Clinical Outcomes of Hemoperfusion using HA330 Filter among patients with Severe and Critical COVID-19 at the University of Santo Tomas Hospital:

A One Year Retrospective Study

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INTRODUCTION. Coronavirus disease-2019 (COVID-19) became a global pandemic in March 12, 2020. Currently, there is no definitive treatment for the disease. Severe and critically ill COVID-19 patients are admitted due to respiratory illness and failure leading to multiple-organ dysfunction syndrome. Cytokine release syndrome (CRS) is prevalent among these patients. Hemoperfusion is a form of extracorporeal therapy that effectively removes the inflammatory cytokines that lead to lung damage. This study was conducted to determine the clinical outcomes of patients diagnosed with Severe and Critical COVID-19 who underwent hemoperfusion at the University and Santo Tomas Hospital.

METHODS. This retrospective study included 135 severe and critical COVID-19 patients who underwent hemoperfusion using HA330 cartridge. Demographic, clinical data and outcomes were described. APACHE II score, Hemoglobin, platelet count, leukocytes, neutrophils, lymphocytes, serum creatinine, inflammatory markers such as serum ferritin, HsCRP, IL-6, LDH, procalcitonin, D-dimer, PaO2/FiO2 (PF) ratio were compared pre and post hemoperfusion (HP) among those survivors and non-survivors. The effects of timing of hemoperfusion on different clinical parameters and outcomes were described.

RESULTS

There were 98 patients (73%) who survived. The most common cause of death is via respiratory route (20%). Mortality rates were elevated among chronic kidney disease and cancer patients. APACHE II score was lower post hemoperfusion compared to baseline levels among survivors.

Table 1. Demographic and clinical profile of patients

	Mortality			P-value
	Total (n=135)	Expired (n=37, 27%)	Alive (n=98, 73%)	
	Frequency (%); Mean ± SD; Median (IQR)			
Age	62.57 ± 12.37	66.68 ± 11.22	61.02 ± 12.49	**0.017**
Sex				1.000
Male	87 (64.44)	24 (64.86)	63 (64.29)	
Female	48 (35.56)	13 (35.14)	35 (35.71)	
Diagnosis				**<0.001**
Severe COVID-19	84 (62.22)	3 (8.11)	81 (82.65)	
Critical COVID-19	51 (37.78)	34 (91.89)	17 (17.35)	
Comorbidities				
Hypertension	98 (72.59)	30 (81.08)	68 (69.39)	0.200
Diabetes mellitus	58 (42.96)	17(45.95)	41 (41.84)	0.700
CKD	33 (24.44)	19 (51.35)	14 (14.29)	**<0.001**
Cardiovascular disease	19 (14.07)	8 (21.62)	11 (11.22)	0.164
Cerebrovascular disease	14 (10.37)	6 (16.22)	8 (8.16)	0.207
Cancer	7 (5.19)	5 (13.51)	2 (2.04)	**0.017**
COPD	5 (3.7)	2 (5.41)	3 (3.06)	0.614
Chronic kidney disease				1.000
On hemodialysis	6 (18.18)	4 (21.05)	2 (14.29)	
On dialysis	27 (81.82)	15 (78.95)	12 (85.71)	
Days of illness on admission	8 (6 to 11)	8 (4 to 11)	8 (6 to 12)	0.329
Days of illness during hemoperfusion	10 (8 to 12)	10 (8 to 12)	10 (8 to 12)	0.913
≤ 14 days	122 (90.37)	31 (83.78)	91 (92.86)	0.186
>14 days	13 (9.63)	6 (16.22)	7 (7.14)	

Table 2. Cause of death (n=37)

	Frequency (%)
Respiratory	20 (54.05)
Cardiovascular	8 (21.62)
Sepsis/Septic shock	6 (16.22)
Gastrointestinal	3 (8.11)

After 4 sessions of hemoperfusion, hemoglobin and platelet counts were lower among non-survivors. WBC levels were increased for all patients. Neutrophils increased compared to baseline among those who expired. Lymphocytes were decreased compared to baseline among non-survivors. There is no significant change in creatinine levels compared to baseline.

Post HP ferritin, LDH, D-dimer were elevated among non-survivors. Among survivors, Hs-CRP and procalcitonin were lower compared to baseline. Post HP ferritin and D-dimer increased among survivors. IL-6 levels showed no significant difference post HP from baseline but we reported higher levels among non-survivors versus survivors. PF ratio was higher post hemoperfusion among patients who survived compared to those who died.

Table 3. Baseline and post hemoperfusion clinical parameters.

