RAD

Experiences Using the MobileDaRt Evolution

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1. Introduction

Kameda Medical Center is located in Kamogawa City, Chiba Prefecture, in the southern part of the Boso Peninsula, directly overlooking the Pacific Ocean. Our main facility is Kameda General Hospital, but we also run Kameda Clinic, Kameda Rehabilitation Hospital and other medical service facilities under the name of the Center. We have 33 medical departments, 1,000 inpatient beds, and see an average of around 3,000 outpatients per day, who nowadays include patients from various different areas in Japan and even overseas. Kameda General Hospital is at the heart of Kameda Medical Center's activities, and operates as a main hospital in the southern part of Chiba Prefecture, having been designated as a tertiary prefectural emergency medical center and a core disaster medical center, among other accreditations. The Hospital is committed to providing advanced acute medical care. As part of our effort to continuously improve the quality of our medical care, we have obtained ISO-9001 certification for our medical services as a whole, have been accredited by the Japan Council for Quality Health Care, and also became the first hospital in Japan to be certified by the international accreditation organization Joint Commission International (JCI) **(Fig. 1)**. We introduced two Shimadzu Corporation wireless FPD-equipped MobileDaRt Evolution mobile X-ray systems to our hospital in October 2013, and have been benefiting from their use ever since

(Fig. 2). This article describes the background to the introduction of the MobileDaRt Evolution, our experience of using the units, their effectiveness and our hopes for the future.

Fig. 2

2. Purpose of Introducing the Systems

We use mobile X-ray equipment with an average of 60 ward patients each day, as well as an average of 10 patients for imaging during or after surgery. Most of this work is done by young technologists. With the opening of our new ward, we considered the introduction of new equipment to address the shortage of mobile X-ray equipment and the aging of existing systems, and also to improve work efficiency and reduce the burden on hospital staff. As part of our measures to improve medical safety,

Fig. 1   Kameda Medical Center

implemented from April 2014, we decided to take postoperative images of all open chest or abdominal surgeries, as well as all endoscopic surgeries, in order to ensure that no foreign objects are left inside patients. This resulted in an increased number of requests for imaging, and we needed to establish a system that helped improve the efficiency of using our operating rooms. Prior to purchasing new equipment we attended ITEM 2013 (the International Technical Exhibition of Medical Imaging), visiting several manufacturers' booths and listening to their explanations of mobile X-ray systems, as well as taking the opportunity to view the equipment for ourselves. We also brought several demonstration models into the hospital and tested them to ascertain their mobility, handling, and operability. The unit-type equipment, which allows FPDs and consoles to be added later, offered the benefit of allowing us to keep our budgets lower than purchasing new mobile equipment. In the end, however, we decided to purchase integrated mobile units, which are easier to use, because they specify exposure parameters according to the selected exposure region, and also transmit actual exposure information (exposure parameters and dose area product) to the RIS for dose management.

3. The Wireless LAN Environment and System

The wireless FPD-equipped mobile X-ray system uses the hospital's internal wireless LAN to transmit and receive orders and implementation information between the RIS and to transmit images to the PACS. Since the wireless LAN is invisible, it is necessary to confirm that the internal wireless environment can cope with such data transfer. The access points (hereinafter "AP") to the existing HIS network at the hospital are mainly used by the nursing department system, and so we implemented a survey to ascertain what impact the introduction of such systems would have on the computer environment within the hospital, and held careful meetings with system managers, manufacturers and radiologists. The number of APs differs from ward to ward, the ward wireless LANs have different SSIDs and IP addresses depending on which floor they are on, and an authentication server has been installed in order to maintain security. Since 2014 was scheduled as a period during which hospital infrastructure would be updated in line with the upgrading of our medical data systems and the promotion of ICT, our intention was to work with the existing systems and networks without having to implement major reforms.

4. Introduction of the MobileDaRt Evolution

The MobileDaRt Evolution comprises a Shimadzu Corporation mobile X-ray system combined with a FUJIFILM DR CALNEO C 1417 wireless flat panel detector. After considering various conditions, including the fact that our general radiography department uses the FUJIFILM FCR computed radiography (CR) system, we purchased and introduced two MobileDaRt Evolution systems, one for use on the wards, and one for use in operating rooms. The reasons for this decision included the following:
- The MobileDaRt Evolution can be used in the same operating environment as that in the general radiography department, allowing the use of the same method of operation both for the general radiography department and the mobile equipment.
- The system can supply images processed in the same way, regardless of where they were captured, which is necessary for observation over time.
- Images can be viewed on the monitor three seconds after exposure, allowing density adjustments and other processing to be carried out (Fig. 3).
- The system is power-assisted, making it easy to move and operate, and the low-vibration wheels are appreciated by hospital staff.
- The equipment is easily operated, and the FPD is light, making it easy even for smaller members of staff to use.
- The unit can be moved forward and backward for fine adjustments using the Inch-Mover buttons.
- The hospital's frequency band is the IEEE 802.11a 5 GHz band, and we were concerned, prior to introduction, that the IEEE 802.11n 5 GHz band used by the wireless FPD may cause interference, but we have found no interference between the two bands either in preliminary checking or subsequent to introduction.
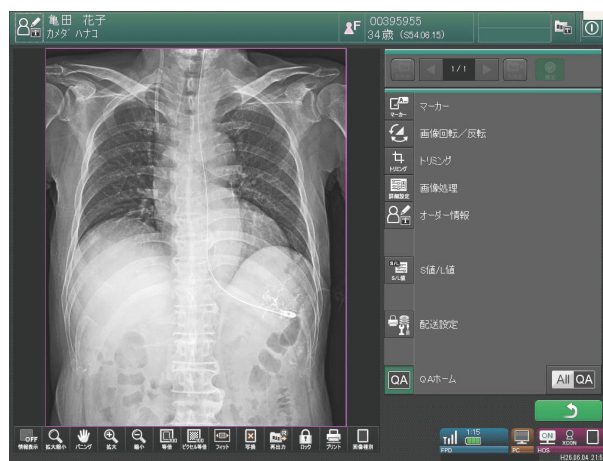

