Detecting anti spike neutralizing igG antibody pre and post covid 19 vaccinations

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Abstract

Background: COVID-19 is a world-pandemic that recorded significant mortality. Multiple COVID vaccines have been developed, the earliest of which were Sinopharm and Pfizer vaccines. Aim of study: To compare antibody titers between after vaccination with either one of the 2 vaccines. Methodology: This a cross sectional study in which 119 patients were assessed; 53 patients were vaccinated with Pfizer/BioNTech, 18 with Sinopharm, and 48 unvaccinated. Results: All vaccinated subjects were seroconverted with no significant difference in antibody titers between Pfizer and Sinopharm vaccinees. Conclusion: In conclusion, Both vaccines showed the same efficacy as all the study subjects were seroconverted after the 1st dose of vaccination; however, the present study findings cannot be generalized to the entire population due to the small sample size

Introduction

More than 6 million fatalities globally as of March 2022 due to COVID-19), a highly infectious viral infection produced by SARS-CoV-2, has had a disastrous impact on the world's demography. After the first cases of this mostly respiratory viral infection were found in Wuhan, Hubei Province, China, in late December 2019, SARS-CoV-2 spread quickly around the world. On March 11, 2020, the World Health Organization (WHO) called it a worldwide pandemic.[1] A great variety of studies, ranging from epidemiological to experimental, have been released in an attempt to better understand the immunological mechanisms of COVID-19 and potential therapies. The number of CD3+, CD4+, and CD8+ cells decreases with the disease stage.[2] Humoral immune responses are very specific and give long-term protection against reinfection. Antibodies work by either preventing cell infection by attaching to the virus and preventing it from interacting with its receptor (neutralizing antibodies) or by destroying infected cells and the virus linked to them and designating them for death through cell-mediated immune response (binding antibodies).[3] A prospective study of 67 COVID-19 patients found that anti-nucleocapsid protein (NCP) IgM and IgG levels began on day 7 and day 10, respectively, and peaked on day 28 and day 49. Furthermore, these antibodies emerge sooner and at greater titers in severe patients than in non-severe individuals.[4] They also discovered that weaker IgG responders had a considerably higher viral clearance rate than stronger responders, indicating that a greater antibody response is related with delayed viral clearance and illness severity.[5] Multiple COVID-19 vaccines have already been authorized, each with a unique mode of action to protect against the illness.[6] Examples of these vaccines are BNT162b1 (BioNTech | Pfizer) vaccine which now appears to be 95% effective.[7] It is an mRNA vaccine that encodes the receptor-binding domain (RBD) of the SARS-CoV-2 spike (S) protein.[8] Another important vaccine is Sinopharm, which is an in activated vaccine. Researches show that it generated antibodies at levels comparable to those reported after natural COVID-19 disease.[9]

Materials and methods

The cases and control group

One hundred nineteen (119) adult participants were involved in this study. Name, age, and gender were collected from all of them from 15th November 2021 to15th May 2022. Seventy-one (71) people were selected from those who came to health institutions from different regions in Iraq for the purpose of receiving the corona vaccine. Forty-five(45) of them were infected with SARS-COV-2 previously and then recovered, while twenty-five (25) were naïve.

All donors were checked clinically and via rapid laboratory tests by covid-19 antigen detection and counting the white blood cells and lymphocytes. The control group was collected from the category that rejected the vaccination and comprised forty-eight (48) participants.

Sample collection and handling

Blood specimens were collected from the control and case groups. Five milliliters of the blood was obtained via venous puncture. One millimeter was poured into an EDTA tube for complete blood count (CBC), and the residual was transferred into a gel tube, allowed to clot for 30 minutes at room temperature then centrifuged for ten minutes (10 min) at 3000 rpm to obtain serum, the supernatant was collected and stored at (-20) degrees centigrade, sera for each subject were divided into two tubes to avoid repeated freeze /thaw cycles.

The study design

This study is a long -term follow-up survey of Iraqi people, it is a prospective cohort study before and after their first and second dose of vaccination with

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the Pfizer and Sinopharm covid-19 vaccine.Two types of vaccines were studied according to choosing people and types of vaccines provided by the ministry of health in Iraq.

