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RESEARCH ARTICLE

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Evaluation of AntiHBs titer in vaccinated hemodialysis Patients and the relating factors in Kowsar hospital of Semnan city

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ABSTRACT

Introduction: The medical literature contains several studies showing that the response of hemodialysis patients after vaccination is inferior to that of the general population.Concerning the specific response to HBV vaccination, several additional factors contribute to an inefficient immune protection. This study was designed to investigate the possible relationship between AntiHBs titers and several factors in our population.

Materials & Methods: in this cross-sectional study all of the vaccinated hemodialysis patients in Kowsar hospital of semnan were enrolled as cases. The information required to analyze the data, including age, sex, BMI, underlying disease, smoking, duration of treatment with hemodialysis and the time elapsed since the last dose of vaccination and AntiHBs titers of them through their hospital documentations were entered in checklist. Data were analyzed by the chi- square test, T test and Fishers exact test and Mann-Whitney U test.

Results: In this study 79 hemodialysis vaccinated patients were studied. After data analysis it was indicated that there was no statistically significant relation between the variables and AntiHBs titer. On the other hand, the relation between AntiHBs titer and the time elapsed since the last dose of vaccination was significant (p=0.010).

Conclusion: our findings indicate that in our hemodialysis center, only the time since last dose of vaccination is effective both on AntiHBs titer and immunity of patients somehow after 12 months of full vaccination there is a significant decrease in AntiHBs levels leading to losing the protective titer.

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INTRODUCTION

Millions of people around the world are infected by HBV each year (1). This virus is transmitted through exposure to blood and contaminated body fluids and sexual contact, also an untreated skin exposure carries a 30% risk of serological positiveness (2). People with chronic HBV infection are at risk for liver fibrosis, hepatocellular carcinoma, and liver cirrhosis and death (3). In the initial infection, about 95% of adults with immunogenicity will experience a self-limiting disease and will also be immune to future re-infection (2, 3). Patients with HIV or People who are undergoing hemodialysis are at higher risk of HBV infection and in case of infection, will become chronic carriers of HBV(2, 4) . The most effective and efficient way to prevent HBV infection is through vaccination(3, 5) .

Vaccine injection induces HBsAg-specific T Helper lymphocyte cells as well as Tcell dependent and cause the production of neutralizing antibodies against the "a" antigen index in HBsAg. Two weeks after the injection of the first hepatitis vaccine, antibody production begins. Since hepatitis B vaccine only contains HBsAg, the produced antibody is antiHBs (6).

There are two types of vaccines available for vaccination; Recombivax, which contains 10 micrograms of HBSAg, and Engenix B, which contains 20 micrograms of HBSAg (2). Recombivax is injected at a dose of 10 micrograms in three stages and Engenix B at a dose of 20 micrograms, is injected three or four times for adults over 20 years of age(7). Studies have shown good immunogenicity of the vaccine(4). There is also a type of combined vaccine which contains 720 Enzyme-Linked immunoassay Units (ELUS) from HAV and 20 micrograms of recombinant HBSAg that is injected three times (7).

Hemodialysis patients are at high risk for HBV infection due to suppression of immune system activity, repeated use of the health care system, multiple surgeries and procedures, as well as the hemodialysis process itself, which directly exposes patient's blood to contaminated equipment. (3). Patients with ESRD have a reduced response to HBV vaccination compared to healthy individuals due to general suppression of their immune system as a result of uremia (5, 8). This indicates damage to the APCs (Antigen Presenting Cells) and T lymphocytes during the damage to immune system (9, 10). As a result, hemodialysis patients have lower antibody titers and are unable to maintain adequate and sufficient titers over time (5, 8). Hemodialysis patients have a shorter duration of protection than healthy individuals, so that more than 40% of hemodialysis patients who respond to hepatitis B vaccination will have undetectable titers three years after the vaccination (2). A multi-variant analysis found that patients with higher CKD stages, people with diabetes mellitus DM, and the elderly were less likely to have the appropriate antibody titer for the protective effect (11). Factors that reduce the immunogenicity of the vaccine include age over 40, males, obesity, people with specific genetic characteristics (HLAs B8, DR3, SCO1), hemodialysis, HIV infection, immunocompromised individuals or those treated with immunosuppressive drugs. , Smoking, subcutaneous injection of the vaccine, injection into the buttocks and freezing the vaccine (6).

