Original Article

Hospital mortality among COVID-19 patients – Experience of a multi-disciplinary tertiary care teaching hospital of Chhattisgarh in Central India

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Abstract

Introduction: The mortality from coronavirus disease 2019 (COVID-19) infection and the severity of it vary among populations. There is a dearth of research on epidemiology and clinical outcomes in central Indian populations with COVID-19. Our aim was to provide an analysis of all hospitalized mortality among patients with COVID-19 infection in a tertiary care hospital of Chhattisgarh in central India. This analysis helped us to know the severity predictors for mortality and in future will help the authorities to formulate a plan to decrease the mortality in the epidemic or uncertain ongoing pandemic. **Methodology:** This was a retrospective observational study using the hospital-based record of multi-disciplinary teaching hospital in Chhattisgarh, India. All COVID-19 reverse-transcriptase polymerase chain reaction-positive patients who were declared dead or died during the course of treatment from April 1, 2020 to March 31, 2021 were included in the study. In-hospital mortality was the primary outcome of interest. In secondary analysis, age and gender distribution, co-morbidity, length of stay, and the cause of death were also investigated. **Results:** A total of 7495 patients with a confirmed diagnosis of COVID-19 were enrolled in the study, of whom 762 (10.16%) died in the hospital with COVID-19 as the primary cause of death. The majority of the patients were more than 60 years of age (45.7%). A total of 416 (54.4%) of the deceased patients were having co-morbidity with diabetes (13.4%), hypertension (16.4%), or both (24.4%). The majority of the patients who succumbed had a hospital stay of less than a week (≤7) (68.5%). More than half of the patients (58.3%) who expired had referred and reported to the hospital in the second or third week of illness. The respiratory system involvement was the dominant contributor of death with pneumonia (78.8%) being the most common cause, followed by acute respiratory distress syndrome (62.2%). 13.6% of expired patients had multiple system involvement, and 11.2% had sepsis as well. **Conclusion:** Mortality in COVID-19 patients was associated with advanced age, co-morbidities such as diabetes and hypertension, and delay in hospitalization. These are high-risk groups and should be vaccinated against COVID-19 on priority.

Keywords: Acute respiratory distress syndrome (ARDS), COVID-19, mortality, multi-disciplinary, pneumonia, severity predictors

Introduction

Pneumonia of an unknown cause was detected in Wuhan, China, in December 2019, which was later named by the World Health Organization (WHO) as coronavirus disease 2019 (COVID-19). This outbreak swept across China and other

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countries, arousing global concern. On March 11, 2020 WHO declared the novel COVID-19, a condition caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) as a pandemic.[1] Compared with SARS and Middle-East respiratory syndrome (MERS), COVID-19 has a lower mortality among confirmed cases. However, elderly patients with underlying co-morbidities, including diabetes, hypertension, and coronary heart disease, are at greater risk of poor outcomes.[2] With a rapid and prolonged increase in patient flow to hospitals, the COVID-19 pandemic has exhausted the hospital systems globally. In India, the first case of COVID-19 infection was reported in Kerala on January 27, 2020.[3] Since then, as of May 29, 2021, 27.89 million people have been infected with the SARS-CoV-2 virus and more than 329 thousand have succumbed to the infection.[4] Despite its tremendous impact, there is a dearth of research on the clinical outcomes and epidemiology of patients with COVID-19 in India. Earlier literature has mainly focused on insights from China and the western or European countries, which are difficult to extrapolate to Indian patients because of different socio-economic, demographic, and clinical characteristics as well as different health care delivery systems that affect utilization patterns.

For management of COVID-19 cases, the Government of India has designated three categories of standalone COVID hospitals, namely, COVID-19 care centers (CCCs), designated COVID-19 health care centers (DCHCs), and dedicated COVID-19 hospitals (DCHs). DCHs have all the emergency and life-saving facilities for patients with the highest severity of disease, and CCCs are meant for patients with mild disease.[5] There have been several studies across the world to assess mortality among COVID-19 patients.[6-10] Similar data are scarce in India, having the second highest COVID-19 death numbers across the world. Our institute is mainly recognized as India's second institute to cater to a large amount of COVID cases. The study intends to analyze the in-hospital mortality retrospectively from the records of COVID-19-diagnosed patients in a tertiary care dedicated COVID-19 hospital.

