Original Article

Severity of respiratory illness among Covid-19-vaccinated and non-vaccinated admitted patients—An observational study from a teaching hospital of Tripura

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Abstract

Objective: To determine the association between vaccination status and mortality among critically ill patients admitted in a dedicated Covid hospital of Tripura who required invasive mechanical ventilation. **Material and Methods:** This study was conducted at a dedicated Covid hospital of Tripura for a period of six months, i.e., from June 2021 to November 2021. A total of 304 patients were enrolled for this study. Baseline epidemiological, radiological data along with other information like heart rate, pulse rate, oxygen saturation (SpO_2), etc., were collected through patient record sheet in all cases during hospitalization. Statistical analysis was done by using SPSS 25 version. **Results:** Admission and mortality rates in hospital and advanced oxygen support like bi-level positive airway pressure (BiPAP), high-flow nasal cannula (HFNOC), and ventilator use incidences were higher in non-vaccinated patients (17.1%) in comparison to double-dose-vaccinated (0.98%) and single-dose (2.3%)-vaccinated patients. **Conclusion:** This retrospective data analysis of Covid-19 positive patients admitted in the dedicated Covid Hospital of Tripura suggests that severe infection, need for invasive and non-invasive ventilation, and death were significantly less in the vaccinated patients as compared to the vaccine-naive one.

Keywords: Covid-19, respiratory illness, treatment outcomes, vaccine

Introduction

Coronavirus disease was originated in Wuhan city of China in early December of 2019. This outbreak of Covid-19 was declared a pandemic by WHO and presented a great challenge for healthcare workers across the globe. This public health emergency required urgent effort to develop and test efficacy and safety of vaccines to combat Covid-19 pandemic. Most consistent features of Covid-19-related lung pathology are distinct parenchymal changes, thrombi in peripheral pulmonary vessels, diffuse alveolar damage, etc., As the disease advances, the oxygenation of the patient is affected, then CO_2 elimination, ARDS, and ultimately respiratory failure. To manage this hypoxia, different type of oxygen delivery devices are in use, like simple

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face mask (SFM), oxygen face mask with non-rebreathing bag, BIPAP, HFNOC, and invasive ventilation. Whole world, including India, was passing through the devastating nature of Covid-19 pandemic. In India, research on the efficacy of single dose vaccine/double dose vaccine in preventing respiratory involvement is very scarce. The case fatality rate (CFR) was higher with ICU patients during the second wave of Covid-19 infection. Even at that time, the need for ventilation and oxygen requirement was much higher as compared to the first wave. Generally, vaccine breakthrough infection occurs when SARS CoV-2 antigen is detected in a respiratory specimen collected from a person who has taken all recommended doses of an authorized Covid-19 vaccine minimum 14 days back. Factors like mutations in the virus, vaccine ineffectiveness, faulty techniques of vaccination, and host factors are mostly involved in this vaccine breakthrough infection.[1,2] During second wave, some vaccinated individuals also got infected with Covid-19 as no vaccine is fully effective.[3] But, it is expected that these individuals will have less severe form of infection and less requirement of intensive care unit (ICU) admission as compared to the non-vaccinated patients. This is mainly due to the ability of vaccines to produce immunological memory responses, which causes the onset of Covid-19 infection.[4,5] Up to April 30, 2021, a total of 10262 SARS-CoV-2 vaccine breakthrough infections were reported from the United States of America.[6] Out of this, 27% vaccine breakthrough infections were asymptomatic, 10% patients were hospitalized, and 2% patients died. In a study from Christian Medical College, Vellore, investigators reported the vaccine effectiveness among 7080 fully vaccinated healthcare workers (HCWs) in preventing infection, hospitalization, oxygen requirement, and ICU admission as 65%, 77%, 92%, and 94% respectively.[7] In fighting the pandemic situation like Covid-19, primary care doctors, who are working on the front lines, are critical for preventing and managing disease as they are the vital part of the entire heath service of this country. The present study was aimed to examine the association between Covid-19 vaccination status, severity, and treatment outcome among admitted patients in a teaching hospital of Tripura who required invasive mechanical ventilation.