ACIP has recommended early vaccination of kidney patients, as well as higher doses of vaccine (40 micrograms) for hemodialysis patients to improve serology (2). He also recommended post-vaccination tests to check the serological response in hemodialysis patients 1-2 months after the last dose of the first vaccination series. If AntiHBS <10, re-vaccination with three doses is recommended, and serological tests should be repeated 1-2 months after the last dose. If AntiHBS > or = 10, serological tests are performed annually to monitor the duration of protection, and effective action is taken as soon as the antibody titer decreases; If AntiHBS falls below 10, then an additional dose of 40 micrograms is prescribed (3). In our country, Iran, vaccination of all hemodialysis patients is performed with double dose (40 micrograms) and four times, and then the antibody level is measured 2-3 months after vaccination. If it is less than 10 units, it is considered sensitive and re-vaccination is performed three times. And if the antibody level is still below 10 units, a booster dose of the vaccine is given and re-tested annually (6).

In January 2014, Ayub et al. Showed that antibody protective titer levels remained longer in dialysis patients who had a strong initial response to vaccination (12). In the same year, another study showed that PCR (protein catabolic rate), was the only factor affecting the responsiveness of a vaccination in patients (13). In a study of hemodialysis patients, it was shown that ferritin acts as a factor in reducing the immune response. Also, patients under the age of 40 remain at their initial levels of antibody titer over time (14). Studies have shown that when intramuscular injection and injection are given 6 months before the start of the hemodialysis process, the immune response increases in hemodialysis patients(15). Chaves et al. On the immunity of hepatitis B vaccine among hemodialysis patients showed that a poor antibody response following the vaccination increases the risk of losing protective antibody levels. (16). In another study, the results showed that in hemodialysis patients, the antibody

response was 44% after initial vaccination and 80% after completion of vaccination (17).

Due to the many complications and problems caused by hepatitis B in hemodialysis patients who are also involved in serious kidney problems, also according to the mentioned statistics related to the reduction of anti-HBs protective titration in dialysis patients compared to normal population and related factors, including smoking, underlying disease, immunosuppressive drugs and overweight, we decided to review the AntiHBs titration in pre-vaccinated hemodialysis patients at the Hemodialysis Center of Kowsar Hospital in Semnan, in order to determine the effect of the mentioned variables on the antibody titer and in case of significant relation, the necessary measures should be taken to reduce or eliminate the effect of the variable and also the necessary attention must be paid more in the field of continuous antibody titration check in these patients and prescribing the booster dose of vaccine if needed to prevent further hepatitis B infection and its complications.

MATERIALS & METHODS

The present study is cross-sectional and has been performed in the hemodialysis department of Kowsar Hospital, Semnan, Iran. The statistical population of this study consists of all vaccinated hemodialysis patients with files in Kowsar Hospital in Semnan who entered the study if they were satisfied, who have already been vaccinated against hepatitis B according to the national protocol.

In this study, the required information was obtained through patients' files. Patients 'height and weight were also measured for the BMI index, and patients' AntiHBs titer were obtained through serological results recorded in the patient's file, all of which were recorded in a checklist. Hemodialysis patients who have not been vaccinated and who have hepatitis B have been excluded.

The procedure is as follows: first a checklist is prepared, then the information needed to analyze the data including patients' age, gender, weight and height of patients for BMI, underlying disease, smoking, duration of treatment with hemodialysis and time after the last dose of the vaccine was collected through the information recorded in the patient's file and registered in the prepared checklist and then, the antiHBs levels of these patients, which are routinely checked, were recorded in the checklist during the study period.

In order to analyze the data, the mean and standard deviation of quantitative variables such as antibody titer and frequency tables for qualitative variables were used. To compare between the subgroups, Chi-square test was used and, if necessary, Fisher's exact test for qualitative variables and T-test and, if necessary, Mann-Whitney U test for quantitative variables.

Ethical considerations

Patient information is kept confidential and patients enter the study with consent. This research is approved by the ethics committee of Semnan University of Medical Sciences at IR.SEMUMS.REC.1394.9.

