Successful treatment of COVID-19-related acute respiratory distress syndrome with rare blood type: A case report

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Abstract

A 62-year-old man with rare blood type exhibited severe respiratory failure due to novel coronavirus. Extracorporeal membrane oxygenation was inapplicable, which requires numerous blood products with the same blood type. We thoroughly restricted fluid volumes by sacrificing renal function. He was discharged with complete recovery of respiratory and renal functions.

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Abstract

A 62-year-old man with rare blood type exhibited severe respiratory failure due to novel coronavirus. Extracorporeal membrane oxygenation was inapplicable, which requires numerous blood products with the same blood type. We thoroughly restricted fluid volumes by sacrificing renal function. He was discharged with complete recovery of respiratory and renal functions.

Introduction

Coronavirus disease 2019 (COVID-19) remains a major threat to the global population since it was first reported in Wuhan, China. Recent epidemiological studies have shown poor prognosis in patients with COVID-19-related acute respiratory distress syndrome (ARDS).[1-3] In fact, the mortality rate of COVID-19 patients with mechanical ventilation is reported to be approximately 40%–60%.[3-5] For the effective management of critically ill COVID-19 patients, the appropriate treatment of respiratory failure is crucial.[6] Moreover, if the oxygenation worsens despite mechanical ventilation, extracorporeal membrane oxygenation (ECMO) should be considered, as recommended in some guidelines.[7,8]

Rhesus (Rh) factor is an inherited protein found on the surface of the red blood cells in the body. Since their discovery in the 1940s, it has been considered as a certain type of blood type.[9] In Asian countries, $<$ 1% of the population has an Rh-negative blood type;[10] therefore, the medical services available for these individuals could be partially limited, e.g., during transfusion and pregnancy.[11,12] In particular, ECMO is unreasonable in rare blood type patients because it requires a large number of blood products with the same blood type. Thus, if rare blood type patients develop ARDS due to COVID-19, it is crucial to prioritize lung protection. Here we report the case of an Rh-negative patient with COVID-19-related ARDS who was successfully treated.

Case Presentation

A 62-year-old man had common cold symptoms and took a polymerase chain reaction (PCR) test for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in his local clinic. Afterward, the patient was transferred to the emergency department of our hospital due to dyspnea. He had a history of partial lung resection for lung cancer and certain comorbidities, such as hypertension, hyperuricemia, and hyperlipidemia. A chest computed tomography (CT) scan showed bilateral ground-glass opacities (GGO) (Figure 1a) with parenchymal bands in the right lower lobe (Figure 1b), while the blood test revealed severe inflammation and Rh-negative blood type. The PCR test for SARS-CoV-2 in the previous clinic also revealed a positive result. Thus, we diagnosed him with COVID-19 pneumonia.

After being admitted to the depressurized room in our ICU, his oxygenation and hemodynamics deteriorated rapidly (Figure 2a). We initiated mechanical ventilation and administered vasopressors, favipiravir, and ciclesonide. It was impractical to perform ECMO with Rh-negative blood products; therefore, we prioritized lung function protection. We severely restricted the amount of fluid volume, while trying to maintain the bare minimum urine output and blood pressure. In fact, as shown in Figure 2b, the average daily fluid intake was about 2000–3000 mL/day during the first seven days.

Furthermore, the hypotension was refractory to vasopressors, although the stroke volume variance was maintained within the normal limits. To stabilize the hemodynamics and avoid more fluid infusion, we replaced hydrocortisone 200mg/day with secondary adrenal insufficiency. Thereafter, we could partially taper the amount of vasopressors. Moreover, the PaO2/FiO2 ratio improved, although it was temporarily around 125, the indication criteria of ECMO for COVID-19 related ARDS.[13] Then, we gradually reduced the dose of hydrocortisone until discharge because the hemodynamics collapsed in a short while after suspending the hydrocortisone.

