



HEMOPERFUSION AS AN ADJUVANT THERAPY IN SEVERE COVID-19 IN HEMODIALYSIS PATIENTS: EXPERIENCE FROM FATMAWATI GENERAL HOSPITAL



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ABSTRACT

Background. Mortality rate among maintenance hemodialysis (HD) patients with COVID-19 is alarmingly high. In Fatmawati General Hospital, most of HD patients with COVID-19 presented with moderate and severe acute respiratory distress syndrome (ARDS). Hemoperfusion (HP) is a blood purification therapy used to remove cytokines and inflammatory mediators to prevent ARDS and organ failure. Hemoperfusion was performed in HD patients whom have not developed to severe ARDS. **Methods.** We report three cases of COVID-19 in maintenance HD patients. HP and HD were performed in two consecutive days when patient developed early ARDS as indicated by inflammatory markers elevation. HD and HP were conducted by using high-flux dialyzer and neutral macroporous resin cartridge HA-330, respectively, for 4 hours. All patients received standard of care i.e. anti-viral agent, unfractionated heparin, empirical antibiotic, acetylcysteine, glucocorticoids, vitamin C, and calcitriol. **Result.** All three ARDS patients who had HP were subsequently managed without intubation. Case 2 was on high flow nasal cannula while case 1 and 3 were on non-breathing oxygen mask. After HP, C-reactive protein (CRP), PaO₂/FiO₂ ratio and chest X-ray were improved. Case 1 and 2 had less dependency to oxygen supplementation and were discharged from the hospital. Case 3 also had improvement after HP but then developed septic shock due bacterial infection few days afterwards and succumbed to the disease. **Conclusion.** Improvement in CRP levels, PaO₂/FiO₂ ratio and chest-X ray were observed after two sessions of HP-HD. Based on our clinical experience, timing of HP delivery is crucial and should be performed in early phase of ARDS with early increase of inflammatory marker. This measure may prevent the requirement for intubation in patients with severe COVID-19. Combination use of HP-HD on maintenance HD patients with COVID-19 is promising that merits further investigations.

Keywords: hemodialysis, hemoperfusion, hemoadsorption, COVID-19, resin, cytokine storm

INTRODUCTION

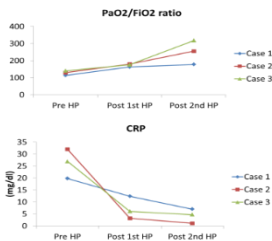
Mortality rate among maintenance hemodialysis (HD) patients with COVID-19 is alarmingly high.¹ Hemoperfusion (HP) is a blood purification therapy used to remove cytokines and inflammatory mediators.^{2,3} In our hospital, HP was performed in HD patients with severe COVID-19 when clinical condition worsened. Severity of the disease was assessed by room air SpO₂, PaO₂/FiO₂ ratio and C-reactive protein (CRP). HD and HP were conducted for 4 hours by using high-flux dialyzer and neutral macroporous resin cartridge HA-330 (Jaftron Biomedical Company, China), respectively. All patients received standard of care i.e. anti-viral agent, unfractionated heparin, empirical antibiotic, acetylcysteine, glucocorticoids and vitamin C.

CASES

Case 1. Female, 42 years old came with shortness of breath and fever 1 day before admission. She was on maintenance hemodialysis for 2 years. She came with Modified Sequential Organ Failure Assessment (mSOFA) score of 7 and PaO₂/FiO₂ ratio 155. Laboratory studies showed leucocyte 8100/μl, absolute lymphocyte count (ALC) 729/ml, neutrophil-lymphocyte ratio (NLR) 9.3, CRP 30.7 mg/dl, procalcitonin 5.4 ng/ml, LDH 919 u/l, lactate 1.2 mmol/l, Ferritin 9,555 ng/ml, d-dimer 3,040 ng/ml, and positive PCR SARS-CoV-2. She was on HD thrice weekly and her clinical condition was improved. On day 5, 7 and 11 CRP were decreased to 33.2 mg/dl, 28.6 mg/dl and 4 mg/dl, respectively. On day 17, she developed severe shortness of breath with room air SpO₂ 85%, PaO₂/FiO₂ 114 and CRP elevation (19.8 mg/dl). HD and HP were then initiated on day 18 and 19. After the first HP-HD, CRP decreased to 12.4 mg/dl and PaO₂/FiO₂ increased to 163. Following the second HP, CRP and PaO₂/FiO₂ were further improved to 7 mg/dl and 178, respectively (Graph 1). The next day, CRP decreased to 3.3 mg/dl, room air SpO₂ was 95%, and chest X-ray (Figure 1) also improved. Patient was then discharged on day 35.