RESULTS

In this study, 97 hemodialysis patients were examined. First, individuals were divided into two groups with a history of vaccination and no history of vaccination. Due to the fact that the objectives of the study are related to vaccinated patients, non-vaccinated individuals were removed from the study and 79 vaccinated individuals were examined as a research population. As shown in Table 1, there were 42 male patients, 53.2% and 37 female patients, accounting for 46.8% of the total research population.

Based on the findings, the median (and Interquartile range) of the antibody titer for the group with a history of vaccine 24 (39.5) and the group without a history of vaccine was 6.5 (3.5). The difference between the two groups was significant (P <0.001). Also, the amount of P obtained from the nonparametric test of Mann-Whitney U confirmed this.

The mean and standard deviation of the participants' age were 63.44 and 13.43, respectively, and the body mass index variable was 23.40 and 4.27, respectively.

Table 1: Gender distribution of patients participating in the study

Gender	Quantity	Percentage
Male	42	53.2
Female	37	46.8
Total	79	100

According to Table 2, 12 people smoke, equivalent to 15.2%, and 67 people, or 84.4% of the total population, do not smoke.

Table 2: Distribution of patients participating in the study by smoking

Smoking	Quantity	Percentage
yes	12	15.2
no	67	84.8
total	79	100

As shown in Table 3, 5 people accounted for 6.3 percent had no disease, 11 people accounted for 14 percent of all people with diabetes, 22 people accounted for 27.8 percent with high blood pressure, and 2 people accounted for 2.5 percent with Nephrotic syndrome, also 1 person (1.3%) had glomerulonephritis and 1(1.3%) had lupus.

Table 3: Distribution of patients participating in the study by underlying disease

Underlying disease	Quantity	Percentage
Without disease	5	6.3
Diabetes	11	14
High blood pressure	22	27.8
Diabetes and High blood pressure	37	46.8
Nephrotic syndrome	2	2.5
Glomerulonephritis	1	1.3
Lupus	1	1.3
Total	79	100

Seven people (8.9%) died, 1 person (1.3 percent) had kidney transplant, two people (2.5%) were transferred, and 69 people (87.3%), underwent hemodialysis (Table 4).

Table 4: Distribution of patients participating in the study based on their outcome

Outcome	Quantity	Percentage
Dead	7	8.9
kidney transplant	1	1.3
transferred	2	2.5
Hemodialysis	69	87.3
Total	79	100

As shown in Table 5, participants were divided into two groups of safe and sensitive based on titer 10. The following table compares the immunity of unvaccinated and vaccinated hemodialysis patients participating in the study.

Table 5: Comparison of the immunity of vaccinated and unvaccinated patients

Group	Sensitive		Safe		total		Possibility
	Quantity	Percentage	Quantity	Percentage	Quantity	Percentage	
Vaccinated	19	24.15	60	75.9	79	100	P<0.001
Unvaccinated	18	100	0	0.0	18	100	
Total	37	38.1	60	61.9	97	100	

According to this table, all 18 people, equivalent to 100% of those who have not been vaccinated before, are sensitive to antibody titers. Of the 79 people who have been vaccinated, 37 (24.1%) are considered to be susceptible to the disease. Given P<0.001, this difference is statistically significant.

According to Table 6, studying the correlation between age variables and body mass index and the duration of treatment with hemodialysis and the amount of time since the last dose of vaccination, using Spearman correlation coefficient showed that only the age variable with antibody

titer were positively and significantly correlated (r = 0.258, P = 0.022).

The following are the frequency tables of vaccinated hemodialysis individuals in the study subgroups.

Table 6: Comparison of the immunity of the vaccinated hemodialysis patients by age group

Group	Sensitive		Safe		Total		Possibility
	Quantity	Percentage	Quantity	Percentage	Quantity	Percentage	
65 years or less	13	34.2	25	65.8	38	100	P=0.042
65 years or more	6	14.6	35	85.4	41	100	
Total	19	24.1	60	75.9	79	100	

Table 7: Comparison of the immunity of the vaccinated hemodialysis patients by body mass index

Group	Sensitive		Safe		Total		Possibility
	Quantity	Percentage	Quantity	Percentage	Quantity	Percentage	
1	13	23.2	43	76.8	56	100	P=0.786
2	6	26.1	17	73.9	23	100	
Total	19	24.1	60	75.9	79	100	

As Table 7 shows, there is no significant difference between having and not having immunity and body mass index due to P = 0.786.

