<u>**Original Research Article**</u>

A Study of Infection of SARS-Cov-2 and its Severity among Post Vaccinated Healthcare Workers

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Abstract

Background and Objective: Coronaviruses are important human and animal pathogens. At the end of 2019, a novel coronavirus was found as the cause of a bunch of pneumonia cases in Wuhan, China. It rapidly spread in the country of China resulting in an epidemic, followed by a global spread in whole world leading to the pandemic. In February 2020, the World Health Organization coined the term COVID-19, The objectives to carry out this study were 1) To determine incidence of Covid-19 in health care workers after partial or complete vaccination 2) To determine severity of Covid-19 in health care workers after partial or complete vaccination at Designated Covid Hospital and Medical College at North Gujarat, India

Methods: A cross sectional retrospective study was carried out at Designated Covid Hospital and Medical College at North Gujarat, India through telephonic and personal interview of health care workers who had received partial or complete vaccination. Key variables of the study were profile of work of health care worker at medical facility, type of vaccine received and how was post vaccination covid-19 infection managed.

Results: We enrolled total 210 health care workers with mean age of 31.5 years with 69 male and 141 female. Out of 210 health workers, 204(97.14%) were fully vaccinated with two dose of covid-19 vaccines,5(2.38%) were partially vaccinated. Symptomatic infection with Covid-19 occurred in total 12 (5.71%) health care worker $\geq$ 14 day after second dose of either vaccine. Only one required hospitalization with oxygen support, rest all are managed with home isolation.

Interpretation &Conclusion: One in twenty health care workers got infected with covid-19 after vaccination in present study. Extended research required to get larger data for ascertaining predictors of infection mainly mutation in virus and effect of comorbidity on antibody response after vaccination and severity of disease.

Keywords: Covishield (AZD1222), Covaxin (BBV152), Covid-19, Health Care Workers, Vaccination.

Introduction

Coronaviruses are important human and animal pathogens. At the end of 2019, a novel coronavirus was found as the cause of a bunch of pneumonia cases in Wuhan, a city in the Hubei Province of China. It rapidly spread in the country of China resulting in an epidemic, followed by a global spread in whole world leading to the pandemic. In February 2020, the World Health Organization coined the term COVID-19, which stands for coronavirus disease 2019.Up to now the Covid 19 pandemic has affected 228 countries and territories worldwide and cause 53 crore cases and 63 lakh death worldwide. India is having the second highest numbers of covid-19 case just being after USA with 4.31 crore case and 5.4 lakh death.[1]Along with disciplinary Covid appropriate behavior, Vaccines are considered mainstay of step in controlling this pandemic. India launched the world's largest Covid-19 mass vaccination campaign from January' 2021 in a phased manner beginning with frontline workers followed by the geriatric population, people with comorbidities, those aged > 45 years, those aged > 18 years and finally to all peoples.[2]The vaccines approved and launched in India by the regulatory authority includes Covishield (AZD1222) and Covaxin (BBV152). Covishield (AZD1222) vaccine manufactured in India by Serum Institute of India after getting license from Astrazeneca-Oxford and is a recombinant replication deficient adenoviral vector vaccine that expresses the SARS-CoV-2 spike protein gene.[3]Covaxin (BBV152) vaccine is India's indigenous Covid-19 vaccine developed by Bharat Biotech in collaboration with the Indian Council of Medical Research (ICMR)-National Institute of Virology (NIV).[4] The efficacy of Covishield (AZD1222) after administration of two doses of the vaccines irrespective of interval between the doses has been reported as 63.1%, with possibly higher efficacy on longer intervals.[5] The interim phase-3 clinical trial data reported Covaxin (BBV152) to have efficacy of 78% against infection with SARS-CoV2. [6,7]However, the real-world effectiveness of vaccines may differ from the efficacy reported in clinical trials due to a multitude of factors including the dynamics of disease exposure, diminished antibody response in sub-groups like the elderly and the immunocompromised, and the emergence of newer mutant strains with greater infectivity and virulence. A small proportion of individuals will contract Covid-19 despite complete vaccination as no vaccine accords 100% protection against the disease, and occasionally newer virus variants evolve mechanisms for bypassing the vaccine induced antibody response. This study was done to check the incidence of SARS-CoV-2 infections in individuals who have already been partially or completely vaccinated with any authorized Covid-19 vaccine in India. According to the ICMR between 0.02 and 0.04% infections have occurred after partial or complete vaccination with either Covishield or Covaxin. However, Health care worker are always at higher risk of getting covid-19 due to persistent occupational exposure to the virus, and incidence rate calculated in this study provide evidence in understanding the effectiveness of vaccine to prevent development of symptomatic and severe disease of covid-19.

