COVID-19 disease in peritoneal dialysis patients: a single centre experience from India

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Abstract

Background This study presents our data on mortality in end stage renal disease (ESRD) patients on peritoneal dialysis (PD) who developed COVID-19.

Materials and methods Sri Padmavathi Medical College Hospital, Sri Venkateswara Institute of Medical Sciences University, was designated the State COVID Hospital in March 2020. In a retrospective observational study, we collected the data of ESRD patients on PD and identified the risk factors for mortality.

Results Prior to the pandemic, 136 patients with ESRD were on peritoneal dialysis at our Institute. Among them, 27 (19.8%) eventually developed COVID-19, and 14 of them (51.8%) died. Serum albumin levels were lower and D-dimer levels were significantly higher in deceased patients than in survivors.

Discussion The mortality rate in ESRD patients on PD with COVID-19 at our institution was higher than in other published studies.

Keywords End stage renal disease · Peritoneal dialysis · SARS-CoV-2 · COVID-19 · Oxygen saturation · Non-invasive ventilation · Serum albumin · D-dimer · Mortality

Introduction

On 28 March, 2020, Sri Padmavathi Medical College Hospital, Sri Venkateswara Institute of Medical Sciences University, was designated the State COVID Hospital for the state of Andhra Pradesh, India, the population of which is approximately fifty million people. The aim of this article is to report our experience with end-stage renal disease (ESRD) patients on peritoneal dialysis (PD) with COVID-19.

Materials and methods

We collected data concerning ESRD patients on peritoneal dialysis consecutively presenting to our hospital between March 2020 and December 2021 in a register. Based on the information in this register, data were retrieved from the patients’ files and a retrospective observational study was carried out. We included demographic, clinical, and laboratory data, as well as treatment schedules of peritoneal dialysis and COVID-19.

For the purpose of this study, we used the following definitions; (1) non-invasive ventilation at admission (NIVA) for patients requiring non-invasive ventilation at admission, (2) non-invasive ventilation during hospitalization (NIVH) for patients requiring non-invasive ventilation at any time during hospitalization, (3) oxygen-dependent for patients requiring oxygen via non-rebreather mask or simple mask. None of the patients in the latter group required NIV during hospitalization.
At admission, we initiated patients on remdesivir 200 mg on day 1, followed by 100 mg/day from day 2 to day 5, which was extended up to day 10 as per the clinical condition, dexamethasone 0.1 mg/kg/day i.v., and low molecular weight heparin till discharge.

All peritoneal dialysis inpatients were treated with automated peritoneal dialysis (APD). Patients who were in home isolation were managed with an APD machine that had the advantage of remote patient monitoring (RPM).

Statistics The data were entered into a Microsoft Excel spreadsheet. The frequency and percentage were calculated for qualitative variables. The mean and standard deviations were calculated for quantitative variables. An independent sample t test was used to test the significant difference between the two means. A Chi-square test was used to test the significant difference between proportions. An odds ratio was calculated between the two means. A Chi-square test was used to test the significant difference were calculated for quantitative variables. An independent sample t test was used to test the significant difference.

Results

With regard to all COVID-19 patients, we admitted and managed 15,719 COVID-19 patients from March 28, 2020 to December 31, 2021. The mortality rate was 18.3% (2878 deaths out of 15,719 patients).

Concerning demographics and admission, prior to the pandemic, 137 patients with ESRD were on peritoneal dialysis at our Institute, of whom 27 (19.7%) eventually developed COVID-19. From March 2020 to March 2021, we treated 10 ESRD patients on peritoneal dialysis with COVID-19, while from March 1, 2021, to December 31, 2021, we admitted 17 ESRD patients on peritoneal dialysis with COVID-19. Seventeen (62.9%) patients were admitted to hospital as inpatients, while home isolation was adopted in 10 (37.0%) subjects. Patients ranged in age from were 17–80 years, and 17 were males (62.9%).

