Correlation between body mass index (BMI) and immunologic Response to Hepatitis B Vaccine

Mojtaba Varshochi and Sepehr Taghizadeh

Infectious Diseases and Tropical Medicine Research Center, Faculty of medicine, Tabriz University of Medical Sciences, Tabriz, Iran. varshochim@yahoo.com

Abstract: Problem statement: To evaluation the Correlation between body mass index (BMI) and immunologic Response to Hepatitis B Vaccine. Methods: In a cross sectional descriptive analytic study carried out on the health care Workers (HCWs) of Tabriz Shahid Madani Hospital in 20010-2011, we evaluated the immunologic response of the staff to vaccination against Hepatitis B and correlation by body mass index (BMI). Results and Conclusion: Results: 122 people (36.8%) from the studied HCWs were male and 209 people (63.2%) female. The mean Primary and secondary antibody titer in the studied HCWs were 304.07±199.98 and 369.13 ± 169.78 *IU/L*. From 331 studied people, 31 (9.4%) showed no response to vaccination, 52 (15.7%) low response and 248 (74.9%) good response and after one booster dose, 7 (2.1%) showed no response to vaccination, 5 (1.5%) low response and 319 (96.4%) good response. In our study, the response rate to the vaccine has been reduced by increased weight and BMI, although this reduction was not statistically significant. Mean of Primary response antibody titer in male was significantly higher than female HCWs(P=0.011).Significant liner correlation was not found between HBsAb level and HCWs weight and BMI.

[Varshochi M, Taghizadeh S. **Correlation between body mass index (BMI) and immunologic Response to Hepatitis B Vaccine.** *Life Sci J* 2013;10(1):210-213] (ISSN:1097-8135). http://www.lifesciencesite.com. 31

Keywords: Hepatitis B Vaccines; Occupational Diseases; BMI; Immunologic Response

1. Introduction

In recent decades, hepatitis is among the diseases considered as serious threats to healthcare workers and patients (Mast, 1998).

Infection with hepatitis B virus, as one of the most common infections in the world, is one of the major health problems in our country as well. Over 2 billion people worldwide have been infected with this virus, of which 400 million are chronic carriers of the virus and approximately 53,000 new cases of infection are reported every year, 8,000 of which are job-related, and recommendations have been made for vaccination of at-risk groups, including healthcare providers working in hospitals and health centers against hepatitis B virus (Lemon, 1997; Lavanchy, 2008).

Vaccine-preventable viral hepatitis continues to be a cause of considerable morbidity and mortality: on worldwide basis, approximately 1.4 million cases of hepatitis A are reported every year. The true incidence, however, has been estimated to be 3-10 times higher. Regarding hepatitis B, more than a third of the world's population has been infected (Van Damme and Van Herck, 2006).

Hepatitis B vaccination is recommended for all healthcare workers (HCW) at risk of exposure to infectious body fluids. However, the absolute duration of protection from immunization is unknown. The purpose of this randomized comparison trial was to determine how previously immunized HCW respond to different booster doses of hepatitis B vaccine(Williams, 2001).

Zhuang et al showed that three-dose intramuscular revaccination did play an important immune protection for non-responder children to primary HB vaccination, but its efficacy could not reach the level of primary vaccination in responders(Zhuang, 2006).

Testing of blood for anti-HBs one month after vaccination is recommended to recognize non-responders as a booster dose will be beneficial in the majority of them (Perera, 2002).

Hofmann et al demonstrated that Estimations of post-vaccination-anti Hbs showed that women, younger persons, persons with a body mass index < 25 and non-smokers had higher anti-HBs concentrations than men, elderly person's overweight persons and smokers (Hofmann, 1997).

Chlíbek et al show that body weight was also observed, with the obese subjects showing the lowest immune response (Chlíbek, 2007).

In this study, we were to review the results of vaccination of healthcare workers and evaluate the effect of BMI on its response rate.

2. Material and Methods

In a cross sectional descriptive analytic study carried out on the HCWs of Tabriz Shahid Madani Hospital in 2010-2011, we evaluated the immunologic response of the HCWs to vaccination against Hepatitis B and correlation by body mass index (BMI).

HCWs are routinely vaccinated against hepatitis B and therefore antibody titration is essential to insure appropriate immunity.

