

Current Medical Care and Approaches to COVID-19, and the Benefits of a Shimadzu Mobile X-Ray System

— Osaka Prefectural Nakakawachi Emergency and Critical Care Center —

In March of this year (2021), Osaka Prefectural Nakakawachi Emergency and Critical Care Center acquired the MobileDaRt Evolution™ MX8 Version c type (hereinafter, “MX8”), a Shimadzu mobile X-ray system, and has since been using it to treat patients with severe COVID-19. We asked center director Hitoshi Yamamura, chief radiological technologist (R.T.) Hideki Mikami, assistant chief R.T. Kenji Nakamura, and lead R.T. Daigo Wada about their approaches to COVID-19 medical care, how they use the MX8, and what effects MX8 has had on COVID-19 medical care.

(Interviews performed on June 21 and 24, 2021)



Hitoshi Yamamura, Center Director

Interview with Hitoshi Yamamura, Center Director

—Please describe your facility.

Osaka Prefectural Nakakawachi Emergency and Critical Care Center is the only tertiary emergency care center in the Nakakawachi medical district, which encompasses Higashiosaka City, Yao City, and Kashiwara City. Higashiosaka City houses numerous backstreet workshops and is crossed by multiple expressways, so the center sees a large proportion of trauma cases. Before the COVID-19 pandemic, the center admitted approx. 1,000 to 1,200 patients per year, of whom one-third were



Osaka Prefectural Nakakawachi Emergency and Critical Care Center, the only tertiary emergency care center in the Nakakawachi medical district

trauma cases, one-fourth were cardiac arrest cases, and the remaining patients included drug poisoning and pneumonia cases. The policy adopted during the COVID-19 pandemic was that cases within Osaka Prefecture would primarily be treated in critical care centers, hence this center has been providing care to patients from outside its medical district for the past 1 to 2 years.

—What is the current situation at your facility regarding the COVID-19 pandemic, and what approaches are you taking?

First Wave: Finding our Feet

Since accepting our first case of COVID-19 on April 2 of last year (2020), the center has taken in 172 severe COVID-19 cases that required mechanical ventilation.

During the first wave, the center treated 13 severe cases and 2 of our 8 ICU beds were operated as negative pressure rooms. As the number of cases increased, we switched to operating all 8 beds under negative pressure.

The center was finding its feet at the time in dealing with various problems, such as area zoning between

COVID-19 treatment areas and other areas in the hospital, and obtaining personal protective equipment for infection control. Also, PCR testing was only available through the government at the time and the government was cooperative, but since nearby Higashiosaka City Medical Center obtained PCR testing equipment, we have coordinated with them on diagnosing COVID-19. The initial State of Emergency caused a slight reduction in severe cases during April and May of 2020, but as the only tertiary emergency and critical care facility in the region, we also needed to maintain local emergency services, and for a period of 1 year we continued to provide emergency medical services alongside treatment for severe COVID-19 cases.



All 8 ICU beds converted for negative pressure operation due to the pandemic

Second Wave: The Center Commences PCR Testing In-House

The second wave reached its peak around the middle of August and the center took in around 25 COVID-19 patients during this period. The challenge at the time was providing medical care for both COVID-19 and heat stroke, as the center was receiving suspected COVID-19 cases based on fever caused by heat stroke who had nowhere else to go. A shortage of personal protective equipment also became a problem over this period with the center purchasing protective clothing intended for painting applications. Nonetheless, we also made the necessary arrangements to perform PCR testing in-house and commenced testing from around the end of June. This allowed us to diagnose COVID-19 in-house without having to rely on other medical institutions or the government.

Third Wave: Converting the ICU, General Ward, and Treatment Areas into Negative Pressure Areas

A shortage of beds became a problem during the third wave. Emergency cases of cerebral infarction, myocardial infarction, and pneumonia increase

through fall and winter. During the 5-month period from November through to March, we treated around 70 such cases. Over the new year period at the peak of the third wave, the prefectural government requested we increase the number of beds being used to treat severe COVID-19 cases. As doing this would leave the center unable to handle the increased number of normal emergency cases, we balanced providing normal emergency services while also dedicating 8 ICU beds to severe COVID-19 cases. Foreseeing that COVID-19 would continue into the future, from November through to January the center undertook renovation work to create negative pressure rooms. All ICU rooms were converted, as were 9 of 22 general ward beds (among 8 HCU beds and 14 general beds). Treatment areas that are entered by patients such as the emergency room, the CT room, angiography room, and operating room were also converted. Performing renovation work in all ICU rooms and 70% to 80% of treatment areas while also continuing to treat severe COVID-19 cases was a difficult task, but undertaken for the protection of patient and staff safety.



