



Emergency Air Medical Transport of Patients with Coronavirus Disease 2019: Experience with an Inflatable Negative Pressure Isolation Chamber on the UH-60M Helicopter

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In 2019, the coronavirus pandemic was caused by severe acute respiratory syndrome coronavirus 2. In Taiwan, an inflatable negative pressure isolation chamber (INPIC) was applied into the emergency air medical transport (EAMT) in 2020. The standard operating procedure of the INPIC as infection control was developed and practiced in the UH-60M helicopter. There were five cases moved by the EAMT from the Lanyu Township and Ludao Township to Taiwan's mainland. After they were screened positive for coronavirus disease 2019 (COVID-19) with a rapid test, the medical staff completed the INPIC preparation and loaded the patients into it before the EAMT. This study reported that none of the crewmembers were infected with COVID-19 during the transfers. However, some restrictions of the INPIC could be improved in the future, e.g. limited space, thermal stress, equipment immobilization, and communication barrier. The medical team should assess the efficiency and safety using the INPIC based on each patient's condition before the flight.

Key words: Coronavirus disease 2019, inflatable negative pressure isolation chamber, emergency air medical transport

INTRODUCTION

The coronavirus disease 2019 (COVID-19) continues to spread globally. In the emergency air medical transport (EAMT), patients diagnosed with COVID-19 infection requires the incorporation of infection control. Flight and medical crews must comply with mandatory COVID-19 protocols.¹

An inflatable negative pressure isolation chamber (INPIC) was loaded and positioned inside the cabin of an UH-60M helicopter [Figure 1a and b].² In Taiwan, Omicron variant of COVID-19 commenced in 2022, including Lanyu and Ludao Township, the offshore islands of Taitung County. The Third Brigade, Third Branch of the National Airborne Service Corps used the INPIC on five EAMT sorties at Taitung County Airport. This study presents those cases so as to investigate the training and conduct after-action reviews to provide a basis for improvement measures.

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CASE REPORTS

Patient 1

An 8-month-old boy was tested positive for COVID-19 at the Lanyu Township Public Health Center. The patient returned to the center with recurrent fever, respiratory distress, and reduced appetite. Due to noticeable signs of pneumonia, the EAMT for the patient was the first mission using an INPIC. The patient laid on the top of his mother and faced her inside the chamber [Figure 2]. The helicopter delivered him to the hospital and then was diagnosed as the COVID-19-induced acute bronchiolitis. He was hospitalized and discharged after 3 days upon recovery.

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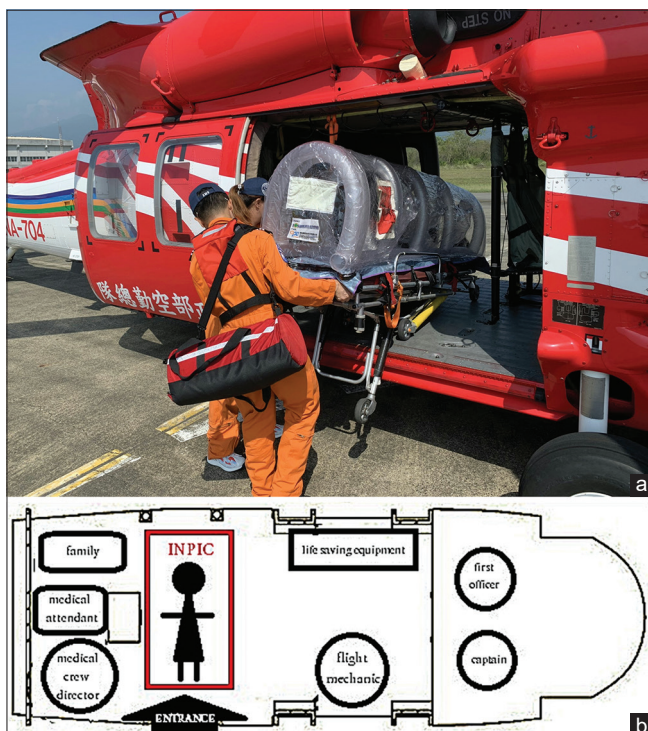


Figure 1: (a) Inflatable negative pressure isolation chamber (INPIC) was fixed onto air transfer rack. Medical team performs hot-pit loading to make sure that it would not be foreign-objective damaged by downstream wind. (b) The position of INPIC system and crewmembers was illustrated inside the cabin. INPIC: Inflatable negative pressure isolation chamber

Patient 2

A 65-year-old male patient was sent to the Ludao Township Public Health Center after a fall. The patient was tested positive for COVID-19 and suspected rib and lumbar vertebra fractures. With the treatment of nasal cannula oxygen, the patient's blood oxygen saturation increased to 92%. He laid in the isolation chamber throughout the EAMT. Flow rate was increased to maintain the blood oxygen saturation that remained between 79% and 88%. At the hospital, a computed tomography image revealed fractures in the 1st and 2nd ribs on the right and hemothorax combined with fractures in the 4th, 10th, and 11th thoracic vertebrae and 2nd lumbar vertebra. The patient was confirmed with COVID-19 infection. He died of sudden cardiac arrest during the hospitalization.

