

Evaluation of Pfizer Vaccine Efficacy and Effect on Thrombosis in Type-2 Diabetes Mellitus Iraqi Patients

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Abstract

Background diabetes mellitus type 2 is associated with the highest risk of SARS-CoV-2 and complications, Vaccination against COVID-19 is highly effective in reducing mortality and morbidity in T2DM objectives The effect of the Pfizer vaccine on humoral immune responses in T2DM was measured by measuring serum Anti-Nucleocapsid SARS-CoV-2-Specific IgG Concentration Antibodies and detecting an effect on D-dimer and platelets after the second dose of the Pfizer vaccine. Methods Venous blood was collected following the second dosage of vaccination, serum Anti-Nucleocapsid SARS-CoV-2-Specific IgG concentration was assayed by ichroma-2 sandwich immunodetection method in which fluorescence and D-dimer measured by HiproBiotechnology (Nephelometry immunoassay). Results the results revealed the efficacy of the Pfizer vaccine in a diabetic is low in comparison to controls while D-dimer is higher in diabetics and lower in controls and platelets are higher in diabetics and lower in controls. Conclusion these results showed lower efficacy of the Pfizer vaccine in diabetics in comparison with control in regard to the studied parameters and the Pfizer vaccine does not effect on thrombosis.

Keywords: T2DM, pfizer, Coronavirus, IgG,platelet,D-dimer

1. Introduction

Type 2 diabetes mellitus (T2DM) is identified by persistent hyperglycemia and reduced glucose metabolism. carbohydrate; lipid and protein metabolism as a result of insufficient insulin secretion or action (1). Diabetes affects more than 425 million people globally; and studies suggest that number will rise to 629 million by 2045(2). In the presence of the SARS-CoV-2 virus, diabetic individuals exhibit substantially more severe illness symptomatology(3). Several SARS-CoV-2 vaccines; including new mRNA (e.g., Pfizer- (BNT162b2); have been produced in the world from December 2020. (4). A full-length spike protein encoding a nucleoside-modified RNA vaccine produced with lipid nanoparticles (5). The COVID-19 vaccine from Pfizer-BioNTech comprises of 2 intramuscular injections (30 g, 0.3 mL each) given three weeks apart (6).

the Pfizer vaccination generates significant IgG and neutralizes antibody responses after 7 to 14 days from immunization with a second dose(7).Diabetes type 2 has been associated with increased thrombin production and the creation of thicker fibrin clots with lower lysability (8). Increased platelets reaction, together with endothelial dysfunction, elevated coagulation factor levels, and impaired fibrinolysis, has been associated to an increased atherothrombotic risk in diabetes individuals.(9). D-dimer; hypertension; diabetes; are all factors that may influence the thrombocytopenia prediction (10). Recent research found a relationship between thrombocytopenia and severe COVID-19 (11).

The aim of the study is an evaluation of humoral

immune responses among three study groups (the first T2DM vaccinated; second T2DM non-vaccinated and third healthy control vaccinated) by measuring Anti-Nucleocapsid SARS-CoV-2-Specific IgG and detecting the effect of Pfizer vaccine on platelet and D-dimer.

2. Material and Methods

Ethical approval

The research was conducted in agreement with the Institutional Board Review's ethical approval (IRB) in the College of Health and Medical Technologies; Middle Technical University; under the date of 5/12/2021. All subjects gave written informed consent before collection their blood for this study.

Subjects and collection methods

Patients with T2DM who were diagnosed by specialist were recruited for the study. The patient received 2 doses of the Pfizer vaccine.

Inclusion criteria

1. one hundred Types -2 diabetes mellitus vaccinated with Pfizer vaccine; age rang (20-70 years).14-21 days after the second dose of vaccination.
 2. Fifty Type -2 diabetes mellitus with no vaccine age rang (20-70 years).
 3. fifty healthy controls, were vaccinated with Pfizer vaccine age range (25-50 years). Second dose after 14-21 days the of vaccination.
- The whole time of the study was 4 months from (December 2021 to March 2022).

Exclusion criteria

patients that has been previously infected with COVID-19; patients that receive single dose of Pfizer vaccine as well as people who have been vaccinated with Sinopharum and AstraZeneca; liver; kidney disease and autoimmune; gestational diabetes mellitus disease all are excluded.

Instruments

1. IgG by i Chroma-2 (biotech) a fluorescence-based POCT (point of care test immunoassay analyzer) that is small and simple to operate. Series from South Korea
2. D-dimer by using Nephelometry immunoassay Method in Hipro device from China
Test product and sample processing
4 ml of venous blood obtained was separated into

three parts.

Whole blood (the HbA1C test measured by HPLC and a complete blood count fully autosamsungs).

Plasma with citric acid for the D-dimer measure by using HiproBiotechnology (Nephelometry immunoassay Method).

