

Predictors of Duration of Hospital Stay in COVID-19 Disease: A Retrospective Study

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ABSTRACT

Introduction: A cluster of pneumonia cases were recognised at the end of the year 2019, and later designated as Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). It was declared as pandemic in early 2020. Coronavirus Disease 2019 (COVID-19) caused considerable morbidity and mortality. Further, it was discovered that presence of co-morbidities like diabetes mellitus, ischaemic heart disease and appearance of cytokine storm caused increased mortality.

Aim: To identify co-morbidities and laboratory parameters associated with prolonged hospitalisation in COVID-19 disease.

Materials and Methods: This retrospective study was conducted in Department of General Medicine at SDM College of Medical Sciences and Hospital, Shri Dharmasthala Manjunatheshwara University, Dharwad, Karnataka, India (tertiary care hospital). Data between 1st July 2020 to 30th September 2020 was collected, and analysis and interpretation was done from November 2020 to March 2021 from data obtained from medical records. Data of 402 participants was analysed for baseline characteristics like demographic distribution (age and gender), presence of co-morbidities like diabetes mellitus, hypertension, ischaemic heart disease. Patients were divided as per level of oxygen requirements, duration of hospitalisation and usage of remdesivir or steroid or both. Laboratory parameters studied were complete blood count, platelet count, serum sodium, parameters of hyperinflammation

like C-reactive Protein (CRP), Lactate dehydrogenase (LDH), ferritin. Markers of COVID-19 associated with high mortality like Neutrophil to Lymphocyte Ratio (NLR) and D-dimer were also taken. Mean hospital stay was associated with all the parameters. Data was analysed by one way Analysis of Variance (ANOVA) and Independent t-test.

Results: Maximum patients seen were in the age group of 40-60 years (45.52%). Common co-morbidities observed were diabetes mellitus (48.26%) and hypertension (45.27%). Presence of co-morbidities like diabetes mellitus (p-value=0.0171), hypertension (p-value =0.0238), ischaemic heart disease (p-value=0.0024) was associated with prolonged hospitalisation. Among laboratory markers higher level of parameters of inflammation like NLR >2 (p-value=0.0183), CRP >6 mg/L (p-value=0.004), ferritin >300 ng/mL (p-value=0.05) and indicators of hypercoagulable state {D-dimer >500 ng/mL (p-value=0.0014)} were associated with significantly prolonged stay. patient who received both remdesivir and steroids stayed longer compared to either remdesivir alone or only steroids (p-value=0.0001).

Conclusion: State of hyperinflammation and presence of co-morbidity especially uncontrolled diabetes mellitus and usage of steroids were associated with prolonged hospitalisation. Periodic assessment of these patients until recovery may help reducing mortality and morbidity.

Keywords: Coronavirus disease-2019, Cytokine storm, High neutrophil-lymphocyte ratio, Hyperinflammation, Hyperferritinaemia, Uncontrolled hyperglycaemia

INTRODUCTION

In December 2019, a cluster of pneumonia cases were recognised. Later it was named as Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), and declared as pandemic by World Health Organisation (WHO) in early 2020. It led to widespread morbidity and mortality across the globe. It further added burden on healthcare with acute shortage of resources and manpower. It still remains a devastating and re-emerging pandemic. It is well known that older age (>65) and diabetes increases severity of pneumonia [1]. However, there is limited data on effect of other co-morbidities like hypertension and ischaemic heart disease in Coronavirus Disease 2019 (COVID-19). This is especially important since the binding of SARS-CoV-2 is mediated by Angiotensin Converting Enzyme-2 (ACE-2) receptor. Studies done so far have given risk factors for fatal outcome in COVID-19 disease [1,2]. A study on predictors of mortality in COVID-19 was also published by the authors of this study [3]. However, factors affecting duration of hospitalisation are not well characterised.

There literature is scarce regarding factors affecting length of hospitalisation from India. Prolonged hospitalisation carries risk of complications like healthcare associated infections, malnutrition, psychosocial insecurity [4,5]. With vast crowding of current health infrastructure, routine screening of patients for these complications

is difficult and may not be effective. Hence, applying screening protocols to a subset of patients with risk factors for prolonged hospital stay will help in early identification of complications, thus improving the overall outcome. The aim of this study was to study the effect of co-morbidities and to identify laboratory parameters associated with prolonged hospital stay in COVID-19 disease.