Nine of 22 general ward beds converted to negative pressure rooms

Fourth Wave: Strengthening Medical Care Systems by Acquiring a Shimadzu Mobile X-Ray System

The fourth wave saw a sudden increase in cases from March of 2021 in Osaka Prefecture, where the number of severe cases grew to over 450, which was far above the 220 beds secured by the prefectural government. This created a situation in which hospitals that normally only accepted moderate cases also started treating severe cases, and a worsening situation among patients staying at home due to a lack of hospital beds, some of whom were brought to us after cardiac arrest. As reported in the news media, Osaka was unable to provide adequate medical services.

At around this time, facilities that had been designated by the prefectural government as dedicated COVID-19 hospitals were not providing normal emergency medical services, and so during the third and fourth waves, there were substantially fewer facilities to

handle emergency cases. As a facility that provided emergency medical care, our center was treating both emergency cases and severe COVID-19 cases transported from outside our medical district in Osaka City. To date, the center has treated 170 severe COVID-19 cases while also accepting close to its usual number of emergency cases, and operations at the center remain strained to this day.

Nonetheless, during the fourth wave, the center both established negative pressure rooms and strengthened its medical systems by acquiring a Shimadzu mobile X-ray system. The Shimadzu mobile X-ray system is used to perform radiographic examinations on severe COVID-19 cases in the ICU, and when replacing endotracheal intubation tubes and central venous catheters. The mobile X-ray system is extremely helpful as it enables us to check the acquired images, perform procedures, and make decisions on image retakes at the bedside.

By contrast, the doctors, nurses, radiological technologists, and other medical staff at the center remained almost unchanged for one year after the first wave. As the center has just 30 beds in total and a relatively small contingent of medical staff, not being able to receive support from staff in other wards or rotate staff between wards has been a challenge.

A Disconnect between Health Care Facilities and the Public Arena

Earthquakes and other disasters have a massive impact on one's visual surroundings and information

on such disasters travels quickly, but with COVID-19, there was a huge disconnect between the situation in the public arena and on the ground in medical facilities. I think this gap increased the psychological strain felt by medical professionals and needed to be overcome in order to reduce the flow of people.

—What do you hope to see from medical equipment manufacturers like Shimadzu?

I believe Shimadzu has released a PCR testing system^{*1}. The COVID-19 situation could resolve itself or new variants may continue to emerge every year. If COVID-19 remains a problem, I think we will see an increased need for more accurate antigen tests that are simple and require no sample pretreatment, and for PCR testing systems that provide results in 30 or 45 minutes. The medical equipment that does this should provide immediate diagnosis after testing at the medical facility, and also be capable of testing for potential variants that may emerge in the future. Therapeutic drugs that provide options for earlier therapeutic intervention also need to be developed.

—What would you say to facilities that are struggling with treating COVID-19?

We do not know what the future holds in terms of medical care and this infectious disease. We also cannot predict what effect variants will have even after vaccination, so we should focus on providing treatment for COVID-19 in tandem with other primary fields of medical care.

Departmento of Radiography Interview

—Please give us an overview of your radiography department.

Mikami The radiography department has 5 part-time and 5 full-time radiological technologists, including myself. Before we operated just one mobile X-ray system, but in March of this year (2021) the department acquired a Shimadzu MobileDaRt Evolution MX8 Version c type (hereinafter, "MX8") system and now operates two mobile X-ray systems.

Nakamura Before the COVID-19 pandemic, when we operated one mobile X-ray system, we performed on average 15 examinations each day almost every day. Now, the previous system is used in the operating room and emergency room on the first floor, and the MX8 is used in the ICU and hospital wards on the second floor.

—What were the events leading up to acquiring the MX8 and why did you choose the MX8?