Aetiology of end stage renal disease varied. Diabetes mellitus was the cause of ESRD in eight (29.6%) of the 27 patients, hypertension in 11 (40.7%), and other aetiologies were present in the remaining eight (29.6%).

Hypertension was identified as the cause of ESRD in 11 (40.7%) patients. However, 17 (62.9%) patients had hypertension at the time of admission or during their hospital stay. The mean systolic and diastolic blood pressures at admission were 141.8 and 85.5 mmHg.

Of 17 patients who were admitted to the institution, NIVa was needed by three (17.6%) patients, eight (47.0%) patients required oxygen, while the remaining six (35.2%) patients did not require oxygen during their hospital stay. However, nine out of 17 (52.9%) patients required a NIVh. This group included patients who were switched from oxygen to NIV or who were admitted without requiring oxygen.

Peritoneal dialysis was performed on 17 inpatients using APD. Patients were given combinations of 5.0 L solutions of 1.5% and 2.5% dextrose exchanges over 15 h/day. APD machine management and patient connections were carried out by peritoneal dialysis nurses. The mean ultrafiltration rate in inpatients was 996 ± 227 mL/day and the mean urine output was 258 ± 151 mL/day. The 10 patients who were in home isolation were managed with an APD machine that had the option of RPM. Patients connected and disconnected themselves from the APD machines at home. RPM was done by the peritoneal dialysis nurse at our Institute. The mean ultrafiltration rate in patients at home was 818 ± 203 mL/day and the mean urine output was 388 ± 111 mL/day.

The demographic, clinical, and laboratory values are provided in Supplementary Table 1. Comparison between clinical and laboratory markers (Table 1) identified serum albumin and D-dimer levels as being significantly higher in deceased patients than in survivors on peritoneal dialysis with COVID-19. We did not observe any adverse effects of remdesivir.

Fourteen out of 27 (51.8%) ESRD patients on peritoneal dialysis with COVID-19 died. There were 11 (64.7%) deaths among the 17 inpatients, and three (30%) deaths among the 10 patients in home isolation. Two, four and five deaths occurred in NIVa, oxygen at admission and in non-oxygen-dependent patients, respectively. There were no significant differences in mortality rates among these three groups. Supplementary table 2 shows the characteristics of ESRD patients on peritoneal dialysis between March 2020 and December 2021 according to infection status. Mortality rates of PD patients who were not affected by COVID-19 were significantly lower than those affected by COVID-19.

Discussion

With the understanding that the outcomes of the general population and of patients admitted to hospital are not comparable, we state that at our Institute, the number of deaths reported was 2878 (18.3%) of the 15,719 COVID-19 admitted patients. The reported mortality worldwide, in India and in the state of Andhra Pradesh was 1.9% [1], 1.38% [2], and 0.64% [3] respectively.

The mortality rate in ESRD patients on maintenance haemodialysis (MHD) with COVID-19 at our Institute was 34.1% (203 deaths out of 595 patients). Fourteen out of 27 (51.8%) ESRD patients on peritoneal dialysis died. We observed that serum albumin and D-dimer levels were significantly higher in patients who eventually died than in survivors.
Ten of our peritoneal dialysis patients (37.0%) were in home isolation after initial consultation at the Institute. Important investigations, including chest radiograph, were carried out during the initial consultation. These patients were taught to recognise hypoxia by means of pulse oximeter and were also trained to take a 6-min walk test. They were already well trained in the technique of PD. In addition, these patients were under RPM. We had three deaths in this home isolation group, all of whom were transferred to the hospital before they died. We must confess that the Institute failed in its careful monitoring of these patients. This could partly explain the higher mortality rate of the peritoneal dialysis patients than haemodialysis patients at our institute and also as compared to other publications.

The earliest report of COVID-19 in ESRD patients on peritoneal dialysis came from none other than Wuhan [1, 4]. Supplementary Table 3 contains data from published studies [2–9].