Material &Methods:

We conducted cross sectional study among health care workers of Nootan Medical College and Research Center Visnagar, which is designated Covid Hospital during Covid pandemic and provides tertiary care services to peoples of North Gujarat, India. After launch of largest covid-19 mass vaccination campaign in January 2021, Covishield (AZD1222) and Covaxin (BBV152) were first available for health care workers in India with interval of 4 week between two doses. Permission for

study was taken from The Institutional Ethics Committee of the Institute. After obtaining consent from participants, data was collected by trained investigator using telephonic and personal interview during October and November 2021. The variables of the study included age, sex, designation, vaccine type, how was the post-vaccination covid-19 infection managed. Breakthrough infection was defined as Rapid Antigen Test (RAT) or Real Time Reverse Transcriptase Polymerase Chain Reaction (RTPCR) test positive covid-19 infection among health care worker occurring ≥ 14 days after receiving both dose of either vaccine. Collected data was entered in MS EXCEL 2010. After data cleaning data was analyzed by Med Calc v 12.5.0 Software. We calculated frequency, percentages and proportion for the variables.

Results :

Total 210 health care workers of Nootan Medical College & Research Center, Visnagar, Gujarat were enrolled into the study including 53 (25%) Medical Doctors and Junior Resident Doctors, 110(52%) nursing staff, 18(8.5%) laboratory staff, 18(8.5%) administrative staff, 11(5.23%) servant staff. Out of 210 health care worker 204(97.14%) health care workers were fully vaccinated with two dose of covid-19 vaccines, 5(2.38%) health care workers had taken one dose of vaccine and only one 0.47% had not taken any vaccine dose. 195(92.85%) health care workers had taken COVISHIELD (AZD1222) vaccine and 11(5.2%) had taken COVAXIN (BBV152) as their two-dose vaccination schedule. Three health care workers did not know

about their vaccine. Because of supply of Covishield vaccine was high as compared to Covaxin at time of vaccination of frontline worker by Government of India, majority of health care workers had taken Covishield vaccine over Covaxin. Out of 210, 137 (65.24%) health care workers were in age group of 20-30 years followed by 34 (16.19%) in 31-40 years, 16(7.62%) in 41-50 years and 23(10.95%) person were above 50 years of age. There was history of natural infection with covid-19 and recovery in 30 (14.28%) peoples before taking first dose of covid-19 vaccine and no such history in remaining 180(85.71%) peoples. Covid-19 infection occurred in 12(5.71%) health care workers out of total 210 health workers. Infections were diagnosed in clinical suspected case of covid19 with either Rapid Antigen Test (RAT) or Real Time Reverse Transcriptase Polymerase Chain Reaction (RTPCR) Test. The severity of infections was mild and treated with home isolation in 11 health care workers (91.66%). Only one case (8.33%) was moderate case and required hospitalization and supplemental oxygen therapy. Out of 12 health care workers who was found covid-19 positive after full vaccination 11 were front line corona worker mainly doctors and nursing staff and only one laboratory person got covid-19 after full vaccination. Proportion of covid-19 infections post vaccination in Covaxin vaccinated group (1/11=9.09%) was higher than in Covishield vaccinated group (11/195=5.94%) but this difference was statistically not significant (Chi square 0.0495, Df-1, p-0.8239)

Table 1: Socio demographic Details of Health Worker

Age Group	Frequency(N=210)	Percentage
20-30 Years	137	65.24%
31-40 Years	34	16.19%
41-50 Years	16	07.62%
>50 Years	23	10.95%
Mean± SD(Years)	31.05±11.87	
Gender		
Male	69	32.86%
Female	141	67.14%

Designation		
Doctor	53	25%
Nursing Staff	110	52%
Laboratory Staff	18	8.57%
Admin Staff	18	8.57%
Aya	09	4.28%
Ward Boys	02	0.95%
Covid positivity before vaccination		
Yes	30	14.28%
No	180	85.71%

