

Supplementary material and methods

Our tertiary care hospital of a medical university in South India had been ordained as the State COVID Hospital on 13 March 2020. From then, till now we had admitted and managed COVID-19 disease patients from several districts of our state and neighbour states.

On 3 April 2020 we had commissioned a haemodialysis and a peritoneal dialysis units exclusively for COVID-19 disease patients. A dialysis water treatment plant with the capacity of 1000 L/hour had been initiated.

We shifted six haemodialysis machines to the state COVID hospital. We earmarked one machine each for hepatitis B, hepatitis C and human immunodeficiency virus infected patients. We also shifted two automated peritoneal dialysis machines.

Patients in these wards are managed by teams of doctors. The nephrologists of the institute had always been part of these teams. The continuity of care for nephrology patients was established by a team of nephrologists, out of which one doctor provided care on all days.

All patients had serum creatinine, blood urea, serum sodium and serum potassium, complete haemogram, liver function tests, prothrombin time and partial thromboplastin time, serum procalcitonin, serum ferritin, C-reactive protein, lactate dehydrogenase and serum D-dimer sent on the first day of admission. We requisitioned for serum IL-6 and later considered to prescribe injection tocilizumab when the patients had features that suggested cytokine storm.

We collected the data of end stage renal disease (ESRD) patients on maintenance haemodialysis (MHD) contemporaneously in a register. From this register and based on the information in this register the data were retrieved from patients files—a retrospective observational study. The data from admission to the outcomes were recorded on a computerised proforma. We included the demography, clinical features, laboratory data and treatment schedules of haemodialysis and COVID-19 disease in this proforma.

Revised Guidelines on Clinical Management of COVID – 19 by Ministry of Health & Family Welfare, Government of India published on 31 March 2020 classified the COVID-19 disease patients as patients of uncomplicated illness, mild pneumonia, severe pneumonia and adult respiratory distress syndrome. In clinical practice most patients of mild pneumonia required oxygen either by non-rebreather mask or by simple mask, severe pneumonia and adult respiratory distress syndrome (ARDS) required non-invasive ventilation or mechanical ventilation. Similar classification was enunciated by the World Health Organisation (WHO). The clinical management of COVID-19 guidelines of WHO published on 27 March 2020 (WHO/2019-nCoV/clinical/2020.5) classified the COVID-19 disease patients as patients of mild, moderate, severe and critical disease. In practice the patients, after admission had migrated from the category of mild pneumonia to severe pneumonia to ARDS and also vice-versa. Therefore, for the purpose of this study we followed these definitions.

Non-invasive ventilation at admission (NIVa): Patients who required non-invasive ventilation at admission.

Non-invasive ventilation patients in hospital (NIVh): Patients who required non-invasive ventilation at any time in hospital. This group included the patients who required NIV at admission. Oxygen dependent: Requirement of oxygen either by non-rebreather mask or by simple mask. These patients did not require NIV.

Our institute has a standard treatment protocol for COVID 19 disease patients. We initiated patients from admission on injection remdesivir 200 mg on the day 1, followed by 100 mg from day 2 to day 5 extended up to day 10 as per the clinical condition, injection dexamethasone 0.1 mg/kg/day iv and low molecular weight heparin till discharge. Almost all patients of maintenance haemodialysis were given this protocol of treatment.

Patients based on the requirement, received antihypertensives, insulin, 1, 25, dihydroxy vitamin D, phosphate binders, carnitine and erythropoietin.

We prescribed injection tocilizumab (Cipla Ltd.) when the serum IL-6 was elevated 10 times the reference range of our lab. We prescribed injection tocilizumab at 8 mg/kg per dose; up to a maximum dose of 400 mg. Likewise total two doses were prescribed. A thorough history and examination including chest radiograph was taken to exclude the current tuberculosis and any other bacterial or fungal infection. We also ensured that the following were not present: platelet count $<100,000/\text{mm}^3$, neutrophil count $<2000/\text{mm}^3$, and alanine aminotransferase (ALT) or aspartate aminotransferase (AST) more than five times the upper limit of the normal range.

The diagnosis of mucormycosis of the paranasal sinuses, orbit and brain were done with the aid of computerised tomography and/or MRI followed by endoscopic biopsy. The patients were treated with injection liposomal amphotericin and posaconazole and their combination. Surgery was decided by the departments of surgery.

Statistics: The data were entered into Microsoft Excel. The frequency and percentage was calculated for qualitative variables. The mean and standard deviation or median and interquartile range (IQR) was calculated for quantitative variables. Independent sample t test was used to test the significant difference between two means. Chi-square test was used to test the significant difference between proportions. Odds ratio with 95% confidence intervals was calculated. Multivariate binary logistic regression was used to predict the occurrence. IBM SPSS 26th version was used. P value less than 0.05 was considered as statistically significant. We obtained the clearance from the institutional ethics committee, number: 1247.