The studied HCWs are vaccinated by hepatitis B vaccine with fallowing properties (entitled EUVAX B, met the WHO requirements, made in Korea, LG life sciences company) for three doses (0, 1 and 6 months) and antibody was titrated three months after vaccination. All utilized vaccines were from one brand and all tests were performed in one laboratory. ELISA test was used to evaluate the samples used kit in this study was the Anti-HBs kit, made by ROCHE Company entitled "COBAS". Methods of this kit was ELISA, in which ELISA micro plates in this method ELISA micro plates are covered by antigen S so that after adding serum containing antibodies against antigen S, antigens would bind with antibodies. In the next step, antigen S conjugated with peroxidase enzyme is added which attaches to the part of the antibodies not bound to antigens. Later, adding chromogene and substrate dies the solution whose color can be read by ELISA reader.

After performing tests and reading the plates by ELISA reader, standard curves were provided using standard samples. Later using these curves, the concentration of antibodies in the tested sample were calculated. Based on the instructions of the kit manufacturer, antibody level less than 10 units per mL was considered negative and amounts higher as positive.

In this study, HCWs vaccinated on schedule, routinely 3 times during the past 5 years (6-1-0), and had a negative HBcAb and HBsAg, were examined in terms of HBsAb titer, height, weight, and BMI.

Table 1. Evaluation of Age, Height, Weight and BMI based on Primary and Secondary response.

	Primary Response				Secondary response (after one booster dose)			
	Good Responders	Low Responders	Non Responders	P	Good Responders	Low Responders	Non Responders	P
Age	31.32 ± 7.02	32.65 ± 7.96	33.71 ± 8.51	0.146	31.40 ± 7.08	37.20 ± 7.46	43.86 ± 8.30	<0.001
Height	1.64 ± .08	1.64 ± .07	1.65 ± .08	0.908	1.64 ± .08	1.71 ± .09	1.65 ± .08	0.129
weight	66.28 ± 12.79	67.75 ± 14.02	69.48 ± 11.96	0.365	66.41 ± 12.71	82.40 ± 12.05	74.00 ± 15.73	0.007
BMI	24.56 ± 4.02	24.94 ±4.10	25.52 ± 3.33	0.408	24.61 ± 3.95	28.08 ± 3.71	26.87 ± 4.16	0.053

Table 2. Evaluation of primary and secondary HBsAb titers of HCWs based on BMI groups.

	BMI Groups					
	<20	20-25	25-30	30-35	> 35	P
Primary Response	272.48 ± 177.27	313.86 ± 197.01	314.59 ± 212.81	225.11 ± 174.85	403.00 ± 125.37	0.173
Secondary response	336.10 ± 149.55	377.71 ± 165.40	377.86 ± 178.08	313.70 ± 165.11	403.00 ± 125.37	0.114

331 HCWs were studied and those without ideal HBsAb titer (below 100) were selected. These employees received a booster dose of hepatitis B vaccine, and were evaluated again in terms of HBsAb titer 3 to 6 months later in the same laboratory.

Finally, the response to vaccination was evaluated in three groups of proper response (HBsAb>100), acceptable response (100>HBsAb>10) and inadequate response (HBsAb<10).

3. Results

This study was carried out on 331 HCWs. The mean Primary and secondary antibody titer in the studied HCWs were 304.07±199.98 *IU/L* and 369.13 ± 169.78 *IU/L*. 122 people (36.8%) from the studied HCWs were male and 209 people (63.2%) female.

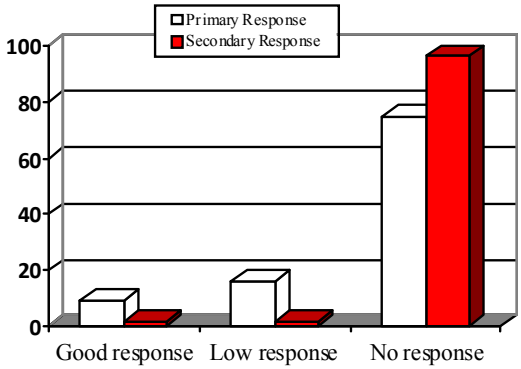
Dividing the antibody titer into three groups of "no response" (Titer < 10 *IU/L*), "Low response" (Titer10-100 *IU/L*) and "Good response" (Titer >100 *IU/L*) revealed that from 331 studied HCWs, at Primary Response: 31 people (9.4%) were in "No response" group, 52 people (15.7%) in "Low response" group and 248 people (74.9%) in "Good response" group and Secondary Response: 7 people (2.1%) were in "No response" group, 5 people (1.5%) in "Low response" group and 319 people (96.4%) in "Good response" group(Chart I).