MATERIALS AND METHODS

This retrospective study was conducted in Department of General Medicine at SDM College of Medical Sciences and Hospital, Shri Dharmasthala Manjunatheshwara University, Dharwad, Karnataka, India (tertiary care hospital). Data between 1st July 2020 to 30th September 2020 was collected, and analysis and interpretation was done from November 2020 to March 2021. Permission was taken from Institutional Ethics Committee and Medical Records Department (ref: SDMIEC/2021/12, date: 15/07/2021). Total 402 patients were included by using consecutive sampling method.

Inclusion and Exclusion criteria: All patients who were positive for COVID-19 infection by RT-PCR and symptomatic for severe acute respiratory illness/infection with positive rapid antigen test for COVID-19 were included in the study. Patients <18 years of age were excluded from the study.

Data Collection

Data was compared for baseline characteristics like demographic distribution (age and gender), presence of co-morbidities like diabetes mellitus, hypertension, ischaemic heart disease. Patients were divided as per level of oxygen requirements, duration of hospitalisation and usage of remdesivir or steroid or both. Laboratory parameters studied were complete blood count, platelet count, serum sodium, parameters of hyperinflammation like C-reactive Protein (CRP), Lactate Dehydrogenase (LDH), ferritin, Neutrophil to Lymphocyte Ratio (NLR) and D-dimer.

STATISTICAL ANALYSIS

One-way Analysis of Variance (ANOVA) and Independent t-test were used for data analysis. Software used for analysis was Statistical Package for Social Sciences (SPSS) version 20.0. A significance was set at 5% level (p-value <0.05).

RESULTS

Data from 402 patients were collected. Demographic profile of patients is shown in [Table/Fig-1]. Out of 402 patients, 183 patients (45.52%) were in the age group of 40-60 year, 64 patients (15.92%) were between 18-39 years, 155 patients (38.56%) above 60 years. There were 111 female patients (27.61%) and 291 (72.39%) male patients in this study.

Variables	COVID-19 patients (n,%)
Age groups (years)	
18-39	64 (15.92%)
40-60	183 (45.52%)
>60	155 (38.56%)
Minimum age	18
Maximum age	95
Mean age (Mean±SD)	55.84±14.91
Gender	
Male	291 (72.39%)
Female	111 (27.61%)
Duration of hospital stay (days)	
Minimum duration	1
Maximum duration	31
Mean±SD	8.89±4.79

[Table/Fig-1]: Demographic profile of COVID-19 patients.

Out of 402 patients 135 patients did not have any co-morbidity and 194 patients (48.26%) had diabetes mellitus, 182 patients (45.27%) had hypertension, 32 patients (7.96%) had chronic kidney disease, 24 patients (5.97%) had ischaemic heart disease.

Out of total 402, 141 patients (35.07%) needed supplemental oxygen, among which 68 patients (48.22%) were on low flow oxygen by face mask, 7 patients (4.96%) required non rebreathing mask, 3 patients (2.12%) required Non Invasive Ventilation (NIV), 63 patients (44.68%) required intubation and mechanical ventilation. Distribution of patients based on laboratory parameters are shown in [Table/Fig-2] [6-13]. A total of 57 patients (14.18%) had HbA1C ≥10%, 156 patients (38.81%) had hyponatraemia, 12 patients had hypernatraemia (2.99%),

Parameters	COVID-19 patients (n,%)
HbA1C [6] (%)	
<10	345 (85.82%)
≥10	57 (14.18%)
Sodium [7] (meq/dL)	
≤135	156 (38.81%)
136-145	234 (58.21%)
>145	12 (2.99%)

TLC (cells/cumm)	
≤4000	43 (10.70%)
4001-10999	276 (68.66%)
≥11000	83 (20.65%)
Platelet (cells/cumm)	
<1.5 lakhs	51 (12.69%)
≥1.5 lakhs	351 (87.31%)
Ferritin [8] (ng/mL)	
≤300	196 (48.76%)
>300	206 (51.24%)
CRP [9,10] (mg/dL)	
<6	99 (24.63%)
≥6	303 (75.37%)
LDH [11] (IU/L)	
<230	91 (22.64%)
≥230	311 (77.36%)
D-dimer [12] (ng/mL)	
≤500	46 (11.44%)
>500	73 (18.16%)
Drugs	
None	93 (23.13%)
Remdesivir	71 (17.66%)
Steroid	37 (9.2%)
Both	201 (50%)
NLR [13]	
<2	83 (20.64%)
≥2	319 (79.35%)

[Table/Fig-2]: Distribution of COVID patients by status of different clinical parameters [6-13].

