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29th

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Best Image Awards Compilation

CT Category

Judging Panel

Dr. Kazuo Awai, Dean of the School of Medicine, Professor and Chairman
Department of Diagnostic Radiology, at Hiroshima University, Japan

Prof. Toshinori Hirai, Diagnostic Radiology Faculty of Life Sciences, Kumamoto University, Japan

Prof. Kunihiro Yoshioka Department of Radiology, Iwate Medical University, Japan

Prof. Masahiro Jinzaki, School of Medicine, Department of Radiology, Keio University, Japan

Invited Professor, Katsumi Tsujioka, Fujita Health University, School of Medical Science and Graduate School of Medical Sciences

Yoshihiro Nakaya Department of Radiology, Toyo Public Health College, Japan

Takayoshi Yamaguchi Director, Division of Radiological Technology, Hanaoka Seishu Memorial Hospital, Japan

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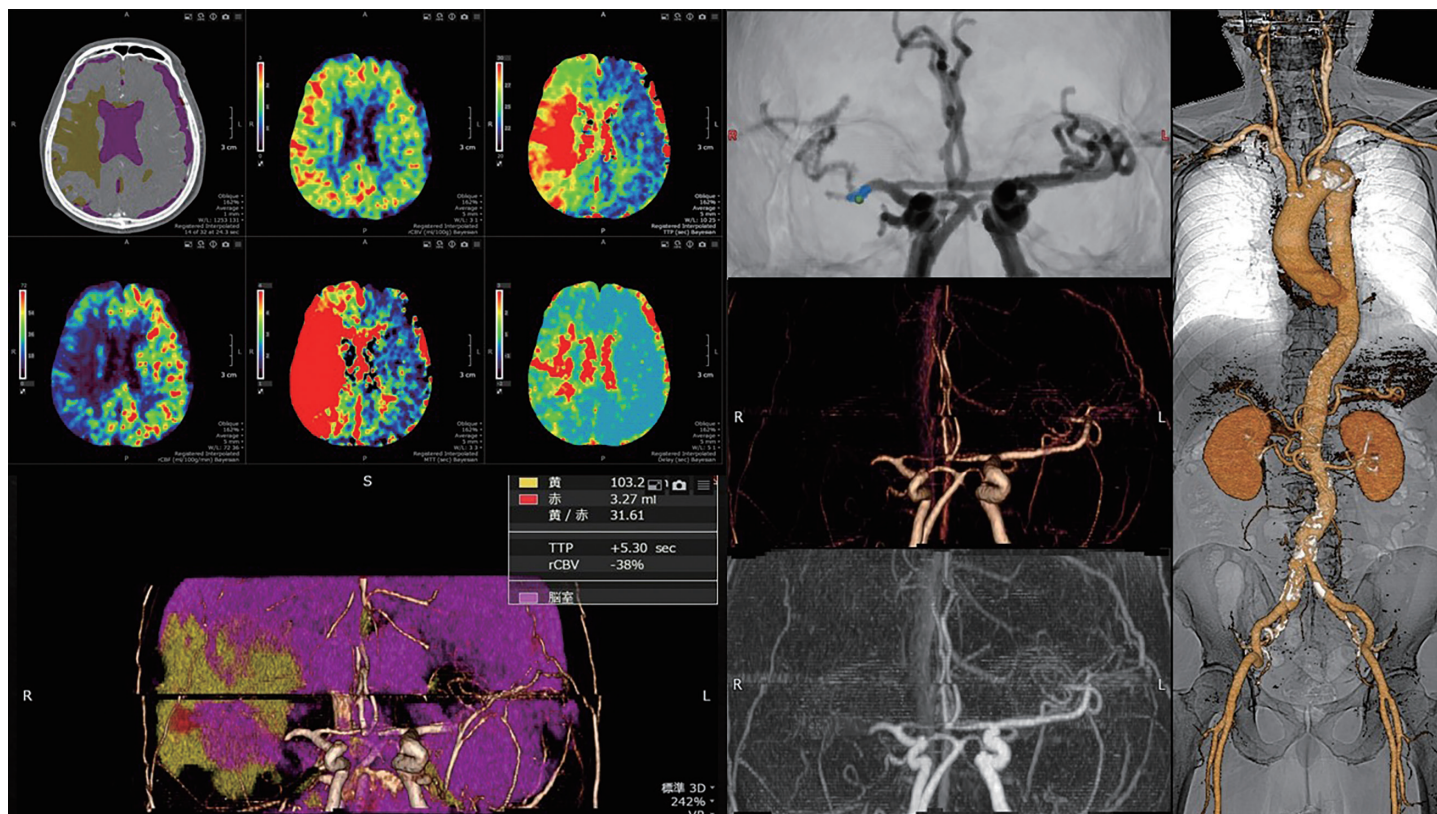
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Tracheal bronchus and anomalous pulmonary venous connection

