Vascular

Experiences Using “unity smart edition,” a New Version of Shimadzu’s Angiography System

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1. Introduction (Hospital Description)

Yawata Medical Center **(Fig. 1)** is located in Komatsu City on Kaga Plain in the Minami Kaga area, Ishikawa Prefecture, where it commands a view of Mount Haku. The center is a secondary emergency core hospital with 227 beds for 18 medical departments and 4 specialty outpatient clinics in total. With acute care wards, recovery and rehabilitation wards, and community integrated care wards, the center provides a wide range of medical care and has established itself as a place of healing and relaxation. As a hospital that aims to prevent illness, in addition to medical treatment, Yawata Medical Center also provides health services, secondary prevention, rehabilitation as tertiary prevention, health improvement services in cooperation with neighboring health improvement facilities, and day care and home-visit nursing services.
The main focus of medical care at Yawata Medical Center is in cardiovascular internal medicine and orthopedic surgery, and the center takes in around 700 cases by emergency transport every year.
A characteristic feature of cardiovascular internal medicine at Yawata Medical Center is a cloud ECG communication system (prehospital ECG) for emergency patients used in coordination with neighboring emergency and rescue teams, including those in adjacent prefectures, to improve the door to balloon time in cases of acute myocardial infarction and achieve early diagnosis and treatment. Yawata Medical Center is the only facility in the Hokuriku region designated by the Japanese Association of Cardiac Rehabilitation as a training facility for cardiac rehabilitation instructors, and also pays close attention to potential risk factors for heart disease such as sleep disorders, diabetes mellitus, and periodontal disease. A variety of endeavors are being implemented with multidisciplinary cooperation, such as CPAP treatment for sleep apnea syndrome, and introducing diabetic dialysis prevention guidance management in the form of a “disease management MAP” for prevention of diabetic progression.

2. Background to Introduction of unity smart edition

When Yawata Medical Center first started performing cardiac catheterization, the first system acquired by the center was Shimadzu’s DIGITEX α Plus in October 2001. DIGITEX α Plus had an established reputation for good image quality at the time, and was upgraded almost 10 years later in July 2011 to the BRANSIST safire HC9 (hereinafter, “BRANSIST safire”), equipped with a direct-conversion FPD. This new system was acquired with the expectation

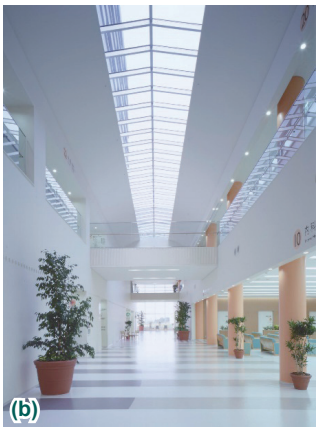

Fig.1 **(a)** Exterior View and **(b)** Lobby View of the Center

of improved image quality, more software features, and the opportunity to advance efforts in X-ray dose reduction.

Procurement of this new system coincided with the Department of Radiology attempting to be certified as a facility with measures aimed at X-ray dose reduction, and allowed for serious work to be done in X-ray dose reduction. After acquiring the BRANSIST safire, re-examination of X-ray doses from angiography systems revealed they produced an X-ray dose that was greater than anticipated, and BRANSIST safire was used to achieve a major result by reducing the X-ray dose by approx. 20 % from default levels. Of course, this reduction took place in consultation with doctors of cardiovascular internal medicine to ensure image quality was not affected in a way that was clinically unfavorable. This dose reduction work was well-received, and in the following year on November 1, 2012, Yawata Medical Center received certification as a facility with measures aimed at X-ray dose reduction from the Japan Association of Radiological Technologists.