Materials and Methods

Study design

This retrospective study was conducted at a dedicated Covid hospital of Tripura for a period of six (6) months, i.e., from June 2021 to November 2021. Inclusion criteria for this study were that all patients (age – minimum 18 years) who were admitted to a dedicated Covid hospital of Tripura due to acute SARS-CoV-2 infection confirmed either by antigen test or RT PCR test or by Truenat mainly from nasopharyngeal swab.

Fully vaccinated patients are if they had received the second dose of either Covishield or Covaxin Covid-19 vaccines, and partially vaccinated are when they had taken only a single dose of any of these vaccines.

Study tool

The study tools are patient record sheet, mechanical ventilator, bi-level positive airway pressure (BiPAP), high-flow nasal cannula (HFNOC), multiple monitor, ABG, and CT scan.

Data collection method

For all the study participants, baseline data containing epidemiological, clinical, laboratory, and radiological along with information regarding Covid-19 treatment were collected through patient record sheet from the dedicated Covid hospital during their hospitalization. Other variables like heart rate, pulse rate, SpO_2, SBP, DBP, etc., were also noted. Pregnant women, patients with active pulmonary tuberculosis, and patients with human immunodeficiency virus were excluded from this study. Confidentiality was maintained at each step of this study. Ethical Clearance certificate was obtained from the Institutional Ethics Committee vide letter no. F.4 (5-244)/AGMC/Academic/IEC Certificate/2021/3933, Dated, 15.03.2022. Written and informed consents were obtained from all the study participants before enrolling into this study.

Statistical analysis

All statistical analyses were performed using the Statistical Package for Social Science (SPSS) 25 version. Descriptive data were expressed in terms of frequencies and proportions. Chi-square test was performed to study the categorical variables of the study participants. The association of socio-demographic and clinical parameters with the Covid-19 vaccination status was expressed with 95% CI.

Result

In this study, a total of 304 study participants were enrolled. They were aged between 18 and 93 years with a mean age of 61.50 ± 18.2 years. 48.7% of the patients were aged more than or equal to 60 years. The sex ratio showed that the number of males (61.2%) was higher than that of the females (38.8%). In this study, it was also observed that mortality occurs most frequently (12.5%) in the age group of 60–80 yrs.

Out of 304 admitted Covid patients, 107 patients were already completed double-dose Covid-19 vaccinations. One hundred and thirteen (113) were taken single dose, whereas 84 patients were non-vaccinated.

Table 1 shows comparison of demographic variables, namely age and sex among the fully or partially vaccinated group and unvaccinated group. Vaccinated patients were significantly older male and with other comorbidities like diabetes mellitus, hypertension, and renal disease. Admission rate in ICU and advanced oxygen support like BIPAP, HFNOC, and ventilator use incidence were higher in non-vaccinated patients group than double-dose- and single-dose-vaccinated patients.

Association between Covid-19 vaccination status, therapy given, and treatment outcome was represented in Table 2. Details

of association between comorbidities, vaccination status, and treatment outcome can be seen in Table 3.

Correlation of SpO2 values during admission time and after treatment therapy with vaccination status is depicted in Table 4.

Chart 1 displays bar diagram of sex distribution against vaccination status and treatment outcome.

Discussion

In this study, it is found that, after adjusting all the confounders, both double- and single-dose vaccinations were associated with lower disease severity as compared to non-vaccinated cases among hospital patients who underwent invasive mechanical ventilation owing to Covid-19-related ARDS. Although vaccination fails to completely prevent the development of ARDS, still it can reduce severity of Covid-19 infection. This inference is supported by the observation that patients with Covid-19 double-dose vaccinations or with single-dose vaccination had better lung mechanics and less severe ARDS at baseline than patients in the non-vaccinated group. According to one prevalence survey from England in June–July 2021 conducted among 100000 people during the peak period of Delta variant surge, fully vaccinated people (n = 55962) were two-thirds less likely to get infected with SARS-CoV-2 as compared to unvaccinated people (n = 15135), which completely supports our present study result.[8]

Most of the clinical trials conducted on post-vaccination Covid-19 infection reported disease severity in terms of symptomatic or asymptomatic condition, the requirement of ICU admissions, or mortality rate concluding that vaccinated patients had a lower severity which is in accordance with our present study result.[9,10]

In this present study, it was found that more Covid-19-vaccinated patients with older age having moderate to severe illness were admitted in ICUs. This is mostly due to the guidelines of Government of India, where individuals older than 45 years were prioritized in the initial Covid-19 vaccination drive.[11]

According to our present study, HTN (38.6%), CKD (22.64%), and DM (19.8%) comorbidities were most common in the fully vaccinated group supported by the study of Mhawish *et al.*[12] that reported the presence of HTN, DM, and CKD among 38.2%, 41.2% and 11.8% vaccinated patients, respectively.