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Head/Neck

Assessing acute cerebral infarction using a one-stop stroke protocol in the hybrid ER

Social Welfare Organization Saiseikai Imperial Gift Foundation Inc.
Saiseikai Yokohamashi Tobu Hospital, Kanagawa, Japan

System used, number of rows: Aquilion PRIME, 80 rows
Reason for examination: This elderly woman developed impaired consciousness (JCS1-3), left hemiparesis, right conjugate eye deviation, and ptosis of the left labial commissure. The time of onset was 8:00 AM. The ambulance crew assessed the patient using the prehospital stroke scale MPSS and assigned her a score of 5 points, meaning that stroke was strongly suspected. She was brought to the hybrid ER at 2:00 PM. On arrival, she was given an NIHSS score of 9 points. A one-stop stroke protocol (noncontrast brain CT + CTP + CTA covering the range from the head and neck to the trunk) was employed to determine whether the patient was a candidate for thrombectomy.

Clinical comments: The brain perfusion "Bayesian-shuttle perfusion" software installed in Vitrea was used for CTP analysis. The ischemic core and penumbra were assessed using summary maps, and the occluded blood vessels were evaluated using 4D-CTA. This approach allowed quick decision-making as to whether to proceed to endovascular treatment. In addition to CTP analysis, CTA covering the range from the head and neck to the trunk was performed and virtual 3D fluoroscopic images were generated using the IVR simulator in VINCENT. This made it possible to confirm the access route by angiography and to obtain images to support the procedure. Thanks to the fast scan protocol used to acquire all the images required for the procedure, first-pass TIC1 3 could be achieved.

Technical comments: The use of Angio CT (80 rows) permitted examination and treatment to be performed quickly using the head immobilization devices for angiography, with careful consideration paid to CTP and thrombectomy. At this hospital, noncontrast CT is performed first, followed by CTP (dynamic 8-cm-wide volume scanning) using the modified TBT method and CTA covering the range from the head and neck to the trunk in a single contrast enhancement and scan protocol. This protocol allows the entire procedure, from the start of contrast medium injection

to the end of the examination and image transfer to the workstation, to be completed in only a single click (skip). In CTP scanning, the use of AEC also supports OEM to help reduce the exposure dose to the lens of the eye.

Comments on images: All required images could be acquired using this one-stop stroke protocol.

Comments of judges: Based on the use of Angio CT (80 rows), a one-stop stroke protocol (noncontrast brain CT + CTP + CTA covering the range from the head and neck to the trunk) was employed to determine whether a patient with acute cerebral embolism was a good candidate for thrombectomy. The cerebral ischemic lesions, the occluded blood vessels, and the systemic blood vessels could all be evaluated at one time. This technique made it possible to assess not only the brain but also the systemic blood vessels in order to confirm the access route by angiography and to obtain the images needed to support the procedure. It is therefore judged to be of great clinical value for evaluating patients prior to therapeutic procedures such as thrombectomy. In addition, the reduced dose to the lens of the eye, the optimal timing of contrast enhancement, and the outstanding quality of the acquired images demonstrate that this is an outstanding technique for Angio CT in the hybrid ER.

Sex	Age	Weight	Scan mode		Gated scan	Scan slice thickness	Number of rows in scanning	Tube voltage	Tube current	
Female	70+ years	60-70 kg	Helical scan [conditions 1] Dynamic scan / Dynamic Volume scan [conditions 1] Dynamic scan / Dynamic Volume scan [conditions 2]			0.5 mm 0.5 mm 0.5 mm	80 80 80	120 kV 80 kV 80 kV	R-EC SD8 (image slice thickness 7 mm, 50-500 mA) V-EC (OEM used) SD6 (image slice thickness 5 mm, 50-500 mA) V-EC (OEM used) SD6 (image slice thickness 5 mm, 50-500 mA)	
Scan speed	Scan range	Helical pitch	Pitch factor	Exposure			Total number of scans	Total scan time	CTDI	DLP
0.5 s/rot. 0.35 s/rot. 0.35 s/rot.	882 mm 80 mm 80 mm	96 — —	1.2 — —	— Intermittent exposure 5.2 to 28.9 s / Interval 4.7 s Intermittent exposure 35.6 to 57.3 s / Interval 4.7 s			— 6 6	19.04 s	5.7 mGy 11.85 mGy 11.85 mGy	541.8 mGy-cm 94.80 mGy-cm 94.80 mGy-cm
Reconstruction method	Image slice thickness	Reconstruction interval	Reconstruction function	Image quality option	Image filter	Quantum denoising filter	Workstation		Contrast medium	
volumeXact	1 mm	1 mm	FC43	Xact+ AIDR 3D (Standard)	—	—	ZIOSTATION2, Vitrea, VINCENT		Omnipaque 350	
Contrast medium injection method					Contrast enhancement protocol			Saline flush	Delay time for next scan	SUREStart
Injection via the right median cubital vein using a 20G needle was selected, and scanning was performed with the contrast enhancement conditions shown on the right using the modified TBT method (interval: 61 s).					50 mL of contrast medium for CTP injected at 4.5 mL/s, followed by a 27-mL saline flush injected at 4.5 mL/s + 50 mL of contrast medium for CTA injected at 3.5 mL/s, followed by a 33-mL saline flush injected at 3.5 mL/s			Used	5 s	Not used
Region for SUREStart	Threshold for SUREStart	Heart rate during scanning	Heart rate information during scanning	Cardiac phase for reconstruction	Reconstruction method	Phase NAVI	ECG Edit	Medications used		



