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Mortality among adult hospitalized patients during the first wave and second wave of COVID-19 pandemic at a tertiary care center in India

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Abstract

The similarities and differences between the mortality patterns of the two waves in India remain largely unknown. This was a retrospective study of medical records conducted in the COVID data center of our hospital This study analyzed data of patients who died in the month of August, 2020 to October 2020 (one month before and after the peak of first wave i.e., 16th September, 2020) and April 2021 to June 2021 (one month before and after the peak of second wave i.e., 6th May, 2021), corresponding to an equal part of the pandemic during first (2020) and second (2021) wave. Out of 1893 patients in the study, 764 patients were admitted during the first wave and 1129 patients during the second wave of pandemic. In total, 420 patients died during the entire study period. Of those, 147 (35%) deaths occurred during the first wave and 273 (65%) during the second wave, reflecting a case fatality rate (CFR) of 19.2% during the first wave and a CFR of 24.18%. There were no significant differences in the age group, gender, presenting complaints, duration of stay and comorbidities. However, the deceased COVID-19 patients had an increase in case fatality rate, average duration of symptoms from onset to hospital admission (DOSHA) and a major shift from MODS to ARDS being the cause of death during the second wave of pandemic. This study demonstrates increased CFR, average DOSHA and a paradigm shift to ARDS as cause of mortality during the second peak of the pandemic. It is necessary to remain vigilant of newer COVID-19 variants of concern, follow COVID-19 appropriate behaviors and keep emphasizing on care of high-risk groups including patients with comorbidities and elderly population to prevent mortality.

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Introduction

Since COVID-19 inception, several countries have seen multiple peaks of reported cases (Figure 1) [1]. In India, the peak of first wave of COVID-19 appeared on 16th September, 2020 with 97,894 new cases in a single day [2]. The world's largest vaccination drive for eligible beneficiaries was initiated on16th January 2021 [3]. Unfortunately, the number of cases of patients with COVID-19 began to increase towards the end of March, 2021 and a month later it presented numbers almost 4 times to those in September, 2020. The number of daily deaths rose sharply in the second wave [4].

A comparison of the mortality patterns of two waves is feasible through the study of the hospitalized patients for whom disease was confirmed by reverse transcription-polymerase chain reaction (RT-PCR) and death occurring in the hospital [5]. Real world data comparing patients hospitalized in the same clinical setting during the different stages of the pandemic are scarce. The current study was planned to compare the mortality profile among admitted patients during the peak period of cases at a tertiary care center.

Materials and Methods

This was a retrospective study of medical records conducted in the COVID data center of our hospital after the approval from Institutional Ethics Committee. This study analyzed data of patients who died in the month of August, 2020 to October 2020 (one month before and after the peak of first wave i.e., 16th

September, 2020) identified as period 1 (P-1); and April 2021 to June 2021 (one month before and after the peak of second wave i.e., 6th May, 2021) identified as period 2 (P-2), corresponding to an equal part of the pandemic during first (2020) and second (2021) wave.

All the patients with confirmed RT-PCR reports were included in the study. Patients younger than 18 years were not included in the study. The patients who were brought dead in hospital were also excluded.

The demographic data, co-morbidities, length of stay (LoS), duration from onset of symptoms to hospital admission (DOSHA), case fatality rate (CFR) and cause of death (CoD) of hospitalized COVID-19 patients during the first and second wave of pandemic have been systematically compared.

Results

During P-1, 764 patients and during P-2, 1129 patients were admitted in the authors' centre. Of 420 deaths, 147 (35%) occurred during P-1 and 273 (65%) during P-2, reflecting a CFR of 19.2% and 24.18% respectively. (Table 1) The mean age of deceased patients is 54.6 years (18-85 years) during P-1 and 57.4 years (18-90 years) in P-2. The age wise distribution of CFR during P-1 and P-2 is depicted in Table 2. The mortality was observed higher in males in both periods (Table1). The average duration from onset of symptoms to hospital admission (DOSHA) was 4.8 (0-25) days and 7.1 (0-30) days in P-1 and P-2 respectively (Table 1) The comparative representation of symptoms is presented in Table 1. The age specific presenting complaints during the first and second wave of pandemic is depicted in Table 2.

Out of all the hospitalized cases during the study period, 20.07% patients presented with Hypertension and 17.01% patients presented with diabetes mellitus (DM) (Supplementary table 1). The comparative frequency of comorbid conditions among the deceased is represented in Table 1; with hypertension and diabetes being equally common. The age wise distribution of comorbidities is represented in Table 2. The frequency of patients with different numbers of comorbidities in P-1 and P-2 is depicted in Table 1. Most of the patients who died had at least 1 comorbidity in P-1 (70.06%) and P-2 (66.66%). Notably, there is a rise in the mortality of patients without any comorbidity in P-2.