Patient 3

An 82-year-old woman experienced shortness of breath at home. The patient was given a nonrebreathing mask with signs of acute respiratory failure. At the Ludao Township Public Health Center, she received the tracheal intubation for mechanical ventilation. EAMT was requested for the patient upon observation of double pneumonia and pleural effusion in a chest X-ray and receipt of a positive result in a rapid



Figure 2: Mother with 8-month-old boy lying on her chest wall inside inflatable negative pressure isolation chamber. Chamber was transported by two medical team members to right side of helicopter. Family member followed carrying baggage

COVID-19 test. After a 10-day hospitalization, she died of COVID-19-induced pneumonia and acute respiratory failure.

Patient 4

With the positive COVID-19 test, an 89-year-old woman was isolated at home and used the antiviral drug Paxlovid at Ludao Township. Upon observation of low blood pressure by a video consultation, the patient was moved to the public health center. She was infused with saline and lactated Ringer's solution and underwent a 12-lead electrocardiography, which revealed sinus bradycardia. The patient was given an atropine bolus and nasal cannula oxygen. After EAMT, she had been incapacitated by an acute large ischemic stroke and expired during the hospitalization.

Patient 5

A 72-year-old gentlemen received a positive COVID-19 test and was prescribed Paxlovid by the Lanyu Township Public Health Center. Several days later, the patient returned to the center due to shortness of breath; his blood oxygen saturation had decreased to 81%. Because of double pneumonia in a chest X-ray, he was given nasal cannula oxygen after which his blood oxygen saturation increased to 97%. After EAMT, the patient was diagnosed as COVID-19-induced double lobar pneumonia and was discharged after 10 days hospitalization.

DISCUSSION

Lanyu and Ludao Townships have <10,000 residents but receive over 350,000 tourists every year. Due to limited medical resources, public health centers rely on EAMT to ensure that residents and tourists receive emergency care.³

In 2003, when severe acute respiratory syndrome spread throughout Taiwan, a Fokker 50 was dispatched to complete

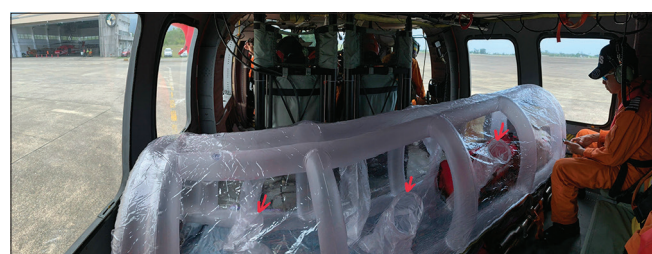


Figure 3: Inflatable negative pressure isolation chamber was fixed to interior of UH-60M helicopter before drill flight. Photograph was taken from left back seat by medical team member. Arrow indicates gloves attached to chamber

the transfer of one patient from Penghu Island to the designated hospital.⁴ In 1999, US Army moved a patient with the infectious disease by the C-130. The patient was placed in a lightweight stretcher isolator.⁵ In Taiwan, the medical team used an INPIC similar to the isolator used by the US Army to conduct EAMT [Figure 3]. Patient 3 received tracheal intubation for mechanical ventilation; however, the INPIC provided inadequate space for the ventilator to be fixed. Medical personnel provided assisted ventilation by a bag valve mask. In addition, the INPIC could not be integrated with the advanced oxygen supply device. If the patient needed more oxygen, the devices must be placed inside the chamber before the patient is loaded.

The INPIC and UH-60M helicopter are both not equipped with an air conditioner or fan. Thermal stress could be harmful to the patient's health during the summer. External cooling methods might be applied using cool intravenous fluid infusion, ice bags, or blankets. Medical teams must ensure that these devices can be fixed safely inside the INPIC.

Using portable isolation devices to transport patients with infectious diseases on aircraft are feasible but could potentially increase risks during the flight. Medical teams should conduct individualized and detailed risk-benefit assessments before flights.⁶ Meanwhile, the information of INPIC fitting should be collected from the medical team member's reflections in the future.

CONCLUSION

The EAMT team studied herein successfully accomplished five patient movements using an INPIC and the UH-60M helicopter. None of the flight or medical crews were infected with COVID-19 during the transfers. Some limitations of INPIC mentioned must be considered and assessed by medical team members before flight.

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Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Data availability statement

Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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