COVID-19 VACCINE BREAKTHROUGH INFECTIONS AMONG HEALTH CARE WORKERS IN MILITARY INSTITUTES OF PAKISTAN – TILL 30TH JUNE 2021

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ABSTRACT

Objective: To measure incidence of COVID-19 vaccine breakthrough infections among health care workers vaccinated with both doses of Sinopharm Vaccine.

Study Design: Prospective cohort study.

Place and Duration of Study: All Military Institutes of Pakistan, from Feb to Jun 2021.

Methodology: Detailed surveillance mechanism was developed before the start of Health Care Workers vaccination in Pakistan Military to report any PCR positive COVID-19 infection post vaccination. Among 39512 health care workers vaccinated with both doses of COVID-19 vaccine; those who developed COVID-19 infection ≥14 days post 2nd dose were included in the study. Total 124 participants till 30 Jun 2021 fulfilled the criteria of COVID-19 vaccine breakthrough infection and were analyzed.

Results: Mean age of the participants was 38.8 ± 11 years. Males were 69.4% while females were 30.6%. Median duration from 2nd dose to development of COVID-19 vaccine breakthrough infection was 36.5 days (IQR, 26-62). Asymptomatic/mild infections were reported among 94.4% and only 5.6% had moderate disease. No severe/critical disease requiring oxygen supplementation or ventilator support was observed. Recovery rate was 100% with no mortality. There was no significant statistical association of age, gender, job category with COVID-19 vaccine breakthrough infection (p>0.05).

Conclusion: Vaccines remain an important weapon in the battle against COVID-19. No vaccine is 100% effective against all strains of COVID-19; however among the completely vaccinated health care workers less severe disease was observed. There was no mortality.

Keywords: Breakthrough infections, COVID-19 vaccine, COVID-19, Health care workers, Vaccine.

INTRODUCTION

The World Health Organization (WHO) authorized emergency use of different COVID-19 vaccines for global use in December 2020[1]. In the COVID-9 pandemic, vaccines played a substantial role in preventing serious infections among confirmed cases of COVID-19 as demonstrated by some randomized controlled trials [2,3]. Despite success, the effectiveness of vaccines varies between 70-90%. This means that the possibility of fully vaccinated individuals getting COIVD-19 infection post vaccination cannot be ruled out.

COVID-19 vaccine breakthrough infections are defined as the detection of SARS-CoV-2 RNA or antigen in specimen collected from respiratory tract of persons after 14 or more days of receipt of all recommended doses of an FDA approved COVID-19 vaccine[4]. COVID-19 vaccine breakthrough infections are lately becoming a concern for health authorities globally demanding a better understanding of the course of the COVID-19 infection, sturdiness of immunity, severity of re-infection, vaccine breakthrough infection and the role of viral mutations for the prevention and control of COVID-19 pandemic[5-8].

Although refuted by a meta-analysis[9], COVID-19 vaccine breakthrough infections constitute a recent phenomenon. A paucity of published data especially from developing countries exists. Pakistan is no different. The country started its COVID-19 vaccination campaign with Sinopharm vaccine as its mainstay in February 2021. Top priority was accorded to the front-line health care workers (HCWs) for vaccination. By July 12, 2021, a total of 3,942,291 Pakistanis were fully vaccinated[10].

The objective of study was to measure the incidence of COVID-19 vaccine breakthrough infections among health care workers (HCWs) who had been vaccinated with both doses of Sinopharm Vaccine.

METHODOLOGY

A prospective cohort study was conducted among HCWs. Vaccination of HCWs in military institutes of Pakistan was started as top priority. A total of 39512 HCWs were vaccinated with both doses of Sinopharm Vaccine since February 2021, accounting for

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84.6% coverage against COVID-19 till June 2021. Through active surveillance meticulous records of vaccinated HCWs were maintained along with dates of administration of first and second dose of vaccine. The process of study participants' selection is described in fig-1.

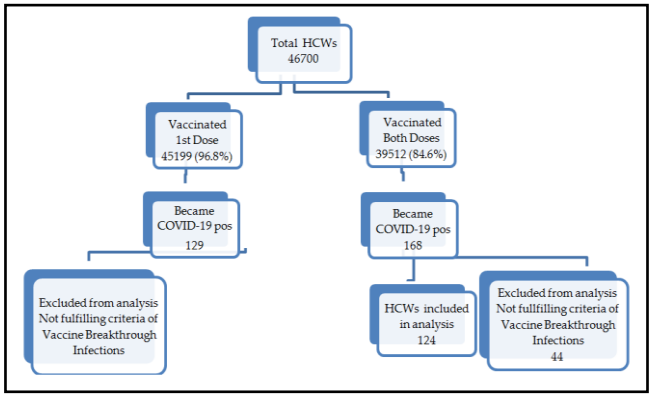

Figure-1: Illustration of inclusion process in selection of study participants.