The mean LoS among the deceased was 6 days (1-32 days) and 7.7 days (1-44 days) in P-1 and P-2 respectively. Most of the patients died during the second week of hospital stay in both P-1 and P-2 (Table 1).

Aon evaluation of the cause of mortality, multi-organ dysfunction syndrome (MODS) was the leading cause of death (59.4%) followed by ARDS (28.37%) during the P-1 but the pattern was reversed in P-2 (Table 1). Th cause of mortality distribution among all age-groups is depicted in Table 2.

Discussion

The current study compared the epidemiological, clinical characteristics and cause of mortality among admitted COVID-19 patients.

The mortality and comorbidities comparison with other nations is shown in Supplementary Table 2 [5,6,8-11]. In authors' current center, the increase in overall in-hospital CFR was similar to the cohort studies from Germany (Supplementary Table 2). On the contrary, Spain, Japan, Iran, UK and Italy demonstrated a marked decrease in CFR during the second wave of pandemic. [5-11] The observatory finding can be attributed to large scale vaccination prior to the second peak and continuation of COVID-19 appropriate behavior. It is also evident that COVID-19 patients from Spain and Italy [5,6] in both waves were predominantly elderly, with comorbidities and had prolonged hospital stay unlike our population which was relatively young, with shorter hospital stay (Supplementary Table 2). This can be attributed to the young population of developing nations like India, but a similar mortality as the elderly of developed nations makes this of immense national importance.

The authors did not observe any significant differences in the age group, gender, presenting complaints, duration of stay and comorbidities among the patients in our center in the two peaks. Notably, an increase in CFR and DOSHA was observed in the second wave. There was an increase in duration of symptoms and length of stay in hospital among the deceased patients in the second wave. Also, there was a major shift from MODS to ARDS being the most common cause of death during the second wave of Pandemic. The decrease in MODS among deceased patients, may be a direct result of increased knowledge about the clinical management of COVID-19, improved treatment strategies and protocol that were developed during the year 2021. It is safe to assume that the experience gained during the first wave have contributed to a better management of hospitalized COVID-19 patients during the second wave.

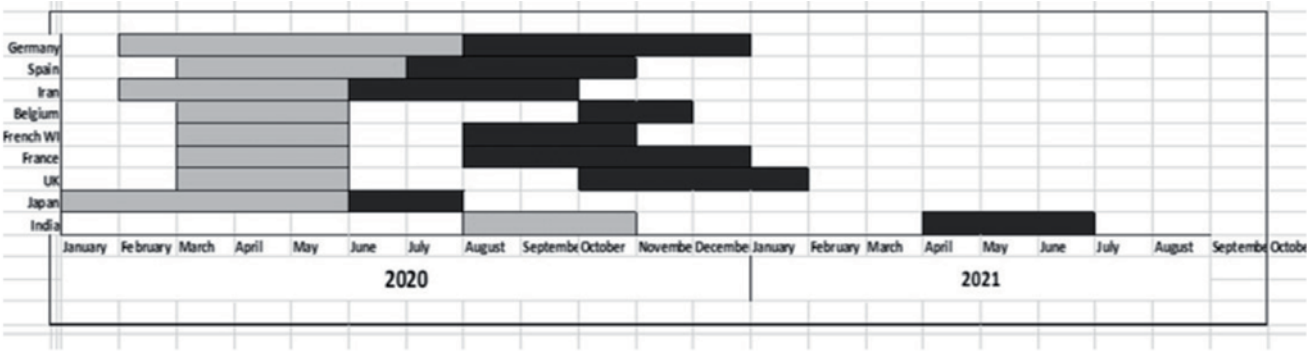

Figure 1. Timeline of COVID-19 peaks in various countries.

Table 1. Epidemiological and clinical profile of COVID-19 patients' mortality in 2020 and 2021.