206 patients (51.24%) had hyperferritinaemia, 303 patients (75.37%) had CRP ≥6 mg/dL and 319 patients (79.35%) had NLR ≥2, 311 patients (77.36%) had elevated LDH. Out of 402 patients, reports of quantitative D-dimer levels were available for 119 patients, among the available reports 73 patients (61.34%) had elevated D-dimer levels of >500. 201 patients (50%) received both steroids and remdesivir, 71 patients (17.66%) received only remdesivir, 37 patients (9.20%) received only steroids, 93 patients (23.13%) received neither.

Comparison of various factors with mean duration of hospital stay (in days) is shown in [Table/Fig-3]. Patients with diabetes mellitus had longer stay in hospital compared to patients without diabetes mellitus with p-value=0.0171, which was statistically significant. Patients with uncontrolled diabetes had longer stay in hospital compared to patients with controlled diabetes with p-value=0.0005 which was statistically significant. Patients with hypertension had longer stay in hospital compared to patients without hypertension with p-value=0.0238 which was statistically significant. Patients with Ischaemic heart disease had longer stay in hospital compared to patients without ischaemic heart disease with p-value=0.0024, which was statistically

Parameters	Mean	Median	SD	Statistics	p-value
Mortality					
Improved	8.72	8	4.53	t=-1.5926	0.1120*
Death	9.77	9	5.96		
Diabetes mellitus					
No	8.34	7	4.42	t=-2.3954	0.0171*
Yes	9.47	8	5.10		
Hypertension					
No	8.40	7	4.33	t=-2.2689	0.0238*
Yes	9.48	8	5.24		

Ischaemic heart disease					
No	8.70	8	4.50	t=-3.0547	0.0024*
Yes	11.75	10	7.59		
Glycosylated haemoglobin (HbA1C) (%)					
<10	8.55	7	4.52	t=-3.5301	0.0005*
≥10	10.93	10	5.80		
Sodium (meq/dL)					
≤135	9.19	8	5.29	F=3.2494	0.0398*
136-145	8.53	8	4.33		
>145	11.83	11.50	5.42		
Total leucocyte count (cells/cumm)					
≤4000	9.67	9	4.93	F=1.3595	0.2580#
4001-10999	8.63	8	4.42		
≥11000	9.34	7	5.77		
Platelet (lakhs) (cells/cumm)					
<1.5	8.12	7	4.38	t=-1.2270	0.2206*
≥1.5	9.00	8	4.84		
Ferritin (ng/mL)					
≤300	8.41	7	4.34	t=1.9576	0.050*
>300	9.34	8	5.14		
C-reactive protein (mg/dL)					
<6	7.86	7	3.54	F=8.325	0.004#
≥6	9.40	8	5.21		
Lactate dehydrogenase (IU/L)					
<230	8.24	7	4.60	t=-1.4609	0.1448*
≥230	9.07	8	4.83		
D-dimer (ng/mL)					
≤500	10.46	9	5.13	t=-3.2656	0.0014*
>500	13.64	14	5.94		
Drugs					
None	7.03	6	3.94	F=12.2910	0.0001#
Remdesvir	8.37	7	3.56		
Steroid	7.30	7	3.97		
Both	10.20	9	5.25		
Neutrophil to Lymphocyte ratio					
<2	7.66	7	3.42	t=-2.3706	0.0183*
≥2	9.20	8	5.09		

[Table/Fig-3]: Comparison of various factors with mean duration of hospital stay (in days) by one way ANOVA and independent t-test.
p-value <0.05 was considered as statistically significant
*Independent t-test
ANOVA test

significant. Patients with hyperferritinaemia (p-value=0.050), raised CRP (p-value=0.0024), D-dimer (p-value=0.0014) and NLR (p-value=0.0183) had longer stay in hospital compared to the rest of the patients. Patients who received remdesivir alone have shorter stay compared to patients who received steroids alone or both steroids and remdesivir (p-value=0.0001).

DISCUSSION

In this study it was found that patients with hypertension had longer hospital stay compared to patients without hypertension with p-value=0.0238 which was statistically significant. A study of 730 patients done by Thiruvengadam G et al., in the year 2020-21 in southern India showed that patients with hypertension had prolonged hospital stay [14]. Kinge KV et al., conducted a study involving 2883 patients at a tertiary care hospital in Mumbai in 2020 comparing presence or absence of hypertension as predictor of fatal outcome and duration of hospital stay showed that there was statistically significant difference in hospital stay in patients with hypertension compared to patients without hypertension [15].