Acquiring an MX8 for Operational Improvements

Nakamura We encountered problems operating just one mobile X-ray system. Radiography for inpatient cases with acute changes or after procedures on the second floor sometimes overlapped with radiography for emergency outpatients and during or after surgery, which required us to interrupt an examination to move the mobile X-ray system. Some situations prevent radiography from being stopped immediately, so we were considering placing a mobile X-ray system on each floor to improve efficiency and reduce patient stress.

Notes from the Editor

*1 PCR testing system: Shimadzu's AutoAmp™ gene analysis system that offers fully automated PCR testing was released in November 2020 (only available in Japan as of Sep. 2021)



Chief R.T. Hideki Mikami



Assistant chief R.T. Kenji Nakamura



Lead R.T. Daigo Wada

Mikami Then the sudden increase in mobile radiography work due to the COVID-19 pandemic prompted us to acquire the second system.

Nakamura Performing radiography in COVID-19 cases takes three times as long as normal radiography; the equipment must be prepared against transmission for each patient and cleaned both during and after the examination. Emergency and critical care centers are always in a race against time, but this workflow prevented a rapid response when a mobile X-ray system was needed on the first floor. As both the first and second floors have only severe cases, a major improvement of acquiring the MX8 was the ability to perform radiography quickly on both floors.

Large Monitor and Slim Body: Designed for Practicality in Medical Settings

Nakamura The MX8 was chosen for its large on-board monitor and slim body design. Being an emergency and critical care center, we immediately proceed to diagnosis and treatment after radiography so a large on-board monitor was essential. Although sites for examination can be localized on a small screen, doctors find it difficult to verify information in detail. Space at the bedside is also very limited, so we chose the MX8 because it was the slimmest system available and very maneuverable.

Wada I also thought the Auto-Power-Off function^{*2} and Inch-Mover buttons^{*3} were good features.

Mikami Looking at the changes to MobileDaRt, they seem to have made it more practical. With the collapsible column and pockets on the main unit to

store equipment, it looks like some thought has been put into how the system will be used in a medical setting.

—Could you tell us how you use the MX8?

Introducing Detailed Infection Control Measures into Patient Rounds, Radiography Workflows, and Radiography Procedures

Wada In rooms with COVID-19 cases, radiography is performed with three people: one MX8 operator, one radiological technologist acting as an assistant, and one nurse. The assistant and nurse are responsible for handling the patient, such as lifting the patient from either side to place an FPD, and the operator is only responsible for system operation and does not touch the bed or the patient. Duties are evenly rotated among all 5 radiological technologists, including the chief radiological technologist. Radiological technologists are also on watch 5 or 6 times per month, and the person on watch that day takes the role of assistant, which the day shift technologist takes the role of operator.

In terms of workflow, hospital room radiography orders are transmitted from the RIS to the mobile X-ray system as an appointment list is simultaneously printed out every morning. The site for examination and exposure conditions are also included on the appointment list. We then move to the second floor where the MX8 is located.

After entering the room, lead glass panels are first placed on either side of the bed. The assistant and nurse don personal protective equipment that includes, from top to bottom: hat, goggles, N95

Notes from the Editor

*2 Auto-Power-Off function: Turns off power to the main unit after a prescribed period without operation.

*3 Inch-Mover buttons: Buttons on the front of the collimator that move the system forward and backward

mask, plastic apron, and nitrile gloves.

The MX8 operator reads the patient bar code ID, checks that the site for examination received from the RIS matches the details in the appointment list, then adjusts exposure conditions for each patient as printed on the appointment list. Next, the MX8 is moved to the bedside and the operator extends the arm to a position where it can be operated by the assistant. The assistant performs positioning by only touching the collimator and irradiation field knobs whenever possible. When positioning is complete, the operator times radiography based on the respiration of patients on mechanical ventilation and aims to perform radiography when no other staff are in the surrounding area. After checking the images, the operator transmits the images to PACS.

The FPD is wrapped in two plastic bags as an infection control measure. The outer plastic bag is changed for each patient and the inner plastic bag is cleaned with alcohol along with the collimator and irradiation field knob touched by the assistant. All personal protective equipment apart from the mask and hat is also replaced between patients. Undertaking these measures for every patient lengthens radiography to take three times as long compared to patients who require no special infection control measures.