Also, the median and Interquartile range of antibody titer in the subgroup of body mass index in subgroup 1 were 26 and 39, respectively, and in subgroup 2, 24 and 42, respectively. Based on the Mann-Whitney U test P = 0.398, which indicates that there is no significant difference between this index and antibody titer.

Table 8: Comparison of the immunity of hemodialysis patients based on the duration of treatment with hemodialysis

Group	Sensitive		Safe		Total		Possibility
	Quantity	Percentage	Quantity	Percentage	Quantity	Percentage	
1	9	24.3	28	75.7	37	100	P=0.957
2	10	23.8	32	76.2	42	100	
Total	19	24.1	60	75.9	79	100	

According to the data in Table 8, P obtained from this test was 0.957, which indicates that there is no significant relation between having and not having immunity and the number of months of hemodialysis.

Also, the median and Interquartile range of antibody titers in subgroup 1 of this variable were 24 and 36.9, respectively, and in subgroup 2, 26.5 and 39.9, respectively, in addition P = 0.722 based on the Mann-Whitney U test, which indicates There is no relation between the above variable and the antibody titer.

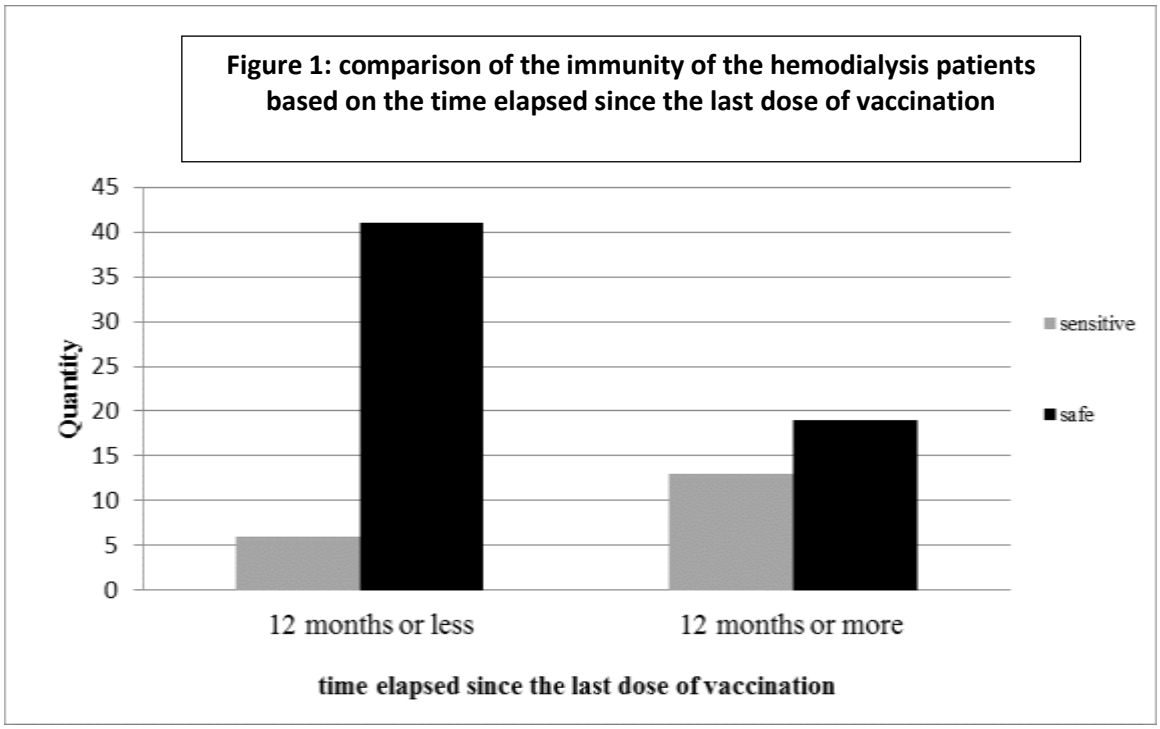
Time elapsed since the last dose of vaccination (month):

Table 9: Comparison of the immunity of the vaccinated hemodialysis patients based on the time elapsed since the last dose of vaccination

Group	Sensitive		Safe		Total		Possibility
	Quantity	Percentage	Quantity	Percentage	Quantity	Percentage	
12 months or less	6	12.8	41	87.2	47	100	P=0.004
12 months or more	13	40.6	19	59.4	32	100	
Total	19	24.1	60	75.9	79	100	

As could be seen in Table 9, the time elapsed since the last dose of vaccination shows a significant correlation with the individual's immunity, in this analysis (P = 0.004). In fact, the percentage of

sensitive people in those who have been vaccinated for more than a year is significantly higher than those who have been vaccinated for less than a year.