In contrast, his serum creatinine level continued to be elevated owing to lower fluid administration and severe systemic inflammation, and it progressed to anuria. Thus, we performed either peritoneal dialysis or

continuous hemodiafiltration from day 7, depending on the preparation status for renal replacement therapy at the time. Thereafter, as the inflammation and body temperature improved over time, the urine output and the P/F ratio also gradually normalized. After confirming a negative result of the PCR test for SARS-CoV-2 and the recovery of adequate urine output, he was extubated on day 26. Finally, he was discharged from our hospital on day 73.

Discussion

Several studies have shown that the prognosis of COVID-19-related ARDS is unfavorable.[1-5] Furthermore, as Rh-negative is quite a rare blood type, ECMO could not be applied to this COVID-19 patient with Rh-negative blood type because it is unreasonable to ensure enough blood products with the same blood type. Thus, we severely restricted the volume of infusion and administered favipiravir and ciclesonide. Despite the presence of acute kidney injury and hypotension, we managed these complications using hydrocortisone and two types of renal replacement therapy. Finally, the patient survived and was discharged from the hospital.

Some clinical guidelines on ARDS recommend conservative fluid management, aiming to achieve a negative balance in body fluid management.[14,15] In fact, the benefit of conservative fluid strategy has been supported in the recent randomized controlled trials (RCT).[16,17] In the conservative group of these RCTs, the total amount of fluid used in the fluid therapy was 3,000–5,000 mL/day. Meanwhile, in our case, the average total fluids from day 2–7 were 2,942 mL/day. These differences indicate that in order to prioritize minimum lung damage, severe restriction of total fluids was required. We believe that this severe conservative management would enable the successful treatment of respiratory failure without ECMO, although it might partially induce acute kidney injury and refractory hypotension.

As for corticosteroids, there are pros and cons of hydrocortisone administration for critically ill COVID-19 patients.[18]In fact, the U.S. National Institute of Health guidelines mention that the efficacy of hydrocortisone has not been robustly supported as that of dexamethasone. The reason for this ambiguous statement could be that the two recent RCTs did not demonstrate the efficacy of hydrocortisone, although a significant reduction in the mortality rate was observed with the use of dexamethasone.[19-21] However, we believe that hydrocortisone should be positively considered for severe COVID-19 patients who are suffering from refractory hypotension due to secondary adrenal insufficiency like our case. In such cases, the hydrocortisone could provide the following two beneficial effects: suppressing the extreme inflammatory response and raising the blood pressure. Actually, in the latter RCT, the hydrocortisone group which was given dependent on the vasopressor requirements, showed the lowest mortality rate, although with no statistical significance.[19] In fact, in our case, although the purpose of hydrocortisone was to improve the hemodynamics without excessive fluid overload, the oxygenation was also restored rapidly in a short while after administration.

Thus, this case highlights the importance of severely conservative fluid management and hydrocortisone therapy for COVID-19 patients, particularly for those with Rh-negative blood type and secondary adrenal insufficiency. These medical interventions need to be positively considered for COVID-19 patients with rare blood types.

Previous publications

The part of this case has already been published, focusing on the modality of renal replacement therapy.[22]

Ethics approval and consent to participate

The Ethics Committee of Kyoto University Graduate School and Faculty of Medicine approved the protocol (R2647). Informed consent was obtained from the patient for publication of this case report.

Conflict of Interest

No author has a direct conflict of interest that is relevant to this study.

Abbreviations

Abbreviations used in this paper are as follows: ARDS, acute respiratory distress syndrome; COVID-19, coronavirus disease 2019; CT, computed tomography; ECMO, extracorporeal membrane oxygenation; GGO, ground-glass opacities; ICU, intensive care unit; RCT, randomized controlled trial; Rh, Rhesus; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2

Figure Legends

Figure 1. Chest computed tomography images on admission. (a) Bilateral ground-glass opacities. (b) Parenchymal bands in the right lower robe.

Figure 2. Clinical course of this case. (a) Chest radiographs on day 1, 6, 13, and 21. (b) Summary of the clinical course.

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