This year marks the seventeenth year since Yawata Medical Center started performing cardiac catheterizations, and over this period the angiography systems used by the center have evolved considerably, from I.I-equipped systems to FPD-equipped systems. Starting with CAG, the center has experience in performing a wide range of cardiac catheterizations, including PCI, EVT (catheter-based treatment for peripheral arterial disease) and ABL (catheter ablation). I still remember when we first introduced an FPD-equipped system, and being shocked at the ease of use and image clarity. Nevertheless, on using the system with more and more patients, we also recognized some inadequacies in the image quality. For example, image quality was inadequate when working from the right coronary artery (LAO 60°) or with patients who were large in stature, and upon encountering a total occlusion, the associated increase in catheter-based procedure times resulted in an excessive X-ray dose. These problems also overlapped with device evolution and demand for low-dose examinations during which physicians of cardiovascular internal medicine complained about X-ray doses and the low visibility of catheter tips. These problems were presumably a cause of much stress among physicians. The center was considering an upgrade because 6 years had passed after introducing the BRANSIST safire, but upgrades to other modalities took precedence at the time. However, around this same time, Shimadzu proposed a version upgrade (reBORN) to our existing system that we decided to consider.

Some of the benefits of reBORN:

(1) A version upgrade that improves the existing system to the latest system
(2) Uses the latest software that assists with clinician procedures.
(3) Simultaneously reduces X-ray dose and improves image quality.
(4) Above all else, is cheaper than obtaining a new system (consumption tax was also soon to be increased).

After thorough consideration, a version upgrade was approved.

3. Circumstances and Experiences of System Use

Around half the approx. 400 catheterization procedures performed in 2017 included therapeutic intervention. Although the number of cardiac catheterizations being performed has been falling for several years, this is speculated to be due to improvement of the coronary artery restenosis rate by improved physician skills, device evolution, and improved cardiac rehabilitation. This fall was also presumed to be due to a reduction in diagnostic catheterizations caused by advancements in coronary CT angiography and the improved ability of surrounding facilities to take on cases. The ongoing fall in cardiac catheterizations is therefore perceived in a favorable light and as a positive trend for local residents.

I will now move onto describing our use of the unity smart edition **(Fig. 2)**, which is the version upgrade (reBORN) of our BRANSIST safire. The change from a direct-conversion FPD to an

Fig.2 unity smart edition

indirect-conversion FPD removed the need for strict temperature and humidity management of the FPD. Although the external size of the FPD remains almost unchanged, the effective field of view has increased from 9 × 9 inches to 12 × 12 inches, and the diagnostic performance of the system has improved in lower extremities and the abdominal region. Although we are currently using an 8-inch and not the conventional 7.5-inch for coronary arteries, we are considering a move to 6-inch operation in the future.

There have been 101 cardiac catheterizations performed in the period between the version upgrade (reBORN) in March and the end of May this year. Image quality has been very well-received by physicians of cardiovascular internal medicine, both in fluoroscopy and radiography. This is thanks to the introduction of new image processing technology in the form of SCORE PRO Advance, which has features that include motion tracking noise reduction to detect subject movement for improved tracking and noise elimination abilities, and the use of object extraction enhancement to extract and enhance important structures for substantial improvements in thin vessel extraction and device visibility.

Despite reducing the fluoroscopy pulse rate from 15 fps to 7.5 fps, fluoroscopy images are improved compared to the previous system at the higher pulse rate of 15 fps. Comparison of radiography images against the previous system also shows a clear improvement in contrast and resolution **(Fig. 3)**. The system is now also better for patients with a mean patient X-ray dose from CAG that is approx. 40 % lower than the previous system **(Fig. 4)**.

Yawata Medical Center also has a focus on EVT, and performs approx. 50 therapeutic procedures each year. DSA imaging is frequently used during EVT, and comes with the Flex-APS function that performs adjustments down to the individual pixel-level. Flex-APS even allows adjustment for twist motion, and has increased our ability to remove bones and improve image quality. Arterial interventions in the lower extremities are performed quite frequently in recent years for improvement of QOL, and Flex-APS is particularly effective in extracting fine vessels in the extremities.

