Vascular

Interventional Radiology of the Abdomen Using Trinias Applications

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1. Introduction

Kumamoto Rousai Hospital is located in Yatsushiro, the second largest city in Kumamoto Prefecture. As a core hospital of the southern region of Kumamoto Prefecture, the hospital provides comprehensive medical care and operates as a core hospital for acute phase care and as a disaster base hospital. As a center for supporting achievement of both treatment and work, Kumamoto Rousai Hospital also plays a role in contributing to working practice reforms promoted by the Japanese government. The emergency room, ICU, and helipad were also upgraded during a recent hospital renovation to improve emergency medical systems and disaster medical services.

The hospital has two angiography rooms to meet the needs of emergency medicine, which are equipped for procedures related to acute myocardial infarction and a variety of other cardiovascular diseases, such as percutaneous coronary intervention (PCI), endovascular treatment (EVT), and ablation. The hospital also utilizes angiography systems (all from Shimadzu Corporation) for tasks that include radiological contrast procedures/IVR and neurosurgical contrast investigations/IVR (cerebral aneurysm coil placement, etc.).

Among these systems, the Trinias C12 system obtained by the hospital in February 2018 not only provides excellent fluoroscopic image quality in its basic specification, but the quality of procedures it supports has also been improved by using accessory applications. In this article, I will briefly describe the functions of Trinias while presenting cases of IVR of the abdomen.

2. Main Trinias Applications Effective for abdominal intervention

(1) Rotational DA (Digital Angiography/SCORE 3D)
(2) RSM-DSA (Digital Subtraction Angiography/ SCORE RSM)
(3) Cone Beam CT (SCORE CT)

(1) Rotational DA (SCORE 3D) (Fig. 1)

With digital subtraction angiography (DSA), we have seen cases of poor separation between vessel branches among abdominal vessels, and in particular among hepatic arteries when only frontal images were used. For scheduled IVR procedures such as transcatheter arterial chemoembolization (TACE) for the treatment of hepatocellular carcinoma (HCC), a procedure plan is created based on information obtained by CT angiography performed before

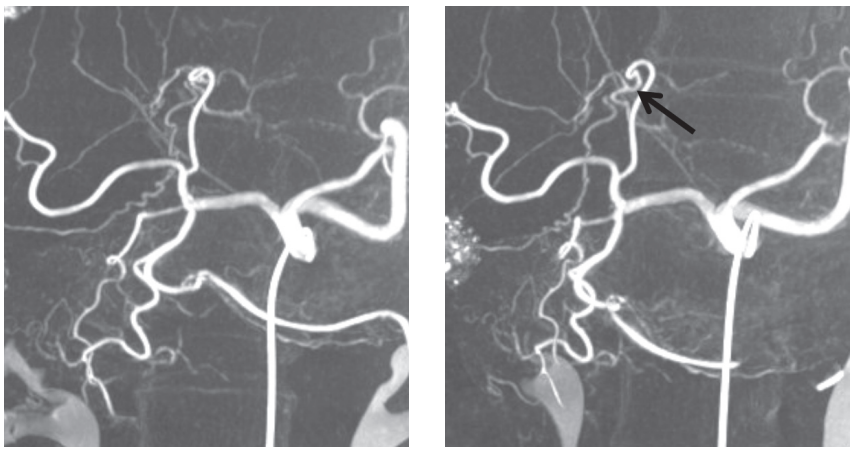

Fig.1 Celiac Artery : by Rotational DA (MIP Processing)
Although there is poor separation at the origin of branches of the left hepatic artery, good separation is obtained by LAO15°/CRA15° (arrow).

surgery. However, when frontal DSA images are used as a mapping during procedure, it can sometimes be difficult to perform selective angiography and implement procedures due to excessive overlapping and poor separation between hepatic arterial branches. Performing repeated DSA acquisitions while searching excursively for an oblique angle that allows branch vessel selection increases the X-ray dose during procedure by the number of acquisitions performed.

When performing rotational DA (digital angiography/ SCORE 3D), the acquired three-dimensional data is stored on a 3D workstation where 3D images are created. If more detailed work is required, the data can also be sent to other workstations in the hospital. 3D images created at the appropriate angle are sent to be displayed by the monitor on the angiography system. Information about the oblique angle used in the 3D image sent to the monitor can also be sent to the angiography system itself to allow immediate and synchronized movement of the C-arm into the appropriate position. This allows procedures to be performed efficiently.

