A comparative cross-sectional analysis on outcomes of Covid-19 patients requiring dialysis

Chinmay N. Gokhale[1], Smita S. Chavhan[1], Harshal N. Mahajan[2], Balkrishna B. Adsul[3], Maharudra A. Kumbhar[4], Aniket R. Ingale[1]

[1]Community Medicine, HBTMC and RNCH, Mumbai, [2]Community Medicine, LTMMC and GH, Mumbai, [3]Dean I/C, Seven Hills Dedicated Covid 19 Hospital, [4]Officer Special Duty, Seven Hills DCH, Mumbai, Maharashtra, India

ABSTRACT

Context: Coronavirus Disease 2019 (COVID-19) was declared as a pandemic by the World Health Organization (WHO) on March 11, 2020. COVID-19 disproportionately affects patients with pre-existing comorbidities including those undergoing dialysis at intermittent intervals. These patients requiring renal replacement therapy like intermittent hemodialysis have a preponderance to go into severe clinical states. Hence, this study was planned to analyze the outcomes of such patients requiring dialysis and suffering from the COVID-19 disease. **Objectives:** This study was carried out to compare the outcomes of the COVID-19 patients requiring hemodialysis with those not requiring hemodialysis. **Materials and Methods:** This cross-sectional observational study was carried out between April 2020 and August 2020 at a dedicated COVID-19 hospital and included COVID-19 patients requiring hemodialysis at the time of admission and an equal number of controls matched for age and sex. **Results:** The study included 271 COVID-19-positive patients requiring dialysis and 271 COVID-19-positive controls without the requirement of a dialysis matched for age and sex; 10.3% cases needed intensive care. There were 18.8% deaths in cases as opposed to 8.9% among controls. Multivariate analysis showed that advancing age (OR 2.6 in cases and 1.06 in controls) need for intensive care (OR 27.9 in cases and 331 in controls), and diabetes alone and with other comorbidities were significant predictors of mortality. **Conclusions:** This study showed that the mortality proportions were more in cases as compared to controls; and advancing age, diabetes, and need for intensive care unit (ICU) were significant predictors. The study also highlighted the crisis faced by patients who require dialysis at regular intervals due to this COVID-19 pandemic.

Keywords: Covid-19, hemodialysis, odds for mortality

Introduction

COVID-19 was declared as a pandemic by the World Health Organization (WHO) on March 11, 2020.[1] India is among the leaders around the globe with respect to the absolute number of cases of SARS-CoV-2 (2019-nCoV)-infected individuals.[2] In such a scenario where the cases are ever-rising and the health sector resources are exhausted every day more than before, it is extremely important that epidemiological studies are conducted to chalk out predictive determinants to aid in risk stratification and optimal allocation of resources.

COVID-19 disproportionately affects patients with pre-existing comorbidities like diabetes, hypertension, and chronic kidney disease (CKD).[3] Among those suffering from CKD is a sub-group of patients who receive a renal replacement by undergoing hemodialysis at intermittent intervals.

Patients requiring renal replacement therapy like intermittent hemodialysis (HD) are a special group of patients with a

Address for correspondence: Dr. Smita S. Chavhan, Associate Professor, Community Medicine, HBTMC and Dr. RNCH, Mumbai, Maharashtra, India.
E-mail: drsmitaschavan@yahoo.com

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preponderance to electrolyte and metabolic disturbances, which are also often accompanied by the compromised immune system and low hemoglobin levels. All these factors along with their repeated exposure to health care institutions for receiving renal Replacement therapies make them vulnerable to acquire prevalent respiratory infections like SARS-CoV-2.[4] Hence, this study was planned to analyze their chances of going into severe forms of COVID-19 disease in comparison to other patients of this pandemic infection.

Objectives

This study was carried out to compare the outcomes of COVID-19 patients requiring hemodialysis with those having COVID-19 but not requiring hemodialysis and to find out the determinants of the outcomes.

Materials and Methods

This cross-sectional observational study was carried out at a dedicated COVID-19 hospital situated in Mumbai after taking ethical and administrative permissions.

