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*Case Report*

# Aeromedical evacuation of a COVID-19 patient from a zonal hospital: A case report

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## ABSTRACT

**Introduction:** The coronavirus disease 2019 (COVID-19) pandemic has affected the whole world including many healthcare workers. In this era of ongoing global pandemic, the patient surge for aeromedical evacuation is going to increase.

**Case Details:** A 54-year, male healthcare worker with no known co-morbidities, presented with complains of fever, myalgia, and sore throat at a zonal hospital of Indian Air Force in the northeast part of India. He was diagnosed with COVID-19 related bilateral extensive pneumonia. Despite of standard treatment, his condition deteriorated. An aeromedical evacuation of the patient was carried out to a tertiary healthcare centre at Delhi which involved 4-h of flying time. The Airborne Rescue Pod for Isolated Transportation (ARPIT) isolation pod was used to minimize the risk of contamination.

**Discussion:** This was the first time that a COVID-19 patient was air evacuated in an isolation pod in Indian Armed Forces to the best of our knowledge. Based on our experience, we recommend that air evacuation of such a patient may be resorted to only as a life saving measure. The use of an isolation pod remains an unsettled issue; whereas, it gives absolute containment to spread of infection, it poses unique challenges in terms of handling the patient in case of an in-flight emergency. Certain modifications in the isolation pod have been recommended.

**Keywords:** COVID-19, Aeromedical evaluation, Isolation pod, Airborne Rescue Pod for Isolated Transportation (ARPIT)

## INTRODUCTION

Coronavirus disease 2019 (COVID-19) is highly contagious and has shown wide spectrum of manifestations in the patients, from completely asymptomatic status to severe lung disease. The COVID-19 pandemic has widely affected all parts of the country; the Armed Forces personnel being no exception. In this ongoing global pandemic, aeromedical evacuation of COVID-19 patient is a double-edged sword. Whereas, there is an essential need for evacuation of seriously ill patients to higher referral centers with well-equipped facilities, there is also an increased risk of exposure to medical team as well as aircrew due to the highly contagious nature of the disease.[1] This has changed the ways we used to air evacuate a patient on routine basis. To minimize the risk of transmission, use of isolation pod and personal protective equipment (PPE) has become an essential need.[2,3] In this paper, we share our experience of aeromedical evacuation of a COVID-19 patient with bilateral pneumonia from a northeast part of the country to Delhi by a fixed wing aircraft. The unique challenges faced during preparation of the patient as well as aircraft and medical support provided to the patient while being air evacuated is presented in this case report.

## CASE REPORT

A 54-year, male, a healthcare worker with no known comorbidities, presented with complaints of fever, myalgia, throat irritation, and cough of 3 days duration. On investigation, he was found to be positive for COVID-19 infection by RT PCR test. Initially, he was managed with supportive oxygen therapy, antibiotics, tab hydroxychloroquine, and dexamethasone. However, patient condition deteriorated on 3$^{rd}$ day of admission with increased episodes of shortness of breath on minimal exertion with drop in oxygen saturation to 88–90 % on room air. He was given oxygen through face mask to maintain a saturation of 94–96%. He was started on remdesivir intravenously. HRCT chest was suggestive of bilateral ground glass opacities, crazy paving pattern, and consolidation, suggestive of COVID-related pneumonia [Figure 1]. Arterial blood gases showed $PaO_2$ of 56 mmHg, $PaCO_2$ of 40 mmHg, and pH of 7.32. In view of the above condition, a decision was taken to air evacuate the patient from a northeast zonal hospital to a tertiary care center at Delhi.

The patient was advised to communicate by gestures (thumbs up or down) and was donned with PPE. A pressurized fixed wing aircraft (C-130 Super Hercules) was tasked for the aeromedical transport. Total flight duration was of 4 hours. The Airborne Rescue Pod for Isolated Transportation (ARPIT) was used during transportation [Figure 2]. Patient was put on non-invasive ventilation (NIV) support from the ICU and made to sit on the stretcher of isolation pod (ARPIT) [Figure 3]. All vital parameters were continuously monitored by attaching the physiological monitoring system through the ports. After ensuring the readiness of the aircraft, the patient was transferred from hospital to tarmac in a critical care ambulance with the critical care air ambulance team (CCAAT) [Figure 4]. During flight, all measures were ensured to maintain $SpO_2$ and other vital parameters within satisfactory level. In-flight, the patient remained stable, keep moving his hands and feet periodically and communicated with the medical team through gesture as advised. The battery of the NIV equipment got discharged after 2 h of flying time wherein the machine was connected to the direct supply of the aircraft. The patient remained stable