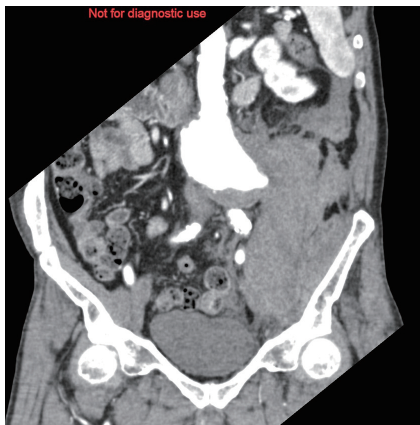
Arterial phase (axial)



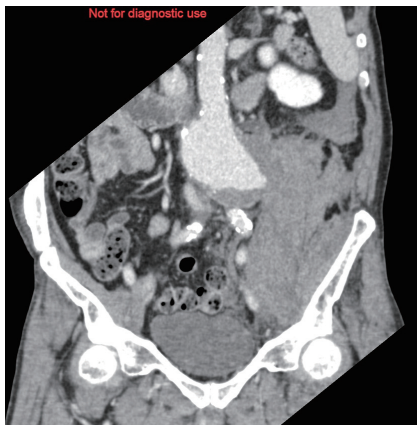
Equilibrium phase (axial)



Black blood image (axial)



Arterial phase (coronal)



Equilibrium phase (coronal)



Black blood image (coronal)

a	b	c
d	e	f

Heart, great vessels, peripheral vessels

Ruptured abdominal aortic aneurysm

Iwate Medical University Hospital, Iwate, Japan
Yuta Kamiyama

System used, number of rows: Aquilion Prime SP, 80 rows
Reason for examination: This elderly man developed left lower quadrant pain and visited his primary care physician as an emergency patient. Noncontrast abdominal CT images showed the presence of a hematoma around an abdominal aortic aneurysm. The patient was referred to our hospital for surgical repair. He underwent a contrast CT examination for detailed evaluation before surgery.

Clinical comments: Patients with ruptured abdominal aortic aneurysms usually have an extremely poor prognosis. Endovascular aneurysm repair (EVAR) of the abdominal aorta was selected in this patient. The use of EVAR in such

patients has been increasing in recent years, but preoperative evaluation with CT is essential. In CTA images, it may be possible to identify the presence of a large hematoma around an aortic aneurysm, but it can be difficult to visualize tears in the aneurysmal walls. The use of CE Boost allowed both the aneurysmal walls and the tears in the walls to be clearly depicted in this patient. The CT findings also showed excellent agreement with the areas where angiographic images showed leakage of contrast medium from the aneurysm. It is expected that this technique will play an increasingly important role in preoperative planning for patients undergoing EVAR.