Data collection

All COVID-19 patients requiring hemodialysis at the time of admission and those who got admitted between April and August 2020 were considered for this study. An equal number of COVID-19 patients not requiring hemodialysis were matched for age and sex and were included for comparison in the control group. Data for both cases and the comparative control group was obtained from hospital records.

Statistical analysis

Patients' data so obtained were entered into the Microsoft Excel Spreadsheet and analyzed using OpenEpi and SPSS software. Bivariate analysis was carried out using the Chi-square test. Quantitative variable, i.e. the mean duration of the Hospital stay was compared using the Student's *t*-test. Multivariate analysis was done by applying the multiple logistic regression with the dependent variable being the outcome in the form of alive or death of the patient.

Results and Observations

This study was carried out in one of the largest dedicated COVID-19 hospitals in the city of Mumbai, Maharashtra, India. The study included COVID-19 patients requiring dialysis and their comparison group of patients admitted during the period of April 2020 to August 2020. The number of COVID-19 cases was comparatively more in this city and along with the National Capital Region of Delhi, Mumbai was one of the leaders in terms of the number of patients as well as the number of deaths due to COVID-19. Concurrently all special sub-groups of patients like those having comorbidities, those requiring intensive care, and those requiring hemodialysis presented in huge numbers to various hospitals of this city.

To make things worse, many private trusts and NGO-run dialysis centers were apparently either shut down or were not having facilities for providing dialysis facilities to COVID-19 positive cases. Restrictions on travel due to the nationwide lockdown, and more importantly, due to psychosocial factors in the society including the medical community like apprehension to the disease, blame-game toward patients, etc., turned the situation even more acute for COVID-19 cases requiring hemodialysis. The superadded fact that the beginning of this pandemic was an unprecedented situation for any and everyone further led to extremely difficult medical circumstances for these patients.

A total of 271 COVID-19 patients requiring hemodialysis were included in this study. An equal number of patients matched ($P > 0.05$) for age and sex [Table 1] were recruited to form the control group. The severity of the disease was measured by comparing the mean duration of hospital stay, requirement of intensive care, and mortality among the two groups [Table 2]. The mean duration of hospital stay was significantly more among hemodialysis patients as compared to the others. Similarly, the need for an intensive care unit (ICU) was significantly more among cases (10.3% as opposed to 6.3% of controls). On comparing the final outcome, there were 51 deaths (18.8%) among the cases group which were significantly more than 24 deaths (8.9%) among the controls group ($P < 0.001$).

Multivariate analysis [Table 3] showed an obvious finding that deaths were more in the elderly age group (60 years or more). However, the odds of death were more among the elderly cases (2.6) as compared to elderly controls (1.06). There was a difference in the proportions of deaths among the two sexes, but these findings were not statistically significant. The need for ICU during the progression of the disease was a strong predictor (statistically significant on bivariate and multivariate analyses) for negative outcomes in the form of death. Compromised renal functions, and thereby, a requirement of dialysis, may have resulted in many deaths among cases not requiring ICU (12.3%). Thereby, the odds ratio of death among those requiring ICU as opposed to those not requiring ICU was much higher in controls (OR = 331) in comparison to cases (OR = 27.9).

In routine clinical practice, a greater duration of hospital stay is generally considered as a predictor of mortality. However, in this study, it was found that patients having hospital stay more than the respective mean duration for both groups had better outcomes and these findings were statistically significant (OR 0.2 among cases and 0.1 among controls having a longer duration of hospital stay). This may be due to the fact that survival for a longer time may have given a better chance for patients' immunity and other systems to recover. Another probable reason could be that as the clinical protocol for COVID-19 was not as established as for some conventionally known diseases (especially during the study period), a longer duration of stay also gave a chance to medical caretakers to adequately treat, support, and revive the patient.

