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Evaluation of the Effect of COVID-19 Vaccine in Preventing COVID-19 Infection in Hemodialysis Patients

Mobina Kaviani[1], Nasrin Rasoulzadeh[1], Fatemeh Keshavarz[2], Fatemeh hosseinzadeh[3], Rana Haddadi[4]

[1]Department of Medical-Surgical Nursing, School of Nursing and Midwifery, Tehran University of Medical Sciences, Tehran, Iran
[2]Department of Nursing, Darab branch, Islamic Azad University, Darab, Iran. Islamic Azad University of Darab, Sardararan Square, Daneshgah Blv., Darab, Fars, Iran.
[3]Sina Hospital, Kerman University of Medical Sciences, Zarand, Iran
[4]Department of Anesthesia, Faculty of Allied Medicine, Kerman University of Medical Sciences, Kerman, Iran

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Abstract

Introduction: The COVID-19 disease caused a global pandemic in a short period of time. One of the reasons for the high prevalence of this disease, especially in Iran, was the lack of a vaccine to prevent the disease. Because, due to the drugs used and the hemodialysis method, these patients were more susceptible to COVID-19 disease. Therefore, this study was conducted with the aim of "Evaluation of the Effect of COVID-19 Vaccine in Preventing COVID-19 Infection in Hemodialysis Patients. **Methodology:**This cross-sectional descriptive study was conducted on 240 hemodialysis patients referred to hospitals of Tehran University of Medical Sciences in 2023 using cluster sampling. The data collection tool was a checklist of vaccination history, type of vaccine, number of vaccine doses, and history of COVID-19 infection. The information was collected through self-reporting and entered into SPSS21 statistical software. Descriptive statistics (table, mean, standard deviation) and inferential statistics (Fisher's test) were used for data analysis.**Results:**2.39% of hemodialysis patients contracted COVID-19. The infection rate was lower in those who had received a full vaccine dose. 35.4% of patients had received the AstraZeneca vaccine. The effectiveness of the Sputnik vaccine was lower than other vaccines. **Conclusion:** Given that hemodialysis patients are considered to be a susceptible and high-risk group in terms of contracting COVID-19, completing the COVID vaccine dose is considered essential. In this group of patients, the type of vaccine should be selected based on the patient's antibody level, as recommended by a physician.

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Introduction

More than four years have passed since the emergence of the COVID-19 pandemic. Undoubtedly, this disease will be recorded in history as one of the most devastating tragedies of the modern era (1). COVID-19 originated in Wuhan, China in 2019 (2). In a short period, it caused a global pandemic (3, 4). Iran was among the countries where the outbreak of this disease was confirmed very early and rapidly (4, 5). The spread and dynamics of this disease were very high and unpredictable (6). One of the reasons for the high prevalence of this disease in Iran was the lack of a vaccine to prevent it (7). Because throughout the recent centuries, safe and effective vaccines have played an important role in controlling and ending epidemics (8).

Correspondence:
Rana Haddadi
E-mail: Rana.hadadi1373@gmail.com

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Fortunately, the unprecedented and coordinated efforts of world governments, scientific institutions, and the private sector have led to tremendous responses to this widespread attack. Approximately one year after the emergence of the pandemic, dozens of COVID-19 vaccines were in various stages of clinical evaluation, human clinical trials, or final testing (1). Therefore, the rapid development and global distribution of COVID-19 vaccines is considered a significant achievement in biomedical research (9). Hence, vaccination is considered the most important method of preventing COVID-19 infection (10).

The World Health Organization-approved vaccines for COVID-19 are the AstraZeneca, Moderna, Janssen, Sputnik V, Pfizer, Sinopharm, and Bharat Biotech vaccines (11, 12).

Vaccination of hemodialysis patients against COVID-19 disease is of particular importance, as these patients are at high risk of severe infection, hospitalization and death from COVID-19 due to immunodeficiency and underlying diseases (13). Vaccination of hemodialysis patients is one of the most important ways to reduce the risk of COVID-19 infection and its complications. These patients should follow their vaccination schedule in accordance with the new recommendations of health organizations and be under the supervision of a doctor to create the best immunity against the virus (14, 15).