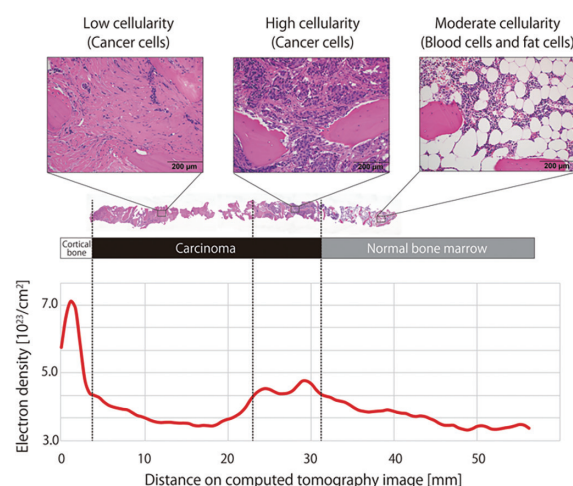
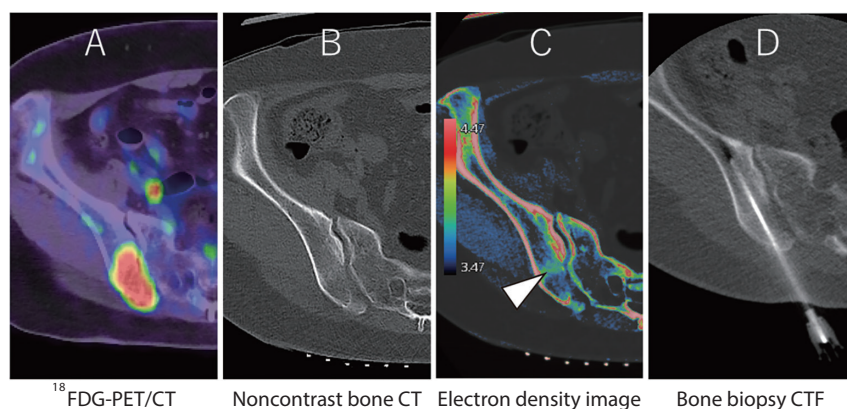
Technical comments: Three-phase scanning (noncontrast, arterial-phase, and equilibrium-phase scanning) of the entire aorta was performed according to the standard protocol for evaluating aortic disease employed at our hospital. After scanning, CE Boost images, in which only the iodinated contrast medium is selectively visualized, were generated by subtracting arterial-phase images from equilibrium-phase images using the SURE Subtraction Iodine Mapping application. CE Boost images are usually generated by subtracting noncontrast images from contrast im-

ages, but in this case, arterial-phase images (blood flow) were subtracted from equilibrium-phase images in order to obtain greater contrast enhancement of the blood vessel walls. This made it possible to generate black blood images with CT and to clearly visualize the characteristics of the blood vessel walls.

Comments on images: (a) Rupture point (axial, arterial phase). (b) Rupture point (axial, equilibrium phase). (c) Rupture point (axial, black blood image). (d) Rupture point (coronal, arterial phase). (e) Rupture point (coronal, equilibrium phase). (f) Rupture point (coronal, black blood image).

Comments of judges: The SMILIE technique, which is usually employed for examination of the heart, was used to evaluate the patient's abdominal aorta. This technique can improve the identification of faintly visible rupture points and is therefore judged to have been of great clinical value in this case. It is expected that black blood images generated by subtraction will be widely employed in clinical CT examinations in the future.

Sex	Age	Weight	Scan mode	Gated scan	Scan slice thickness	Number of rows in scanning	Tube voltage	Tube current	
Male	70+ years	60-70 kg	Helical scan		1.0 mm	40	120 kV	R-EC SD10 (image slice thickness 5 mm, 50-600 mA)	
Scan speed	Scan range	Helical pitch	Pitch factor	Exposure		Total number of scans	Total scan time	CTDI	DLP
0.5 s/rot.	660 mm	47	1.175	-		-	22.9 s	11 mGy	770 mGy-cm
Reconstruction method	Image slice thickness	Reconstruction interval	Reconstruction function	Image quality option	Image filter	Quantum denoising filter	Workstation	Contrast medium	
V-TCOT	1 mm	1 mm	FC13	AIDR 3D (Mild)	-	-	ZIOSTATION2	Iopamiron 370	
Contrast medium injection method					Contrast enhancement protocol		Saline flush	Delay time for next scan	SUREStart
100 mL of Iopamiron 370 (high concentration) was injected at 2.5 mL/s, followed by a 35-mL saline flush injected at 2.5 mL/s.					As shown on the left		Used		Used (manual)
Region for SUREStart	Threshold for SUREStart	Heart rate during scanning	Heart rate information during scanning	Cardiac phase for reconstruction	Reconstruction method	Phase NAVI	ECG Edit	Medications used	
Descending aorta (near aortic aneurysm)	Visual confirmation								



a | b

Abdomen/Pelvis

Metastatic bone tumor
(breast cancer)

Tokai University Hachioji Hospital, Tokyo, Japan

System used, number of rows: Aquilion ONE / PRISM Edition, 320 rows**Reason for examination:** Bone metastases of breast cancer were suspected, and biopsy of the iliac bone was performed for histopathological evaluation.**Clinical comments:** This is a female patient with breast cancer who underwent bone biopsy for suspected bone metastases or multiple myeloma. 18FDG-PET-CT showed FDG uptake in the entire dorsal part of the right iliac bone.

However, the bone cortex appeared intact in the noncontrast bone CT image, which is a finding suggestive of intertrabecular metastases. A high-signal region (white arrowhead) was observed at one location on the electron density map. Bone biopsy was performed in this region, and a tumor tissue sample with high cell density was obtained. Histopathological examination confirmed the diagnosis of bone metastases of breast cancer. Use of the electron density map allowed a region containing viable tissues to be targeted for biopsy in this case.