This difference in duration of hospitalisation in hypertension is due to multiple factors like severity of the disease itself i.e., patients with hypertension having severe COVID-19 compared to patients without hypertension [16], cardiovascular events, hypertensive crisis. Further, Immune dysregulation can be a common denominator to complications of COVID-19 [17] as well as cardiovascular events secondary to hypertension [18]. The Canakinumab Antiinflammatory Thrombosis Outcome Study (CANTOS) trial showed that immunomodulation targeting IL-1 β in hypertension reduced cardiovascular events in patients with hypertension though it did not reduce blood pressure itself [18]. Few cytokine measurements on the day of admission like IL-12p (70) and IL-10 can predict progression in hypertensive patients as shown in BRACE CORONA trial [19]. Future research is needed whether using immunomodulation for patients with hypertension and COVID-19 can help preventing progression to severe illness/acute renal failure/cardiovascular events which may affect severity of the disease or prolong hospital stay.

In this study it was found that, patients with ischaemic heart disease had prolonged stay compared to patients without any heart disease (p-value=0.0024). A meta-analysis done by Liang C et al., from 40 studies with total of 22,148 patients has shown that severity of COVID-19 disease increases in patients with coronary artery disease [17]. Risk increases in patients with hypertension. COVID-19 disease causes many cardiovascular complications like myocardial dysfunction, myocarditis, cardiomyopathy, right ventricle dysfunction, pulmonary embolism. Also, the drugs used to treat COVID-19 might be cardiotoxic. Patients with ischaemic heart disease poses an additional risk for cardiovascular complications [17]. Most of the cardiac injury begins from day five [20] and continues in post COVID phase or long COVID-19. This might explain prolonged hospitalisation in patients with ischaemic heart disease.

In this study it was found that patients with uncontrolled diabetes had prolonged hospitalisation compared to controlled hyperglycaemia (p-value=0.0005) and also patients with diabetes had significantly prolonged stay compared to patients without diabetes with COVID-19 (p-value=0.0171). A study done in Greece by Petrakis V et al., involving 133 type 2 diabetic patients showed that hospitalisation was significantly (p-value=0.004) prolonged in patients with glucose >180 mg/dL than those with lower levels on admission [21]. Pre-existing hyperglycaemia is associated with poor outcome as shown in research conducted in Scotland and Swedish population [22,23]. Difference might be secondary to altered cell mediated and humoral immunity, elevated proinflammatory cytokines [24,25], associated obesity, presence of ACE-2 receptor in adipose tissue. Severe COVID-19 disease, oxygen dependency, secondary infections, retriaging to ICU after recovery, control of hyperglycaemia complicated by use of steroids in moderate to high-risk patients, electrolyte disturbances in diabetic patients etc. contribute to increased length of hospital stay [26]. On the contrary a study done by Wu Y et al., showed no significant difference in duration of hospitalisation with respect to presence or absence of comorbidity-hypertension, diabetes mellitus, coronary artery disease [27].

In this study it was found that elevated CRP >6 mg/L (p-value=0.0025) and hyperferritinaemia (serum ferritin >300: p-value =0.05) was associated with prolonged hospitalisation. A study done by Tezcan ME et al., comprising 149 patients showed that patients with higher CRP levels (p-value=0.002) and higher ferritin level (>300 mg/mL, p-value=0.01) had prolonged hospitalisation compared to patients in short-term group [28]. Severe COVID-19 disease is associated with hyperinflammation and cytokine storm [29]. Rising acute phase reactants like CRP [30] and ferritin [31-33] are taken as markers of hyperinflammation in COVID-19 and reflects progression of the disease. It is imperative that patients with severe disease are also the candidates for immunomodulatory therapies and steroids. This increases the risk for secondary infections, and a challenge for euglycaemia which may add further morbidity [34,35].

In this study it was found that high neutrophil to lymphocyte ratio is associated with prolonged hospitalisation (p-value=0.0183, for NLR>2). A study done in China by Wu Y et al., including 125 patients showed that lymphocytopenia is associated with prolonged hospitalisation [27]. Another study done in Turkey including 639 patients by Kalyon S et al., in 2020 showed that NLR was significantly higher in non survivors than survivors and non survivors had longer hospitalisation compared to survivors [36]. A meta-analysis done by Henry BM et al., [37] showed that neutrophilia and lymphopenia is associated with progression to severe COVID-19 patients in hospitalised patients. This difference could be due to severity of the disease itself, need for immunomodulation and/or steroids leading to secondary infections, metabolic complications like hyperglycaemia further prolonging hospitalisation.