Mean age of male HCWs was 34.05 ± 8.58 and in female HCWs was 30.43 ± 6.15 year (P<0.001).Mean of Primary response antibody titer in male HCWs was 340.59 ± 205.15 *IU/L* and in female HCWs were 282.75 ± 194.22 *IU/L*.

Mean of Primary response antibody titer in male was significantly higher than female HCWs (P=0.011).Significant liner correlation was not found between HBsAb level and HCWs weight and BMI.

Mean and STD deviation of age, height, weight and BMI of HCWs based on Primary and secondary response to vaccination was shown in table 1.

Evaluation of primary and secondary HBsAb titers of HCWs based on BMI groups were shown in table 2. Frequency of Primary and Secondary Responders based on BMI Groups were shown in table 3.



Char 1. Primary and Secondary response to Vaccinations in HCWs

4. Discussions

Several factors affect the rate of response to hepatitis B vaccination of healthcare workers including obesity and high BMI, the effect of which is evaluated on the response to vaccination of health care workers that there was no significant linear relationship between the HBsAb level, weight and BMI of health care workers under study; however, the response rate to the vaccine has been reduced by increased weight and BMI, although this reduction was not statistically significant.

Martínez Pérez et al showed that Obesity is a factor providing a prior indication of a minor response to the same (Martínez Pérez, 1998).

Wood et al demonstrated that age (P = .01), body mass index (P < .01), and smoking status (P < .01) were associated with lacking anti-HBs only for Recombivax HB recipients; and gender (P = .03) was associated with lacking anti-HBs only for Engerix-B recipients (Wood, 1993).

Roome et al demonstrated that the frequency of inadequate level of antibody increased significantly relative to age, from 2.8% among those younger than 30 years to 42.1% among those older than 60 years (P < .0001). Smoking (odds ratio [OR], 3.6; 95% confidence interval [CI], 2.0 to 6.4), extreme obesity (OR, 13.3; 95% CI, 3.8 to 49.1) (Roome, 1993).

In the study of Cockcroft et al, the responders were significantly younger than the non-responders and had significantly lower values of body mass index (wt/ht2) (Cockcroft, 1990).

Chlíbek et al demonstrated that body weight was also observed, with the obese subjects showing the lowest immune response (Chlíbek, 2007).

Although body mass index affected the response to the first hepatitis B booster, when full compliance to regular revaccination was ensured, all non- and low-responders eventually reached sufficient anti-HBs levels (Clemens, 1997).

Horowitz and et al show that, low levels HBsAB were associated with smoking, older age, and higher body-mass index (Horowitz, 1998).

As well, in two other studies by Averhoff et al in 1998 and Rendi-Wagner et al in 2000 there was no negative relationship between high weight and Anti-HBs titer (Averhoff, 1998; Rendi-Wagner, 2000).

Table 3. Frequency of Primary and Secondary Responders based on BMI Groups

		BMI Group					
		<20	20-25	25-30	30-35	> 35	P
Primary Response	Non Responders	2	13	13	3	0	
	Low Responders	6	23	16	7	0	<0.001
	Good Responders	21	118	89	17	3	
Secondary response	Non Responders	1	1	3	2	0	
	Low Responders	0	1	3	1	0	<0.001
	Good Responders	28	152	112	24	3	

In the study of Averhoff et al conducted double blinded and prospective, obesity, being male, chronic disease, and smoking were the factors effective on reduced Anti-HBs titer (Averhoff, 1998). In a similar research by Sezer et al on 50 hemodialysis patients, being male was one of the factors effective on reduction of Anti-HBs titer (Sezer, 2000).

The above mentioned studies suggest that high weight and BMI are among the factors effective on reduction of the response to Hepatitis B vaccination.

Perera J et al demonstrated that duration of vaccination, sex and body mass index were not significantly associated with anti-HBs levels (Perera, 2002).

Cardell K et al showed that Sex or body mass index had no influence on response rate of HCWs to Hepatitis B vaccination (Cardell, 1999).

Like the results of the above mentioned studies, in our study as well there was no significant relationship between high weight and BMI and reduced response to vaccination.

Conclusions

From 331 studied people, 31 (9.4%) showed no response to vaccination, 52 (15.7%) low response and 248 (74.9%) good response and after one booster

dose, 7 (2.1%) showed no response to vaccination, 5 (1.5%) low response and 319 (96.4%) good response. In our study, the response rate to the vaccine has been reduced by increased weight and BMI, although this reduction was not statistically significant.