One Indian study from PGIMER, Chandigarh, reported 1.6% incidence of vaccine breakthrough Covid-19 infection which did not support our present study result.[13] In this present study, out of 304 patients admitted in ICU during the study period, 20.4% patients expired mostly due to the older age and also for presence of comorbidities. Out of this, mortality was higher among non-vaccinated group (17.1%). After considering all statistically significant confounders, we found an association between mortality rate at ICU and vaccination status. Available data from India presents heterogeneous nature of ICU mortality due to differences in geographical variations among patients, presence of comorbidities, baseline health status, and need for respiratory support.[14] According to few studies from Italy, the

Table 1: Comparison of demographic variables (age and sex) with the treatment outcome of the study participants

Variables	Treatment Outcome		Total	*P*
	Expired	Discharged		
Age group				
18–38 years				0.001
Male	0	18	18 (5.9%)	
Female	1	31	32 (10.5%)	
39–59 years				
Male	1	46	47 (15.4%)	
Female	1	18	19 (6.2%)	
60-80 years				
Male	16	75	91 (29.9%)	
Female	22	35	57 (18.7%)	
81-99 years				
Male	16	14	30 (9.8%)	
Female	5	5	10 (3.3%)	
Total	62	242	304	

Table 2: Association between therapy given and treatment outcome against Covid-19 vaccination status

Treatment outcome	Vaccination Status	Treatment Therapy						
		On Face mask and Nasal Cannula	Re-breathing Mask	HFNOC	BIPAP	Ventilation	Total	*P*
Expired	Double Dose	0	0	0	3	0	3 (0.9%)	
	Single Dose	0	1	1	3	2	7 (2.3%)	0.002
	Non-vaccinated	0	0	0	22	30	52 (17.1%)	
	Total	0	1	1	28	32	62 (20.4%)	
Discharged	Double Dose	31	49	19	4	0	103 (33.9%)	
	Single Dose	15	26	38	24	1	104 (34.2%)	<0.001
	Non-vaccinated	2	14	10	8	1	35 (11.5%)	
	Total	48	89	67	36	2	242 (79.6%)	
Total	Double Dose	31 (10.19%)	49 (16.1%)	19 (6.25%)	7 (2.30%)	0	106 (34.8%)	
	Single Dose	15 (4.93%)	27 (8.9%)	39 (12.82%)	27 (8.9%)	3 (0.98%)	111 (36.5%)	<0.001
	Non-vaccinated	2 (0.65%)	14 (4.6%)	10 (3.28%)	30 (9.8%)	31 (10.19%)	87 (28.6%)	
	Total	48 (15.8%)	90 (29.6%)	68 (22.36%)	64 (21.05%)	34 (11.18%)	304	

Table 3: Comorbidities vs Vaccination status and treatment outcome

Comorbidity	Treatment Outcome	Double Dose Vaccination	Single Dose	Non-vaccinated	Total	*P*
DM	Expired	0	3	9	12 (3.9%)	
	Discharged	21	19	11	51 (16.7%)	0.001
	Total	21	22	20	63 (20.7%)	
HTN	Expired	0	0	4	4 (1.3%)	
	Discharged	41	35	13	89 (29.2%)	0.00
	Total	41	35	17	93 (30.5%)	
CKD	Expired	2	1	16	19 (6.2%)	
	Discharged	22	20	7	49 (16.1%)	0.00
	Total	24	21	23	68 (22.3%)	
COPD	Expired	0	1	7	8 (2.6%)	
	Discharged	4	8	2	14 (4.6%)	0.003
	Total	4	9	9	22 (7.2%)	
CAD	Expired	1	2	12	15 (4.9%)	
	Discharged	5	7	1	13 (4.2%)	0.001
	Total	6	9	13	28 (9.2%)	
CLD	Expired	0	0	3	3 (0.9%)	
	Discharged	5	7	1	13 (4.2%)	0.004
	Total	5	7	4	16 (5.2%)	
Malignancy	Expired	0	0	1	1 (0.3%)	
	Discharged	1	0	0	1 (0.3%)	0.1
	Total	1	0	1	2 (0.65%)	
Others	Expired	4	8	0	12 (3.9%)	
	Discharged	4	8	0	12 (3.9%)	0.02
	Total	8	16	0	24 (7.8%)	
Total	Expired	3	7	52	62 (20.3%)	
	Discharged	103	104	35	242 (79.6%)	0.00
	Total	106	111	87	304	