Methodology

Study design and setting

This is a single-center, hospital-record-based, observational (descriptive) retrospective study for all the COVID-19 patients died or declared dead in our hospital from April 1, 2020 to March 31, 2021. Being a retrospective study, the consent waiver was requested, and the study was approved from the institute ethical committee (IEC) in accordance with the principles of the Declaration of Helsinki. The study setting includes a dedicated COVID-19 multi-disciplinary teaching hospital in Chhattisgarh, India.

Study population

The study population consists of all the patients who were diagnosed COVID-19-positive with reverse-transcriptase polymerase chain reaction (RT-PCR) and admitted in the hospital and who died during the treatment. All those patients who died while coming to the hospital and were declared dead inside the hospital were included, if the history of the disease and its progression could be elicited with reasonable clarity from the hospital records or from the next of kin or attendant accompanying the patient.

Inclusion and exclusion criteria

All the COVID-19 deceased patients from April 1, 2020 to March 31, 2021 were included in the study. All those deceased patients whose demographic information and cause of death were incomplete were excluded from the study.

Data collection

The data were collected from the medical record department (MRD), admission and discharge registers, online investigation records using standardized data collection sheets and compiled using Microsoft excel 2015 version.

Statistical analyses

The data analysis was performed using SPSS (Statistical Packages for Social Science) version 22. The qualitative information represented with frequencies and percentage. The quantitative data were analyzed through normality test and were represented using mean or median values along with standard deviation or inter-quartile range (IQR).

Results

Demographic profile

From April 1, 2020 to March 31, 2021, a total of 7495 patients were admitted after they were diagnosed COVID-19-positive through RT-PCR testing. Among them, 762 (10.16%) died during the treatment. The mean age of COVID-19 patients was 48.1 ± 5.2 years as compared to the mean age of 57.6 ± 2.4 years among those expired. The difference was significant (p value <0.04) among all the patients who died after the diagnosis of COVID-19 and included in this study (N = 762); the majority of the patients were more than 60 years of age (45.7%), followed by 40–60 years (322, 42.1%). Among the deceased, 24 patients were under 20 years of age, and five patients below 10 years of age. The minimum and maximum age ranged from 3 years to 100 years [Table 1].

There was a significant difference of age and gender distribution among those discharged after being cured and those who died during the treatment (*P* value < 0.001, 0.001, respectively) [Table 2].

Clinical and laboratory profiles

The most common symptoms with deceased patients were cough (33.9%), followed by fever (27.5%) and dyspnea (17.4%). A total of 416 (54.4%) of the deceased patients were having

Table 1: Key characteristics of patients

Age	
Mean Age (Years)	57.6±2.4
Distribution – No. (%)	
<10 years	5 (0.6)
10 years	19 (2.4)
20 to 40 years	68 (8.9)
40 to 60 years	322 (42.1)
>60 years	349 (45.6)
Gender – No. (%)	
Female	188 (24.4)
Male	577 (75.6)

Table 2: Demographic comparison among discharged and dead patients

	Discharged Patients	Dead Patients	*P*
Age group			
<20 years	661 (8.8%)	24 (3.14%)	<0.001
20-40 years	2586 (34.5%)	68 (8.9%)	
40-60 years	2590 (34.7%)	322 (42.14%)	
>60 years	1622 (21.6%)	350 (45.8%)	
Gender			
Male	4898 (55.4%)	577 (75.5%)	<0.001
Female	2597 (34.6%)	187 (24.4%)	

co-morbidity with diabetes (13.4%) or hypertension (16.4%), and the majority among them (24.4%) were having both diabetes and hypertension [Table 3].

Most of the diseased patients had tachypnea (68.9%), and a significant number had SpO2 <95% (55%) at the time of presentation. Only 7.3% of the patients were on nasal prong, 28.4% of patients required a non-re-breather mask (NRBM), 34.9% were on continuous positive airway pressure therapy (CPAP), and 8.3% were on intermittent mandatory ventilation (IMV) at admission [Table 3].