With regard to manipulation of the table and C-arm, the cyber grip has been replaced by the cyber console. Controls for C-arm rotation and travel are now separate from controls for distance from the FPD. There have been some complaints that this increases the number of manipulations that require two hands to complete, so this change is something that requires a little more time to become familiar. A SMART Touch digital console has also been placed beside the cyber console **(Fig. 5)**. SMART Touch combines a touch panel with lever manipulation, and integrates successfully the advantages of a touch panel that allows customizable screen layout with the analog advantages of the previous IVR-NEO digital console. The same SMART Touch digital console is also installed in the control room and allows for switching between fluoroscopy and radiography modes by the same method used in the examination room. The touch panel can also

Fig.3 Comparison of Radiography Images
(a) Previous system **(b)** unity smart edition

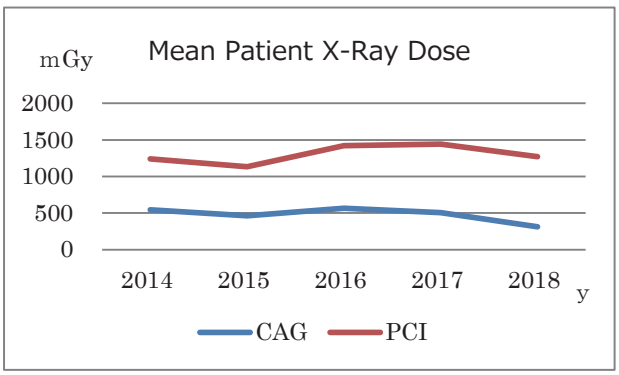

Fig.4

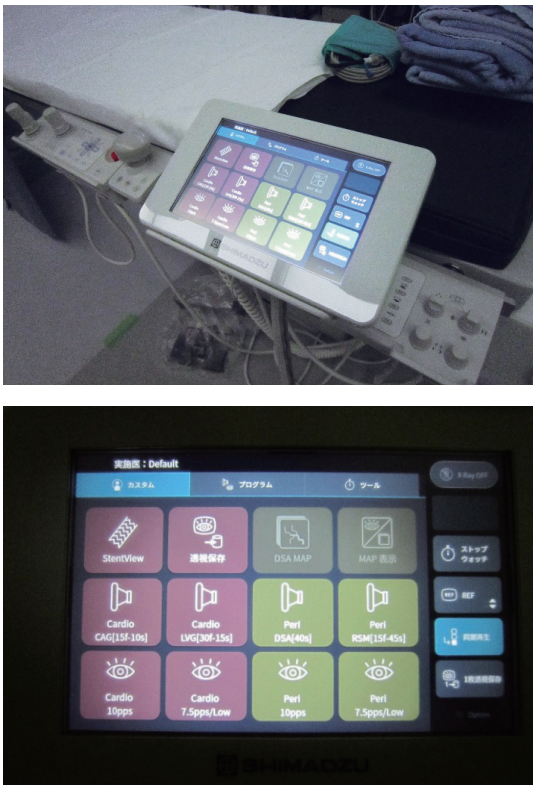

Fig.5 SMART Touch Digital Console

be customized with functions commonly used for certain procedures or for particular physicians, which allows physicians stress-free control.

We have also obtained the latest version of SCORE StentView PCI support software. SCORE StentView displays stents in a fixed position by compensating for heart movements, which helps positional confirmation when overlapping stents and during post-dilatation of stent with balloon. The previous software was unable to recognize the stent adequately in some cases, and image quality was also inadequate. The latest version of SCORE StentView promises improved visibility as it shows the stabilized stent in a whole screen view. Since this software has only been used a limited number of times, we have yet to verify it fully, but intend to make effective use of SCORE StentView in the future.

4. Summary

Shimadzu's proposition for a version upgrade of our BRANSIST safire to the unity smart edition occurred with especially good timing. With the variety of applications that were included in this version upgrade, I feel like our BRANSIST safire has been transformed into a system that physicians can now use stress-free for diagnoses and procedures. Lately, despite ever-greater demands for improved fluoroscopy and radiography image quality, it is taken for granted that X-ray doses will also be reduced. Although demands from users are anticipated to become much more specific in the future, I hope Shimadzu will consider the voice of the end user as a useful guide in future product development.