Table 2: Covid 19 infection after Vaccination

Covid positivity after vaccination	Frequency	Percentage
Yes	12	5.71%
no	198	94.28%
Severity(N=12)		
Home isolation	11	91.66%
Hospitalization	1	8.33%
Vaccine		
Covishield	11	91.67%
Covaxin	1	8.33%
Type of staff		
Doctor	8	66.67%
Nursing	3	25%
Laboratory	1	8.33%
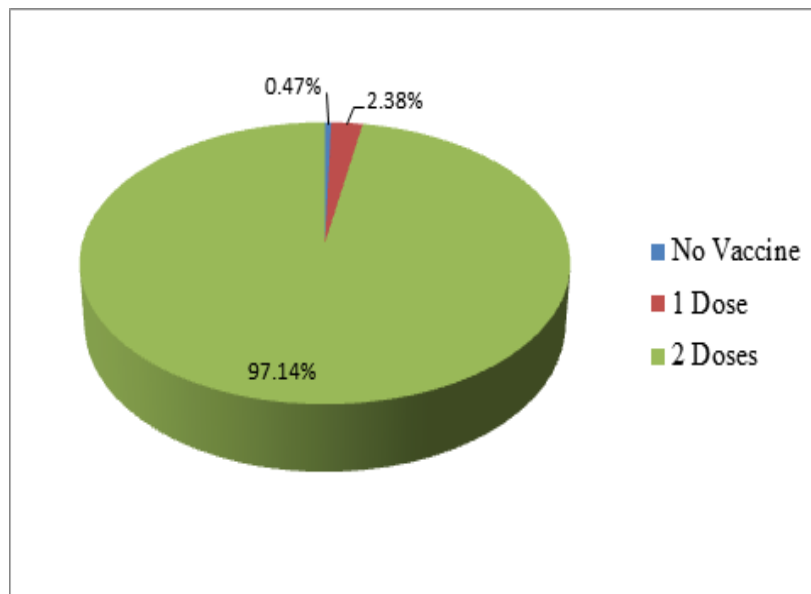
Figure 1: Vaccination Status
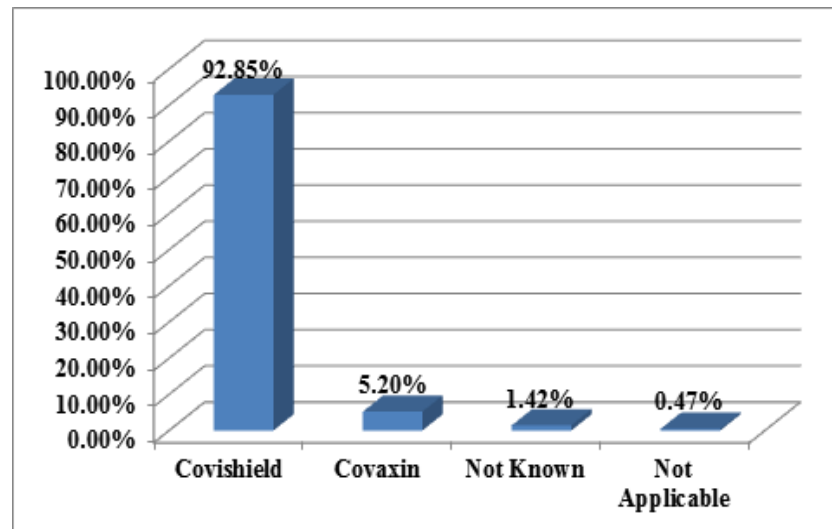
Figure 2: Type of Vaccine Received

Discussion:

Infection occurring with covid-19 after adequate vaccination is a matter of focus in every country of the world and adequate data about this still accumulating at slow pace. Vaccines are effective in decreasing risk of getting infection and also preventing development of severe disease. So, vaccines are considered main step in controlling covid-19 pandemic along with Covid appropriate behaviour. And, no any vaccine is 100 % effective, so it is possible that some peoples get infected with covid-19 despite of vaccination. Health care worker are always at high risk of getting covid-19 infection than general population because of occupational exposure. Unpublished and published data from India and another part of world suggest that this infection are occurring and are rare. Also, it seems that these infections are asymptomatic or mild in nature. A study by Chicago Department of Public Health (CDPH) identified a SARS-CoV-2 infection in a skilled nursing facility resident >14 days after receipt of the second dose of a two-dose COVID-19 vaccination series. Chicago Department of Public Health observes 627 persons with SARS-CoV-2 infection across 75 SNFs since vaccination clinics began. 22 SARS-CoV-2 infections were identified among 12 residents and 10 staff members across 15 facilities, ≥14 days after receiving their second vaccine dose (i.e., breakthrough infections in fully vaccinated persons). Nearly two thirds (14 of 22; 64%) of persons with breakthrough infections were asymptomatic, two residents were hospitalized because of COVID-19, and one died.[8] A statement from Directorate General Indian Council of Medical Research state that 2-4 per 10000 got infected with covid-19 after vaccination in India[9],however this has not been published in any journal. In this study we found 1 in 20 health care workers got infected with covid-19 after vaccination. In this study we found that 5.71% (1 in 20) of health care workers got infection with covid19 despite of fully immunization with both dose of vaccine. This shows that high risk peoples like health care workers are vulnerable to get infected with Covid19 despite of full vaccination. Among health care workers front line worker like doctors and nurses are at higher risk than other health care workers like laboratory or administrative staff in hospital setups. Vaccination leads to sero-conversion in form of development and induction of anti-spike antibody against Covid-19 virus. A study done by Singh AK, Phatak SR, Singh R, et al. shows that robust antibody response is seen after single dose of Covishield (AZD1222) as compared to