Groups	2020		2021		Total		p-value
	n=147	%	n=273	%	n=420	%	
Duration of symptoms (days)							0.00161
0	13	8.84	5	1.83	18	4.29	
1-5	91	61.9	124	45.42	215	51.19	
6-10	32	21.77	98	35.9	130	30.95	
11-15	6	4.08	29	10.62	35	8.33	
>15	5	3.4	17	6.23	22	5.24	
Length of stay (days)							0.00961
<1	16	10.88	15	5.49	31	7.38	
1-7	86	58.5	147	53.85	233	55.48	
8-14	29	19.73	69	25.27	98	23.33	
15-21	9	6.12	28	10.26	37	8.81	
22-28	6	4.08	10	3.66	16	3.81	
>28	1	0.68	4	1.47	5	1.19	
Sex ratio							
Male	83	56.46	157	57.51	240	57.14	
Females	64	43.54	116	42.49	180	42.86	
Comorbidity							
Cardiovascular diseases	62	42.18	155	56.78	217	51.7	0.00429
Hypertension	53	36.05	115	42.12	168	40	
Coronary artery disease	9	6.1	37	13.55	46	10.9	
Rheumatic heart disease	0	0	2	0.73	2	0.47	
Neurological	8	5.44	17	6.23	25	6	0.74572
Stroke	6	4.08	8	2.93	14	3.3	
Seizure disorder	2	1.36	2	0.73	4	1	
Vertigo	0	0	1	0.37	1	0.2	
Alzheimer's disease	0	0	1	0.37	1	0.2	
Parkinsonism	0	0	2	0.73	2	0.5	
Guillain-Barré syndrome	0	0	1	0.37	1	0.2	
Peripheral neuropathy	0	0	2	0.73	2	0.5	
Endocrine	62	42.18	127	46.52	189	45	0.39345
Diabetes mellitus	53	36.05	103	37.73	156	37.1	
Hypothyroidism	9	6.12	24	8.79	33	7.9	
Respiratory diseases	11	7.48	18	6.59	29	6.9	0.73162
Chronic obstructive pulmonary disease	9	6.12	12	4.4	21	5	
Bronchial asthma	2	1.36	6	2.2	8	1.9	
Renal	10	6.8	19	6.96	29	6.9	
Chronic kidney disease	9	6.12	17	6.23	26	6.2	
Renal calculi	1	0.68	2	0.73	3	0.7	
Liver	7	4.76	2	0.73	9	2.1	
Chronic liver disease	6	4.08	2	0.73	8	1.9	
Hepatitis C virus infection	1	0.68	0	0	1	0.2	
Tuberculosis	4	2.72	6	2.2	10	2.4	0.73724
Pulmonary tuberculosis	4	2.72	4	1.47	8	1.9	
Extra-pulmonary tuberculosis	0	0	2	0.73	2	0.5	
Malignancy	6	4.08	18	6.59	24	5.7	
Hematological							
Leukemia	2	1.36	6	2.2	8	1.9	
Non-hematological							
Carcinoma bladder	2	1.36	2	0.73	4	0.95	
Ovarian mass	1	0.68	3	1.1	4	0.95	
Carcinoma lung	1	0.68	0	0	1	0.24	
Carcinoma urothelial	0	0	2	0.73	2	0.48	
Carcinoma stomach	0	0	3	1.1	3	0.71	
Carcinoma breast	0	0	2	0.73	2	0.48	
Miscellaneous	6	4.08	16	5.86	22	5.24	
Psychiatric illness	0	0	1	0.37	1	0.24	
Intestinal obstruction	1	0.68	1	0.37	2	0.48	
Choledolithiasis	1	0.68	2	0.73	3	0.71	
Dyslipidemia	1	0.68	2	0.73	3	0.71	
Human immunodeficiency virus	0	0	1	0.37	1	0.24	
Myasthenia gravis	0	0	1	0.37	1	0.24	
Benign prostatic hyperplasia	2	1.36	7	2.56	9	2.14	
Rheumatoid arthritis	1	0.68	1	0.37	2	0.48	
Number of comorbidities in 1 person							
0	44	29.93	91	33.33	135	32.14	
1	52	35.37	73	26.74	125	29.76	
2	30	20.41	63	23.08	93	22.14	
3	17	11.56	34	12.45	51	12.14	
≥4	4	2.72	12	4.4	16	3.81	

The common presenting complaints among deceased patients were similar in both waves with an increase in the percentage of dyspnea, fever, and cough and sore throat during the second wave of pandemic. Thus, despite similar epidemiological profile of admitted patients, there was evidence of increased pulmonary involvement as a primary cause of mortality. The finding could be attributed to mutational variants and decrease in adherence to COVID-19 appropriate behavior (CAB) in the country [12].

The mean age of admitted patients in current study noted increase in hospital admissions and mortality among 60 years and older in comparison to P-1. Despite the age difference among hospitalized patients at different phases of the pandemic, it has been shown that more deaths have occurred in geriatric patients in most European countries [5,6,10,11] in both the first and second waves of the pandemic, which is also in line with our single-center observation. Thus, the geriatric population should continue to be the major target to be vaccinated at the earliest to prevent future morbidity and mortality.

A significant increase in the average duration of onset of symptoms to hospital admission during second wave may be attributed to the unavailability of beds due to high burden of patients, the presence of new variant of SARS-CoV-2, and the increased pulmonary severity during the second wave of Pandemic in 2021.

The risk of severity, need of hospital admission and an unfavorable outcome is increased in the presence of comorbidities [13]. The most common pre-existing illness among all the hospitalized patients as well as deceased patients in our hospital, was cardiovascular disorders (including hypertension) followed by diabetes mellitus. This trend is similar in hospitalized COVID–19 patients across the globe (Supplementary Table 2) except in Japan where the leading comorbidity is chronic respiratory disease followed by cardiovascular disorders [8]. This finding is of immense public health significance. The importance of prevention, diagnosis and adequate control of comorbidities, especially diabetes mellitus, cannot be overemphasized [14].

