Vascular

Clinical Utility of RSM-DSA for Lower Extremity intervention

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1. Introduction

Kansai Denryoku Hospital is located in the city of Osaka. It comprises 23 medical departments with 400 beds. The original hospital was built in 1967, but a new hospital is currently under construction. Stage 1 is scheduled for completion in 2012 and Stage 2 in 2014.
The hospital was originally established to look after the health and welfare of employees at Kansai Denryoku (Kansai Electric Power Co. Inc.) and offered a lower level of medical care than other hospitals in Osaka City. To enhance acute care in the face of current medical circumstances, the new hospital will incorporate a new cardiovascular center that includes a new cardiac surgery department. I was appointed director of cardiovascular medicine in March 2010. Prior to 2009, the hospital handled less than 100 interventions a year, but in 2010 this grew to 209 coronary artery interventions and 50 peripheral artery interventions per year. The greater number of interventions and the large number of complex lesions treated, such as chronic total occlusions, stretched the I.I. angiography system we used at the time to its limit. The angiography room at this hospital is a single room containing a dual-plane angiographic system used for neuro and abdominal angiography as well as cardiac angiography, which is somewhat unusual nowadays. All operations have to be handled by a single system until the new hospital is established, and the number of manufacturers who could supply such a system was limited to a few companies at the time. After comparing various products, we decided on the dual-plane angiography system with direct-conversion flat panel detector (FPD) from Shimadzu Corporation. We spent the month of August 2010 installing the system, which commenced operation in September.

2. System Overview

As described above, a dual-plane angiography system is used at this hospital. A single room contains a BRANSIST safire with 9" × 9" direct-conversion FPD for cardiac angiography and angiography of the lower extremities and a BRANSIST safire with 17" × 17" FPD for neuro and abdominal angiography. **Table 1** shows an overview of the system. The 9" × 9" FPD is used for the coronary artery and arteries in the lower extremities. The system permits both coronary angiography and lower-extremity arteriography by RSM-DSA with the patient in the same posture.

	Dual-plane system	
Main examination region	Cardiac (PCI) Lower extremities (PPI)	Abdominal angiography (TAE) Neuroangiography
FPD view field	9 × 9 inches	17 × 17 inches
C-arm	Floor-mounted 6-axis C-arm	Ceiling-mounted C-arm
FPD type	Direct-conversion	Direct-conversion
X-ray tube	3.0 MHU tube	3.0 MHU tube
Monitor	6-plane monitor	6-plane monitor (shared)
Image processing functions	SUREengine PRO Realtime DSA RSM-DSA Dynamic reference Saving video fluoroscopic images	SUREengine Realtime DSA RSM-DSA Dynamic reference Saving video fluoroscopic images 3D workstation

Table 1 System Overview

3. Clinical Experience Using RSM-DSA

Case 1
78-year-old male. The patient has a medical history of stent placement in the right coronary artery due to silent myocardial ischemia. The patient was referred to this hospital because of intermittent claudication in the left lower extremity

on walking approximately 500 m. Ankle-brachial indices (ABI) of 1.01 at the right and 0.58 at the left lead to suspicion of reduced blood flow in the left lower extremity. Vascular ultrasonography confirmed total occlusion approximately 20 cm below the region of origin of the left superficial femoral artery. The patient was therefore hospitalized for endovascular therapy. Initially, coronary angiography confirmed restenosis in the right coronary artery stent and severe stenosis of the left anterior descending artery **(Fig. 1)**. Next, left lower extremity arteriography confirmed total occlusion approximately 20 cm below the region of origin of the left superficial femoral artery, the same as vascular ultrasonography **(Fig. 2)**.

Subsequently, endovascular therapy was performed at this position. First, the knuckle wire technique with a 0.035-inch 1.5J guide wire was used to insert a multi-purpose catheter to the distal portion of the occlusion. After rotating the catheter under fluoroscopy to align the tip with the orientation of the blood vessel, it was successfully passed along to the guide wire to the occlusion **(Fig. 3)**. After confirming the guide wire position in the blood vessel by intravascular ultrasound, the stent was placed and expanded by a balloon. Satisfactory blood flow was confirmed after the intervention **(Fig. 4)**.

Patients with peripheral arterial disease often suffer from other arteriosclerotic disease, such as coronary artery disease, cerebral arterial disease, or renal artery stenosis. The vital prognosis is poor for peripheral arterial disease, but becomes even poorer when other arteriosclerotic disease is involved. In this case, the patient had an existing coronary artery stent. The coronary angiography confirmed restenosis in the previously placed coronary artery stent, in addition to new lesions. If peripheral arterial disease is involved, the limitations on walking mean that chest symptoms may not be apparent, even if coronary artery stenosis is progressing. Therefore, when we perform peripheral artery interventions at this hospital, we actively promote coronary angiography for the early detection of coronary artery stenosis.

