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Study of the relation between glycemic control in Egyptian patients with type-2 diabetes mellitus and helicobacter pylori infection

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Abstract
This study found a positive association between H. pylori status and HbA1c level (a valid and reliable biomarker for long-term blood glucose level) in the groups of diabetic patients, as Hemoglobin A1c levels were significantly higher in Helicobacter Pylori positive patients than in H. Pylori negative ones.

Objective: The study aims to clarify the effect of H. pylori infection on the glycemic control and lipid profile and to correlate the severity of Helicobacter pylori induced gastritis and chronic inflammation with the glycemic control and lipid profiles among Egyptian patients with type 2DM.

Material and Methods: Patients were selected from those admitted to the gastro-enterology & endoscopy unit of internal medicine department (Al azhar University) for gastro-duodenoscopy after approval of the medical ethical committee and taking an informed written consent from all the patients enrolled in the study. The study included 80 patients with type 2 DM divided as follows: Group A: included 60 patients (38male and 22 female) with type 2 Diabetes mellitus and Helicobacter pylori induced gastritis or gastro-duodenitis. This group was divided into 3 subgroups according to the severity of gastritis. Group B: included 20 patients (13male and 7female) with type 2 Diabetes mellitus and Helicobacter pylori negative gastritis or gastro-duodenitis. Instrumentation: Anthropometric measurements: Height and weight measurements then calculation of body massindex (BMI). Waist circumference Investigations: CBC, ESR, Liver enzymes (ALT, AST), Blood urea and serum creatinine. 2. Complete lipid profile.3. Glycemic profile. Exclusive criteria: Those who received previous anti-helicobacter treatment or drugs known to affect Helicobacter pylori growth (like antibiotics or anti-secretory drugs) were excluded from the study. Patients with uncontrolled hypertension (blood pressure measurement was more than 140\90). Were subjects who had other co morbidities which affect results.

Conclusion: Helicobacter Pylori infection affects glycemic control in T2 DM patients as it was correlated to elevated levels of Hb A1c. Infection with H. Pylori is associated with an atherogenic lipid profile in diabetic patients; it can cause lipid metabolism disorders that may act as risk factors for cardiovascular diseases. Helicobacter Pylori plays a role in inducing atherosclerosis by elevating LDL cholesterol and triglycerides levels. Infection with H. Pylori is linked to higher degrees of chronic inflammation and intestinal metaplasia in gastric mucosa. Severity of chronic inflammation, intestinal metaplasia, glandular atrophy and neutrophil infiltration induced by Helicobacter Pylori infection are positively correlated to higher levels of HbA1c in diabetic patients.

Keywords: diabetes mellitus - helicobacter pylori infection- glycemic control

Introduction

Diabetes mellitus (DM), commonly referred to as diabetes, is a group of metabolic disorders in which there are high blood sugar levels over a prolonged period. (World Health Organization 2014) [1]. Type 2 DM is primarily due to lifestyle factors and genetics (Risérus, *et al.*, 2009) [2]. A number of lifestyle factors are known to be important to the development of type 2 DM, including obesity(defined by a body mass index of greater than30), lack of physical activity, poor diet, stress, and urbanization (Shlomo *et al*, 2011) [3].

Symptoms of high blood sugar include frequent urination, increased thirst, and increased hunger. If left untreated, diabetes can cause many complictions. Acute complications can include diabetic ketoacidosis, hyperosmolar hyperglycemic state, or death. Serious long-term complications include cardiovascular disease, stroke, chronic kidney disease, foot ulcers, and damage to the eyes. (Diabetes Fact sheet, 2013) [4].

Helicobacter pylori previously named Campylobacter pyloridis, is a Gram-negative, microaerophilic bacterium found in the stomach. It was identified in 1982 by Barry Marshall and Robin Warren, who found that it was present in

patients with chronic gastritis and gastric ulcers; conditions that were not previously believed to have a microbial cause. It is also linked to the development of duodenal ulcers and stomach cancer. However, over 80 percent of individuals infected with the bacterium are asymptomatic (Blaser, *et al*., 2006) [5].

Gunji *et al*, performed a study examining the association between H. pylori infection and insulin resistance; a total of 1107 a symptomatic population were studied and results showed that H. pylori infection significantly and independently contributed to promoting insulin resistance. (Gunji *et al*., 2009) [6].