Case 2. Female, 44 years old presented with cough and shortness of breath 2 days before admission. She was a maintenance hemodialysis patient for 5 years. She came with mSOFA score of 8 and PaO₂/FiO₂ ratio 150. Laboratory studies demonstrated leucocyte 1,100/ml, ALC 88/ml, NLR 10.5, CRP 2.1 mg/dl, procalcitonin >32 ng/ml, LDH 447 u/l, lactate 1.0 mmol/l, ferritin 1,614 ng/ml, d-dimer 850 ng/ml and positive PCR SARS-CoV-2. On day 5, her shortness of breath progressed, room air SpO₂ 88%, PaO₂/FiO₂ ratio 130, CRP elevated to 32 mg/dl. High flow nasal cannula with FiO₂ 70% was administered. HP-HD were then performed on day 6 and 7. After the first and second HP-HD, CRP, PaO₂/FiO₂ ratio, and chest X-ray were improved. She was subsequently stepped down to general ward in day 15, and later was discharged on day 20.

Case 3. Male, 67 years old presented with shortness of breath for 12 hours before admission. He had hypertension and was on maintenance hemodialysis for 8 months. Initially, he had mSOFA score of 7, PaO₂/FiO₂ ratio 206. Laboratory studies showed leucocyte 1,030/μl, ALC 1,030/μl, NLR 8.7, CRP 3 mg/dl, procalcitonin 4.11 ng/ml, LDH 520 u/l, lactate 1.4 mmol/l, d-dimer 3,814 ng/ml, and positive PCR SARS-CoV-2. He had regular HD on alternating days. On day 5, his respiratory condition deteriorated with room air SpO₂ 83%, PaO₂/FiO₂ 141 and elevated CRP 26.9 mg/dl. HD and HP were performed on day 5 and 6. After the first and second HP, CRP PaO₂/FiO₂ ratio, and chest X-ray were improved. *Klebsiella pneumoniae* was found in his blood culture. Despite antibiotic escalation, his clinical condition was worsened on day 15. His clinical condition progressed into septic shock while procalcitonin level remained high. Ultimately, he succumbed to the disease on day 17.



Graph 1. PaO₂/FiO₂ ratio and CRP level pre and post HP

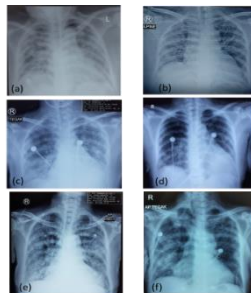


Figure 1. Chest X-ray pre and post hemoperfusion. a,c,e. CXR pre-HP; b, d, f CXR post-HP.

DISCUSSION

Hemoperfusion was reported to be beneficial when conducted with HP machine or combined with CRRT in severe COVID-19.^{4,5} Due to limitation in number of CRRT machines in our hospital and stable hemodynamic condition of these patients, we initiated HP with HD machine.

Timing for HP is critical to yield an optimal outcome. CRP elevation and deterioration of clinical condition in case 1 appeared later than case 2 and 3. This finding suggests systemic cytokine release can appear in different timing between patients. Inflammatory marker close observation along with clinical condition is crucial hence facilitating early detection of deterioration that requires prompt treatment.

HP was suggested to be performed in 2-1-1 order.³ Due to limitation of cartridges in our hospital, we modified the protocol by assessing the requirement of HP for individual patient. We found improvement in PaO₂/FiO₂ ratio, CRP level, and chest X-ray after second HP and we did not continue to third HP.

CONCLUSION

Improvement in CRP levels, PaO₂/FiO₂ ratio and chest-X ray were observed after two sessions of HP-HD. Based on our clinical experience, timing of HP delivery is crucial and should be performed in early phase of ARDS with early increase of inflammatory marker. This measure may prevent the requirement for intubation in patients with severe COVID-19.

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38th Vicenza Course on AKI&CRRT
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