Serum Anti-Nucleocapsid SARS-CoV-2-Specific IgG antibodies were determined. Using ichroma employs a sandwich immunodetection method in which fluorescence). Stored serum without and delayed at -80 °C

3. Results

The data in table (1) revealed that most of the diabetic patients had lower efficacy of IgG in highly significant differences among diabetics in comparison with control with higher efficacy at (p < 0.0001)

Variables	Study Groups	N	Mean	S. E	T-test	P-value
Anti-Nucleocapsid IgG +ve >1.1. -ve < 0.9	Controls	50	26.09	1.881	6.095	<0.0001
	DM-2 Vaccinated	100	13.30	1.171		
(****)P value <0.0001 significant differences P value <0.05						

The results in a table (2) showed that most of the diabetic patients had higher levels of D-dimer in

significant differences (p < 0.0005) than in control was lower

Variables	Study Groups	N	Mean	S. E	T-test	P-value
D-dimer 0-500ng/ml	Controls	50	145.6	6.916	7.847	<0.0005
	DM-2non vaccinated	50	236.2	15.67		
	DM-2 Vaccinated	100	220.1	16.38		
(*** P value <0.0005 significant differences p value < 0.05						

The data in th table (3) revealed that most diabetic patients had a higher count of platelets in a

highly significant difference (p < 0.0001) than controls.

Variables	Study Groups	N	Mean	S. E	T-test	P-value
Platelet 150-400 103/ μL	Controls	50	207.2	5.125	15.08	<0.0001
	DM-2non vaccinated	50	273.9	10.62		
	DM-2 Vaccinated	100	247.6	6.524		
(****) P value <0.0001 significant differences P value <0.05						

The results in table (4) showed that most of the diabetic patients had higher levels of HbA1C in

highly significant differences (p < 0.0005) than those in the control

Variables	Study Groups	N	Mean	S.E	T-test	P-value
HbA1C ≥ 6.5 %	Controls	50	4.947	6.916	75.67	<0.0001
	DM-2non vaccinated	50	8.331	15.67		
	DM-2 Vaccinated	100	8.067	16.38		
(****)P value <0.0001 significant differences						

4. Discussion

The novel coronavirus illness (COVID-19) has a bad prognosis in patients with diabetes mellitus (DM). Primary prevention remains the most effective method of lowering the risk of COVID-19 in diabetes individuals(12).This is a recent study in Iraq to evaluate humoral immune responses to the (Pfizer)

vaccine in diabetes mellitus type -2. the efficacy of the Pfizer vaccine in diabetics is low due to reduced T cell activity and viral clearance, as well as greater affinity cellular binding and effective virus entrance (13). In diabetes patients, both the innate and adaptive immune systems are impaired (14). B-lymphocytes require T-helper cell signals to activate antibody-producing plasma cells. T-helper cells have been shown to be improperly differentiated in

people with T2DM (15). Furthermore, decreased memory for pathogens T-cells (CD4+) variety and features observed in people with uncontrolled diabetes are more likely to impair humoral immune response (16). **Antibody responses were lower in susceptible groups, suggesting that they may be more vulnerable to outbreak viruses (17).** The Healthy subject showed an excellent immune response and efficacy of vaccine higher than 95% efficacy IgG titer control subjects after two doses of Pfizer (2 intramuscular doses 30 µg; 0.3 mL each) at least 21 days after vaccination. Pfizer provided 95 percent protection against Covid-19 in those aged 16 and above (18). Type 2 diabetes (DM) non vaccinated have no Antibodies. It has been shown that type 2 diabetes (DM) is linked with Increased D-dimer (8). Both types of diabetes are prone to hypercoagulability. This phenomenon may play a function in the development of diabetes microvascular problem (19).

The current study revealed no effect of the Pfizer vaccine on the D-dimer levels in two studied groups (T2 DM and healthy control). The current study showed a higher level in platelet count in two groups of diabetics both (vaccinated with Pfizer and non-vaccinated with Pfizer) because Hyperglycemia may improve platelet reactivity by causing non-enzymatic glycation of proteins on the surface of platelets the platelet's surface. Glycation reduces membrane fluidity and increases platelet activation (20). The current study revealed no effect Pfizer vaccine, all studied groups showed that platelet counts were within the normal range after vaccination.

Abbreviations

HbA1C Glycated hemoglobin

HPLC high-performance liquid chromatography

SARS-CoV-2- severe acute respiratory syndrome-corona virus-2

BNT162b2 Pfizer-BioNTech COVID-19 Vaccine

Acknowledgments

The authors are thankful to al Suwayrah hospital staff in the Biochemistry and Hematology department for coordinating and facilitating this study.

