Vascular

Usefulness of Trinias C12 MiX package in Abdominal Region

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1. Introduction of Kofu-Kyoritsu Hospital

Since first established as Kofu Clinic in 1955, Kofu-Kyoritsu Hospital has developed alongside the local community based on the idea that the importance of human life should not be swayed by wealth disparities. After bankruptcy in 1983, the hospital was rebuilt with the support of the local community and today, Kofu-Kyoritsu Hospital has 233 general beds and 50 community-based integrated care beds, and carries out acute medical care and community health care **(Fig. 1)**.

Our hospital receives approximately 20 % of all emergency transport cases in Kofu, and a total of 3568 emergency vehicle visits during 2014. The gastroenterological medicine and cardiovascular medicine departments are also designated among final destination hospitals for Yamanashi Prefecture according to "Standards related to acceptance and conveyance of the sick and wounded."

Elderly people represent over 30 % of the population in the area around our hospital, and over 40 % of hospital inpatients are 70 years or older. In response to this aging local population, we actively engage in mobile care, coordination between hospitals and clinics, coordination with nursing facilities, have operated a community-based integrated care ward since 2016, and are expanding our coordination with the local community.

As poverty and wealth disparities become more prevalent, and more sick people are unable to afford the price of becoming a patient, our hospital acts in support of the human right to health care. The hospital plays the role of last refuge for patients in financial difficulties by collecting no special bed fees from the patient and providing free and low price medical care.

Our hospital emphasized early clinical training of doctors before clinical training systems became compulsory, and has maintained this emphasis for over 30 years. Audited by the Japan Council for Evaluation of Postgraduate Clinical Training in 2014, the hospital was also the first hospital in Yamanashi Prefecture to receive a 4-year certification. As the only municipal hospital in Yamanashi Prefecture that is also an internal medicine training hospital, Kofu-Kyoritsu Hospital also focuses on education for internal medicine doctors.

2. Background to Obtaining Trinias C12 MiX package

Kofu-Kyoritsu Hospital has 5 gastroenterologists who provide wide-ranging medical care, from matters of the gastrointestinal tract to the liver, pancreas, and biliary tract.

The gastroenterological department has a dedicated angiography room where approximately 120 angiography examinations or treatments and approximately 50 percutaneous cystic or biliary duct treatments are performed each year.

Fig.1 Kofu-Kyoritsu Hospital

Fig.2 Trinias C12 MiX package

The previous angiography system we obtained in 2001 was aging and difficult to maintain, so with a view to obtaining a new system we compared options from several companies. Based on its ability to capture high quality radiographic and fluoroscopic images at low radiation doses due to its latest SCORE PRO Advance image processing software and highly original image guidance application, in September 2015, the hospital obtained a ceiling-mounted Trinias C12 MiX package angiography system **(Fig. 2)**.

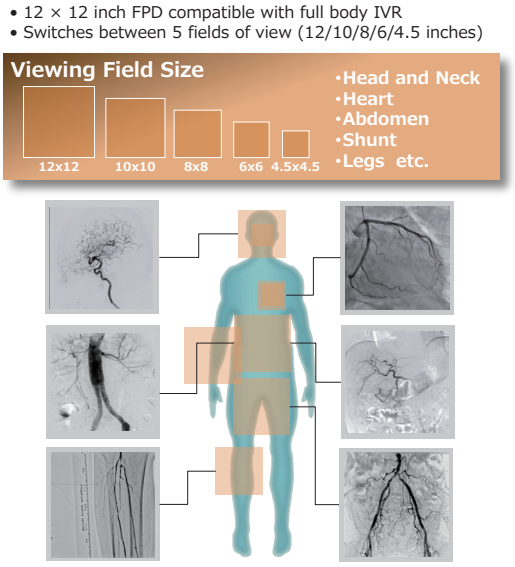

Fig. 3 The FPD can capture a 12 × 12 inch field of view that allows imaging of the entire hepatic area. Many other fields of view are also available (12, 10, 8, 6, and 4.5 inches) which allow imaging of large blood vessels and microscopic blood vessels and are compatible with interventions not only in the abdominal area, but also the head, heart, and extremities.