In this study it was found that higher D-dimer is associated with prolonged hospitalisation with p-value=0.0014. A study done by Thiruvengadam G et al., [14] showed that patients with high D-dimer, ferritin and high neutrophil to lymphocyte ratio had prolonged hospital stay. D-dimer is a traditional marker of hypercoagulability [38]. D-dimer is the product of fibrinolysis. D-dimers are the D fragments from lysis of cross-linked fibrin, not the fibrinogen or soluble fibrin. Thus, elevated D-dimers indicate active fibrinolysis in turn activation of coagulation cascade [38]. D-dimer have been in use to rule out venous thromboembolism and deep vein thrombosis because of its high negative predictive value [39]. Traditionally RNA viruses are associated with haemorrhagic manifestations [40]. However, SARS-CoV-2 is associated with immune-thrombosis. SARS-CoV-2 induces endothelial cell damage which recruits neutrophils and monocytes, and releases cytokines [41]. This along with tissue factor exposure accelerates thrombosis. There is activation of intrinsic coagulation secondary to Neutrophil Extracellular Traps (NETs) in COVID-19. This explains occurrence of thrombotic events in COVID-19 patients. Since, the COVID-19 pandemic D-dimer has been used in triaging and management of patients with COVID-19 [12,42]. Studies done till date have shown higher incidence of critical illness, thrombotic events, acute kidney injury and death in patients with elevated

D-dimer levels [12,42]. Systemic anticoagulation has been included in the treatment of moderate to severe COVID-19 worldwide [43].

In this study it was found that patients with hyponatraemia and hypernatraemia had prolonged hospitalisation compared to patients with normal serum sodium. A study done by Martino M et al., in Italy with 117 patients in year 2020 showed that hypernatraemia is associated with prolonged hospitalisation and hyponatraemia with severe COVID-19 [44]. A retrospective study of 642 patients done by Pillai J et al., in Johannesburg, South Africa in the year 2020 showed that serum sodium more than 145 mmol/L is associated with prolonged hospital stay [45]. An analysis by HOPE registry showed that dysnatraemia was associated with mortality and sepsis in patients with COVID-19 [46]. Severe disease, need for Intensive Care Units (ICU), sepsis might explain prolonged hospital stay in patients with dysnatraemia.

In this study it was found that, patients who received remdesivir alone have shorter stay compared to patients who received steroids alone or both steroids and remdesivir (p-value=0.0001). A double blinded multicentric randomised clinical trial- Adaptive COVID-19 Treatment Trial (ACTT) has shown that treatment with remdesivir will shorten the time to recovery [47]. Recovery trial showed that addition of steroid lowers mortality in patients with high oxygen requirement or mechanical ventilation but not in patients requiring low flow oxygen or no oxygen [48]. Another study done by Anderson M et al., showed length of hospitalisation reduced by four days in remdesivir treated group [49]. A retrospective study of 450 patients in China conducted by Yiming Ma et al., showed that steroid usage resulted in longer hospitalisation (p-value=0.001) in non severe group and higher use of antibiotics [50].

Secondary infections, hyperglycaemia after steroid therapy and electrolyte disturbances in ICU patients might explain prolonged stay in patients who received remdesivir and steroids both [34,35].

Hence, authors suggest the use of steroids only in severe cases i.e, patients requiring high flow oxygen or mechanical ventilation and use of remdesivir in all patients with lower respiratory tract involvement. Similar studies from the literature has been tabulated in [Table/Fig-4] [14,15,17,21,27,28,36,37,44-50].

