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Case Report

A patient affected by critical COVID-19 pneumonia, successfully treated with convalescent plasma

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ABSTRACT

We present a critically ill patient affected by COVID-19, whose chest computed tomography (CT) scan featured lung consolidations and severe patchy ground-glass opacities. On day 3 since hospital admission the patient was placed on convalescent plasma treatment. A combined treatment with supportive care, hemoperfusion and convalescent plasma successfully managed to save the patient's life. Convalescent plasma probably contributed to heal this patient and should always be considered in the management of critically ill COVID-19 cases.

1. Introduction

There are still no antiviral drugs for COVID-19 and the efficacy of currently available therapeutic remedies is limited [1,2]. Under the Blood Regulators Network, the World Health Organization recommends passive immunotherapy by administration of convalescent plasma (CP) or serum when vaccines and antiviral drugs are unavailable for emerging infection-related diseases [3–5]. CP already proved useful for the management of critical cases of SARS-CoV-1 [6,7] and offers potential also with the severe forms of MERS-CoV infections [8].

We report a critically ill patient admitted to Baqiyatallah hospital in Tehran (Iran) for COVID-19, successfully treated with CP.

2. Case presentation

On 16th March 2020, a 42-year-old male patient with a well-known history of type 2 diabetes and referral delay was admitted to the emergency department and critical care center of Baqiyatallah Hospital in Tehran (Iran), with symptoms of fever, dyspnea, cough, fatigue and chest distress for 10 days. On admission the patient had body temperature of 38.8 °C, a heart rate of 98/min, a respiratory rate of 32/min, a

blood pressure of 60/30 mmHg and O₂ saturation of 40 %. Reverse transcription-polymerase chain reaction (RT-PCR) was positive for COVID-19 and chest computerized tomography (CT) scan showed consolidations and severe patchy ground-glass opacities (GGO) (Fig. 1A, B, C). Due to his critical health conditions the patient was immediately admitted to the Intensive Care Unit (ICU) where he had to be intubated due to worsening symptoms and progressive respiratory distress.

Laboratory examination showed elevation of white blood cells (WBC = 15.4 × 10³/μL), prothrombin time (PT = 22.0 s), partial thromboplastin time (PTT = >120 s), international normalized ratio (INR = 1.76 s), troponin I (10.174), serum creatinine (1.8 mg/dL), blood urea nitrogen (BUN = 40 mg/dL), fasting blood sugar (FBS = 285 mg/dL), alanine aminotransferase (ALT = 209 U/L), aspartate aminotransferase (AST = 60 U/L), total bilirubin (5.2 mg/dL), direct bilirubin (1.4 mg/dL), serum albumin (6.0 g/dL), creatinine phosphokinase (CPK = 660 U/L), C-reactive protein (CRP = 45.6 mg/L), lactate dehydrogenase (LDH = 2255 μL), D-Dimer (10 ng/mL), lactate (1.2 mmol/L) and ferritin (1897.701 ng/mL). There was also decreased red blood cell (RBC = 3.74 × 10⁶/μL), lymphocytes count (2.1 % cells/L), hematocrit (HCT = 30.9 %), hemoglobin, (Hb = 10.7 g/dL), platelets (PLT = 108 × 10³/μL), and serum minerals as sodium

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(Na = 128 mEq/L), potassium (K = 3 mEq/L), calcium (Ca = 6.8 mg/dL), and phosphorus (P = 2.4 mg/dL).

The patient was placed on antibiotic therapy with:

- meropenem 500 mg (i.v. trice a day) for 2 weeks; and
- vancomycin i.v. for 10 days, initially at 1 g on day 1, subsequently reduced to 500 mg/day due to high serum creatinine value at admission; and
- Lopinavir/ritonavir (400/100 mg, 2 tablets twice a day) for 5 days; and
- norepinephrine for hypotension (initial dose: 8–10 mcg/min continuous IV infusion; subsequent maintenance dose: 2–4 mcg/min).

Since pro-calcitonin test was negative and there was no clinical and laboratory evidence of bacterial infection, high dose steroid therapy was started on March 26. Pulse steroid therapy with methylprednisolone was administered at the initial dose of 500 mg on day 1, to be reduced at 250 mg daily on day 2 and 3 and to 100 mg daily from day 4 for the following 10 days.

Since pulse therapy with methylprednisolone increased blood sugar, insulin therapy was started. Following the first 2 days of methylprednisolone pulse treatment (on day 3) the patient was administered also with 2 bags (500 cc each bag) of CP and three sessions of hemoperfusion in 2 days. Four doses of tocilizumab 162 mg He were also subsequently administered subcutaneously.

On day 10 since admission the patient recovered from shock and his O₂ saturation increased, but he could not be extubated yet. Following the above treatment regimen, lung CT showed residual homogenous GGO in both lungs, remarkably improved since hospital admission.

On April 22, O₂ saturation increased to 96 % using nasal cannula, although without it reduced to 60 %. Oral pirfenidone treatment was then started at the dose of three tablets of 200 mg/day. Lung rehabilitation continued in the general ward for 7 days, until the patient was discharged (on April 29), with O₂ therapy to be continued at home.