Table 1: Age and sex distribution of cases and controls groups						
Age (in years)	Cases group			Controls group		
	Female	Male	Total	Female	Male	Total
Up to 30 yrs	6	13	19 (7.01%)	6	17	23 (8.49%)
Between 30 and 60 yrs	59	103	162 (59.78%)	63	96	159 (58.67%)
60 yrs or more	33	57	90 (33.21%)	31	58	89 (32.84%)
Total	98 (36.16%)	173 (63.84%)	271 (100%)	100 (36.9%)	171 (63.1%)	271 (100%)
	Mean age 52.4 +/- Std Dev 14			Mean age 51.7 +/- Std Dev 13.81		

P-value for comparison between the two groups: For Age=0.53 and for Sex=0.85

Table 2: Duration of hospital stay, need for ICU, and overall outcome of patients			
Variable	Cases (*n*=271)	Controls (*n*=271)	*P*
Duration of hospital stay			
Mean	17.98 days	13.04 days	*P*<0.01*
Std dev	9.8 days	7.41 days	
Need for intensive care			
Yes	28 (10.3%)	17 (6.3%)	*P*=0.04*
No	243 (89.7%)	254 (93.7%)	
Outcome			
Death	51 (18.8%)	24 (8.9%)	*P*<0.001*
Alive	220 (81.2%)	247 (91.1%)	

*Statistically significant *P*

Around 58% of cases and 42% of controls had one or more comorbidities like diabetes, hypertension, etc. The number of patients having only hypertension was more among both cases and controls. However, deaths were associated with the presence of diabetes among the patients; 14.8% controls having only diabetes (OR = 3.6) and 30% cases with only diabetes (OR = 4.4) had a negative outcome. In those having both diabetes and hypertension, these proportions were higher, 19.2% among controls (OR = 2.4) and 33.3% among cases (OR = 2.9). These proportions further went up in the presence of other comorbidities like Ischaemic Heart Disease (IHD), stroke, cancer, etc., with diabetes and/or hypertension. Even in the absence of comorbidities, the death rates in cases (12.3%) were significantly more than controls (3.8%). Clearly, the presence of comorbidities is more in cases group and also the proportion of deaths in each individual category is clearly more in cases group. This summarizes the additional mortality load among COVID-19 patients who were already on dialysis before the beginning of the pandemic.

Discussion

This cross-sectional study with the comparative control group was carried out during the early months of the COVID-19 pandemic with a focus on COVID-19 patients requiring hemodialysis. As already stated in the Results section, this sub-group of patients struggled with both medical and nonmedical problems in getting appropriate care in the pandemic times which may have been a contributor to the enhanced mortality found in this study among the cases group. These adversities faced by patients requiring dialysis were also highlighted in a previously published study.[5] Another study

from Karnataka also voiced the collateral impact of COVID-19 on patients receiving dialysis.[6]

The mortality rate among the hemodialysis patients was clearly in excess of that in the control group. The mortality rate in cases group was similar to that mentioned in an Italian Society of Nephrology editorial.[7] However, the 18.8% mortality found among cases is much less than 30% suggested by a similar study in Spain.[8] This may be due to the fact that this dedicated COVID-19 hospital had multi-specialty comprehensive clinical services for dialysis patients. However, a study done in the USA showed that those end-stage renal disease patients who required dialysis had better outcomes than the comparable group.[9] This contradiction may be attributed to the difference in the proportion of comorbidities and may also be to the accessibility of medical treatments for COVID-19 patients receiving dialysis during the times of the pandemic.

There was a significant difference between the requirement of ICU among cases and controls. Also, the need for ICU was a significant predictor of mortality. In other words, those patients who presented or progressed to a severe clinical state had apparently more odds of dying even in the presence of advanced intensive care.

The mean duration of hospital stay was around 5 days more among cases. Thus, the dialysis patients not only had higher mortality but also required prolonged care during the pandemic. Another staggering finding of this study was that patients who had a lesser duration of hospital stay (for respective cases and controls) had a higher chance of dying as compared to those who stayed in the hospital for a longer duration.

In this study, diabetes and hypertension were found to be the two most common comorbidities which are similar to a previously published study.[10] The death rates were generally more among cases as compared to controls within each comorbidity group. The odds of death were more in the diabetes group and diabetes along with the hypertension group. The presence of other comorbidities with diabetes/hypertension, like ischemic heart disease, stroke, cancer, etc., also increased the risk of a negative outcome. This study showed that advancing age and comorbidities are predictors of a bad outcome in COVID-19. This finding is in accordance with a study published in Wuhan, China.[11] Another study done during the times of Swine flu also showed that diabetes had a strong relation with death in the flu patients receiving dialysis.[12]

Table 3: Bivariate analysis (using Chi-square) and Multivariate analysis using (Multiple Logistic Regression) between Cases and Controls