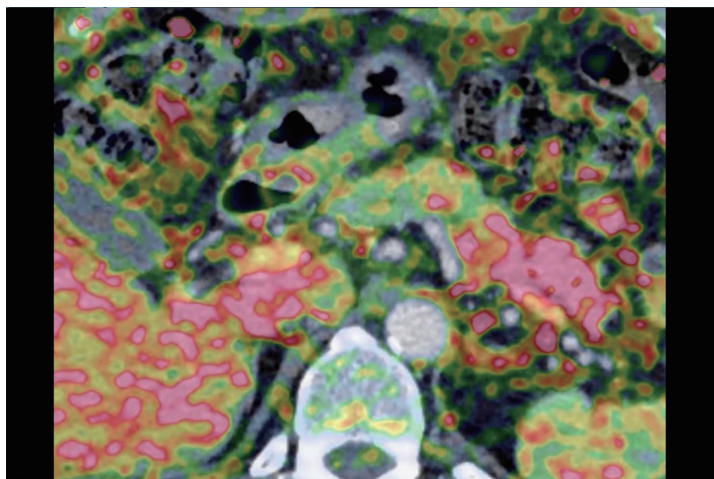
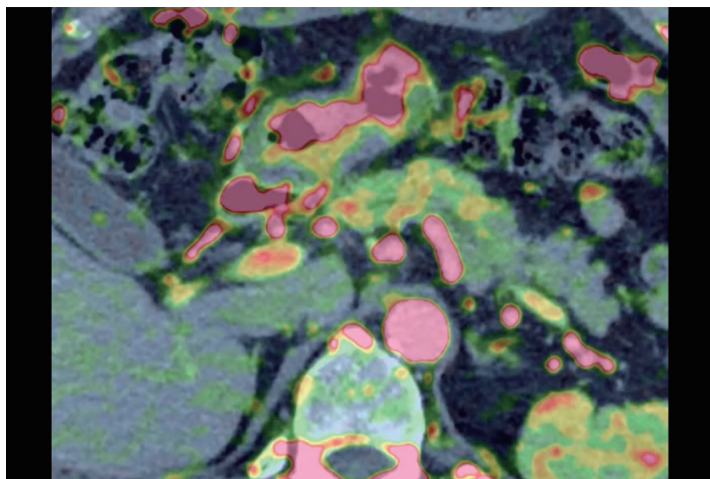
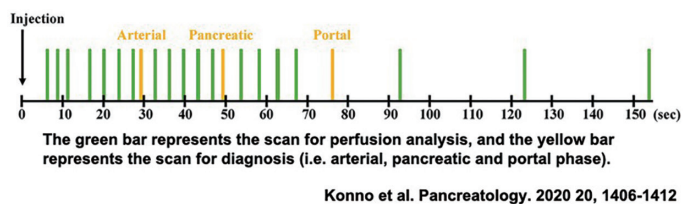
Technical comments: In CT-guided biopsy procedures, the puncture site is usually selected using single-energy CT. However, it can be difficult to identify the lesion by bone CT scanning. Electron density images obtained by spectral scan can be used to detect changes in bone lesions. In this patient, electron density images were displayed in color, permitting the bone lesion to be clearly visualized. In order to reduce the artifacts near the pelvis which are seen in

spectral reconstruction and thus improve the accuracy of analysis, the rotation time was set to 0.75 s/rot. A helical pitch setting for high-definition scanning was also selected to ensure good image quality.

Comments on images: (a) A: 18FDG-PET-CT, B: noncontrast bone CT, C: electron density image, D: bone biopsy CT. (b) Histopathological images.

Comments of judges: The most notable aspect of this case is the excellent agreement between the region of high cell density in CT-guided biopsy and the region with high pixel values in the electron density image. The clinical usefulness of electron density images and effective atomic number images acquired using dual-energy CT has not yet been established, but this case demonstrates the great potential of electron density images in clinical examinations. It is hoped that this technique will be employed to gather further clinical data in evidence-based medicine.

Sex	Age	Weight	Scan mode		Gated scan	Scan slice thickness	Number of rows in scanning	Tube voltage	Tube current	
Female	60-70 years	60-70 kg	Spectral Helical scan			0.5 mm	80	80 kV	V-EC SD6 (image slice thickness 5 mm, 230-650 mA)	
Scan speed	Scan range	Helical pitch	Pitch factor	Exposure			Total number of scans	Total scan time	CTDI	DLP
0.75 s/rot.	170 mm	51.0	—	—			—	6.4 s	13.7 mGy	288.6 mGy·cm
Reconstruction method	Image slice thickness	Reconstruction interval	Reconstruction function	Image quality option	Image filter	Quantum denoising filter	Workstation		Contrast medium	
Others	2 mm	2 mm	Spectral	Spectral (BODY) (Standard)	—	—	Vitrea			
Contrast medium injection method					Contrast enhancement protocol			Saline flush	Delay time for next scan	SUREStart
Region for SUREStart	Threshold for SUREStart	Heart rate during scanning	Heart rate information during scanning		Cardiac phase for reconstruction	Reconstruction method	Phase NAVI	ECG Edit	Medications used	