This study was approved by the ethics committee of Armed Forces Postgraduate Institute Rawalpindi, in accordance with National Research Committee and Helsinki Declaration. The data collection on post vaccination COVID-19 cases ensured participants volunteer participation and confidentiality of identifiers.

Any HCW who became PCR positive after receiving both doses and fulfilled criteria of COVID-19 vaccine breakthrough infections was included in study. Study variables included age, gender, job category, indication for PCR test, source of exposure, severity of symptoms, associated comorbids (if any) and outcome of the disease.

All those individuals who are not directly involved in patient care like ayas, sanitary workers, ambulance drivers, ward boys, stretcher-bearers, administrative clerks, etc were considered as support staff. Asymptomatic/mild disease was defined as no symp-toms or flu like symptoms including temperature, loss of smell or taste, mild or no cough. The patients are not out of breath on normal household activity. Most asymptomatic cases harbor mild disease. Moderate Disease was considered as lower respiratory illness on imaging or clinical assessment with SpO2 ≥94% on room air at sea level. Severe disease was defined as patients with SpO2 <94% on room air at sea level, a respiratory rate >30 breaths/min, PaO2/FiO2 <300 mmHg or lung infiltrates >50%. Critical disease was defined as patients have acute respiratory distress syndrome, septic shock, cardiac dysfunction, exaggerated inflammatory response which may lead to multi-organ failure. Recovery was taken as any person who becomes COVID-19 PCR negative and is either clinically free of all symptoms or joins back at work after a period of 10 days sick leave.

The data was analyzed using SPSS-20. Mean and standard deviation was calculated for quantitative variables while frequencies and percentages were calculated for categorical/qualitative variables. Chi square test of statistical significance was used to determine the association of age, gender, job category with COVID-19 vaccine breakthrough infections.

RESULTS

Out of 297 HCWs reporting positive after vaccine inoculation, only 124 fulfilled the operational definition of vaccine breakthrough infection. Remaining 173 HCWs were not made part of analysis since 129 became positive after 1st dose and 44 HCWs became positive within two weeks of receiving the 2nd dose (fig-2).

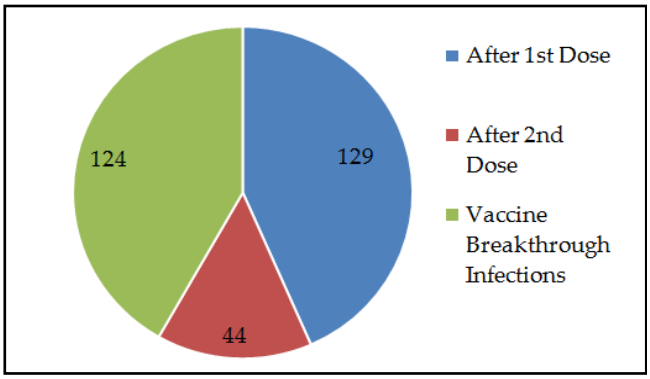

Figure-2: Post vaccination COVID-19 cases among health care workers.

The mean age of HCWs with breakthrough infections was 38.8 ± 11 years. There were 110 HCWs (88.7%) who developed breakthrough infection within 3 months of 2nd dose while 14 HCWs (11.3%) developed infection after 3 months. Median duration for the break through infections to occur was 36.5 days (IQR 26-62). On inquiring about h/o exposure and getting PCR test done, around 46 (37.1%) had close contact with COVID-19 cases, 19 (15.3%) got symptoms and 59 (47.6%) had both h/o exposure as well as symptoms before getting tested. Baseline characteristics, severity wise disease distribution and its outcome among HCWs is given in table-I.

Our data showed that 94.4% infections were asymptomatic/mild and 5.6% were moderate. Even those who got hospitalized didn't require supplemental

oxygen or ventilator support. The overall incidence of COVID-19 vaccine breakthrough infections among HCWs among HCWs of military institutes of Pakistan was found to be 3.1/1000. There was no statistically significant association of age, gender, job category with COVID-19 vaccine breakthrough infections (p>0.05) given in table-II.

Table-I: Baseline characteristics of study participants (n=124)

Variables		n (%)
Age group (in years)	Up to 39	79 (63.7)
	40-50	34 (27.4)
	>50	11 (8.9)
Gender	Male	86 (69.4)
	Female	38 (30.6)
Job category	Doctors	31 (25)
	Nurses	28 (22.6)
	Paramedics	20 (16.1)
	Support Staff	45 (36.3)
Time of occurrence of breakthrough infection (in days)	15-30	46 (37.1)
	31-45	28 (22.6)
	46-60	14 (11.3)
	61-75	10 (8.1)
	75-90	12 (9.6)
	>91	14 (11.3)
Disease Severity	Asymptomatic/Mild	117 (94.4)
	Moderate	7 (5.6)
	Severe/ Critical	-
Co-morbids	Yes	3 (2.4)
	No	121 (97.6)
Outcome	Recovered	124 (100)
	Deaths	-

Table-II: Statistical association between vaccine breakthrough infections and age, gender and job category (n=124).

