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The Usefulness of a Portable X-Ray System in Obtaining Chest X-Rays at the Scene

Kazuhiko Omori MD.PhD, Hiroki Nagasawa MD, Ikuto Takeuchi MD, Shunsuke Madokoro MD, Kei Jitsuiki MD, Hiromichi Ohsaka MD.Ph, Kouhei Ishikawa MD.PhD, Youichi Yanagawa MD.PhD*

Department of Acute Critical Care Medicine, Shizuoka Hospital, Juntendo University Tokyo 113-0033, Japan

***Corresponding author:** Youichi Yanagawa

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Abstract **Case Report**

We herein report our experience using this portable X-ray system at the scene after transportation by a doctor helicopter (DH). We introduce two cases in which a chest X-ray obtained using a portable X-ray system transported by a physician staffed helicopter was useful in the management of a patient. In the first case, the chest X-ray was useful for confirming the tracheal tube position; in the other it was useful for making a differential diagnosis at the scene. This system may be useful for performing prehospital medical treatment.

Keywords: portable X-ray; a physician staffed helicopter; prehospital.

INTRODUCTION

Chest X-rays are performed daily in medical facilities for various reasons, including the diagnosis of lung disease, heart disease, and foreign bodies and to confirm the positioning of a tracheal tube.

FUJIFILM (Tokyo, Japan) developed a portable X-ray system called the CALNEO Xair®. (https://fujifilm.jp/business/healthcare/digital_xray_imaging/dr04/calneo_xair/index.html). The X-ray radiation machine weighs 3.5 kg. Its dimensions are as follows: height 144 mm, length 148 mm, and width 258 mm. The radiation dose of a chest X-ray performed with this system is approximately 45 μGy. The system requires a special cassette and notebook-type personal computer to operate and display X-ray images (Figure 1). Our hospital is the physician-staffed helicopter (called a doctor helicopter [DH] in Japan) base for eastern Shizuoka Prefecture [1]. We herein report our experience using a portable X-ray system at the scene under transportation by the DH.

CASES

Case 1

The patient was a 78-year-old woman who did not wake in the morning. On the previous day, her activity had been normal. She had not significant past history. When her husband found her, she was on the floor with a blanket beside her bed. It was the middle of winter, and her husband initially thought that she was sleeping. However, at noon, she had still not woken and her husband was unable to wake her. Her husband called an ambulance. The fire department dispatched an ambulance and requested the dispatch of a DH after receiving an emergency call. When emergency medical technicians checked her, her vital signs were as follows: Glasgow Coma Scale, E1V1M1; systolic blood pressure, 160/110 mmHg; pulse rate, 68 beats per minute; respiratory rate, 16 breaths per minute. She was transported to a rendezvous point by the ambulance. When the DH staff, who were equipped with a portable X-ray system checked her at the rendezvous point, her vital signs were as follows: Glasgow Coma Scale, E1V1M1 with non-reactive 2 mm pupils; systolic blood pressure, 44/24 mmHg; pulse rate, 80 beats per minute; percutaneous oxygen of saturation, 96% under room air; respiratory rate, 14 breaths per minute; and body temperature, 30.2°C. Her blood glucose level was 96 mg/dl. There were no significant physical findings. As she was in a deep coma state, tracheal intubation and rewarming were performed after receiving securing venous route. A chest X-ray obtained using the portable X-ray system showed that the distal end of the tracheal tube was positioned in an orifice of the right bronchus; thus, the tracheal tube was pulled out 2 cm from the bifurcation (Figure 2). After she being transported to the hospital by the DH, head computed tomography revealed intra-ventricular hemorrhage. Bilateral ventriculostomy was performed.

Case 2

While taking a bath with her husband, an 84-year-old woman experienced nausea, vomited and

showed left hemiplegia. Her husband called an ambulance. She had asthma. The fire department dispatched an ambulance and requested the dispatch of a DH after receiving the emergency call. She was transported to a rendezvous zone by the ambulance. The staff of the DH, who was equipped with a portable X-ray system, checked the patient after landing at the rendezvous zone. Her vital signs were as follows: Glasgow Coma Scale, E4V5M6 with reactive 2 mm pupils; systolic blood pressure, 204/84 mmHg; pulse rate, 86 beats per minute; percutaneous oxygen of saturation, 86 % under room air; and respiratory rate, 26 breaths per minute. Wheezing was heard in the bilateral lung fields. Oxygen was administered, a venous route was secured and an antiemetic agent was infused to treat emesis triggered by microaspiration. Electrocardiography showed no ST changes, and a Chest X-ray was negative (Figure 3). The DH staff judged that she had suffered stroke, hypertension and an asthma attack. After these treatments, her systolic blood pressure decreased to 150 mmHg, and she was transported to our hospital by the DH. She was finally diagnosed with putaminal hemorrhage at our hospital. Chest computed tomography on arrival revealed no specific findings.