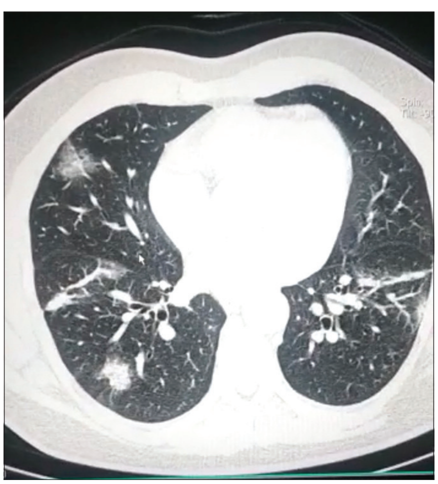

**Figure 1:** Axial CT chest showing bilateral ground glass opacities.

**Figure 2:** Airborne rescue isolation pod for transportation.

**Figure 3:** Patient inside Airborne Rescue Pod for Isolated Transportation.

**Figure 4:** Patient being shifted into the aircraft.

throughout the flight and on landing at the destination; he was handed over to the receiving team. At that time, the patient was conscious, oriented, maintaining a $SpO_2$ of 94% on oxygen through facemask, and heart rate of 80 bpm. The PPE of the medical team and the load master were doffed in the designated area in the tarmac and new PPE were donned. In the meantime, the aircraft was also sanitized by 5% cresol. Subsequently, patient received convalescent plasma therapy in the tertiary care center and recovered completely after a hospital stay of 14 days.

## DISCUSSION

Air evacuation of patients is almost a routine activity in the Indian Air Force (IAF). The prioritization and various activities undertaken during routine air evacuation of patients are well laid out. This paper brings out the unique aeromedical measures we undertook while air evacuating a 54-year-old healthcare worker with COVID-19 manifesting with severe disease. The evacuation was unique because; (a) The case was required to be isolated during evacuation due to the highly contagious nature of the disease and hence had the potential of infecting the medical team as well as aircrew (b) experience in evacuating such a case was almost minimal, probably this was the first case of COVID who was air evacuated in the IAF. In addition, the international literature is scant (c) the guidelines and triage had not been laid down and hence a decision on evacuation of such a case always would create aeromedical dilemma and (d) stringent measures were required to be ensured during pre-flight, in-flight as well as post-flight phase to prevent any possibility of deterioration of patient condition. Our experience in addressing the above issues and ensuring safe and successful air evacuation of such a COVID patient has been discussed in the subsequent paragraphs.

Selection of aircraft in such an instance is important. This is because the flight time to the destination tertiary care center is quite high; hence, the cruising speed of the aircraft should be comparatively high. Moreover, since such a patient can desaturate early, the aircraft should be well pressurized. In addition, the patient requires life support system while being evacuated; thus, the aircraft should have an inbuilt power back up system. The aircraft we chose met most of the above criteria. In fact, the battery of the NIV equipment got discharged after 2 h of flying time wherein the machine was connected to the direct power supply of the aircraft.

Pre-flight management of such a patient is paramount as there is little scope for intervention in-flight with the patient inside the isolation pod. It was anticipated that communication in the ARPIT would be difficult; hence, patient was briefed to communicate by gestures (thumbs up or down). Lemay *et al*.[4] in their article stressed on early intubation and proning posture of patient during transfer. Our patient was stable in NIV support (maintaining 95–97% saturation) and early intubation would have deteriorated his health condition.[5] However, early intubation versus NIV/HFNC support is still a debatable topic in COVID-19 patients. There are studies which have shown that NIV support does not increase the risk of contamination in COVID-19 patients.[6] Protection of aircrew from exposure was utmost importance; hence, the rear cabin of the aircraft was separated from the cockpit by a transparent plastic sheet.