While mistrust and hesitancy towards vaccination are influenced by confidence in vaccine safety and efficacy, they can also be affected by various socio-economic and cultural factors, such as religious beliefs, fake news and misinformation about vaccines, and the general public's health literacy (16, 17). Furthermore, previous research has shown that compliance and acceptance of vaccines are variable and inconsistent, achieving widespread acceptance requires extensive education regarding the safety and efficacy of various vaccines (18). Few studies have been conducted on the effectiveness of the Covid-19 vaccine (19). Therefore, in this study, the researchers set out to conduct a study entitled "Investigating the willingness to receive the Covid-19 vaccine and related factors in hemodialysis patients."

Methods

This descriptive cross-sectional study was conducted on 240 hemodialysis patients admitted to the hemodialysis ward of hospitals affiliated with Tehran University of Medical Sciences in 2023. Inclusion criteria for this study included all patients with an admission record undergoing hemodialysis 2 to 3 times a week, with a duration of kidney disease and hemodialysis of more than 1 year. All research units were aware of the time and place, and had the ability to establish verbal and visual communication.

The sample size of this study was calculated to be 240 people based on this formula

$$n = \frac{(z_{1-\alpha/2} + z_{1-\beta})^2}{w^2} + 3$$

The sampling method in this study was cluster sampling. First, a list of hospitals in Tehran was selected. Two centers were randomly selected. Then a list of research units was prepared, and patients who met the research conditions were selected by simple random sampling. The data collection tool in this study was a demographic checklist including age, gender, duration of dialysis, dialysis frequency per week, vaccine type, number of vaccine doses, underlying cause, and history of COVID-19 infection. This project, after approval by the Ethics Committee of Tehran University of Medical Sciences with the number (IR.TUMS.FNM.REC.1400.098), was carried out. After obtaining permission from hospital authorities and explaining the research objectives to the participating units, the researcher assured them of the safety and anonymity of their data. All research units were also given the option to withdraw from the study if they wished. After obtaining informed consent from the research units, data were collected through self-reporting. The data were analyzed using SPSS21 statistical software with descriptive statistics (tables, mean, standard deviation) and inferential statistics (chi-square, Fisher's exact test) at a significance level of 0.05.

Results

The average age of the research units was 52.25 + 8.97 years. In terms of gender, 40.4% (97 individuals) were male and 59.6% (142 individuals) were female. The duration of the kidney disease was 9.05 + 2.11 years. 80.81% (194 individuals) underwent hemodialysis three times a week, and 19.2% (46 individuals) underwent it twice a week. 39.2% (n=94) had a prior history of COVID-19 infection. 87.1% (209 individuals) had received three doses of the COVID-19 vaccine, and 12.9% (31 individuals) had received two doses. Regarding the type of vaccine, 35.4% (85 individuals) received the AstraZeneca vaccine, 22.5% (66 individuals) received the Sinopharm vaccine, 22.5% (54 individuals) received the Sputnik vaccine, and 3.3% (8 individuals) received the Barekat vaccine (Table 1).

Fisher's exact test showed a significant difference between the type of COVID-19 vaccine and the incidence of COVID-19 disease ($P < 0.01$). The incidence of COVID-19 disease was higher in the Sputnik vaccine (Table 2).

The Fisher exact test showed a significant difference between the number of vaccine doses and COVID-19 disease. 2 doses of vaccine provide little immunity (Table 3).

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Table 1: Absolute and Relative Frequency Distribution of COVID-19 Vaccination in Hemodialysis Patients

Factors Influencing COVID-19 Vaccination		
History of COVID-19 infection	Yes	94 (39.2%)
	No	146 (60.8%)
Number of COVID-19 vaccine injection doses	2 times	31 (12.9%)
	3 times	209 (87.1%)
COVID-19 vaccine type	Sinopharm	54 (22.5%)
	AstraZeneca	85 (35.4%)
	Sputnik	27 (11.3%)
	Bharat	8 (3.3%)
	Barekat	66 (27.5%)

Table (2) Relationship between COVID-19 infection and vaccination type in hemodialysis patients

COVID-19 infection / Vaccination type	Yes	No	The percentage of infection	P_Value
Sinopharm	21	33	38.88%	P=0/01
Astrazeneca	19	47	38.35%	
Sputnik	47	38	55.29%	
Bharat	0	8	0%	
Barekat	7	20	25.92%	
total	94	146	39.2%	