DM=Diabetes mellitus, HTN=Hypertension, CKD=Chronic kidney disease, COPD=Chronic obstructive pulmonary disease, CAD=Coronary arterial disease, CLD=Chronic liver disease

Table 4: Correlation of mean values of SpO_2 with vaccination status

Vaccination Status	*n*	Mean value of SpO_2 at admission time (mean±S.D)	Significance (*P*)	Mean value of SpO_2 after treatment (mean±S.D.)	Significance (*P*)
Double Dose	106 (34.8%)	87.3±10.9	0.013	95.3±3.04	0.000
Single Dose	111 (36.5%)	85.1±11.8		94.5±3.4	
Non-vaccinated	87 (28.6%)	87.3±10.9		87.3±10.9	
Total	304	84.9±12.9		93.3±5.4	

SpO_2=Saturation of Peripheral Oxygen, S.D=Standard Deviation

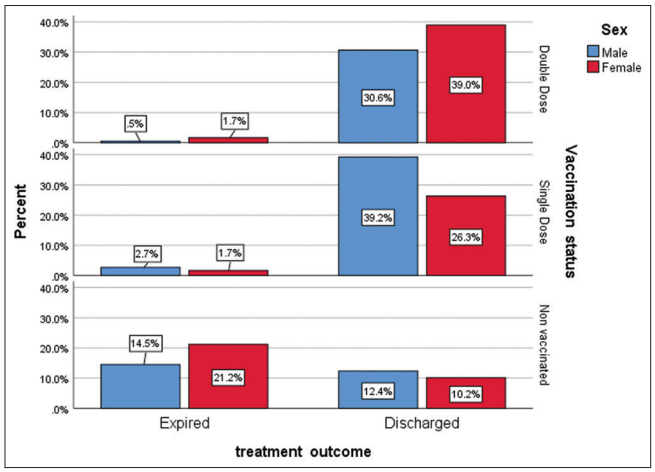

Chart 1: Bar diagram of sex distribution against vaccination status and treatment outcome

reported mortality ranged from 23% to 33% for vaccinated patients and 22% and 29% for unvaccinated patients.[15,16]

In a study from Saudi Arabia, AlQahtani *et al.*[17] observed that requirements of non-invasive ventilation was significantly lower in vaccinated group as compared to non-vaccinated group (73.6% vs 91.6%, p value < 0.011) which also supports our present study result.

In our study, it has been observed that single dose of Covid-19 vaccine can also reduce disease severity. Other than this, certain factors such as old age and presence of some comorbidities are also associated with disease severity in vaccinated patients. However, the exact mechanism by which partial vaccination reduces the severity of the disease still remains imprecise.

Primary healthcare doctors or family physicians should encourage non-vaccinated patients (Covid-19) to get vaccinated

at the earliest. While treating the non-vaccinated patients with symptoms like breathing problems, Primary healthcare doctors or family physicians should keep in mind the serious progression of the symptoms to severe conditions and evaluation of patients' clinical status for referring to the nearby well equipped health facilities in time to be kept in mind.

Conclusion

This retrospective study of Covid-19 positive patients admitted at a dedicated Covid hospital of Tripura suggests that severity of the infection, requirement of invasive and non-invasive ventilation, and death were significantly less in the vaccinated (either fully or partially) patients as compared to the vaccine-naive one. Although out of 217 individuals who turned Covid-19 positive after taking either single or double dose of vaccinations, ten deaths occurred, there were only three deaths among individuals with second dose of Covid-19 vaccine, and the remaining seven were after a single dose of vaccine. So, vaccines play an important role to prevent death or complications due to Covid-19 infection among the population of Tripura.

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Conflicts of interest

There are no conflicts of interest.

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