In this case, the patient exhibited Fontaine stage II a intermittent claudication due to a lesion in the left superficial femoral artery. We considered drug therapy and follow-up, but as we believe that aggressive exercise therapy is important for the secondary prevention of atherosclerotic disease, we performed revascularization to ensure adequate functional recovery.

As the lesion was classed as a TASC (TransAtlantic Inter-Society) Type D lesion, bypass surgery was indicated for revascularization. However, endovascular therapy was eventually performed, due to the strong preference of the patient. Even with such a long total occlusion lesion, good results are expected thanks to the introduction of the bidirectional approach and subintimal angioplasty.

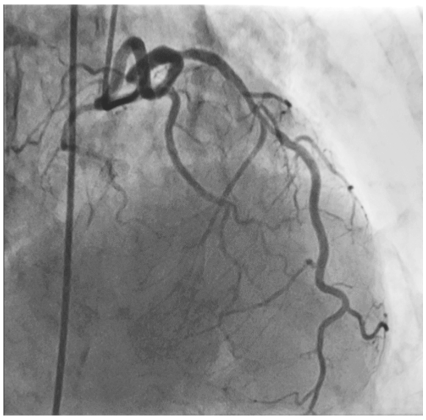

Fig. 1

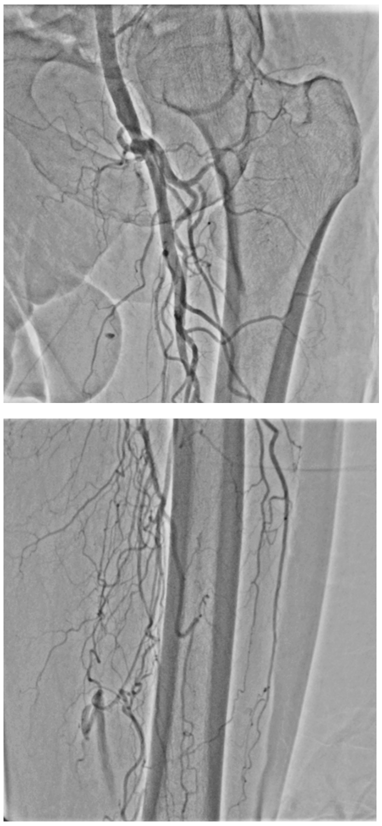

Fig. 2

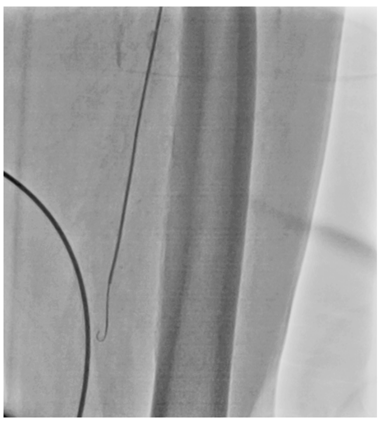

Fig. 3

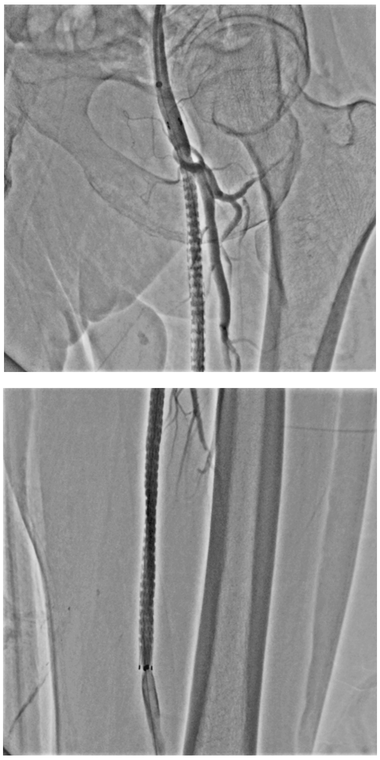

Fig. 4

Case 2

86-year-old male. The patient was undergoing maintenance hemodialysis due to chronic renal failure and suffered from an intractable ulcer in the second toe on the right foot. He was referred to this hospital for endovascular therapy after angiography confirmed total occlusion of the three branches below the right knee. Right lower extremity arteriography confirmed no significant lesion up to the popliteal artery but confirmed total occlusion of the anterior tibial artery, peroneal artery, and posterior tibial artery **(Fig. 5)**. Subsequently, endovascular therapy was performed on the posterior tibial artery. We attempted to pass a guide wire though the position of the occlusion from an antegrade approach. However, while the passage of the guide wire appeared to be confirmed by angiography from one direction, angiography while rotating the X-ray tube revealed that the guide wire passed through a false lumen **(Fig. 6)**. Consequently, we punctured the posterior tibial artery near the medial condyle and attempted to pass the guide wire using a retrograde approach. Using the guide wire inserted from the antegrade approach as an indicator, we rotated the guide wire from the retrograde approach under fluoroscopy, and successfully passed it through the occlusion **(Fig. 7)**. Subsequent balloon dilation achieved a satisfactory blood flow **(Fig. 8)**.