Table 1 Designed for Low Radiation Dose
Features that substantially reduce radiation dose to operators as well as patients

Feature	Description
MBH filter	Eliminates X-rays that do not contribute to image quality by using multiple materials—Al and Au are combined with the commonly used Cu.
Pulsed fluoroscopy	Select from 10 rates depending on the procedure.
Grid control	Eliminates unnecessary wave tail radiation and ensures low radiation dose and high image quality.
Virtual collimation	Enables collimation without fluoroscopy.
SCORE PRO Advance	Allows fluoroscopic imaging without residual images even at low rates and reduces noise effectively at low doses, mainly through motion tracking noise reduction.
Fluoroscopy video recording	Immediate recording of the fluoroscopy screen, which reduces the number of acquisitions needed
Area dosimeter	The actual radiation dose and dose at interventional reference point are displayed on the live monitor in real time, which helps to focus the operator's attention on radiation dose levels.

3. System Outline

As mentioned above, we used the previous angiography system for at least 10 years. Equipped with an image intensifier, it posed many problems and also had an inadequate radiation dose management system with no dosimeter mounted.

The Trinias C12 MiX package uses the latest FPD **(Fig. 3)**, is designed with a strong emphasis on low radiation dose with pulsed fluoroscopy and grid control **(Table 1)**, and focuses the operator's attentions on radiation dose reduction with features such as real time display of dose area products.

The system also comes with the SCORE Imaging image guidance application that achieves high image quality at low radiation doses, and includes a wealth of 3D functions. The next section of this article will describe the merits of this system and some clinical case examples.

4. Clinical Examples

4.1 SCORE PRO Advance

The latest SCORE PRO Advance image processing software that comes with Trinias employs motion tracking noise reduction to provide excellent visibility at low doses (fluoroscopy area). The software also produces images without residual images even at low fluoroscopy rates.

We perform angiography examinations using 3.3 Fr guiding catheters, 2.4/1.9 Fr micro catheters, and 0.014 inch micro guide wires.

As a general rule, 7.5 pps is used when manipulating guiding catheters, and 10 pps-Low is used during manipulation of micro catheters and during treatment with Gelpart and Lipiodol. Visibility is good, uptake of Lipiodol into tumors can be observed in more detail than the previous system, and TACE can be performed with high therapeutic efficacy and fewer complicating liver disorders than was previously possible **(Fig. 4)**.

Fig. 4 Fluoroscopy Recording During Injection of Embolization Material
(Fluoroscopy conditions: 10 pps-Low, 10 pulses/second, low dose mode)

4.2 SCORE RSM

The image quality of normal DSA is well known, and SCORE RSM is acknowledged to produce excellent images through use of DSA technology. SCORE RSM performs DSA without the need to acquire mask images, a feature not available with conventional DSA. The images produced resemble DA images with bones present, though signals from non-vascular structures like bones and intestines are compressed by a method of frequency subtraction that enhances blood vessels in the obtained image. SCORE RSM is also of enormous benefit for patients unable to hold their breath, as it is not affected by respiratory motion. With ages of our HCC patients increasing and many unable to hold their breath, this system meets our current medical needs **(Fig. 5)**.

SCORE RSM does not need the patient to hold their breath and does not need to manipulate a mask image in order to create DSA images as with conventional DSA. These improvements lead to reductions in treatment times. SCORE RSM also produces extremely clear images with almost no halation **(Fig. 6)**.

4.3 SCORE 3D

Performing rotational angiography with an automated contrast media injector allows for creation of 3D images that show only target blood vessels. Images captured over 180 degrees at 60 degrees per second by rotational angiography can be reconstructed on the workstation to allow effective embolization by moving the C-arm to an angle at which vessels are most visible and show both microscopic blood vessels and vessels with an otherwise indistinct blood stream.