Result and discussion

Sociodemographic characteristics of the studied sample

The age of the studied sample ranged from 16-70 years with a mean of (25.5 ± 15.3 SD). The majority aged between 16-40 years. Regarding gender, the male to female ratio was 0.83:1; as illustrated in table (1).

Table (1): Sociodemographic characteristics of the studied sample.

Sociodemographic characteristics	Frequency	Percentage
Age		
16-40 years	82	68.9
41-60 years	27	22.7
61-90 years	10	8.4
Total	119	100.0
Gender		
Male	54	45.4
Female	65	54.6
Total	119	100.0

The vaccination status of the studied sample

The vaccination status of the studied sample is illustrated in table (2).

Table (2): Vaccination status of the studied sample.

Vaccination status	Frequency	Percentage
Vaccinated with Pfizer/BioNTech	53	44.5
Vaccinated with Sinopharm	18	15.1
Unvaccinated	48	40.3
Total	119	100.0

Association between vaccine type and antibody titers 3 months after 1st dose

After 3 months of the 1st vaccine dose, No statistically significant difference was detected between antibody titers in the Pfizer/BioNTech group and the Sinopharm group; as illustrated in table (3).

Table (3): Association between vaccine type and antibody titers 3 months after 1st dose.

IgG	Vaccine type		P value
	Pfizer/Biontech	Sinopharm	
Positive	53 (100.0%)	18 (100.0%)	0.578
Negative	0 (0.0%)	0 (0.0%)	
Total	53 (100.0%)	18 (100.0%)	
Mean ± SD	**68.238 ± 13.55**	**66.12 ± 14.72**	

Association between vaccine type and antibody titers 3 months after 2nd dose

After 3 months of the 2nd vaccine dose, No statistically significant difference was detected between antibody titers in the Pfizer/BioNTech group and the Sinopharm group; as illustrated in table (4).

Table (4): Association between vaccine type and antibody titers 3 months after 1st dose.

IgG	Vaccine type		P value
	Pfizer/BioNTech	Sinopharm	
Positive	53 (100.0%)	18 (100.0%)	0.390
Negative	0 (0.0%)	0 (0.0%)	
Total	53 (100.0%)	18 (100.0%)	
Mean ± SD	**64.69 ± 14.57**	**61.17 ± 15.83**	

Association between vaccination status and antibody titers 3 months after 1st dose

After 3 months of the 1st vaccine dose in the vaccinated group, A statistically significant difference was detected in IgG antibody titers between the vaccinated group and the unvaccinated group; as illustrated in table (5).

Table (5): Association between vaccination status and antibody titers 3 months after 1st dose

IgG	Vaccination status		P Value
	Vaccinated	Unvaccinated	
Positive	71 (100.0%)	35 (72.9%)	<0.001
Negative	0 (0.0%)	13 (27.1%)	
Total	71 (100.0%)	48(100.0%)	
Mean ±SD	**67.70 ± 13.78**	**27.70 ± 26.73**	

Association between vaccination status and antibody titers 3 months after 2nd dose

After 3 months of the 2nd vaccine dose in the vaccinated group, A statistically significant difference was detected in both IgG antibody titers between the vaccinated group and the unvaccinated group; as illustrated in table (6).

Table (6): Association between vaccination status and antibody titers 3 months after 2nd dose

IgG	Vaccine status		P Value
	Vaccinated	Unvaccinated	
Positive	71(100.0%)	34 (70.8%)	<0.001
Negative	0 (0.0%)	14 (29.2%)	
Total	71 (100.0%)	48 (100.0%)	
Mean ± SD	**63.80 ± 14.87**	**27.6 ± 29.52**	

Comparison between antibody levels before vaccination and 3 months after the 1st dose

After 3 months of receiving the 1st dose, IgG levels significantly increased; as illustrated in table (7).

