath. The hepatocellular phase can be acquired by non-gated UTE or respiratory-gated scanning, but dynamic scanning is difficult. Because the detailed assessment of hepatic tumors requires information ranging from hemodynamics to hepatocellular function, a new method has been developed in which imaging that covers the range from dynamic scanning to the hepatocellular phase can be performed without gating (under free breathing) by adjusting the scan conditions.

Clinical comments: Case 1: Patient with difficulty in breath-holding. This patient with a tumor in the head of the pancreas underwent follow-up examination for multiple hepatic metastases and detailed evaluation of a tumor (cyst) in the posterior segment of the right lobe of the liver. The hemodynamics of the tumor below the dome of the liver and around the hepatic port and the position of the tumor are clearly visualized in the dynamic phase under free breathing. Case 2: Detailed evaluation of multiple he-

patic metastases. The enhancement effect in the dynamic phase under free breathing was low, and the lesions were therefore determined to be multiple hepatic cysts. The image acquired in the hepatocellular phase is comparable to UTE-T1 WI. Images obtained using this method are able to provide useful information concerning hemodynamics even under free breathing.

Technical comments: There are two breathing methods: abdominal breathing and costal breathing. The appropriate scan conditions were selected according to the patient's breathing method. For patients with abdominal breathing, the encoding order was changed from SE to PE and 2.5/1.2 was set for the SPEEDER factor in order to reduce the acquisition time and obtain scan conditions suitable for movement. For patients with costal breathing, the encoding order was changed from PE to SE and the number of segments was set to 8 in order to obtain scanning conditions suitable for movement under free breathing. There was no difference in the detection rate for the hepatocellular phase as compared to UTE under free breathing. In addition, because areas other than the liver are clearly visualized using this method, it can be also used to perform a variety of contrast-enhanced examinations in the epigastric region.

Comments on images: (a) When scanning the liver in patients who have difficulty holding their breath, it is usually the case that less information can be obtained. However, even under free breathing, the tumor below the dome of the liver is clearly visualized in the Dynamic3 phase and hepatocellular phase. (b) The tumor in the left lobe of the liver can be confirmed under free breathing. The hemody-

namics of the metastases in the S5 segment and the area around the tumor in the S6 segment can be as clearly visualized as in the breath-holding scan. Such images are much more useful than images obtained using the conventional method in patients who have difficulty holding their breath. (c) The tumor in the periphery of the S4 segment can be observed in all phases. In the hepatocellular phase, images can be acquired in a significantly shorter scan time as compared to UTE-T1 WI. (d) The hemodynamics of the cysts in the S2 segment and the hepatic port can be evaluated. The degree of enhancement of the bile duct in the hepatocellular phase is equivalent. (e) Pre-T1 WI examination is performed in patients who have difficulty holding their breath. It is not possible to obtain sufficiently detailed information inside the liver when scanning is performed using conventional scan conditions. However, when the method described here is employed, structures as small as the hepatic vessels can be clearly visualized. (f) The detection rate for lesions is improved in UTE-T1 WI due to the shortening of T1 caused by the uptake of contrast medium by the hepatocytes. However, the image does not provide any information concerning the pancreas or kidney. This method allows the observation of all phases under free breathing.

Comments of judges: The method employed here can provide hemodynamic information under free breathing. It is judged to be very effective because it employs the basic principle of selecting the most suitable scan conditions according to the patient's breathing method (abdominal or costal).

Sex	Age	Weight	Software version	Fasting	Contrast medium
Female	70+ years	50-60 kg	V4.0	Yes	EOB-Primovist
Dose	Injection rate	Administration method	Workstation		
5.5	1.0	Intravenous injection using an injector, 30-mL saline flush			

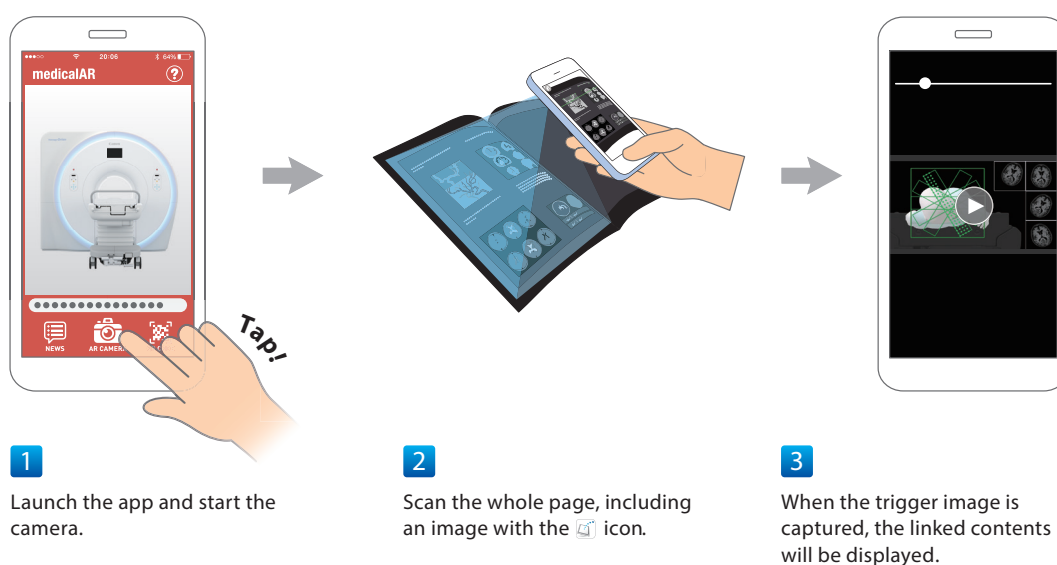
Acquisition conditions for (a), (b), (c), and (d)	FFE3D, TR: 3.2, TE: 1.3, FA: 13, fat suppression: Enhanced Fat Free, gating: none, SPEEDER factor: 2.5/1.2, FOV: 45×45, matrix: 256×256, slice thickness / number of slices: 5 mm / 1.2, number of segments: 1, number of acquisitions: 1, scan time: 0:13
Acquisition conditions for (d)	UTE, TR: 3.7, TE: 0.093, FA: 27, fat suppression: none, gating: none, SPEEDER factor: 1, FOV: 45×45, matrix: 256×256, slice thickness: 2, number of segments: 10, number of acquisitions: 1, scan time: 2:28
Acquisition conditions for (e)	FFE3D, TR: 3.5, TE: 1.3, FA: 15, fat suppression: Enhanced Fat Free, gating: none, SPEEDER factor: 2.5/1.2, FOV: 45×45, matrix: 168×320, slice thickness / number of slices: 5 mm / 1, number of segments: 2, number of acquisitions: 1, scan time: 0:19
Coils used	Atlas SPEEDER Body and Atlas SPEEDER Spine

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