Supplementary references

- S1. Wang R, Liao C, He H, Hu C, Wei Z, Hong Z et al. COVID-19 in Hemodialysis Patients: A Report of 5 Cases. *Am J Kidney Dis.* 2020;76(1):141-143
- S2. Chan L, Jaladanki SK, Somani S, Paranjpe I, Kumar A, Zhao S et al. Mount Sinai COVID Informatics Center (MSCIC). Outcomes of Patients on Maintenance Dialysis Hospitalized with COVID-19. *Clin J Am SocNephrol.* 2021;16(3):452-455.
- S3. Ghonimi TAL, Alkad MM, AbuhelaiqaEA, Othman MM, Elgaali MA, Ibrahim RAM, et al. Mortality and associated risk factors of COVID-19 infection in dialysis patients in Qatar: Anationwide cohort study. *PLoS ONE* 2021; 16(7): e0254246.
- S4. Creput C, Toledano D, Diaconita M, Izzedine H. COVID-19 in patients undergoing hemodialysis: prevalence and asymptomatic screening during a period of high community prevalence in a large Paris center. *Kidney Med.* 2(6):716-723.
- S5. Smolander J, Bruchfeld A. The COVID-19 epidemic: management and outcomes of hemodialysis and peritoneal dialysis patients in Stockholm, Sweden. *Kidney Blood Press Res* 2021;46:250–256.
- S6. Kazmi S, Alam A, Salman B, Saeed F, Memon S, Chughtai J et al. Clinical course and outcome of esrd patients on maintenance hemodialysis infected with COVID-19: A single-center study. *Int J NephrolRenovasc Dis,* 2021;14:193-199.
- S7. Valeri AM, Robbins-Juarez SY, Stevens JS, Ahn W, Rao MK, Radhakrishnan J et al. Presentation and outcomes of patients with ESKD and COVID-19. *J Am SocNephrol.* 2020;31(7):1409-1415.
- S8. Ng JH, Hirsch JS, Wanchoo R, Sachdeva M, Sakhiya V, Hong S, et al. Outcomes of patients with end-stage kidney disease hospitalized with COVID-19. *Kidney Int.* 2020;98(6):1530–9.
- S9. Vardhan H, Kumar A, Shyama S, Chaudhary N, Pandey S, Rai DK et al. Clinical Profile and Outcome of Haemodialysis in Patients With COVID-19 - A Single Centre Experience. *Cureus.* 2021 Aug 14;13(8):e17170.
- S10. Prasad N, Behera MR, Bhatt M, Agarwal SK, Gopalakrishnan N, Fernando E et al. Outcomes of symptomatic coronavirus disease 19 in maintenance hemodialysis patient in India. *Semin Dial.* 2021;34(5):360-367.
- S11. Banerjee S, Patel HV, Engineer DP, Gupta V, Patel H, Gupta A, Shah PR, Kute VB. COVID-19 in Hemodialysis Patients: Experience from a Western Indian Center. *Indian J Nephrol.* 2022;32(3):216-222

S12.Trivedi M, Shingada A, Shah M, Khanna U, Karnik ND, Ramachandran R. Impact of COVID-19 on maintenance haemodialysis patients: The Indian scenario. *Nephrology (Carlton)*. 2020 Dec;25(12):929-932

Supplementary table 1: Age and Mortality

Quartile-Age (years)	Number of patients	Mortality N (%)
<45	158	36 (22.8)
46-54	144	55 (38.2)
55-62	146	51 (34.9)
>62	147	61 (41.5)
Total	595	203 (100)

Supplementary table 2: Risk factors for mortality: Univariate analysis of
continuous variables

Variable	Mortality		P
	Yes Mean±SD	No Mean±SD	
Duration of stay (days)	8.24±8.01	8.15±4.10	0.868
Age (years)	56.12±12.42	51.90±13.16	<0.001
Computerised tomography severity score	14.29±7.67	14.93±5.05	0.815
SPO ₂ at admission (percentage)	88.49±11.83	94.42±6.09	<0.001
SBP at admission (mm)	133.21±25.67	134.11±21.85	0.653

Hg)			
DBP at admission (mm Hg)	82.06±15.32	82.55±12.92	0.676
Number .of dialysis sessions	2.92±2.47	3.43±2.00	<0.001
Haemoglobin (g/dL)	9.73±2.63	9.33±2.87	0.124
Total leucocyte count (/cu mm)	13193.68±8424.44	8441.90±5570.57	<0.001
Neutrophils	84.49±11.39	74.51±13.07	<0.001
Lymphocytes	9.39±8.41	17.50±11.71	<0.001
ESR (mm at end of first hour)	69.62±32.41	71.69±31.74	0.587
Platelet count (/cu mm)	2.11±1.24	2.00±0.86	0.257
Blood urea (mg/dL)	161.54±67.89	120.28±58.54	<0.001
Serum creatinine (mg/dL)	9.61±22.75	8.27±4.06	0.355
Serum potassium (mEq/L)	5.03±1.096	4.77±2.56	0.208
Serum sodium (mEq/L)	145.81±112.36	135.21±12.18	0.806