4.4 SCORE CT

Similar to SCORE 3D, SCORE CT acquires images by rotational angiography. CT-like images are created by performing angiography with slightly longer acquisition time at a rotational speed of 20 degrees per second. Although a patient must hold their breath for slightly longer time because of longer acquisition time, the findings it produces are useful for verifying the presence or absence of staining prior to treatment, and checking the target area after treatment (Lipiodol straining). In terms of image quality, spatial resolution is almost equivalent to helical CT. Although contrast resolution will obviously be inferior to helical CT, fairly sharp images can be captured if breathing is halted effectively. **Fig. 7** shows a series of TACE images.

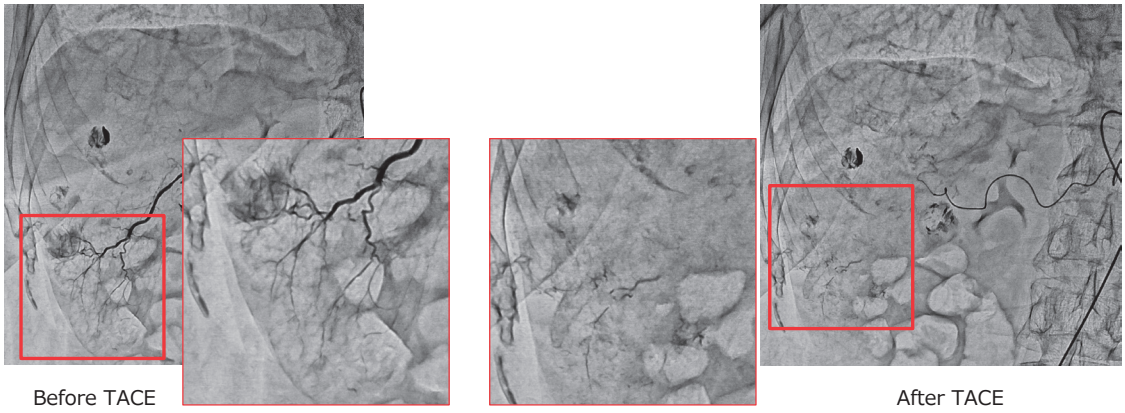

Fig. 5 TACE was performed on A6 in an elderly patient who had difficulty holding their breath. DSA could not be performed due to excessive movement, so entire angiography was performed by SCORE RSM. Imaging of the low contrast region was good, and the procedure was completed without issue.

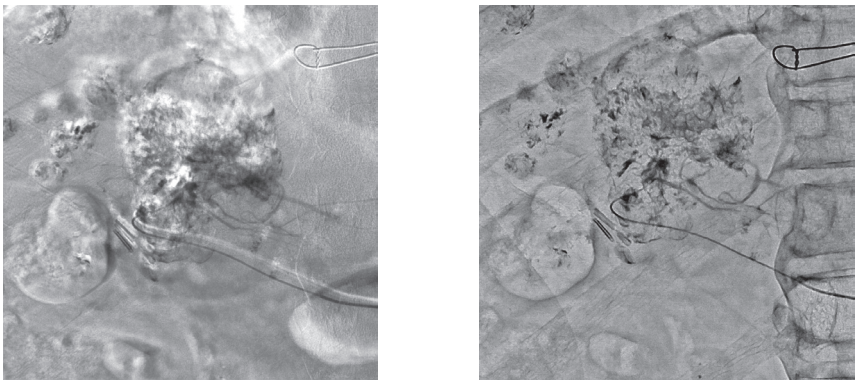

Fig. 6 The patient was unable to hold their breath after TACE, so the feeder artery was imaged by SCORE RSM. The anterior segment area that was difficult to depict by DSA was successfully shown by SCORE RSM.