Limitations

The data was mainly collected from death files and digital data management portal. Therefore, the effect of other variables, such as weight, body mass index, smoking history and socio-economic status on outcome and mortality could not be assessed. The two periods were highly dissimilar in terms of strain on healthcare system and resources; the second wave was characterized by overloaded medical care. Therefore, only in-hospital mortality could be assessed. Besides, it was a single-center retrospective study which may not be representative of the entire population of India.

Conclusions

This study demonstrates increased CFR, average DOSHA and a paradigm shift to ARDS as cause of mortality during the second

Table 2. Age-wise distribution of mortality, symptoms, comorbidities and cause of death in deceased patients.

	18-45 years		46-60 years		>60 years	
	2020	2021	2020	2021	2020	2021
Hospital admissions	404 (52.88)	450 (39.86)	189 (24.74)	358 (31.71)	171 (22.38)	321 (28.43)
Mortality	43 (29.25)	63 (23.08)	50 (34.01)	88 (32.23)	54 (36.73)	122 (44.69)
Case fatality rate	10.64	14.00	26.46	24.58	31.58	38.01
Presenting complaints						
Dyspnea	31 (21.09)	47 (17.22)	42 (28.57)	74 (27.11)	42 (28.57)	105 (38.46)
Fever	24 (16.33)	48 (17.58)	28 (19.05)	68 (24.91)	35 (23.81)	102 (37.36)
Cough	15 (10.20)	44 (16.12)	25 (17.01)	61 (22.34)	31 (21.09)	88 (32.23)
Sore throat	1 (0.68)	9 (3.30)	6 (4.08)	13 (4.76)	4 (2.72)	23 (8.42)
Bodyache	4 (2.72)	2 (0.73)	3 (2.04)	13 (4.36)	1 (0.68)	10 (3.66)
Headache	1 (0.68)	1 (0.37)	2 (1.36)	5 (1.83)	0 (0.00)	2 (0.73)
Diarrhoea	0 (0.00)	1 (0.37)	1 (0.68)	2 (0.73)	1 (0.68)	4 (1.47)
Vomiting	2 (1.36)	1 (0.37)	0 (0.00)	2 (0.73)	0 (0.00)	1 (0.37)
Chest pain	1 (0.68)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	2 (0.73)
Rhinorrhea	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.37)	0 (0.00)	1 (0.37)
Comorbidities						
Hypertension	6 (4.08)	9 (3.30)	25 (17.01)	33 (12.01)	22 (14.97)	73 (26.74)
Diabetes	9 (6.12)	14 (5.13)	23 (15.65)	34 (12.45)	21 (14.29)	55 (20.15)
CAD	2 (1.36)	0 (0.00)	3 (2.04)	3 (1.10)	1 (0.68)	23 (8.42)
Hypothyroidism	1 (0.68)	4 (1.47)	4 (2.72)	5 (1.83)	4 (2.72)	15 (5.49)
CKD	2 (1.36)	3 (1.10)	6 (4.08)	6 (2.20)	1 (0.68)	8 (2.93)
Respiratory diseases	1 (0.68)	2 (0.73)	2 (1.36)	4 (1.47)	8 (5.44)	12 (4.40)
Cause of death						
ARDS	10 (23.26)	27 (42.86)	19 (38.00)	43 (48.86)	13 (24.07)	76 (62.30)
Cardiogenic shock	1 (2.33)	2 (3.17)	3 (6.00)	3 (3.41)	1 (1.85)	5 (4.10)
Hemorrhage	0 (0.00)	0 (0.00)	3 (6.00)	0 (0.00)	0 (0.00)	0 (0.00)
MODS	27 (62.79)	27 (42.86)	24 (48.00)	35 (39.77)	36 (66.67)	38 (31.15)
Pulmonary embolism	1 (2.33)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
Septic shock	4 (9.30)	7 (11.11)	1 (2.00)	7 (7.95)	4 (7.41)	3 (2.46)

CAD, coronary artery disease; CKD, chronic kidney disease; ARDS, acute respiratory distress syndrome; MODS, multiorgan dysfunction syndrome.

peak of the Pandemic. It is necessary to remain vigilant and keep emphasizing on care of high-risk groups including patients with comorbidities and elderly population to prevent mortality.

It is necessary to remain vigilant in the constant study of the characteristics of the disease, if necessary, shall be able to modify our strategies quickly to combat this pandemic and disseminate our results to the scientific community and society as soon as possible for coordinate and global actions. Appropriate triage [13] into mild, moderate and severe categories with judicious utilization of resources for severe and life-threatening cases can prevent morbidity and mortality.

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