a	b
c	d

Abdomen/Pelvis

Small pancreatic cancer detected only by perfusion CT

Yamagata University Hospital, Yamagata, Japan
Yoshihiro Konno

System used, number of rows: Aquilion ONE / ViSION Edition, 320 rows

Reason for examination: This patient was found to have persistently elevated blood amylase levels during outpatient follow-up after receiving a living-donor kidney transplant. Abdominal MR images showed obstruction of the main pancreatic duct and dilatation of the main pancreatic duct in the tail of the pancreas, but a mass was not seen. Pancreatic cancer was suspected, and pancreatic dynamic CT scanning combined with perfusion CT was performed for detailed evaluation.

Clinical comments: The patient underwent surgical resection, and pathological examination of the pancreatic tail revealed invasive ductal carcinoma. Pancreatic cancer should always be suspected in patients with obstruction of the main pancreatic duct, and fast and accurate diagnosis is essential for curative treatment. Pancreatic cancers are typically poorly perfused and can therefore be detected as areas of reduced blood flow (BF) or prolonged mean transit time (MTT) compared to surrounding normal pancreatic parenchyma. This case demonstrates that pancreatic dynamic CT scanning combined with perfusion CT is useful for the diagnosis of lesions which are difficult or impossible to detect in standard morphological images.

Technical comments: Except for the images used for perfusion CT analysis acquired during free breathing, the patient should be instructed in advance that breath-holding must be performed according to the instructions and without inhaling during any of the scans, including the scout scans. To minimize the exposure dose, the tube current was fixed at 35 mA during scanning for perfusion analysis. The acquired images were processed using the

body registration software and then analyzed using the CT volume perfusion software on the ZIOSTATION2. By combining the analysis images and the post-registration images, which were of diagnostic quality, it was possible to generate fusion images with outstanding accuracy.

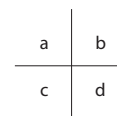
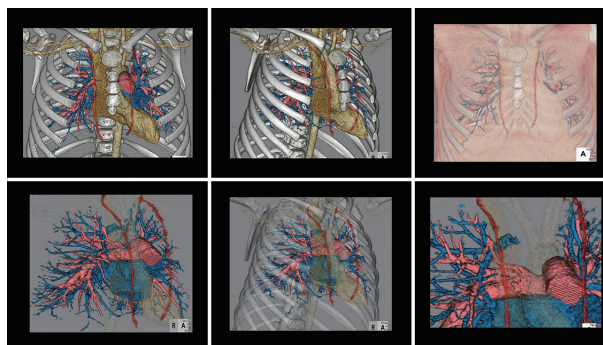
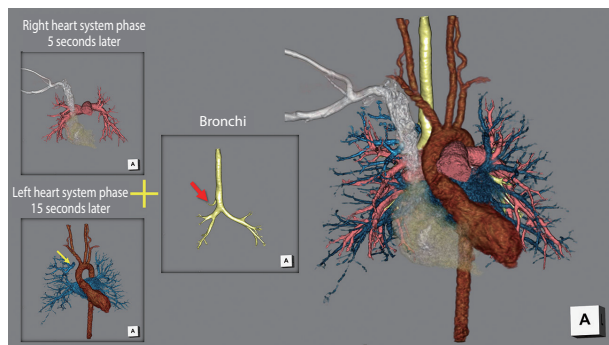
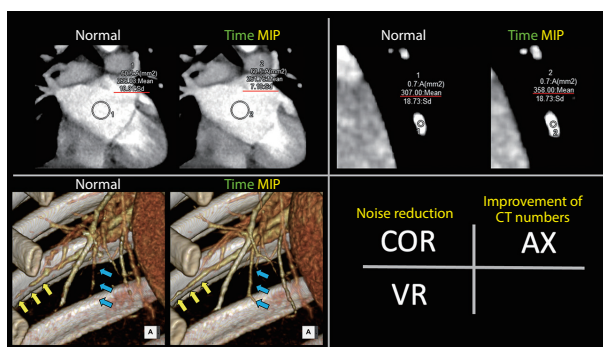
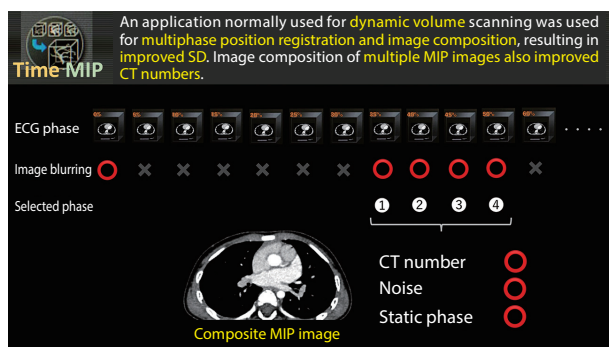
Comments on images: (a) Protocol for pancreatic dynamic CT scanning combined with perfusion CT. (b) The mass is not visible in the arterial, pancreatic parenchymal, and portal phase images. (c) Fusion image combining a BF map and a pancreatic parenchymal phase image. (d) Fusion image combining an MTT map and a pancreatic parenchymal phase image.