Serum bilirubin (mg/dL)	0.66±0.66	0.58±0.91	0.326
AST (IU/L)	73.82±108.35	44.72±89.65	<0.001
ALT (IU/L)	48.21±83.75	39.03±105.12	<0.001
Serum alkaline phosphatase (IU/L)	137.91±96.54	130.54±99.52	0.161
Serum total protein (g/dL)	5.16±2.36	4.79±2.82	0.163
Serum albumin (g/dL)	3.32±2.36	3.42±1.85	0.614
C reactive protein (mg/L) (reference range: 0-10mg/L)	106.63±89.57	61.92±71.33	<0.001
Procalcitonin (ng/mL) (reference range: 0.1 ng/mL)	46.50±115.95	9.82±18.94	0.066
Serum ferritin (ng/mL) (reference range: 20 to 250 ng/mL)	896.49±1138.97	661.64±613.45	0.003
D-dimer (µg/mL)) (reference range: 0.5 µg/mL)	3.89±6.96	8.789±38.62	0.499

Serum IL-6 (pg/mL) (reference range: between 0 and 43.5 pg/mL)	106.84±107.81	57.27±100.43	0.299
LDH (U/L) (reference range: 140 to 280 U/L)	746.79±1178.74	419.16±263.99	0.000

SPO₂ Oxygen saturation of blood, SBP: systolic blood pressure, DBP: diastolic blood pressure, AST: aspartate aminotransferase, ALT: alanine transaminase, IL-6: interleukin-6, LDH: lactate dehydrogenase

Supplementary table 3: Risk factors for mortality: Univariate analysis of categorical variables

Variable	Number	Presence/absence of the variable	Mortality n (%)		Total	P, OR (95% CI)
			Yes	No		
Oxygen at admission	595	Yes	117 (46.2)	136 (53.7)	253	<0.001 2.561 (1.809-3.625)
		No	86 (25.1)	256 (74.8)	342	
Non-oxygen requirement at admission	595	Yes	32 (11.6)	242 (88.3)	274	<0.001 0.116(0.07-0.178)
		No	171(53.2)	150(46.7)	321	
NIV at admission	595	Yes	54(79.4)	14(20.5)	68	<0.001 9.785 (5.276-18.15)
		No	149(28.2)	378(71.7)	527	
NIV in hospital	595	Yes	108(74.4)	37(25.5)	145	<0.001 10.908(7.05-16.88)
		No	95(21.1)	355(78.8)	450	
InjTocilizumab	595	Yes	16 (48.5)	17 (51.5)	33	0.073 1.887; 95%CI:0.933-3.82
		No	187 (33.3)	375 (66.7)	562	
HIV	425	Yes	0 (0)	1 (100)	1	0.304

		No	152 (35.8)	272 (64.2)	424	
HBs Ag	387	Yes	2 (22.2)	7 (77.8)	9	0.650
		No	164 (34.8)	307 (65.2)	471	
Anti HCV Antibody	387	Yes	1 (10)	9 (90)	10	0.234
		No	165 (35)	306 (65)	471	

NIV: non-invasive ventilation

Supplementary table 4: Oxygen requirement and Mortality

Parameter	Total	Death
NIV at admission	68	54 (79.4%)
Oxygen at admission	253	117 (46.2%)
Non oxygen at admission	274	32 (11.6%)
Total	595	203 (34.1%)

NIV: non-invasive ventilation

Supplementary table 5: NIV patients & patients requiring Oxygen versus patients not requiring oxygen

NIV patients & patients requiring Oxygen versus patients not requiring oxygen	Definition	Mortality		Total	P, OR (95% CI)
		Yes	No		
Yes	On NIV & oxygen requirement at admission	171	150	321	<0.001 8.621 (5.614- 13.239)
No	Patients not requiring oxygen	32	242	274	
Total		203	392	595	

NIV: non-invasive ventilation

Supplementary table 6: Patients requiring Oxygen versus patients not requiring oxygen

Oxygen patients versus Non-oxygen patients	Definition	Mortality		Total	P, OR (95% CI)
		Yes	No		
Yes	Oxygen requirement at admission, NIV patients not included	117	136	253	<0.001 6.506 (4.174-10.141)
No	Patients not requiring oxygen, NIV patients not included	32	242	274	