Fig-1: CALNEO Xair® developed by FUJIFILM (Tokyo, Japan). Left: The system carried by a physician. Right: The system carried in the helicopter. (1) The X-ray radiation apparatus, (2) the special cassette, (3) a notebook-type personal computer

The X-ray showed that the distal end of the tracheal tube was positioned in an orifice of the right bronchus.

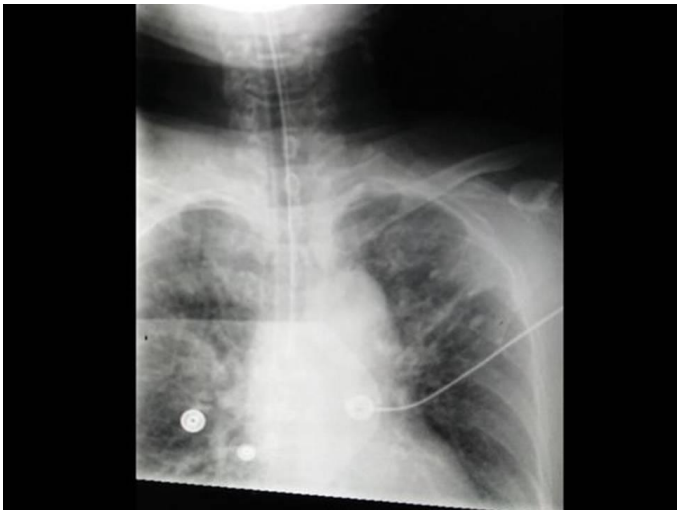

Fig-2: Chest X-ray in Case 1

The X-ray was negative

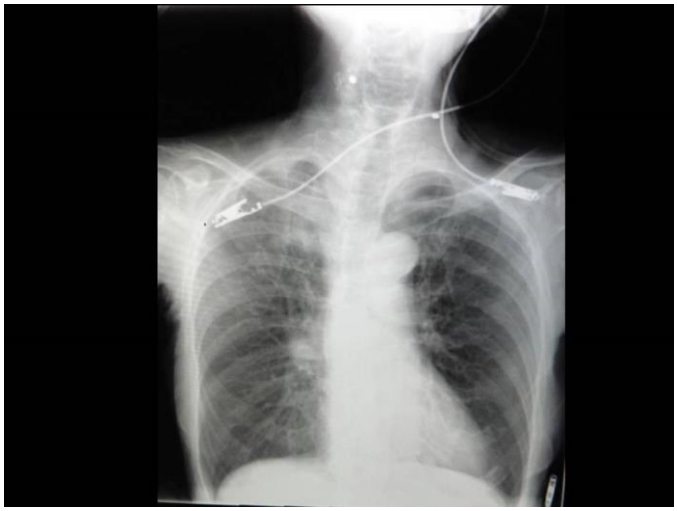

Fig-3: Chest X-ray in Case 2

DISCUSSION

There are many methods for verifying endotracheal tube (ETT) placement [2]. Maneuvers that are commonly used to confirm endotracheal intubation include observation of symmetrical bilateral chest movements and palpation of upper chest excursions during compression of the reservoir bag. Auscultation of the bilateral breath sounds in the lung field is the method that is most commonly used to ensure proper ETT placement. Epigastric auscultation and observation to detect abdominal distention are used to detect esophageal intubation. Confirmation of tube condensation by water vapor is another standard method. Recently, quantitative capnography or ultrasonography has been reported to be useful for confirming ETT [3]. These methods are useful for discerning ETT from esophageal intubation; however, it is difficult to detect malposition in tracheal intubation or bronchial intubation by methods other than auscultation. In contrast, a chest X-ray can show the precise positioning of the tube and detect esophageal intubation. Accordingly, the use of a chest X-ray in the prehospital setting may be useful for confirming safe ETT, similarly to case 1.

In case 2, obtaining information about the clear lung field was useful for the differential diagnosis, which included among aspiration after vomiting, heart failure with stroke-induced cardiomyopathy or a recurrent asthma attack induced by microaspiration [4-6]. This system may be useful for performing prehospital medical treatment.

CONCLUSION

We introduced the usefulness of a chest X-ray obtained by a portable X-ray system that was transported by a DH. This system may be useful for performing prehospital medical treatment.

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Conflicts of interest

The authors declare no conflicts of interest in association with this study.

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