The hemoglobin level of the deceased patient was 12.8 gm/dL (IQR 10.9–14.2), suggesting that anemia was not one of the severity predictors. The total leucocyte count (TLC) was in tune of 13.2 x 10^9/L (8.7–16.8). The renal and liver function test has not deteriorated during admission. Inflammatory markers including C-reactive protein (CRP), lactate dehydrogenase (LDH), and ferritin were all higher among non-survivors [Table 4]. The median CRP level was 80.0 mg/L (IQR 39.4–133.1) against the normal of less than 1; similarly, LDH was around 610 U/L (IQR 473.2–786.2) against the normal upper limit of 210 U/L. The ferritin level was also raised during admission in a tune of 1081.8 ng/ml (IQR 768.0–1650.0); the value of ferritin is slightly undermined because the laboratory report has a maximum ceiling of 1650ng/ml; any values more than this were not being recorded. With these three inflammatory markers, there was a clear association that more the rise in inflammatory markers, more the chances of mortality [Table 4].

Delay in and duration of hospitalization

Delay in hospitalization was another factor adding to mortality. The median duration of illness prior to admission was 7 days (IQR 5–11). More than half of the patients (58.3%) who expired had reported to the hospital in the second or third week of illness [Table 5].

The median duration of stay among all those deceased was 5.5 days (IQR 3–9) after being diagnosed. The majority of the patients who succumbed had a hospital stay of less than a week (≤7) (68.5%). Another thing noticed was that 75.9% of those who expired had stayed in the hospital for more than 48 hours [Table 6]. These mortalities might be attributed to hospital-acquired infection.

There was no significant difference of median length of hospital stay among males and females or between the different age groups before they succumbed (*P* value 0.94 and 0.125, respectively). There was also no statistically significant difference of duration of hospital stay among those who died and those who were discharged (*P* value 0.09).

Multi-disciplinary Involvement

60.9% of all the deceased patients were admitted to the Department of General Medicine or the Department of Trauma and Emergency with difficulty in breathing but without a confirmed COVID-19 report. Eventually, they were tested and were diagnosed as COVID-19-positive before being shifted to the COVID ward. Only 10.4% of the deceased patients came to the hospital with a positive test report and were admitted directly to the COVID ward.

Apart from General Medicine and Trauma and Emergency, other departments, which had significant patient load, were Pulmonary Medicine, Pediatrics, Neurology or Neurosurgery, General Surgery, and Nephrology or Urology. Assessment of the death reports to find the system involvement among all the deceased patients revealed that the respiratory system involvement was the dominant contributor of death among the COVID-19 patients, followed by urinary and cardio-vascular systems. 4.7% of the patients were brought dead to the hospital.

Multi-system disorder

The most common respiratory causes of death included pneumonia, followed by acute respiratory distress syndrome [Table 7]. Other causes included acute pulmonary edema, pulmonary hypertension, pulmonary embolism, acute exacerbation of chronic obstructive pulmonary disease (COPD), acute hypoxic respiratory failure, aspiration pneumonia, cardio-pulmonary arrest, community acquired pneumonia, pulmonary hemorrhage, extensive pulmonary tuberculosis, hospital-acquired pneumonia, Type I and Type II respiratory failure, lower respiratory tract infection, persistent pulmonary hypertension of newborn, empyema, respiratory acidosis, and right lung carcinoma with respiratory failure.

Table 3: Clinical signs at presentation in non-survivors

Clinical Signs at Presentation	Percentage (%)
Symptoms	
Fever	27.5
Cough	33.9
Dyspnea	17.4
Co-morbid conditions	
Hypertension (HTN)	16.4
Diabetes (DM)	13.4
DM+HTN	24.4
Mask Required	
Nasal Prong	7.3
Face Mask	14.7
Non-Re-Breather Mask (NRBM)	28.4
High Flow Nasal Cannula (HFNC)	3.7
Bi-level Positive Airway Pressure (BiPAP)	1.8
Continuous Positive Airway Pressure Therapy (CPAP)	34.9
Intermittent Mandatory Ventilation (IMV)	8.3
Systolic Blood pressure (mm/Hg)	
<90	2.8
90-140	79.6
>140	17.6
Diastolic Blood Pressure (mm/Hg)	
<60	5.6
60-80	47.2
>80	47.2
Pulse Rate/min	
<60	1.9
60-100	64.8
>100	33.3
Respiratory Rate/min	
<16	0
16-20	31.1
>20	68.9
Oxygen Saturation (%)	
SpO_2 <95	22
SpO_2 ≥95	78