(2) RSM-DSA (SCORE RSM) (Fig. 2)

With RSM-DSA, a low-frequency mask image is created from data acquired during injection of contrast media, which is then subtracted in real time (RSM: Real-time smoothed mask) to obtain a relatively enhanced image of the vessels. Although RSM-DSA is considered slightly inferior to DSA in some areas, such as image contrast and evaluation of tumor staining in particular, it is effective in cases not suited to DSA due to body movement or emergency cases that are unable to suspend breathing, and can be considered a necessity for IVR procedures performed in emergency cases.

Furthermore, using RSM-DSA that utilizes precessional movement of the C-arm allows the discovery of angles that have few overlapping arterial branches, and transmitting this angular data to the C-arm, as described above for rotational DA, allows for speedy implementation of the next procedure.

(3) Cone Beam CT (SCORE CT) (Fig. 3)

TACE for the treatment of HCC is a procedure that involves identifying the feeding arteries of the tumor to be treated, inserting a microcatheter near the tumor, and injecting antitumor agents or obstructing material. However, due to complex hemodynamics, HCC can be supplied with blood by multiple arteries or receive blood flow from non-hepatic arteries (extrahepatic blood supply arteries).

CT like imaging that uses the latest cone beam CT (SCORE CT) is considered useful for perioperative decision-making in cases that make feeding vessel identification difficult. After a hepatic arterial branch is selected with a microcatheter, falsely identified feeding vessels can be identified just before drug injection by injecting dilute contrast media while performing cone beam CT. When the results of angiography (Rotational DA, DSA, Cone beam CT) performed just before performing TACE do not agree with results from CT angiography performed before a procedure, complications such as abscess formation from ischemia associated with unwanted arterial embolism can be avoided by choosing a two-stage procedure that takes into account the possibility of an extrahepatic blood supply.

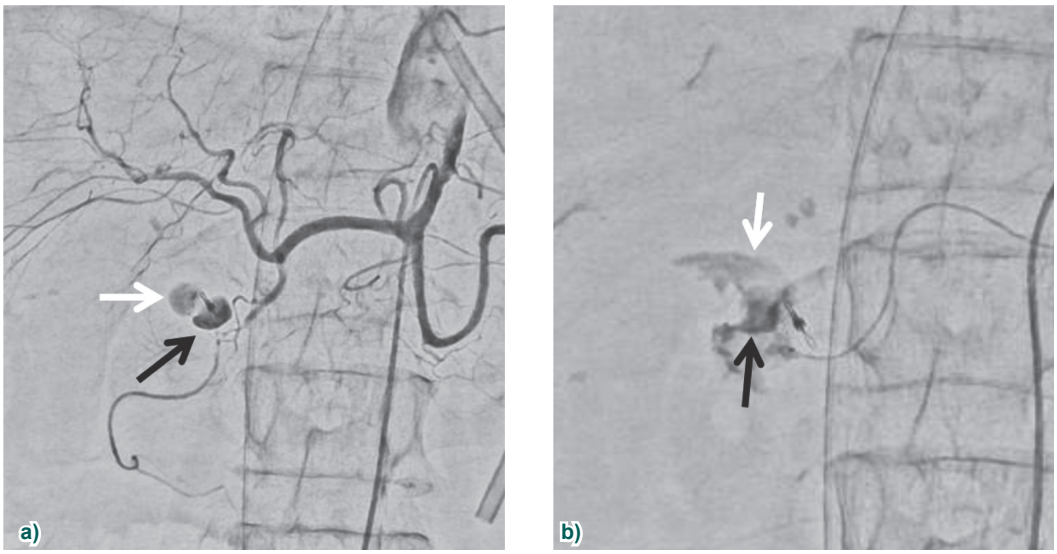

Fig.2 Celiac Arterial : by RSM-DSA (SCORE RSM)
a) Pseudo aneurysm found in duodenal branch of gastroduodenal artery (black arrow)
b) Extravasation and pseudo aneurysm observed at bleeding vessel (white arrow)