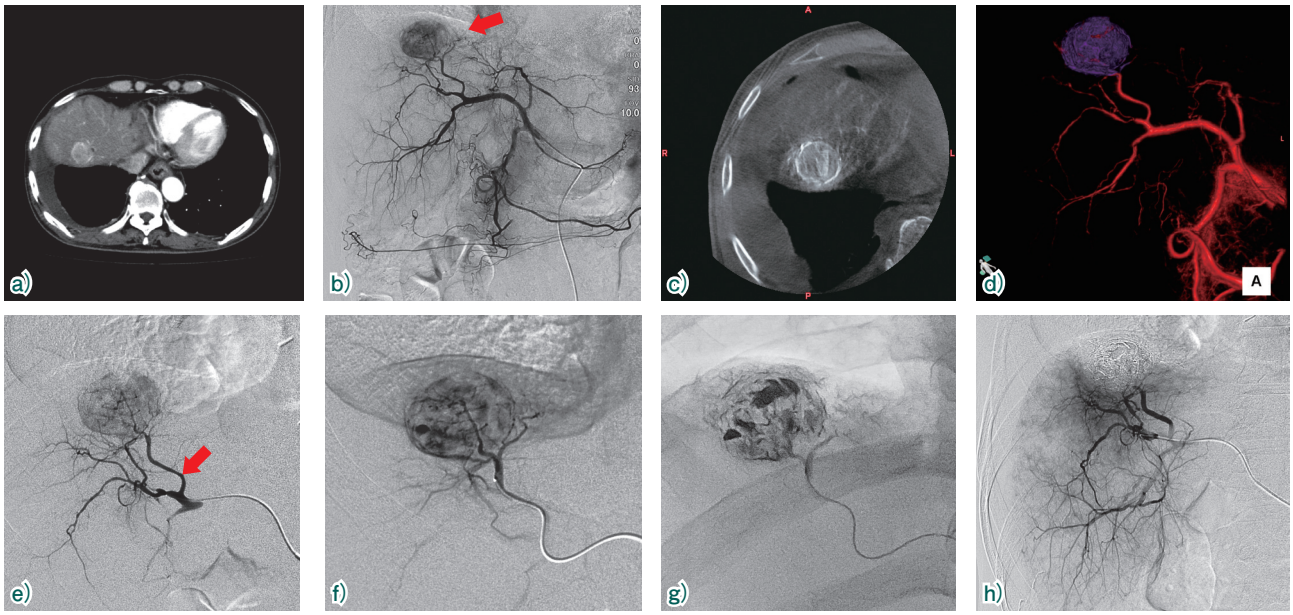

Fig.7 76-Year-Old Man
Findings: Staining of a 30-mm area confirmed in S8. After inserting a micro catheter to the target position, anticancer drugs and a Lipiodol emulsion were injected and TACE was performed with Gelpart.

a) Staining of a 30-mm tumor in S8 found by preoperative CT
b) Tumor staining in S8 confirmed by DSA
c) Tumor staining of same size and in same location as on preoperative CT confirmed by SCORE CT
• Contrast media injection conditions: 3 mL/sec, total volume 42 mL (diluted 50 %), delay 4.0 seconds
d) Blood stream determined using VR display
e) A8 (red arrow) identified as feeding vessel
f) Selective contrast radiography of A8 only to confirm staining
g) Embolization of A8 with Gelpart + anticancer drugs (fluoroscopy video recording)
h) Confirmation of no tumor staining outside A8

5. Example Low Radiation Dose

Two monitors are equipped with the system to show images, one is a live monitor and the other is a reference monitor, with the reference monitor available for reviewing images with play or pause even during ongoing fluoroscopy or acquisition. The system can be operated using the system controller inside the examination room, allowing an operator to easily compare findings before and after treatment and resulting in shorter treatment times and reduced radiation dose.
In light of the above benefits of the system, treatments at our hospital are now performed with radiation doses of 1/2 to 1/3 that used with the previous system.
Furthermore, for cholangiography **(Fig. 8)** and stent treatments, biliary stents are shown more clearly compared to the previous angiography system and stent placement can be performed more accurately.

Fig. 8 Biliary Duct Contrast Radiography for PTGBD

6. Summary

We have reported on obtaining a Trinias C12 MiX package and our experience using the system.
Obtaining this system has allowed us to acquire clear images at half the radiation dose or less compared to our previous angiography system, which has given us the opportunity to implement more rigorous treatment.
SCORE RSM and SCORE CT are particularly useful for TACE.
The C-arm and examination table have a wide range of motion and the grid and collimator are compact, which allows us to perform a variety of treatments.
We are also considering using the system for endoscopic treatments, such as ERCP-related techniques and gastrointestinal tract stent insertion.