Corresponding Author:
Dr. Mojtaba Varshochi,
Infectious Diseases and Tropical medicine research center, Tabriz University of Medical Sciences, Tabriz, Iran.
E-mail: varshochim@yahoo.com

References:

1-Mast EE, Williams JT, Alter MJ, Margolis HS. Hepatitis B vaccination of adolescent and adult highrisk groups in the United States. Vaccine 1998; 16: 27-9.
2-Lemon SM, Thomas DL .Vaccines to prevent viral hepatitis .N Engl J Med 1997;336:196-204.
3- Lavanchy D. Chronic viral hepatitis as a public health issue in the world. Best Pract Res Clin Gastroenterol 2008;22:991-1008.
4- Van Damme P, Van Herck K. A review of the long-term protection after hepatitis A and B vaccination. Travel Med Infect Dis 2007; 5(2):79-84. Epub 2006 Jun 19.
5-Williams JL, Christensen CJ, McMahon BJ, Bulkow LR, Cagle HH, Mayers JS, Zanis CL, Parkinson AJ, Margolis HS. Evaluation of the response to a booster dose of hepatitis B vaccine in previously immunized healthcare workers. Vaccine 2001;19(28-29):4081-5.
6- Zhuang GH, Yan H, Wang XL, Wu Q, Wang LR, Gao HY. A five-year observation on efficacy of revaccination in children of non-response to hepatitis B vaccine. Zhonghua Yu Fang Yi Xue Za Zhi 2006;40(1):8-12.
7-Perera J, Perera B, Gamage S. Seroconversion after hepatitis B vaccination in healthy young adults, and the effect of a booster dose. Ceylon Med J 2002;47(1):6-8.
8-Hofmann F, Kralj N, Hasselhorn HM, Nübling M, Michaelis M, Berthold H. Efficacy of hepatitis B preventive vaccination. Gesundheitswesen 1997; 59(8-9):527-34.
9-Chlíbek R, Smetana J, Sindelár R, Cecetková B, Prymula R, Kohl I. Immunogenicity of vaccines against viral hepatitis A and B in the population above 40 years of age -- impact of risk factors. Epidemiol Mikrobiol Imunol 2007;56(3):119-28.
10-Martínez Pérez JA, Belmonte Santamaría JE, Gascueña Luengo M, Caballero Moreno L, Sabroso Alcázar C, García Pasan MJ. Coverage and immune response to hepatitis B vaccine in adolescents of the Guadalajara province. Rev Esp Salud Publica 1998;72(2):119-26.
11-Wood RC, MacDonald KL, White KE, Hedberg CW, Hanson M, Osterholm MT. Risk factors for lack of detectable antibody following hepatitis B vaccination of Minnesota health care workers. JAMA 1993;270(24):2935-9.
12-Roome AJ, Walsh SJ, Cartter ML, Hadler JL. Hepatitis B vaccine responsiveness in Connecticut public safety personnel. JAMA 1993; 270(24):2931-4.
13-Cockcroft A, Soper P, Insall C, Kennard Y, Chapman S, Gooch C, Griffiths P. Antibody response after hepatitis B immunisation in a group of health care workers. Br J Ind Med 1990;47(3):199-202.
14-Clemens R, Sänger R, Kruppenbacher J, Höbel W, Stanbury W, Bock HL, Jilg W. Booster immunization of low- and non-responders after a standard three dose hepatitis B vaccine schedule--results of a post-marketing surveillance. Vaccine 1997;15(4):349-52.
15-Horowitz MM, Ershler WB, McKinney WP, Battiola RJ. Duration of immunity after hepatitis B vaccination: efficacy of low-dose booster vaccine. Ann Intern Med 1988;108(2):185-9.
16- Averhoff F, Mahoney F, Coleman P, Schatz G, Hurwitz E, Margolis H, et al. Immunogenicity of hepatitis B vaccines implications for persons at occupational risk of hepatitis B virus infection. Am J Prev Med 1998; 15(1): 1-8.
17- Rendi-Wagner P, Kundi M, Stemberger H, Wiedemann G, Holzman M, Hofer M, et al. Antibody-Response to three recombinant hepatitis B vaccines: comparative evaluation of multicenter travel-clinic based experience. Vaccine 2000; 19:1055-60.
18- Sezer S, Ozdemir FN, Guz G, Arat Z, Colak T, Sengul S. Factors influencing response to hepatitis B virus vaccination in hemodialysis patients. Transplant Proc 2000; 32: 607-8.
19-Cardell K, Frydén A, Normann B. Intradermal hepatitis B vaccination in health care workers. Response rate and experiences from vaccination in clinical practise. Scand J Infect Dis 1999;31(2):197-200.

11/13/2012