Table 3: Correlation of COVID Vaccine Dose Number with COVID-19 infection in Hemodialysis Patients

COVID-19 infection / Vaccine Dose	Yes	No	P_Value
2 doses of vaccine	31	0	P=0/01
3 doses of vaccine	61	146	

Discussion

The study results indicated that 39.2% of hemodialysis patients had contracted COVID-19. Patients with chronic kidney disease (CKD) on dialysis have a weaker immune response compared to healthy individuals, placing them at a higher risk of severe COVID-19 complications. Therefore, vaccination is considered a supportive preventive measure in hemodialysis patients (15, 20, 21).

Although studies have shown that education plays a significant role in improving health and preventing diseases (22-24), preventative measures such as vaccination are crucial to ensure protection for dialysis patients against illnesses. However, successful protection through vaccination can be challenging in these individuals, as impaired immune responses to infections are also associated with reduced immune responses to vaccines (13).

COVID-19 poses a major threat to patients with chronic kidney disease. It significantly increases their risk of mortality. In these patients, in addition to therapeutic interventions, vaccination can be very helpful. However, the severity of kidney disease and also the concurrent administration of immunosuppressive drugs can affect the efficacy of SARS-CoV-2 vaccines (25).

This study demonstrated that despite vaccination, the incidence of COVID-19 remained higher in patients with kidney disease. Like other vaccines used throughout history, the COVID-19 vaccine, while offering good individual protection, does not have 100% efficacy, and at best, can prevent up to 95% of COVID-19 infections. Therefore, there is still a small chance of infection, and this small probability should be reduced by using all preventive methods. Also, preliminary data suggest that vaccines may be less effective against some variants (26).

The results of this study showed that the injection of two doses of the vaccine provided less immunity in patients. It can be said that the effectiveness of the vaccine has been shown in completing the vaccination dose. According to the studies conducted, completing the vaccination program and injecting three doses of the vaccine leads to more immunity (27). Adherence to the injection of two vaccinations plays an important role in

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the prevention of infectious diseases and the exacerbation of chronic diseases (19).

Therefore, high acceptance and coverage rates are considered crucial for the success of immunization programs (28). In addition to vaccination, educational methods and patient empowerment in self-care should be utilized (29, 30).

The results indicated that the highest percentage of research units had used the AstraZeneca vaccine. According to articles published on February 15, 2019, the AstraZeneca vaccine was introduced as a safe vaccine in preventing COVID-19 (27). The effectiveness of the AstraZeneca vaccine has been shown to be greater than other vaccines (18). However, it can be said that the tendency to accept the vaccine is associated with factors such as age, belief in fatalism, average household expenditure, and socio-economic status (28). In this study, the highest incidence of COVID-19 disease was in the Sputnik vaccine injection. This is despite the fact that studies have reported the effectiveness of this vaccine to be 96% (31). The high humoral and cellular immune response of this vaccine is associated with good tolerance, immunogenicity, and efficacy (32). However, the Sputnik vaccine should be injected in patients with high antibody levels. This is because in patients with low antibody levels, the side effects of this vaccine are greater (33). The Sputnik vaccine has more side effects than other vaccines (34).

It can be said that the effectiveness of vaccines may vary depending on differences in demographic characteristics and the type of disease. In general, the small sample size of the study can be mentioned as one of its limitations. In future studies, a similar study can be conducted on a larger sample size.

Conclusion

The results of this study showed that, due to their lower level of immunity, hemodialysis patients are more susceptible to COVID-19. In patients who did not complete the vaccination dose, the rate of infection was higher. Also, the protective effect of the Sputnik vaccine was lower, which requires further investigation of this vaccine in hemodialysis patients. Therefore, it is necessary for managers and health system officials, by raising awareness among patients, not to rely solely on vaccination in the prevention of the disease.

Patients undergoing hemodialysis utilize the COVID-19 sputnik vaccine. The rate of COVID-19 infection is higher. The use of the Sputnik vaccine in hemodialysis patients had fewer effects. It can be said that the injection of this vaccine in patients with lower immune systems has a lower antibody titer, which is less effective.

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Conflict of Interest

In the conduct of this research, no conflict of interest was observed.

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