Supplementary table 7: Comparison between the patients admitted in 2020 and 2021

Parameter	From March 2020 to 1 March 2021	From March 1, 2021 to till December 31, 2021	Total
Number of patients	269 (37.6%)	445 (62.3%)	714
Number of files available	210 (35.2%)	385 (64.7%)	595
Age (mean \pm SD) (years)	52.13 \pm 12.32	54.00 \pm 13.41	-
Sex			
Male	166 (38.0%)	270 (61.9%) 72.9	436
Female	43 (27.0%)	(30.1%)	159
NIV at admission	22 (32.3%)	46 (67.6%)	68
NIV at hospital stay	46 (31.7%)	99 (68.2%)	145
Oxygen at admission	83 (32.8%)	170 (67.1%)	253

Non oxygen	114 (41.6%)	160 (58.3%)	274
Mortality	57 (28.0%)	146 (71.9%)	203

Supplementary table 8: International Published Studies

S no	Reference	Type of the study	Duration of data collection and year of publication	Number of ESRD patients on MHD with COVID-19 disease	Mortality	Risk factors
1	S1 [9]	Single centre	December 2019 to February 2020/2020	5	0	-
2	S2 [10]	Single centre	March 15 and June 7, 2020 /2021	122	11 (9%)	None
3	2 [11]	Single centre	March 12th to April 10th, 2020 /2020	36	11 (30.5%)	Longer dialysis vintage, increased LDH, higher CRP, lower lymphocyte count
4	3 [12]	Four	March	94 out of	27 (28.7%)	Fever at disease

		dialysis centres	2020/2020	643 (15%)		diagnosis, cough at disease diagnosis, higher serum CRP at disease diagnosis
5	4 [13]	47 centres in Turkey	17th April to 1st June 2020. /2021	567	93 (16.3%)	Cox regression survival analysis: Age, severe-critical disease at the time of diagnosis, presence of congestive heart failure, ferritin levels on admission, AST (> 2x upper limit of normal) during hospitalization, thrombocytopenia during hospitalization
6	S3 [18]	Nationwide study	February 1, 2020, to July 19, 2020/2021	76 out of 1064		Multivariate analysis: ICU admission Univariate Cox regression:age,

						CHF, COPD, history of DVT, atrial fibrillation, hypoxia, ICU admission, mechanical ventilation, using inotropes
7	S4 [19]	Two centres	March 31 to April 4, 2020	38 (19%) out of 200	8 (21%)	None
8	S5 [20]	Single centre	March 12 to April 17, 2020, /2021	40	9 (22.5%)	Median age in non- survivors (78 years) was significantly higher than in survivors, median time in dialysis (11.5 years) significantly longer in non- survivors, CRP at diagnosis significantly higher
9	S6 [21]	Single centre	15 March 2020 to 30	43	11 (25.6%)	Multivariate logistic regression: Age >

			September 2020 /2021			65 years, high TLC Other significant risk factors: lymphocyte count, LDH
10	S7 [22]	Single centre	March 9, 2020 to April 8, 2020 /2020	57	18 (31%)	Age >75 years, higher median Charlson comorbidity index
11	S8[23]	13 centres	March 1, 2020, to April 27, 2020/2020	419/10482 (3.9%)	133(31.7%)	Increased age, being on a ventilator, lymphopenia, blood urea nitrogen and serum ferritin.

TLC: total leucocyte count, LDH: lactate dehydrogenase, C-reactive protein levels, AST: aspartate transaminase, CHF: congestive heart failure, COPD: chronic obstructive pulmonary disease, DVT: deep vein thrombosis

Supplementary table 9: Published studies from India

S no	Reference	Type of the study	Duration of data collection and year of publication	Number of ESRD patients on MHD with COVID-19 disease	Mortality	Risk factors
1	S9 [14]	Single centre	Between May 1st, 2020 and March 31st, 2021/ July 2021	40	16 patients (40%)	Multiple logistic regression: Invasive ventilation, deranged TLC, hypoalbuminaemia Other significant factors: Age, mean SpO ₂ at presentation and raised inflammatory markers were significantly associated with mortality
2	S10 [15]	11 public and private	Between March 2020 and July	263	35 (13.3%)	Multivariate analysis: CVC use, disease severity,

		centres	2020/July 2021			NIV support Other significant factors: Older, diabetic kidney disease, comorbidities, severe COVID-19, on twice-weekly MHD than thrice-weekly, dialysis through central venous catheter
3	S11 [16]	Single centre	Between May 2020 and July 2020	58	22 (37.9%)	Disease severity, CRP above 175 mg/L at admission
4	S12 [17]	Two dialysis centres	Between 1 April and 30 April 2020	37	14 (37.8%)	-

TLC: total leucocyte count, LDH: lactate dehydrogenase, C-reactive protein levels, AST: aspartate transaminase, CHF: congestive heart failure, COPD: chronic obstructive pulmonary disease, DVT: deep vein thrombosis