Comments of judges: In this patient, the mass could not be detected in the MR images. Low-dose CT scanning was performed during free breathing for perfusion CT analysis. Extremely accurate fusion images were generated by employing high-performance body registration processing. It is expected that this image processing technique will prove very useful for evaluating blood flow in small structures and will be increasingly employed in the future.

Sex	Age	Weight	Scan mode		Gated scan	Scan slice thickness	Number of rows in scanning	Tube voltage	Tube current	
Male	50-60 years	70-80 kg	Volume scan [conditions 1] Volume scan [conditions 2]			0.5 mm 0.5 mm	320 320	100 kV 100 kV	V-EC SD12 (image slice thickness 5 mm, 100-500 mA), 35 mA	
Scan speed	Scan range	Helical pitch	Pitch factor	Exposure			Total number of scans	Total scan time	CTDI	DLP
0.5 s/rot. 0.5 s/rot.	160 mm 160 mm	— —	— —	— —			3 19	160 s	13.2 mGy 1.16 mGy	211.5 mGy-cm 18.6 mGy-cm
Reconstruction method	Image slice thickness	Reconstruction interval	Reconstruction function	Image quality option	Image filter	Quantum denoising filter	Workstation		Contrast medium	
volumeXact	0.5 mm	0.5 mm	FC13	AIDR 3D (Mild) AIDR 3D (Strong)	—	—	ZIOSTATION2		Iopromide	
Contrast medium injection method					Contrast enhancement protocol			Saline flush	Delay time for next scan	SUREStart
A 22G needle was introduced into a right antecubital vein and contrast medium was injected using an injector.					100 mL of contrast medium was injected at 3.5 mL/s.			Not used	6 s	Not used
Region for SUREStart	Threshold for SUREStart	Heart rate during scanning	Heart rate information during scanning		Cardiac phase for reconstruction	Reconstruction method	Phase NAVI	ECG Edit	Medications used	



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Heart, great vessels, peripheral vessels

Tracheal bronchus and anomalous pulmonary venous connection

Fukuoka Sanno Hospital, Fukuoka, Japan
Kazuto Sakamoto

System used, number of rows: Aquilion ONE / VISION Edition, 320 rows

Reason for examination: This 1-year-old patient was evaluated for tachypnea. Initial echocardiography showed abnormal blood flow in the SVC. Follow-up echocardiography showed an abnormal increase in SVC blood flow, and anomalous pulmonary venous connection was suspected. CT examination was then performed to determine the presence of total or partial anomalous pulmonary venous connection and an ASD.

Clinical comments: Echocardiography showed abnormal blood flow in the SVC. Increased blood flow was confirmed in a follow-up examination, and anomalous pulmonary venous connection was suspected. CT examination was then performed. A tracheal bronchus was found and associated partial anomalous pulmonary venous connection was clearly visualized. These CT findings made it possible to establish an accurate diagnosis. The extremely clear CT images were also very helpful when discussing the patient's

complex abnormalities with the parents. Although an ASD was considered unlikely, increased blood flow and mild right heart enlargement were observed, and the patient was therefore transferred to another hospital for surgical repair of anomalous pulmonary venous connection. To avoid the need for repeat CT examination after the patient was transferred, the physicians at the referring hospital also prepared useful CT images and sent them to the surgeons at the other hospital, clearly demonstrating their strong commitment to providing patient-friendly health-care.

Technical comments: In anomalous pulmonary venous connection, blood flow from the right heart system to the left heart system via an ASD is suggestive of total anomalous pulmonary venous connection. Imaging was therefore performed separately for the right and left heart systems. The contrast medium injection time should be as short as possible in such separate imaging procedures, so the injection time was set to 6 s. When scanning patients with a high heart rate during free breathing, image blurring is likely to occur even in helical scanning with a high pitch factor. In this patient, it was judged that half reconstruction and static phase detection should be possible with ECG gating, so ECG-gated scanning was selected. Although image noise is increased in half reconstruction, noise reduction and improved visualization of the peripheral vessels could be achieved by multiphase composition with Time MIP.