Table (7): Antibody levels before vaccination and 3 months after the 1st dose			
IgG	Vaccine status		
	Before vaccination	3 months after 1st dose	P Value
Positive	45 (63.4%)	100 (100.0%)	<0.001
Negative	26 (36.6%)	0 (0.0%)	
Total	71 (100.0%)	100 (100.0%)	
Mean ± SD	24.7 ± 31.3	67.7 ± 13.8	

Comparison between antibody levels before vaccination and 3 months after the 2nd dose

After 3 months of receiving the 2nd dose, IgG titers remained significantly increased; as illustrated in table (8).

Table (8): Antibody levels before vaccination and 3 months after the 2nd dose			
IgG	Vaccine status		
	Before vaccination	3 months after 2nd dose	P Value
Positive	45 (63.4%)	100 (100.0%)	<0.001
Negative	26 (36.6%)	0 (0.0%)	
Total	71 (100.0%)	100 (100.0%)	
Mean ± SD	24.7 ± 31.3	63.8 ± 14.9	

Discussion

This is a cross sectional observational study, in which the T cell and antibody responses were evaluated in adult participants who had either the (mRNA technology based) Pfizer-BioNTech vaccine or the Sinopharm (inactivated virus technology based) vaccines in healthy adult volunteers. Blood samples were obtained from all participants prior vaccination and 3 months following their first and second doses. The present study assessed 119 participants, in which 48 (40.3%) participants were previously infected without vaccination, 53 (44.5%) were vaccinated with pfizer/BioNTech and 18 (15.1%) with Sinopharm. In Jordan, the research by (Alqassieh et al. 2021) evaluated 288 participants, of which 141 were administered the Pfizer-BioNTech vaccine, while 147 were administered the Sinopharm vaccine.[10] In Bulgaria, (Vályi-Nagy et al., 2021) assessed 57 adult volunteers, of which 32 received the Pfizer/BioNTech vaccine and 25 received the Sinopharm vaccine.[11] The present study found no significant difference in mean IgG antibody responses to both Pfizer-BioNTech and Sinopharm, as both vaccines were successful in achieving positive IgG responses in all participants in both occasions (3 months after the 1st dose and 3 months after the 2nd dose). The findings of the current study are in discordance with that of (Alqassieh et al. 2021) who found that Pfizer-BioNTech vaccine outperformed Sinopharm vaccinees in terms of quantitative efficiency, and recommended a third booster dose for Sinopharm recipients.[10] Our findings are also in discordance with (Vályi-Nagy et al., 2021) who found that antibody levels were 6 folds higher in Pfizer vaccinated individuals than Sinopharm vaccinated individuals; However, individuals of both groups were seroconverted after two doses, which is in agreement with the present study.[11]

The differences between the present study and those mentioned earlier can be attributed to the following:

1. The small sample size, especially that of Sinopharm vaccinees, which is non-representable of the entire population.
2. Most of the vaccinees of the current study were previously infected, vaccinating recovered patients has been proven by many researchers to result in neutralizing antibodies that are up to a thousand times more potent and protective than those elicited by infection or vaccination alone.[12,13,14,15]

Although the current research examined both IgM and IgG levels, IgG was the main focus of the research since it is mostly responsible for long-term protection after vaccination.[16] Despite the fact that the median seroconversion time for IgM and IgG is 12 days and 14 days, respectively. In contrast to IgG, which normally stays positive for months to years, IgM remains detectable for 14 to 21 days after symptoms first appeared. Since the samples were obtained 3 months after each vaccination, IgM levels were not taken into account in the present study.

It is worthy to mention that the mRNA vaccines (Pfizer) creates immune responses that strictly targets the spike protein of the Covid virus most prone to mutations, while the inactivated virus vaccine (Sinopharm) induces wider responses against epitopes of nucleocapsid, spike, and membrane proteins. Thus, although BBIBP-CorV vaccine elicited weaker responses, it targets multiple viral sites, which contributes to its potential in reducing the possibility of immune escape by new mutations.[17] Additionally, this raises the need for research to investigate the effect of heterologous vaccination (vaccinating with both Pfizer and Sinopharm vaccines) and whether it increases protection.

Conclusion

In conclusion, Both vaccines showed the same efficacy as all the study subjects were seroconverted after the 1st dose of vaccination; however, the present study findings cannot be generalized to the entire population due to the small sample size.

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