Table 4: Baseline laboratory parameters

Lab. Investigation in Non-Survivors	Median (IQR)
Hemoglobin (gm/dl)	12.8 (10.9-14.2)
WBC Count (10^9/L)	13.2 (8.7-16.8)
Platelet Count (10^9/L)	213.0 (147.0-293.5)
Absolute Neutrophil count (ANC) (10^9/L)	8.9 (8.3-9.3)
Absolute Lymphocyte count (ALC) (10^9/L)	6.3 (3.4-10.2)
Creatinine (mg/dl)	1.1 (0.8-1.5)
Total Bilirubin (mg/dl)	0.7 (0.6-1.0)
Direct Bilirubin (mg/dl)	0.2 (0.1-0.3)
ALT (U/L)	39.0 (24.0-67.0)
AST (U/L)	45.0 (32.0-80.0)
Prothrombin Time (sec)	12.9 (11.3-14.8)
APTT (sec)	33.4 (28.1-42.1)
C-Reactive Protein (mg/L)	80.0 (39.4-133.1)
Lactate Dehydrogenase (LDH) (U/L)	610.0 (473.2-786.2)
Ferritin (ng/ml)	1081.8 (768.0-1650.0)

Common cardiovascular causes of death included cardiac arrest, followed by coronary arterial disease and acute myocardial infarction. Urinary complications causing death were most commonly because of acute kidney injury, followed by chronic kidney disease and end stage renal disease.

Multiple system involvement was seen among 13.6% of the deceased patients. 11.2% of them had sepsis as a major complication. Central nervous system causes of death included meningitis and encephalitis. The rarer causes included acute ischemic or hemorrhagic stroke, cerebro-vascular accidents with or without hemiparesis, brain coning, raised intra-cranial pressure, cerebral edema, encephalopathy, hypoxic brain injury because of embolism, and intra-ventricular hemorrhage.

The rarer gastro-intestinal causes of injury included upper gastrointestinal bleed, fulminant hepatitis, acute liver failure, hepatic encephalopathy, acute viral hepatitis, chronic liver disease, de-compensated liver failure, alcoholic pancreatitis, and alcoholic hepatitis.

Discussion

Demographic profile

This study revealed about the analysis of in hospital mortality among the COVID-19 patients who were hospitalized in our institute from April 1, 2020 to March 31, 2021. The mean age of our study population was 57.6 (±2.4) years, with the highest rate of mortality in the age group above 60 years. This finding of a higher rate of mortality in the advancing age group is in line with one of the largest studies with detailed data focused on older patients with COVID-19. Dr. Bhargava *et al.*[7] found that the mean age of deceased COVID-19 patients was 70.4 years and 52% of all those who died were male. Torres *et al.*[8] performed a study to assess determinants of death among COVID-19 patients and concluded that overall, more than 75% of the deaths were among patients older than 75 years of age. There was a significant difference of death among more than 80 years and less than 60 years of age. Dr. de Souza *et al.* assessed the clinical outcomes among the hospitalized patients in Mumbai, India, and found that among the deceased patients, 41% were more than 60 years of age and more than 43% were among 40–60 years age group, only 1.8% constituted less than 20 years age group, and males represented 60% of the all death among the COVID-19 patients.[11] Our study also confirms the male dominance which is in view of multiple co-morbidities as compared to females among the deceased COVID-19 patients. The mean age of the patients who died in our hospital was younger than those of previously reported studies elsewhere in the country. The population of 20 to 60 years contributed more than 50% among total death. This might be because of delayed access to multi-disciplinary health care for COVID patients in our community.

Risk factor

Shi *et al.*,[12] in their study to analyze the risk factors for in-hospital mortality of COVID-19 patients with diabetes,

Table 5: Duration of illness prior to admission (Delay in Hospitalization)

No. of Days of delay in Hospitalization	Percentage of expired patients	
1-5	38.0	
6-10	35.1	}58.3
11-15	18.6	
16-20	4.6	
21-25	2.8	
25-30	0.9	

Table 6: Duration of hospital stay

No. of Days of hospitalization			Percentage (%)		
0-2	}≤7 days	≤48 hrs	24.1	}68.5	24.1
3-7		}>48 hrs	44.4		}75.9
8-14			24.1		
15-21			7.4		

Table 7: Distribution of predominant systems involved in causes of death among COVID-19 patients