Also, the statistics related to the median and Interquartile range related to antibody titers in subgroups of 12 months or less were 29 and 37, respectively, and related to subgroups of more than 12 months were 12 and 42.8, respectively. According to the results of the Mann-Whitney U test P = 0.010, this indicates that there is a significant difference between the two groups in terms of antibody titer, which differs from the amount of time elapsed since last dose of the vaccine.

Table 10: Comparison of the immunity of vaccinated hemodialysis patients by smoking

Group	Sensitive		Safe		Total		P value
	Quantity	Percentage	Quantity	Percentage	Quantity	Percentage	
Smokers	5	41.7	7	58.3	12	100	P=0.121
Non-smokers	14	20.9	53	79.1	67	100	
Total	19	24.1	60	75.9	79	100	

According to Table 10, with P=0.121, there was no significant difference between smoking and immunity.

The median and Interquartile range of antibody titers for the non-smoking group was 24 and 39, respectively, and for the subgroup that smoked 14.75 and 37.8, respectively. According to the results of Mann-Whitney U test, P = 0.174 was obtained, indicating that there was no significant difference between smoking and antibody titers.

Table 11: Comparison of the immunity of vaccinated hemodialysis patients by gender

Group	Sensitive		Safe		Total		P value
	Quantity	Percentage	Quantity	Percentage	Quantity	Percentage	
Male	11	26.2	31	73.8	42	100	P=0.635
Female	8	21.6	29	78.4	37	100	
Total	19	24.1	60	75.9	79	100	

According to Table 11, the result of the test showed that there is no significant difference between the gender and the antibody titer (P = 0.635).

Also, the median and Interquartile range of antibody titers in the male subgroup were 16 and 41.5, respectively, and in the female subgroup 31 and 39.3, respectively; Based on Mann-Whitney U test, P = 0.284 was calculated, indicating that there was no significant correlation between sex and antibody titer.

Table 12: Comparison of the immunity of hemodialysis patients based on underlying disease

Group	Sensitive		Safe		Total		Possibility
	Quantity	Percentage	Quantity	Percentage	Quantity	Percentage	
With underlying disease	16	21.6	58	78.4	74	100	P=0.87
Without underlying disease	3	60	2	40	5	100	
Total	19	24.1	60	75.9	79	100	

As the results of Table 12 show, P=0.87 was obtained from Fisher's exact test, indicating that there was no relation between having and not having immunity and underlying disease.

Also, the median and Interquartile range of the antibody titer variable for the subgroup without underlying disease were 9.80 and 28.3, respectively, and for the underlying disease subgroup were 24.50 and 39.0, respectively. According to Mann-Whitney U test, P = 0.107, indicating that there was no significant relation between antibody titer and underlying disease.

DISCUSSION

In patients undergoing hemodialysis whose immune systems are weakened, hepatitis B virus infection leads to chronic infection, resulted from the lack of proper antibody titer production (18) . Numerous studies have shown that the immune system's response to antibody production following vaccine injection in people with chronic kidney disease is reduced compared to the general population (19). It is noteworthy that several factors are involved in reducing the rate of response to vaccine injections, including age, duration of treatment with hemodialysis, diabetes, etc. (16, 20-22). Therefore, we conducted a study to investigate the level of antibodies and related factors, as well as the effect of several factors on the immunity of vaccinated hemodialysis patients against hepatitis B virus in this population.