As highlighted earlier, to keep the patient absolutely contained, we used ARPIT. The isolation pods are in use to transfer contagious patients since the days of Ebola virus outbreak. The ARPIT, what we used for evacuation of our patient, was indigenously designed and developed by the IAF.[7] It is made up of aircraft grade material with a weight of 33 kg and dimensions of 183 cm length, 56.5 cm width, and 54 cm height. The stretcher is made of aluminum and the canopy is made of cast acrylic material so that it offers not only better optical clarity but also makes it light weight, rigid, and good impact strength. It has multiple opening ports to facilitate the passage of electromedical equipment. The negative pressure inside the pod is created by air depression system by means of a small exhaust fan fitted onto a transparent perspex box at the foot end of the pod which sucks the filtered air through the vents. The negative pressure ventilation facilitates in expansion of lungs and helps in better air flow into the alveoli. This fan is operated by a toggle switch and powered by two 9V Duracell batteries whose life is about 4½ h. The air inlet and outlet ports are fitted with High Efficiency Particulate Air filters with certified efficiency of 99.97%. This ensures maximum filtration of infective organisms. The assembly of the pod is easy and simple to use. It can be easily integrated into the currently available transport aircraft of the IAF. However, there are certain limitations, we experienced while evacuating the case in ARPIT. First, the isolation pod gives a claustrophobic feeling. It gives minimum scope for active intervention. A literature search on evacuation of patients using isolation pod revealed certain important facts.[8] Several countries such as Norwegin Air Ambulance Service, United Kingdom Royal Air Force, and Australian Defense Force experts emphasized the difficulty in managing ventilated patients in isolation pods and believed that the risks imposed outweighed any benefit to the patient.[9,10] Some patients can be transferred in a sitting position, but in an isolation pod they are made to lie down flat or in semi recumbent position thus complicating the oxygen perfusion. Since our patient was orthopneic, two pillows were placed below the neck and shoulders and a propped-up position was made. The design of the ARPIT and the space constraints does not permit any change of the patient position, which is considered desirable. We advised our patient to keep moving his hands and feet periodically, as part of thromboprophylaxis measures. During the flight, the oxygen flow was increased to 15 lit/min and NIV support was increased by 5 cm of water to inspiratory positive airway pressure-14 cm of water. A positive end-expiratory pressure of 6 cm of water was also applied to avoid desaturation. Vitals during the in-flight period were $SpO_2$ of 93–95%, heart rate of 70–75/min, respiratory rate of 25–30/min, and non-invasive blood pressure (NIBP) of 130/78 mmHg. In-flight, the patient remained stable and communicated with the medical team every 15 min by gestures (thumbs-up/down) as instructed.

Although the aeromedical evacuation went off smoothly and the patient was evacuated successfully, the entire process posed unique challenges what we experienced. To start with, there was reluctance of patient to enter inside the isolation pod due to feeling of claustrophobia. There was difficulty in placing an even simple monitoring equipment such as pulse oximetry, NIBP, and ECG through the isolation pod. In case of any in-flight emergency, it would be very difficult to remove the canopy and manage the patient. Communications at all level were difficult with the patient. Working in PPE for 4 h inside the aircraft was exhaustive. The aircrew took an ample amount of time for donning, probably; they were doing it for the 1st time.

Certain modifications of existing ARPIT are suggested based on our experience. The ARPIT should be modified to give 45° head up position (semi recumbent) to the patient inside the pod. Port should be of adequate size so that physiological monitoring devices can be easily introduced. The width of the isolation pod should be increased so that the patient can change his posture to lateral or prone position. Back up batteries for both the fans should be available to create negative pressurized chamber. Ports should be given on the inner side near the head end of the patient so that early intubation can be done, in case of requirement, with minimum contamination.

## CONCLUSION

This was the 1st time that a COVID-19 patient was air evacuated in an isolation pod in Indian Armed Forces, to the best of our knowledge. Based on our experience, we recommend that air evacuation of such a patient may be resorted to only as a life saving measure. The use of an isolation pod remains an unsettled issue; whereas, it gives absolute containment to spread of infection, on the other hand, it poses unique challenges in terms of handling the patient in case of an in-flight emergency. We used the indigenously designed isolation pod (ARPIT) and successfully evacuated the patient. However, we feel certain modifications as mentioned earlier will definitely help in facilitating patient monitoring, management and patient comfort.

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### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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### Conflicts of interest

There are no conflicts of interest.

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