Fig. 3　Image Confirmation Screen

5. Operating System

We have located one MobileDaRt Evolution on the wards, and one in the operating rooms. The operating system includes a single RIS tablet terminal (hereinafter the "tablet") and a single spare battery for each MobileDaRt Evolution unit. Imaging on the wards is done across four wards on 28 floors, by two technologists, while imaging in the operating rooms is done by one technologist, in 18 rooms across two floors. Requirements for ward-based mobile imaging cannot be completely covered by the single MobileDaRt Evolution unit, and as such we are also using conventional CR equipment.

6. Operating Method

Our basic operating method is the same as that in the general radiography department.
(1) Order information is received by the radiography department before starting ward rounds. Additional order information is gathered using the tablet during ward rounds **(Fig. 4)**.
(2) On the ward, the order information selected on the tablet is compared with the patient's wristband, and after confirmation, the order and patient information is sent to the MobileDaRt Evolution via MWM.
(3) After exposure, the image is confirmed, density is finely adjusted, markers are inserted, and the imaging process is completed.
(4) Once the imaging is complete, the image is forwarded to the hospital PACS via the wireless LAN.
(5) Actual information (exposure parameters and area dose product) is forwarded to the RIS via MPPS, and recorded.
⊙ When exposures are performed based on conventional paper order forms, in operating rooms or in emergency cases, for example, the patient information is acquired by searching for the patient ID using the tablet, and then sent to the MobileDaRt Evolution, before the exposure area is selected and the image is captured.

Fig. 4. Tablet RIS Terminal

⊙ When being used in a wireless LAN environment, the process of exposure → image confirmation on unit monitor → image forwarding → image display on PACS usually takes around 30 seconds, although this depends on the condition of the wireless LAN.

7. Experience of Use

7.1 Ease of Operation

Since the operating method has been made the same as for general radiography, there have been no problems with ease of operation. The use of the tablets has assisted in paperless mobile radiography, and allowed us to respond swiftly even to requests for emergency imaging.

7.2 Improved Work Efficiency and Reduced Burdens

Replacing CR systems with the FPD system has allowed a significant improvement in work efficiency. We now no longer need to carry a large pile of CR cassettes around with during ward rounds. If we ran out of CR cassettes, we would previously not be able to respond immediately to requests for emergency imaging, but with the FPD we can continue exposures as far as the battery lasts, which has reduced both the physical and the mental burden on our technologists.

7.3 Reduced Burden on Patients

Being able to confirm the image right where it has been taken has significant benefits for both doctors and technologists, and the fact that we can now confirm the position of gastric tubes and IVH catheters immediately after procedures reduces the burden not only on medical staff but also on patients **(Fig. 5)**. In the operating room, the ability to confirm images on site during or immediately after surgery has reduced stress in both surgical staff and patients, and all our doctors have commented on the excellent clarity of the images displayed on the MobileDaRt Evolution monitor **(Fig. 6a and 6b)**.
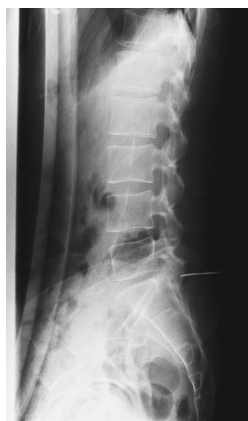
Fig. 5 Surgery in Progress

Fig. 6a Confirming a Gastric Tube

Fig. 6b Confirming Position During Surgery

7.4 Average Operating Time

The introduction of the MobileDaRt Evolution has not allowed us to significantly reduce the average operating time of capturing an image, compared with the time taken prior to its introduction. We believe that this is due to the fact that our hospital has a lot of floors, and we need to switch between different wireless LANs every time we move, and possibly also to the fact that our staff are not yet used to using the tablets. In the future, we believe it will be important to construct a wireless LAN environment that allows a roaming function to be incorporated, facilitating the automatic switching between APs when the terminal equipment is moved.

8. Effectiveness

When capturing images of an acute injury, time is of the essence. The MobileDaRt Evolution has the major benefit of allowing images to be viewed almost immediately after exposure, and is therefore very useful in emergency medicine. It also has functions that will be useful in disaster situations, in that providing the internal generator 100 V power supply is restored and the FPD can be connected via cables, the equipment can be used as a stand-alone X-ray unit, allowing the capturing, viewing and saving of images. Safety design features include a function preventing overcharging, so that if the equipment is plugged in once ward rounds have been completed, the battery can be topped up at all times, allowing it to be used fully charged whenever needed.

9. Hopes for the Future

The use of the FPD system for ward radiography has contributed to reducing the work burden placed on technologists, improved work efficiency, and reduced the burden placed both on doctors and patients. I hope that we will see even lighter FPDs and smaller mobile radiography units being produced in the future.

10. Conclusion

The MobileDaRt Evolution units we introduced this time use one 14 × 17-inch FPD, but we would like to install a miniFPD for use with newborn infants. We also would like to install two additional FPD systems, one for the emergency medical center and the other for ward use, so that all mobile radiography throughout the hospital is performed by MobileDaRt Evolution. Compared with CR systems, FPD systems provide images with higher quality while reducing the exposure dose. We will continue studying exposure conditions and image quality so as to be able to further reduce exposure dosage, and provide safe, high-quality medical care to our patients.

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