Our study included a review of the HBs Ab titer in 79 hemodialysis patients who had previously been vaccinated against hepatitis B with three full doses, as well as the effect of variables such as age, gender, BMI, underlying disease, duration of hemodialysis treatment, and the time elapsed since the injection of the last dose of vaccine on the antibody titer and on the immunity of hemodialysis patients was examined; The results are as follows:

Age

The results of the study of the effect of age variable on the anti-HBs titer of patients showed that there was no significant correlation between antibody titer and age, but there is a significant correlation between the age of vaccinated hemodialysis patients and the immunity of patients according to titers higher than 10, while the number of safe people in the over 65 age group has been higher, and the results of this study are due to the fact that vaccinated older people have been fully vaccinated in recent months, and the effect of the time elapsed since injection of the last dose of vaccine has not been removed in the study of this variable in our study population; In a 2011 study, Chaves et al. Found no significant correlation between age and loss of antibody protection levels (16); In a 2007 study by Khamene et al., the number of vaccinated hemodialysis patients who had antibody protection levels was higher in those under 39 years of age (23). A study by Pereira ZT et al. in July 2012 at the Federal University of Rio de Grand found that patients under the age of 40 did not experience significant reductions in protective antibody levels (14). On the other hand, in a 2008 study by Velayati et al. On the immunity of hepatitis B vaccination in hemodialysis patients over 37 patients, no correlation was found between age and Immunogenicity (24). Studies by Ayub in 2014 and Khalil al-Saran in 2014 and Ramezani in 2009 also found no relation between the age of the patients participating in the study and the response to the hepatitis B vaccine (13, 21, 25). In general, age is an important factor in immunogenicity and cellular response (22).

BMI

In this study, there was no significant correlation between antibody titer and body mass index of participating patients. There was also no significant correlation between patient immunity and BMI. A 2003 study by Kovacic et al. Found no

significant relation between body mass index and antibody titer (1). A 2014 study by Khalil al-Saran et al., Entitled factors affecting response to Hepatitis B Vaccine in Hemodialysis Patients on 114 Patients, found that there was no correlation between BMI of hemodialysis patients and antibody response rate after vaccination (13). Also, in a study by Ramezani et al. in 2009, there was no correlation between the weight of the participating patients and the rate of response to vaccination (25).

Duration of treatment with hemodialysis

This study did not find a significant correlation between the number of months that vaccinated patients were treated with hemodialysis and the antibody titer, and there was no correlation between the effect of this variable on the immunity of the population. A 2008 study by Velayati et al. In Masih Daneshvari Hospital found no relation between the duration of patients' hemodialysis treatment and the level of antibody protection left after vaccination (24). However, in Khamene's study, the result showed that the longer the duration of treatment with hemodialysis was, the immunity was greater. Thus in his study, which included 141 vaccinated hemodialysis patients, the number of immunocompromised patients who were treated with hemodialysis for over 5 years, was greater (23). In studies conducted by Shatat HZ et al. In 2000 on the immunity response to hepatitis B vaccination in hemodialysis patients over 65 patients, Ramezani et al. In 2009 and Khalil al-Saran et al. In 2014, the duration of treatment with hemodialysis did not affect the rate of hepatitis B vaccination response(13, 21).

Time elapsed since the last dose of vaccination

In this study, 76 vaccinated hemodialysis patients were included, each of whom was different in terms of time elapsed since the last dose of the vaccine, so the effect of the variable on antibody titers was measured, and based on the results, there is a significant correlation between antibody titer and this variable. Also, in examining the effect of the time elapsed since the injection of the last dose of the vaccine on patient immunity, it was found that there is a significant correlation between these two variables, so that the number of safe people who have had their last dose of vaccine in less than 12 months, was greater (87.2%). While the percentage of the patients who have been injected for more than 12 months, is 59.4%. According to a 2014 study by Ayub et al., 55.6% of patients had a negative antibody protective titer, 1 year after vaccination and 44.4% of them had this negative titer in the first 6 months after the vaccine was injected. It should be noted, that this significant reduction in the protective antibody titer is related to patients whose titers after vaccination, although higher than 10, were among the weaker respondents (12). A study by Chaves, also showed that the amount of time since the vaccine injection had an effect on reducing the protective titer, so that as this time increased, the protective titer decreased. The reduction in protective titer was related to the initial titer, which was measured after the vaccination, so that in only 44% of weak respondents after 12 months, antibody protection was visible; But in strong respondents, after 12 months in 92% and after 24 months in 68%, the protective titer was visible (16). In 2011, Roznovsky et al. conducted a study of hepatitis B vaccine in patients with chronic renal failure between 1988 and 2010 from four hemodialysis centers with 1,271 hemodialysis patients who were vaccinated, the results showed a decrease in protective antibody levels in 47 % of patients after 3 years and in 68% of patients after five years (26). In another study by Tsouchnikas et al. in October 2007 on immunodeficiency against hepatitis B virus in hemodialysis patients after vaccination or after innate immunization in a Greek hospital, the results showed that the median time of losing antibody protection titer in vaccinated patients was 12 months. They also also found that patients who acquired immunogenicity by hepatitis B infection, lost their protective titer by median time of 15 months; However, in these patients, the protective levels of antibodies would renew, while in vaccinated patients this is not the case and even the antibody titer decreases more rapidly, and this indicates the need to consider the antibody titer of vaccinated patients (27). The results of these studies show, that the time elapsed since the injection of the last dose of vaccine, have been proved to reduce the titer of the protective antibody, as in other studies such as the 2008 Velayati study and the Ramezani study in 2009 can be seen (21, 24). Therefore, according to the results of our study and the mentioned studies, it is necessary to pay attention to measuring antibody levels in hemodialysis patients to ensure the immunity of these patients against possible infection with hepatitis B virus.