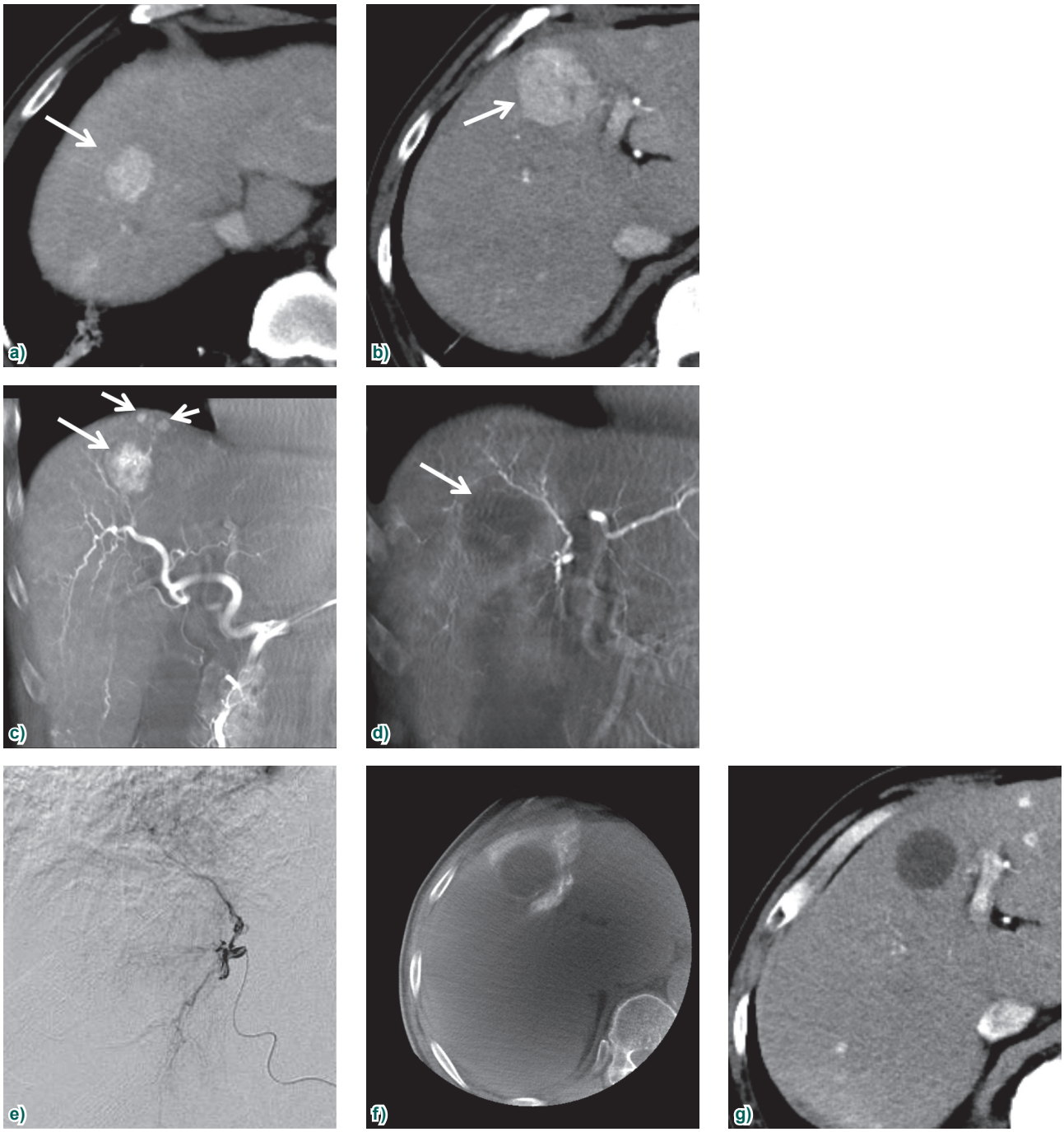

Fig.3 Cone Beam CT (SCORE CT) Used Successfully in HCC Case
- **a), b)** CT before TACE: Early phase staining of HCC observed in S8 of right hepatic lobe and S4 of left hepatic lobe (arrows)
- **c), d)** Rotational DA (Slab MIP image): Shows staining of S8 HCC that uses right hepatic artery anterior segment branch as feeding artery, and daughter nodules (arrows)
  No feeding vessel or tumor staining observed for S4 HCC (arrow)
- **e)** DSA of middle hepatic artery (A4): Feeding vessel for S4 HCC not found
- **f)** Cone beam CT (SCORE CT): Imaging performed after injection of dilute contrast media from middle hepatic artery (A4)
  No contrast effect observed at S4 HCC. TACE not performed from the same artery due to possibility of extrahepatic blood supply
- **g)** Follow-up CT angiography: Shows shrinkage of S4 HCC and no contrast effects inside HCC. Determined to be spontaneous necrosis (case of severe necrosis).

3. Summary

The increasing age of patients undergoing hemostasis surgery in emergency medicine or scheduled procedures often results in poor DSA images during IVR procedures due to inadequate breath-holding and other problems. However, being able to use RSM-DSA in addition to normal DSA has increased substantially the range of imaging used in procedures. Also, using cone beam CT during TACE for hepatocellular cancer is likely to help the prevention of so-called human error, including the misidentification of tumor feeding vessels.