Variable	Groups	Cases				Controls			
		Total (n=271)	Deaths (n=Total of group)	Bivariate analysis	Multivariate analysis (OR and P)	Total (n=271)	Deaths (n=Total of group)	Bivariate analysis	Multivariate analysis (OR and P)
Age	Up to 30	19 (7.01%)	2 (10.5%)	P<0.0001*	1	23 (8.49%)	1 (4.3%)	P<0.001*	1
	30-60	162 (59.78%)	13 (8.03%)		0.36 (0.07-1.9) P=0.23	159 (58.67%)	5 (3.1%)		0.19 (0.02-2.3) P=0.187
	60 or more	90 (33.21%)	36 (40%)		2.6 (0.5-13.5) P=0.25	89 (32.84%)	18 (20.2%)		1.06 (0.1-12.9) P=0.96
Sex	Female	98 (36.16%)	14 (14.3%)	P=0.15	1	100 (36.9%)	11 (11%)	P=0.34	1
	Male	173 (63.84%)	37 (21.4%)		2.3 (0.9-2.7) P=0.07	171 (63.1%)	13 (7.6%)		0.43 (0.11-1.55) P=0.197
Need for ICU	No	243 (89.7%)	30 (12.3%)	P<0.0001*	1	254 (93.7%)	10 (3.9%)	P<0.0001*	1
	Yes	28 (10.3%)	21 (75%)		27.9 (7.8-100) P<0.001*	17 (6.3%)	14 (82.4%)		331 (28-3873) P<0.0001*
Hospital Stay	<Mean	161 (59.4%)	37 (22.9%)	P=0.03*	1	166 (61.3%)	17 (10.2%)	P=0.31	1
	>Mean	110 (40.6%)	14 (12.7%)		0.27 (0.11-0.68) P=0.005*	105 (38.7%)	7 (6.7%)		0.103 (0.01-0.86) P=0.04*
Comorbidities	Nil	114 (42.1%)	14 (12.3%)	P=0.002*	1	156 (57.6%)	6 (3.8%)	P<0.001*	1
	DM only	10 (3.7%)	3 (30%)		4.4 (0.7-25.4) P=0.09	27 (10%)	4 (14.8%)		3.66 (0.4-30.2) P=0.23
	HTN only	57 (21%)	5 (8.8%)		0.66 (0.19-2.2) P=0.5	26 (9.6%)	2 (7.7%)		1.28 (0.1-13.9) P=0.84
	DM+HTN	48 (17.7%)	16 (33.3%)		2.9 (1.01-8.3) P=0.048*	26 (9.6%)	5 (19.2%)		2.47 (0.4-15.4) P=0.34
	DM and/or HTN + Others	30 (11.1%)	10 (33.3%)		1.8 (0.5-6.4) P=0.34	24 (8.6%)	7 (29.1%)		4.5 (0.7-31.7) P=0.12
	Others only	12 (4.4%)	3 (25%)		0.302 (0.03-2.9) P=0.3	12 (4.4%)	0		-

*Statistically significant *P*, DM=Diabetes mellitus, HTN=Hypertension<mean=Patients who had hospital stay less than mean duration for cases and controls, respectively. Similarly, >mean=Duration of stay more than mean duration for cases and controls

To summarize, it is clear from this study that patients requiring dialysis had a higher mortality load; and advancing age, need for intensive care, shorter duration of hospital stay, and presence of diabetes were significant determinants of negative outcomes.

Conclusions

This study highlighted the crisis faced by one of the medically challenged groups of patients who require dialysis at regular intervals owing to their retarded renal functions. This study showed that mortality was more in COVID-19 patients requiring dialysis across age groups, sexes, and comorbidities groups. One of the strengths of this study was that a large number of COVID-19 patients included in this study were those who reported during the first few months of pandemic when the availability of medical care was relatively compromised and the panic state due to the pandemic was perhaps at its peak. Therefore, this study is a fair representation of the important public health problem that patients with the requirement of dialysis at regular intervals present with. A limitation of this study is that biochemical markers of the patients were not considered which may have influenced the clinical outcomes.

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Conflicts of interest

There are no conflicts of interest.

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