	Mortality			P-value
	Total (n=135)	Non Survivor (n=37, 27%)	Survivor (n=98, 73%)	
	Mean ± SD; Median (IQR)			
Laboratory results				
APACHE score				
Baseline	8.48 ± 5.33	12.03 ± 5.9	7.14 ± 4.44	**<0.001**
Post hemoperfusion	8.48 ± 6.76	14.24 ± 8.74	6.31 ± 4.17	**<0.001**
P-value	1.000	0.062	**0.005**	
Hemoglobin (g/L)				
Baseline	131.53 ± 16.55	127.41 ± 17.71	133.09 ± 15.91	0.075
Post hemoperfusion	123.10 ± 21.89	112.46 ± 26.53	127.11 ± 18.47	**<0.001**
P-value	**<0.001**	**<0.001**	**<0.001**	
Platelet count (10^9/L)				
Baseline	266.56 ± 84.96	271.24 ± 124.24	264.79 ± 65.06	0.695
Post hemoperfusion	268.93 ± 85.82	230 ± 64.31	283.63 ± 88.56	**0.001**
P-value	0.748	**0.024**	**0.010**	
WBC (10^9/L)				
Baseline	9.33 ± 4.39	10.58 ± 6	8.96 ± 3.53	**0.042**
Post hemoperfusion	12.06 ± 7.09	17.18 ± 9.36	10.12 ± 4.80	**<0.001**
P-value	**<0.001**	**<0.001**	**0.005**	
Neutrophils				
Baseline	0.82 ± 0.10	0.83 ± 0.11	0.82 ± 0.09	0.715
Post hemoperfusion	0.85 ± 0.10	0.91 ± 0.05	0.82 ± 0.10	**<0.001**
P-value	**0.011**	**<0.001**	0.0732	
Lymphocytes				
Baseline	0.15 ± 0.09	0.15 ± 0.10	0.15 ± 0.08	0.959
Post hemoperfusion	0.14 ± 0.11	0.08 ± 0.05	0.16 ± 0.12	**<0.001**
P-value	0.201	**<0.001**	0.407	
Creatinine				
Baseline	1.41 ± 1.67	2.17 ± 2.43	1.15 ± 1.21	**0.002**
Post hemoperfusion	1.42 ± 1.86	2.4 ± 2.43	1.09 ± 1.5	**<0.001**
P-value	0.876	0.497	0.215	
Inflammatory markers				
Ferritin (ng/mL)				
Baseline	1572 (992 to 2736)	1479 (1165 to 3213)	1634 (963 to 2662)	0.478
Post hemoperfusion	2094 (1139 to 3160)	2489 (1226 to 3213)	1948 (1109 to 2852)	0.080
P-value	**0.004**	**0.023**	**0.045**	
hs-CRP (mg/L)				
Baseline	131.9 (44.7 to 222)	162 (37.73 to 235.6)	122 (50.3 to 210)	0.591
Post hemoperfusion	19.04 (9.01 to 57.57)	50.93 (13.34 to 202)	14.89 (8.33 to 35.45)	**0.001**
P-value	**<0.001**	0.071	**<0.001**	
IL-6 (pg/mL)				
Baseline	65.12 (30.2 to 134)	115 (46.6 to 187.1)	57.6 (28.65 to 102)	**0.004**
Post hemoperfusion	67.56 (7.94 to 250.7)	147.5 (52 to 545)	29.79 (4.65 to 144.2)	**<0.001**
P-value	0.140	0.177	0.483	
LDH (units/L)				
Baseline	436 (337 to 568)	453 (347 to 761)	425.5 (331 to 524)	0.136
Post hemoperfusion	450.5 (358 to 645)	714 (441 to 885)	415 (349 to 56)	**<0.001**
P-value	0.130	**<0.001**	0.340	
Procalcitonin (ng/mL)				
Baseline	0.27 (0.1 to 0.67)	0.67 (0.18 to 1.42)	0.2 (0.1 to 0.46)	**<0.001**
Post hemoperfusion	0.14 (0.06 to 0.59)	0.63 (0.3 to 2.97)	0.09 (0.06 to 0.28)	**<0.001**
P-value	**0.010**	0.486	**<0.001**	
D-dimer (mg/L)				
Baseline	0.96 (0.59 to 1.71)	1.28 (0.79 to 2.97)	0.86 (0.54 to 1.39)	**0.046**
Post hemoperfusion	2.72 (1.31 to 5.88)	3.36 (1.79 to 13)	2.35 (1.17 to 4.49)	0.051
P-value	**<0.001**	**<0.001**	**<0.001**	
PF-ratio				
Baseline	147.3 (86.7 to 208)	104 (73.5 to 201)	161 (97 to 219)	**0.015**
Post hemoperfusion	171 (119.3 to 267)	110.5 (73 to 139.5)	219 (142 to 285)	**<0.001**
P-value	**<0.001**	0.502	**<0.001**	

The effect of timing of hemoperfusion was divided within 14 days versus more than 14 days of illness. The APACHE II score for those who underwent hemoperfusion within 14 days showed lower score. There was no significant difference from the baseline levels of hematologic counts, inflammatory markers and PF ratio among those who underwent hemoperfusion beyond 14 days. For those who underwent hemoperfusion within 14 days, hemoglobin, HsCRP, IL-6, procalcitonin were lower compared to baseline while neutrophils, ferritin, d-dimer and PF ration had increased levels. Most patients who underwent hemoperfusion within 14 days of illness required high flow O2 supplementation than invasive mechanical ventilator.

CONCLUSION. Hemoperfusion results in lower APACHE II score, hemoglobin, HsCRP and procalcitonin levels. There was no significant difference from baseline clinical parameters among those who underwent hemoperfusion beyond 14 days of illness. Those who underwent hemoperfusion within 14 days of illness required less invasive mechanical O2 support.