COVID-19 cases have a scheduled morning examination consisting of chest radiography once a day, apart from Mondays when both chest radiographs and abdominal radiographs are taken. When beds are full, this entails all 10 patients performing 20 radiographic examinations. After including non-COVID-19 patients, about 25 examinations are performed in total, which takes around 1 hour 30 minutes. Apart from scheduled examinations, radiography is also used during the day shift to confirm the position of endotracheal intubation tubes after reinsertion or repositioning, to confirm feeding tube insertion, or after replacing a central venous catheter. Radiography is also used when patients

develop acute changes. Images may be acquired 3 or 4 times from the same patient in a day to replace and confirm the position of an intubation tube.

Mikami Each examination requires the donning of personal protective equipment and other infection control measures and it takes time, which means unscheduled examinations are performed at around midday.

Wada We also take steps to ensure early notification from doctors and nurses before an intubation procedure and set up the FPD accordingly in preparation.

Nakamura Given these working conditions, the ability to immediately check images at the bedside on the large MX8 monitor is extremely useful.

Wada Each person on night watch also adopts special infection control measures to be able to perform an examination efficiently even when working alone. For example, wearing two layers of gloves or covering the exposure switch with a plastic bag or cloth to disinfect it with alcohol.

Nakamura Our center has an ICT team^{*4} that determines basic infection control measures, such as rules for entering ICU areas or for performing portable X-ray radiography. I believe that if each facility in Japan shared its procedures, these types of basic rules will become standardized.

MX8 with Features Optimum for both Emergency Care and the COVID-19 Pandemic

Wada If I forget to recharge the main unit battery after multiple emergency examinations, the MX8 has an Auto-Power-Off function that conveniently reduces power consumption from the main unit battery. Other staff members have also mentioned the Inch-Mover buttons make positioning easier, and the responsive exposure switch makes it easier to time image acquisition with maximal inspiration. I have also heard people comment the brightness of the monitor on the main unit makes examining reference images easier, the storage areas for the FPD and small objects are well thought out, and the surface coating and wiring are easy to clean and good for infection control. The collimator on the MX8 is also more compact and has less surface area to be wiped. Plastic bags and cleaning wipes can also be kept in the storage box while on rounds, a particularly useful feature during the COVID-19 pandemic.



Thanks to the collapsible column, the system can even be stored under shelving.



During hospital rounds, plastic bags and cleaning wipes for infection control are stored in the rear storage box of the MX8 (left). A protective apron is also carried on a hanger from the hook on the support column.

Nakamura In terms of moving the system and system operability, I have seen female radiological technologists in training using the MX8 with no apparent difficulty.

Mikami Maneuvering the MX8 is really quite easy. The smaller main unit also makes cleaning easier.

—What do you hope to see from medical equipment manufacturers like Shimadzu?

Wada It would be helpful if the FPD battery and barcode reader could be charged on the main mobile unit. I would like the mobile X-ray system to be able to receive exposure conditions after they are configured for each patient on the RIS, then apply those conditions automatically. Also, while the monitor display is flat and easy to clean, for infectious diseases it would be nice if all components could be cleaned with alcohol. We mentioned covering the FPD in plastic bags earlier, and it would be helpful if this could also be done in the FPD storage area.

Nakamura think remote equipment repairs will become more prevalent in the future and I would like to see it implemented as a feature. Even when repairs can only be undertaken on-site, I want logs to be collected remotely so on-site visits happen with some degree of readiness.

Mikami Eventually, I hope the service engineer and necessary components arriving at the facility



From left: R.T. Okamiya, chief R.T. Mikami, lead R.T. Wada, assistant chief R.T. Nakamura, and R.T. Fujimoto

simultaneously, allowing the engineer to complete repairs there and then.

—What would you say to facilities that are struggling with treating COVID-19?

Nakamura Medical professionals throughout Japan, including us, are still in the process of finding our feet, and we do not know if current practices are correct. Nevertheless, we cannot stop fighting the virus and must do the best we can.

Mikami Right now we are barely keeping our head above water, but this is exactly the time that calls for the greatest resolve.

We cannot afford to relax or lose sight of the significance of our work and must keep on fighting.

Osaka Prefectural Nakakawachi Emergency and Critical Care Center

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- Hospital beds
8 ICU beds (including 2 beds in private rooms with negative pressure management), 8 HCU beds, 14 general ward beds
- Medical departments
General Surgery, Orthopedic Surgery, Neurosurgery, Intensive Care, IVR and Endoscopy

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