	Frequency	Percentage
Respiratory System		
Pneumonia	602	78.8
ARDS (acute respiratory distress syndrome)	475	62.2
ARDS and COPD	2	0.3
COPD	2	0.3
Tuberculosis	8	1
Cardio-vascular Symptoms		
Cardiac failure	2	0.3
Cardiac arrest	24	3.1
Coronary artery disease	22	2.9
Acute Myocardial Infarction	8	1.0
Renal Complications		
Acute Kidney Injury	51	6.7
CKD (chronic kidney disease)	15	2
Renal failure and ESRD (end stage renal disease)	9	1.2
CNS complications		
Encephalitis	2	0.3
Meningitis	2	0.3
Multiple system involvement		
Sepsis and Septic shock	89	11.6
Multiple organ dysfunction	15	2

had concluded that COVID-19 patients with diabetes had worse outcomes compared with the sex- and age-matched patients without diabetes. Older age and co-morbid hypertension independently contributed to in-hospital death of patients with diabetes. Similarly, a meta-analysis concluded that diabetes, hypertension, and especially cardio-vascular disease are important risk factors for severity and mortality in COVID-19-infected people.[13] The findings of our study confirm that having co-morbidity with diabetes (13.4%) or hypertension (16.4%) or both (24.4%) increases the in-hospital mortality.

Duration of stay

Dr. Rees *et al.*[14] assessed the in-patient hospital stay among the COVID-19 patients and concluded that the median duration of stay outside China is 5 days (IQR 3–9 days). The median length of stay among the deceased patients in our study is 5.5 days (IQR 3–9), which is comparable to those previously reported. Apparently, a shorter length of stay may be because of the adverse outcome and higher severity of referred patients in our study setting.

Outcome

Malhotra *et al.*[15] performed a study at the largest dedicated tertiary care COVID-19 government hospital in New Delhi, India, to assess the outcomes among hospitalized COVID-19 patients with moderate to severe illness and have found that mortality in the patients with COVID-19 also occurred early after admission, suggesting rapid deterioration, delayed reporting by patients, or their late referral from other health facilities. Similar findings were seen in our study, that is, more than half of the patients (58.3%) who expired had reported to the hospital in the second or third week of illness.

Mortality

In-hospital mortality among admitted COVID-19 patients in our study found in 762 (10.16%) of cases. An Indian study conducted at All Institute of Medical Sciences, Patna, and another at the dedicated tertiary care COVID-19 government hospital in New Delhi had reported in-hospital mortality of 11%[15] and 13.72%,[16] respectively, whereas the one conducted at Jaipur with 234 mild COVID-19 cases among young adults reported that all patients were discharged alive. The mortality rate among the hospitalized patients in our study as well as other Indian studies was significantly lower compared with reports in Brazil (39.6%)[17] and New York, USA (21%).[18] Another study to assess in-hospital mortality of patients with COVID-19 across the globe, which combined findings of 43 studies from 12 countries, reported the in-hospital mortality across America, Europe, and Asia to be 22%, 22%, and 12%, respectively.[19] From this, we can conclude that in-hospital mortality among COVID-19 varies across the world and this variation probably depends on demography, age composition of the region, availability of health care facility, socio-economic status, severity criteria of admission, co-morbidities in the patient, and so on.

Multi-system involvement

Casals *et al.*[20] assessed the multiple organ involvement among the COVID-19 patients and reported involvement of respiratory, cardio-vascular, cerebro-vascular, hematological, and pancreatic involvement among the patients. Dr. Gavriatopoulou *et al.*[21] also reviewed the organ involvement among the COVID-19 patients and reported significant involvement of respiratory, cardio-vascular, gastro-intestinal, and central nervous systems.[21] Similar findings have been corroborated in our study, which reveal the involvement of the respiratory and cardio-vascular systems as two major systems contributing to COVID-19 adverse outcomes.

Strength and limitation of the study

The major strength of this study was the large number of patients both admitted and deceased; this has helped to do a thorough analysis of this pandemic.

The major limitation of this study was that being a retrospective study which has its own limitation, the case control study was very difficult to plan in view of a very high infectivity rate among health care workers. The other limitation was poor supply of chemical reagents, which has led to frequent non-availability of important investigations such as interlukin-6 (IL-6), d-dimer, ferritin, and so on.

Conclusion and Recommendation

The importance of hospital-based mortality statistics cannot be over-emphasized as it serves as an indirect measure for access to health care and the true burden of disease among specific age or gender categories. This also reflects on the part of the health care system affected disproportionately as compared to others. This can serve as an important decision-making tool for re-structuring and prioritization of the health care resources.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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