Comments on images: (a) Time MIP was used to reduce

noise in the half-reconstruction images and thus improve visualization of the peripheral vessels. Half reconstruction in 5% increments was performed with ECG-gated reconstruction. Four static-phase images were selected from among the reconstructed images in order to create a composite MIP image. (b) Time MIP processing of the four static-phase images reduced noise in the half-reconstruction images and low-dose scan images. In addition, MIP processing improved the CT numbers, making it possible to more clearly visualize the peripheral vessels. (c) The right heart system and the pulmonary arteries were imaged in the first phase, and the left heart system and the pulmonary veins were imaged in the second phase. Image composition was performed with an image of the bronchi to create a VR image. (d) The patient was transferred to another hospital for surgical repair of the anomalous pulmonary venous connection, so useful CT images were prepared at the referring hospital and sent to the surgeons at the other hospital.

Comments of judges: When 4D imaging is performed in pediatric patients, minimizing the dose and reducing the effects of pulsatile movement are very important considerations. In this patient, ECG gating was used to minimize motion artifacts, and Time MIP of successive cardiac phases in a single cardiac cycle was used to reduce noise. This new technique for improving detectability without the use of full reconstruction is considered to be extremely helpful for the examination of such patients.

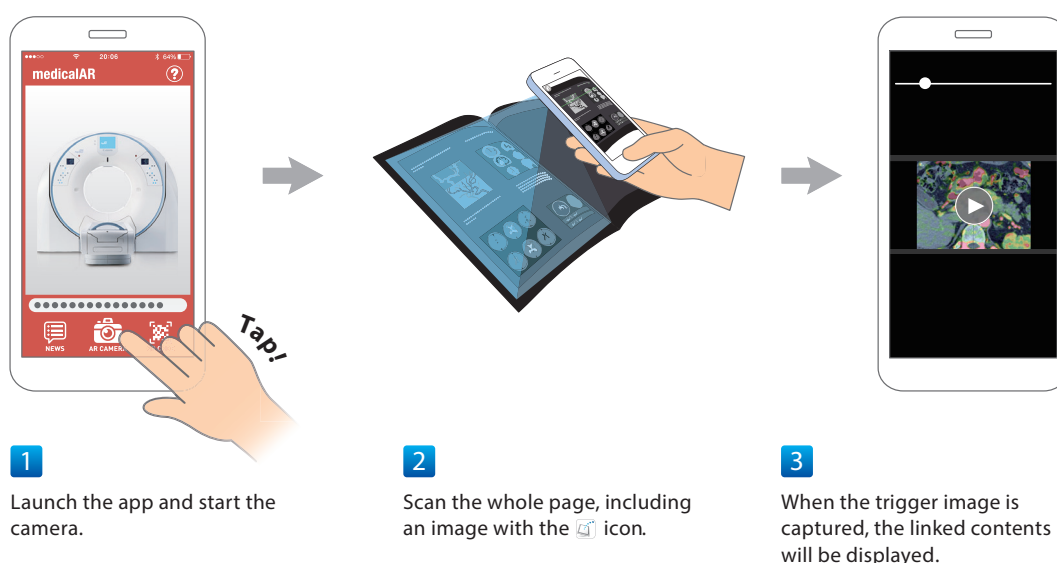
Sex	Age	Weight	Scan mode		Gated scan	Scan slice thickness	Number of rows in scanning	Tube voltage	Tube current		
Male	Infant (0-6 years)	0-10 kg	Volume scan		ECG-gated scan	0.5 mm	320	80 kV	130 mA		
Scan speed	Scan range	Helical pitch	Pitch factor	Exposure			Total number of scans	Total scan time	CTDI	DLP	
0.275 s/rot.	160 mm	—	—	—			—	0.275 s	13 mGy	208.8 mGy-cm	
Reconstruction method	Image slice thickness	Reconstruction interval	Reconstruction function	Image quality option	Image filter	Quantum denoising filter	Workstation		Contrast medium		
volumeXact	2 mm	2 mm	FC43	AIDR 3D Enhanced (Standard)	—	—	ZIOSTATION2		Omnipaque 300		
Contrast medium injection method					Contrast enhancement protocol			Saline flush	Delay time for next scan	SUREStart	
A total of 12-mL of diluted contrast medium (contrast medium 8 mL + saline flush 4 mL) was injected at 2 mL/s over 6 seconds. The amount of contrast medium was 0.1 mL per kg body weight.					Diluted contrast medium 2.0 mL/s (contrast medium 8 mL + saline flush 4 mL)			Used	5 s	Not used	
					+ Saline solution flush after contrast medium injection 2.0 mL/s (10 mL)						
Region for SUREStart	Threshold for SUREStart	Heart rate during scanning	Heart rate information during scanning		Cardiac phase for reconstruction	Reconstruction method	Phase NAVI	ECG Edit	Medications used		
		108			Time MIP using 4 static phases in the range of 35%-60%	Half	Used	Used			

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