Following 4 months at home all symptoms disappeared, chest CT scan normalized (Fig. 1D, E, F) and the patient was able return to his job.

3. Discussion

A number of studies reported that CP therapy is also one of the few promising medications for the management of critically ill COVID-19 patients, useful to decrease the viral load, improve the patients clinical outcome, reducing their mortality rate, increasing the probability of extubation and containing the length of hospital stay [9–13]. Likewise, therapeutic plasma exchange (TPE) was also reported to be beneficial in critical COVID-19 patients [14,15].

For instance, in a study on 31 cases of severe COVID-19 admitted to intensive care unit (ICU) of Royal Hospital in Oman from April 17 to May 11, 2020, although 11 patients treated with TPE were more likely to stay longer in ICU as compared with 20 controls (14 vs. 6 days) – the former being affected by more severe forms of COVID-19 – they were still more likely to be extubated [15]. Moreover, albeit they was no difference in all-cause mortality between the two groups in the latter study, TPE patients had lower mortality risk than controls at 14 and 28 days since plasma exchange [15].

However, plasma therapy may be beneficial for all COVID-19 patients, regardless the severity of the disease, to prevent worse clinical outcomes. In a non-randomized multicenter clinical trial conducted in Iran, CP administered to 115 COVID-19 patients significantly reduced the need of intubation, improved the survival and contained the length of hospitalization as compared with 74 controls [16].

Although there are some concerns on potential antibody dependent enhancement (ADE) with CP therapy [17], in a USA clinical trial on 5000 patients affected by severe or life-threatening COVID-19 and transfused with CP, the incidence of untoward outcomes within the first 4 h since CP was negligible (<1%) and in line with figures expected from critically ill patients treated with plasma [18].

In conclusion, emergency therapy with CP probably contributed to heal our critically ill COVID-19 patient, thanks to the antibodies from CP seemingly suppressing the viraemia, which in most viral diseases peaks during the first 7 days since infection [16]. As the primary immune response arises after 10–14 days since viral infection, CP is more beneficial if administered as soon as possible in COVID-19 patients affected by ARDS and multi-organ disease syndrome, not later than 14 days since symptoms onset [15,19,20].

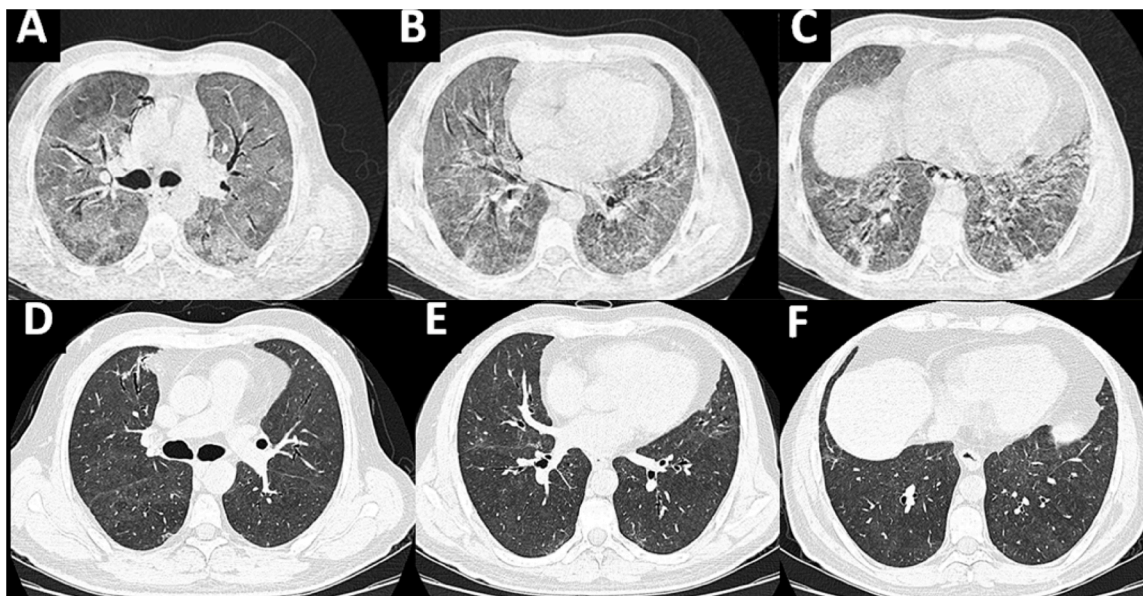


Fig. 1. Axial chest CT scan without contrast of patient affected by COVID-19 pneumonia. (A, B, C): Bilateral severe ground glass opacities superimposed with bilateral consolidative and linear opacities. (D, E, F): Normal lung parenchyma with a very faint residual of ground glass opacities in both lungs field, compatible with a dramatic follow-up response at 4 months since treatment with convalescent plasma.

Authors' contributions

All authors contributed equally to the drafting, designing and writing of the manuscript and provided critical revision. All authors read and approved the final manuscript.

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Ethics approval and consent to participate

This case report has been described in accordance with the ethical standards laid down in the "Declaration of Helsinki 1964".

Consent for publication

Informed written consent was taken from the patient

Declaration of Competing Interest

The authors report no declarations of interest.

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