Variables	Vaccine Breakthrough Infections		p-value
	No	Yes	
Age (years)			
0 -19	2	1	0.481
20-39	55	22	
40-49	37	7	
Gender			
Female	40	54	0.83
Male	89	114	
Job Category			
Nurses	26	41	0.214
Doctors	45	42	
Paramedics	26	31	
Support Staff	32	54	

DISCUSSION

Robust surveillance systems are pivotal for timely reporting of new infections.Their importance cannot be over emphasized[11-13]. In United States, the centre for disease control (CDC) in collaboration with state health departments monitors SARS-CoV-2 infection characteristics and trends among individuals who have completed their vaccinations.

In a study conducted at Chicago, 627 staff members of 75 skilled nursing care facilities COVID-19 vaccine breakthrough infections were 22 (4%). Out of these 14 (64%) remained asymptomatic[14]. In University of California, Los Angeles (UCLA) and University of California, San Diego (UCSD) HCWs vaccination started in December 2020 and a total 28, 184 HCWs received two doses till February 2021. In this cohort, the risk of developing COVID-19 vaccine breakthrough infection was 0.97% and 1.91% respectively[15].

Unpublished data from the Indian Council of Medical Research states that 0.2-0.4/1000 got COVID-19 Vaccine Breakthrough Infection[16]. Another Indian study from a single center reported COVID-19 vaccine breakthrough infection in 15 (13.3%) out of 123 employees. All of them had mild symptoms while one required hospitalization[17]. Yet another study from New Delhi reported 280 (90.9%) of 326 HCWs who were fully vaccinated reported COVID-19 vaccine breakthrough infection i.e. 128 per 1000 HCWs[18].

The currently available vaccines activate immune system and confer protection against COVID-19 variants by initiating production of antibodies and cells[19].

The incidence of COVID-19 vaccine breakthrough infections in our study was 3.1/1000, whereas a study conducted in a tertiary care hospital in India[20] revealed an incidence of 81.7/1000. There were no differences among enrollment criteria in both the studies. However, in our study participants were inoculated two doses of Sinopharm vaccine at 21 days interval whereas ChAdOx1 nCoV-19 vaccine was administered to participants of Indian study. An incidence rate of 16/1000 HCWs was reported by a study conducted on a cohort of 3000 HCWs which is much higher as compared to our study. Hacisuleyman *et al*[21] report an incidence of 5/1000 in a cohort of 417 HCWs. A study carried out at University of California[15] reported an incidence of 0.24/1000 among HCWs.

The gender distribution in our study was 69% males and 31% females. A similar gender distribution pattern at work place (66% males and 34% females) has been reported among HCWs of a tertiary care hospital in New Delhi[18].

The mean age of participant in our study was 38.8 ± 11 years where almost 64% were <40 years of age. A

study carried out in a tertiary care hospital at Kerala, India[20] revealed an age distribution of 31.9 ± 9.7 years among HCWs.

This was also indicated in the disease severity observed among cases of COVID-19 vaccine breakthrough infections. In our study 94% participants suffered asymptomatic to mild infection while around 6% endured moderate infection. None of the subjects experienced severe or critical disease requiring ventilator support. These results correspond with the findings reported by the center of excellence for metabolic diseases & endocrinology, New Delhi[17] indicating a more robust response to COVID-19 Vaccine Breakthrough Infections.

No mortality was observed in our study which is similar to the findings reported by a study carried out at a tertiary care hospital in Tel Aviv, Israel[22] with a cohort 5036 of HCWs who were vaccinated and followed up for vaccine breakthrough infections for a period of 3 months.

LIMITATION OF STUDY

Our cohort predominantly comprises of younger group of individuals without significant comorbid for COVID-19 infection, as compared to the general population. National level data is required with higher presentation of those with multiple risk factors and age groups to compare the disease outcomes in similar cohort of HCWs.

Ongoing data collection could add into numbers of vaccine break through infections.

RECOMMENDATION

1. Vaccine roll out should be more robust and inclusive to achieve 100% coverage of target population.
2. Data reporting on COVID-19 Vaccine Breakthrough Infections should continue so as not to miss even a single case.

CONCLUSION

In addition to the public health mitigation measures like face mask, physical distancing, symptom screening and regular testing, vaccination constitutes an important weapon in the armamentarium of HCWs in their battle against COVID-19.

Although no vaccine is 100% effective against all COVID-19 strains, however, their use is advocated since they play an important role in mitigating mortality and morbidity (rate and severity of disease) among completely vaccinated as compared to unvaccinated or partially vaccinated individuals.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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