Covaxin (BBV152)[10]. However, two dose of vaccine with appropriate interval are required to stimulate adequate antibody levels. This study also shows that rates of covid-19 infection are higher in Covaxin (BBV152) vaccinated group than Covishield (AZD1222) vaccinated group though it is statistical not significant. Breakthrough infection with Covid-19 after vaccination observed in present study 5.71% which is lower than 13.3% observed in surveillance study by Tyagi K, Ghosh A, Nair D in chronic care medical facility in New Delhi, India.[11] In contrast, another study by Rana K, Mohindra R, Pinnaka L report the incidence of Covid-19 infection after vaccination was only 1.68% (48 out of 3000) and 2.6% found positive after receiving at least one dose of vaccine on large number of health care worker from tertiary care setting in India vaccinated with AZD1222 (ChAdOx1-S).[12] Another study by Hacisuleyman et al. report the incidence of covid-19 infection as just 0.5% in a sample of 417 health care workers who had previously received two doses the Pfizer– BioNTech (BNT162b2) or Moderna (mRNA-1273) vaccine [13]. As evidence from previous study by Parai, D., Choudhary, H. R., Dash, G. C et al. show that single dose of either Covishield or Covaxin induce higher neutralizing antibody response in those who have previous natural history of infection and recovery with covid-19.[14] Similarly, in this study, history of natural infection and recovery from covid-19 observed to be protective against subsequent infection with covid-19 in health care workers who had taken at least single dose of Covid-19 vaccine. This study was done just after completion of second wave of Covid 19 in India when Covid 19 case are decreasing but genome sequencing shows mutation in virus and emergence of newer variant called variant of concern B.1.617.2 delta having higher transmission rate than previous variant. This variant also proves that breakthrough infection with covid-19 due to immune escape mechanism that

bypass the vaccine induced immunity. Delta variant B.1.617.2 of SARS COV2 also shows diminished neutralizing antibody response and increase transmission rate globally in peoples vaccinated with currently available vaccine against covid-19.[15,16] There are several limitations of study also. There was high rate of transmission and rapid spread of infection during second wave of Covid-19 in India. Multiple members of family of health care workers were simultaneously infected and vaccination status of household members was not recorded. Various Comorbidities can lead to impaired vaccine induced antibody response. Comorbidity status of participants are not confirmed, however there are less chance of underlying comorbidity as a greater number of health care workers are in low median age group. Third infection with covid-19 after vaccination was self-reported by health care workers who are symptomatic. Symptomatic infection were diagnosed and documented with either Rapid Antigen Test (RAT) or Real Time Reverse Transcription Polymerase Chain Reaction (RTPCR) test. However, there are also chance of not capturing asymptomatic infection in the study showing potential virus transmission. [17] Future studies can help to find vaccine induced antibody response and also incidence and severity of infection after vaccination in patients with comorbidities like Diabetes Hypertension, Heart disease, Chronic Lung Disease, Chronic Kidney Disease and old age group peoples. This study also not able to compare incidence of breakthrough infection in either Covishield or Covaxin vaccinated group as statistical significant was not attained

Conclusion:

Breakthrough infection with covid-19 after vaccination represent a great challenge to end covid-19 pandemic. Potential epidemiological study with statistical significant sample size required to ascertain predictors of infection among peoples at risk of getting Covid-19 infection after

vaccination, effect of comorbidity status on antibody response after covid-19 vaccination. Also required strengthening of genomic analysis for emerging culprit variant of virus that has greater infectivity despite of mass vaccination in the country.

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