Smoking

There was no significant correlation between smoking and antibody titers in this study and according to the results, smoking did not affect the immunity of patients and the survival of protective antibodies in them. In addition, no similar study was found to investigate the effect of smoking on the immunity of vaccinated hemodialysis patients. However, in the study conducted by Ayub, smoking also had no effect on the rate of response to vaccination (12).

Gender

In the present study, there was no significant correlation between the gender variable and antibody titer among vaccinated hemodialysis patients. There was also no significant relation between the gender of the participants and whether they were safe or not. In a study by Ramezani in 2008, there was no difference between the gender of the participants and their immunity (24). In a 2011 study by Chaves, among 77 hemodialysis patients participating in the study, which included 44 men, male patients in the study had a greater reduction in antibody titers and, consequently, loss of protective antibody levels (16). On the other hand, in a study conducted by Khamene et al. on 141 vaccinated hemodialysis patients with 76 men, the results showed that a higher percentage of men have complete levels of immunity, although it is noted, that the results of this study need more detailed examination (23). A 2003 study by Elwell et al. on the factors associated with Prolonged production of protective antibodies by injection of hepatitis B vaccine, showed no correlation between gender variable and patient immunity (28). In studies conducted by Ayub et al., Ramezani et al. and Khalil al-Saran et al., No association was found between the age of the patients participating in the study and the rate of response to hepatitis B vaccination (13, 25, 29).

Underlying disease

In our study, the majority of study participants were patients with high blood pressure and diabetes (88.6%) and the results showed that the underlying diseases had no effect on antibody titers and there is no significant correlation between this variable and the immunity of patients. In a study by Chaves, diabetes also had no effect on patients' immunity (16). However, according to a study by Ayub, diabetes and high blood pressure have had a negative effect on vaccination response (12). Also, in a study by Khaled Al saran in 2011, the incidence of an underlying disease such as diabetes did not affect the response rate (13). A 2014 study by Theodoros Eleftheriadis on the factors affecting the effectiveness of Hepatitis B Vaccination in Hemodialysis Patients, found that diabetes reduced vaccination efficiency (30). A 2003 study by Kovacic et al. in Croatia on whether effective hemodialysis improved the response to hepatitis B vaccination, found that there was no significant association between antibody titers and diabetes(1) . In a 2003 study by Gerald Daroza et al., which was performed on 165 hemodialysis patients, diabetes was a factor in reducing seroconversion (11).

Due to the negative role of this virus on the health of dialysis patients and the attention of various studies on the importance of vaccine production, vaccination and nutrition of hemodialysis patients (31-33), it is important to pay attention to fundamental researchs and strategies in this regard.

CONCLUSION

Among the vaccinated hemodialysis population at the mentioned hemodialysis center, the amount of time elapsed since injection of the last dose of hepatitis B vaccine was the only variable affecting the antibody titer and patient immunity; so that after more than 12 months since the injection of last dose of the vaccine, this titer would decrease significantly and eventually leads to the loss of protective antibody titers in hemodialysis patients.

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