This study has some limitations: first of all, we could not compare COVID-19 patients on peritoneal dialysis to those on MHD. We also could not compare COVID-19 patients on dialysis to those not on dialysis. Moreover, ours is a retrospective, single centre study with a small sample size. Finally, we were not able to obtain the vaccination status of patients, and its modulating effect remains unknown.

Our work underlines the fragility of peritoneal dialysis patients and the need to protect them from severe forms of SARS-CoV-2 infection since they are affected by a higher mortality rates related to COVID-19.

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**Table 1** Comparison between clinical and laboratory markers between deceased s and surviving hospitalised COVID-19 patients

| Variable                        | Non-survivors (n=11) Mean (SD) | Survivors (n=6) Mean (SD) | P value |
|--------------------------------|--------------------------------|--------------------------|---------|
| Duration of stay$^a$           | 15.7 (16.6)                    | 16.6 (11.3)              | 0.305   |
| Age                            | 50.7 (18.5)                    | 40.8 (14.6)              | 0.277   |
| SPO$_2$ at admission           | 76.6 (37.9)                    | 76.5 (37.6)              | 0.994   |
| Haemoglobin$^b$                | 8.9 (2.4)                      | 9.2 (2.7)                | 0.856   |
| Total leucocyte count$^b$      | 9045.4 (5617.7)                | 8280.0 (4975.6)          | 0.796   |
| Neutrophils$^b$                | 80.9 (11.5)                    | 76.0 (11.4)              | 0.440   |
| Lymphocytes$^b$                | 11.5 (6.1)                     | 19.4 (10.7)              | 0.078   |
| ESR$^b$                        | 82.1 (32.9)                    | 51.6 (43.2)              | 0.141   |
| Platelet count$^b$             | 1.8 (0.8)                      | 1.9 (0.7)                | 0.881   |
| Blood urea$^b$                 | 124.5 (35.3)                   | 107.8 (45.9)             | 0.435   |
| Serum creatinine$^b$           | 9.8 (3.3)                      | 8.2 (2.1)                | 0.357   |
| Serum potassium$^b$            | 4.5 (0.9)                      | 4.3 (1.2)                | 0.680   |
| Serum Sodium$^b$               | 136.0 (7.1)                    | 137.2 (2.3)              | 0.722   |
| Serum bilirubin$^b$            | 0.6 (0.3)                      | 0.5 (0.1)                | 0.419   |
| SGOT$^b$                       | 36.0 (33.9)                    | 58.0 (52.9)              | 0.328   |
| SGPT$^b$                       | 33.4 (45.7)                    | 30.4 (7.7)               | 0.889   |
| ALP$^b$                        | 88.9 (41.2)                    | 116.0 (58.5)             | 0.302   |
| Serum total protein$^a$         | 4.5 (2.4)                      | 6.1 (0.4)                | 0.200   |
| Serum albumin$^b$              | 2.2 (1.1)                      | 3.2 (0.4)                | 0.030   |
| CRP$^b$                        | 44.3 (66.6)                    | 97.8 (89.9)              | 0.201   |
| Procalcitonin$^b$              | 0.2 (0.4)                      | 08 (1.4)                 | 0.137   |
| Serum ferritin$^b$             | 314.4 (495.8)                  | 211.0 (307.9)            | 0.677   |
| D-dimer$^b$                    | 0 (0)                          | 0.2 (0.3)                | 0.024   |
| Serum IL-6$^b$                 | 0 (0)                          | 42.0 (93.9)              | 0.143   |
| LDH$^b$                        | 129.9 (258.6)                  | 380.0 (510.6)            | 0.287   |

$^a$Number of non-survivors = 10
$^b$Number of survivors = 5

$SPO_2$ oxygen saturation of blood, AST aspartate aminotransferase, SGOT serum glutamic-oxaloacetic transaminase, ALT alanine transaminase, SGPT serum glutamic-pyruvic transaminase, IL-6 interleukin-6, LDH lactate dehydrogenase, ESR erythrocyte sedimentation rate
Declarations

Conflict of interest The authors have declared that no conflict of interest exists.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

Compliance with ethical standards Yes.

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