Author's name and year of publication	Place of study	Number of subjects	Age of patients	Parameters compared	Conclusion
Hypertension					
Thiruvengadam G et al., 2021 [14]	India	730	20-80 years	Hypertension, diabetes, coronary artery disease, D-dimer, ferritin, NLR	Presence of multiple co-morbidity (more than two), high D-dimer, ferritin and NLR increases duration of hospitalisation.
Kinge KV et al., in 2020 [15]	Mumbai, India	2883	21-90 years	Hypertension	Hypertension was associated with prolonged hospital stay.
Present study, 2022	Dharwad, Karnataka	402	≥18 years	Hypertension	In this study it was found that patients with hypertension had longer hospital stay compared to patients without hypertension with p-value =0.0238 which was statistically significant.
Ischaemic heart disease					
Liang C et al., 2021 [17]	Meta-analysis	22148 patients from 40 studies	≥18 years	Ischaemic heart disease	Coronary heart disease is a risk factor for mortality in COVID-19, progression of disease, ICU admission more so in patients with hypertension.
Present study, 2022	Dharwad, Karnataka	402	≥18 years	Presence or absence of IHD	patients with ischaemic heart disease had prolonged hospital stay.
Diabetes mellitus					
Wu Y et al., 2020 [27]	China	125	≥18 years	Hypertension, Diabetes, Coronary heart disease, Leukopenia Lymphocytopenia	No difference in duration of hospitalisation with or without co-morbidity. Lymphocytopenia is associated with prolonged hospitalisation.
Petrakis V et al., 2021 [21]	Greece	133	≥18 years	Glucose>180mg/dL on the day of admission	Hyperglycaemia on admission prolongs hospital stay.
Present study, 2022	Dharwad, Karnataka	402	≥18 years	HbA1c>10	Pre-existing hyperglycaemia prolongs hospital stay.
Inflammatory markers					
Tezcan ME et al., 2020 [28]	Turkey	149	≥18 years	CRP (10 mg/L) Ferritin (>300 mg/mL)	Prolongs hospital stay >7 days.
Kalyon S et al., 2020 [36]	Turkey	258	≥65 years	NLR	NLR was significantly higher in non survivors than survivors and non survivors had longer hospitalisation compared to survivors.

Henry BM et al., 2019 [37]	-	Meta-analysis		NLR	Neutrophilia and Lymphopenia is associated with progression to severe COVID-19 patients in hospitalised patients.
Martino M et al., 2020 [44]	Italy	177	-	Sodium	Hypernatraemia is associated with prolonged hospitalisation and hyponatraemia with severe COVID-19.
Present study	Dharwad, Karnataka	402	≥18 years	C-Reactive Protein (CRP) Ferritin NLR	Elevated CRP >6 (p-value=0.0025), hyperferritinaemia serum ferritin >300: (p-value -0.05), NLR>2 (p-value=0.0183) was associated with prolonged hospitalisation.
Serum sodium					
Pillai J et al., 2020 [45]	Johannesburg, South Africa	642 patients	>18 years	Serum Sodium	Showed that serum sodium more than 145 mmol/L is associated with prolonged hospital stay.
HOPE registry [46]	-	-	-	Serum Sodium	Showed that dysnatraemia was associated with mortality and sepsis in patients with COVID-19.
Present study	Dharwad, Karnataka	402	≥18 years	Serum Sodium	Patients with hyponatraemia and hypernatraemia had prolonged hospitalisation compared to patients with normal serum sodium.
Drugs					
RCT- Adaptive COVID-19 Treatment Trial [47]	Multicentric	1062	≥18 years	Effect of remdesivir	Reduced time to recovery.
Anderson M, et al, 2020. [49]	Single centred Retrospective	1643	≥18 years	Effect of remdesivir on length of hospital stay	Remdesivir shortened Length Of Stay (LOS) by 4 days in more than 9 days cohort. It prolonged LOS in <5 days cohort.
Recovery Trial Group [48]	Multicentric	6425	≥18 years	Effect of steroids in COVID-19	Addition of steroid lowers mortality in patients with high oxygen requirement or mechanical ventilation but not in patients requiring low flow oxygen or no oxygen.
Ma Y et al., 2020 [50]	China	450 patients	≥18 years	Effect of steroids in hospitalised patients with COVID-19	Showed that steroid usage resulted in longer hospitalisation (p-value=0.001) in non severe group and higher use of antibiotics.
Present study	Dharwad Karnataka	402	≥18 years	Effect of remdesivir and steroid	In this study it was found that patients who received remdesivir alone have shorter stay compared to patients who received steroids alone or both steroids and remdesivir.

[Table/Fig-4]: Similar studies from the literature [14,15,17,21,27,28,36,37,44-50].

Limitation(s)

Limitations of this study includes the retrospective nature of the study, heterogeneity of treatment received, lack of systematic monitoring of SARS-CoV-2 PCR and anti SARS-CoV-2 immune response. Also the present study was unable to differentiate from relapsed versus refractory disease.

CONCLUSION(S)

In this study duration of stay in COVID-19 patients was prolonged among patients with underlying co-morbidities like hypertension, diabetes mellitus, ischaemic heart disease. The presence of factors like cytokine storm, hyperinflammation, dysnatraemia, usage for steroids, contributed to prolonged stay in the present study. Further studies are needed to identify other biomarkers that can predict length of hospitalisation.

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