Reference

- 1 Pordzik J, Jakubik D, Jarosz-Popek J, Wicik Z, Eyileten C, De Rosa S, et al. Significance of circulating microRNAs in diabetes mellitus type 2 and platelet reactivity: bioinformatic analysis and review. *Cardiovascular diabetology*. 2019; 18(1):1-19.
- 2 Erenner S. Diabetes, infection risk and COVID-19. *Molecular metabolism*. 2020; 39:101044.
- 3 ANDREI PM, IONESCU-TÎRGOVIŞTE C. the pathophysiology of COVID-19 disease in diabetes mellitus. *Proceedings of the Romanian Academy Series B, Chemistry, Life Sciences and Geosciences*. 2020:180-2.
- 4 Briggs FBS, Mateen FJ, Schmidt H, Currie KM, Siefers HM, Crouthamel S, et al. COVID-19 Vaccination Reactogenicity in Persons With Multiple Sclerosis. *Neurology(R) neuroimmunology & neuroinflammation*. 2022; 9(1).
- 5 Thomas SJ, Moreira ED, Jr., Kitchin N, Absalon J, Gurtman A, Lockhart S, et al. Safety and Efficacy of the BNT162b2 mRNA Covid-19 Vaccine through 6 Months. *The New England journal of medicine*. 2021; 385(19):1761-73.
- 6 Oliver SE, Gargano JW, Marin M, Wallace M, Curran KG, Chamberland M, et al. The advisory committee on immunization practices' interim recommendation for use of Pfizer-BioNTech COVID-19 vaccine—United States, December 2020. *Morbidity and Mortality Weekly Report*. 2020; 69(50):1922.
- 7 Levin EG, Lustig Y, Cohen C, Fluss R, Indenbaum V, Amit S, et al. Waning immune humoral response to BNT162b2 Covid-19 vaccine over 6 months. *New England Journal of Medicine*. 2021; 385(24):e84.
- 8 Konieczynska M, Fil K, Bazanek M, Undas A. Prolonged duration of type 2 diabetes is associated with increased thrombin generation, prothrombotic fibrin clot phenotype and impaired fibrinolysis. *Thrombosis and haemostasis*. 2014; 111(4):685-93.
- 9 Bosco O, Vizio B, Gruden G, Schiavello M, Lorenzati B, Cavallo-Perin P, et al. Thrombopoietin Contributes to Enhanced Platelet Activation in Patients with Type 1 Diabetes Mellitus. *Int J Mol Sci*. 2021; 22(13).
- 10 Pranata R, Lim MA, Yonas E, Huang I, Nasution SA, Setiati S, et al. Thrombocytopenia as a prognostic marker in COVID-19 patients: diagnostic test accuracy meta-analysis. *Epidemiology and infection*. 2021; 149:e40.
- 11 Zhao X, Wang K, Zuo P, Liu Y, Zhang M, Xie S, et al. Early decrease in blood platelet count is associated with poor prognosis in COVID-19 patients—indications for predictive, preventive, and personalized medical approach. *The EPMA journal*. 2020; 11(2):139-45.
- 12 Pal R, Bhadada SK, Misra A. COVID-19 vaccination in patients with diabetes mellitus: Current concepts, uncertainties and challenges. *Diabetes & metabolic syndrome*. 2021; 15(2):505-8.
- 13 Acter T, Uddin N, Das J, Akhter A, Choudhury TR, Kim S. Evolution of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) as coronavirus disease 2019 (COVID-19) pandemic: A global health emergency. *Science of the Total Environment*. 2020; 730:138996.
- 14 Guo X, Meng G, Liu F, Zhang Q, Liu L, Wu H, et al. Serum levels of immunoglobulins in an adult population and their relationship with type 2 diabetes. *Diabetes research and clinical practice*. 2016; 115:76-82.
- 15 Erenner S. Diabetes, infection risk and COVID-19. *Mol Metab*. 2020; 39:101044.
- 16 Martinez PJ, Mathews C, Actor JK, Hwang S-A, Brown EL, De Santiago HK, et al. Impaired CD4+ and T-helper 17 cell memory response to *Streptococcus pneumoniae* is associated with elevated glucose and percent glycated hemoglobin A1C in Mexican Americans with type 2 diabetes mellitus. *Translational Research*. 2014; 163(1):53-63.
- 17 Lustig Y, Sapir E, Regev-Yochay G, Cohen C, Fluss R, Olmer L, et al. BNT162b2 COVID-19 vaccine

and correlates of humoral immune responses and dynamics: a prospective, single-centre, longitudinal cohort study in health-care workers. *The Lancet Respiratory medicine*. 2021; 9(9):999-1009.

18. Polack FP, Thomas SJ, Kitchin N, Absalon J, Gurtman A, Lockhart S, et al. Safety and efficacy of the BNT162b2 mRNA Covid-19 vaccine. *New England Journal of Medicine*. 2020.

19. El Asrar MA, Adly AA, El Hadidy ES, Abdelwahab MA. D-dimer levels in type 1 and type 2 diabetic children and adolescents; Relation to microvascular complications and dyslipidemia "own data and review". *Pediatric endocrinology reviews: PER*. 2012; 9(3):657-68.

20 Schneider DJ. Factors contributing to increased platelet reactivity in people with diabetes. *Diabetes Care*. 2009; 32(4):525-7.