Fontaine stage III (ischemic rest pain) or stage IV (ulceration or gangrene) are considered to be critical limb ischemia. The prognosis is extremely poor, at 25 % 1 year mortality. The 30 % leg amputation rate is also high. Even for TASC II, revascularization for critical limb ischemia is required, unless there is some contraindication. An increasing number of reports indicate that, in the below-the-knee artery region, bypass surgery offers superior long-term patency to endovascular therapy but equivalent limb salvage rates. As difficulties often occur with bypass surgery due to poor general health or the involvement of cardiovascular disease, we believe that endovascular therapy should be the preferred option if the therapeutic goal is the vital prognosis and reducing the leg amputation rate.

In this case, endovascular therapy was performed for critical limb ischemia due to total occlusion of the three branches below the knee. Passage of the guide wire was difficult from the antegrade approach only, but one straight line of blood flow could be achieved by also using a retrograde approach. At this hospital, we adopt vessel puncture under angiographic guidance for the retrograde approach. Puncturing the dorsalis pedis artery or distal posterior tibial artery requires clear angiographic images of the peripheral arteries at the position of the collateral blood flow. The Shimadzu angiography system offers images with adequate clarity.

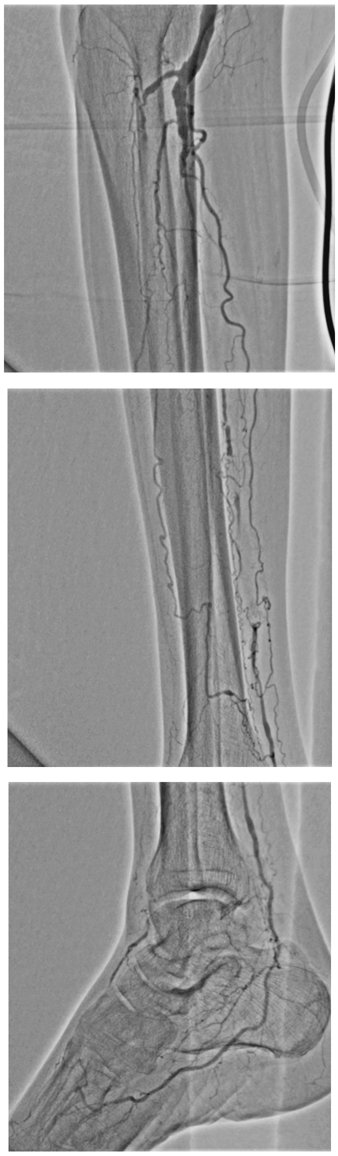

Fig. 5

Fig. 6

Fig. 7

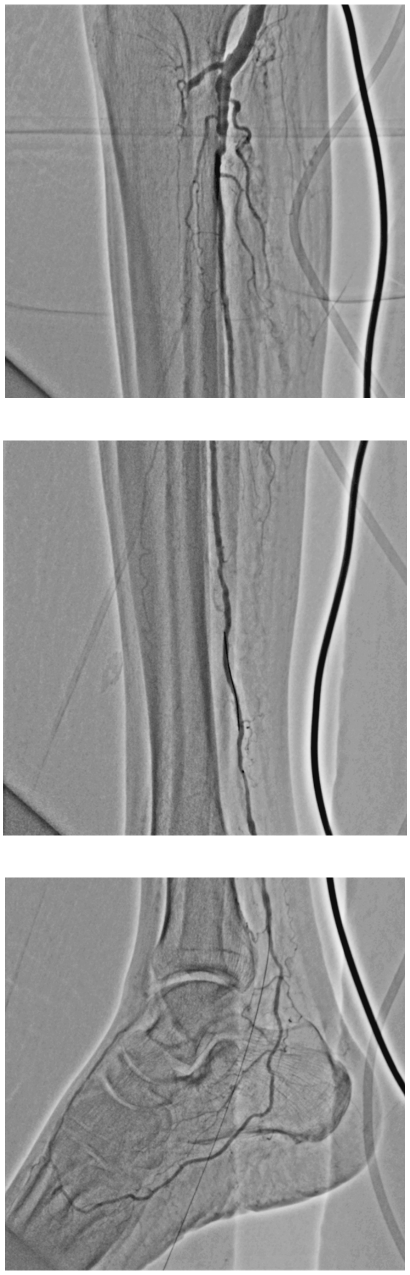

Fig. 8

4. Conclusions

With some angiography systems, the patient's posture must be changed when performing coronary angiography and angiography to the peripheries of the limbs simultaneously. Such cumbersome procedures can lead to contamination of the sterile area. While the BRANSIST safire used in this department has a floor-mounted C-arm, its wide range of movement eliminates the need to move the patient and permits angiography from the coronary artery to the lower extremity peripheries. The system ensures safety and contributes to reduced examination times. Three-dimensional representations are important for peripheral artery interventions. RSM-DSA angiography using precession and pendulum motions is extremely useful for this.

We aim to offer less invasive global vascular interventions at a lower X-ray exposure dose in the future.