Another study conducted on 130 type 2 DM patients showed that H. pylori infection had a significant effect on the daily blood glucose level and blood glucose fluctuation in those subjects (Wang,*et al*., 2009) [7].

Material and Methods

Patients were selected from those admitted to the gastro-enterology & endoscopy unit of internal medicine department (Al azhar University) for gastro-duodenoscopy after approval of the medical ethical committee and taking an informed written consent from all the patients enrolled in the study

The study included 80 patients with type 2 DM divided as follows:

Group A: included 60 patients (38male and 22 female) with type 2 Diabetes mellitus and Helicobacter pylori induced gastritis or gastro-duodenitis. This group was divided into 3 subgroups according to the severity of gastritis.

Group B: included 20 patients (13male and 7female) with type 2 Diabetes mellitus and Helicobacter pylori negative gastritis or gastro-duodenitis.

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Instrumentation

Anthropometric measurements

1. Height and weight measurements then calculation of body Massindex (BMI).
2. Waist circumference

Investigations

1. CBC, ESR, Liver enzymes (ALT, AST), Blood urea and serum creatinine.
2. Complete lipid profile.
3. Glycemic profile.

Statistical analysis

In this study, the obtained data was recorded Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp)(Kirkpatrick, *et al*., 2013)(325) Qualitative data were described using number and percent. The Kolmogorov-Smirnov test was used to verify the normality of distribution Quantitative data were described using range (minimum and maximum), mean, standard deviation and median. Significance of the obtained results was judged at the 5% level.

The used tests were

1. Student t-test

For normally quantitative variables, to compare between two studied groups

2. F-test (ANOVA)

For normally quantitative variables, to compare between more than two groups

3. Mann Whitney test

For abnormally quantitative variables, to compare between two studied groups

4. Kruskal Wallis test

For abnormally quantitative variables, to compare between more than two studied groups, and Post Hoc (Dunn's multiple comparisons test) for pairwise

5. Spearman coefficient

To correlate between two abnormally quantitative variables.

Results

Fasting blood glucose and hemoglobin A1c

Our results showed that there was no statistically significant difference between patients group and the control group as regard fasting blood glucose (P value=0.070). However, we found that Hemoglobin A1c was significantly higher in H. Pylori positive patients as compared with H. Pylori negative control group (p<0.001).

Table 1: FBG and HbA1c in the studied groups.

	Cases (n= 60)	Control (n= 20)	t	P
FBG				
Min. – Max.	108.0 – 204.0	90.0 – 180.0	1.851	0.070
Mean ± SD.	143.17 ± 26.48	130.30 ± 19.86		
Median	140.0	126.50		
Hb A1c				
Min. – Max.	7.60 – 12.0	6.50 – 8.60	7.199*	<0.001*
Mean ± SD.	9.32 ± 1.15	7.50 ± 0.63		
Median	9.05	7.60		

t, p: t and p values for Student t-test for comparing between the two groups

*: Statistically significant at p ≤ 0.05.

Histopathology

Analysis of groups showed that there was a statistically significant difference between group A and group B as regard different histo-pathological parameters of Sydney score which are (neutrophil infiltration, chronic inflammation, glandular atrophy, intestinal metaplasia and H. Pylori density) with P value <0.001

Diabetic patients infected with H. Pylori had significantly higher grades of inflammation of gastric mucosa (graded by Sydney score) compared to uninfected patients (p<0.001).

Table 2: Total Sydney score in the studied groups.

	Cases (n= 60)		Control (n= 20)		MW	P
	No.	%	No.	%		
Total Sydney score						
None	0	0.0	3	15.0	25.500*	<0.001*
Mild	6	10.0	17	85.0		
Moderate	36	60.0	0	0.0		
Severe	18	30.0	0	0.0		
Min. – Max.	2.0 –15.0		0.0 – 5.0		19.500*	<0.001*
Mean ± SD.	9.07 ± 3.28		2.30 ± 1.56			
Median	9.0		2.50			

MW, p: U and p values for Mann Whitney test for comparing between the two groups
*: Statistically significant at $p \leq 0.05$

Relation between different parameters of Updated Sydney system and HbA1c in cases group

The results of the present study showed statistically significant relation between chronic inflammation and HbA1c in cases group.

Table 3: Relation between chronic inflammation and HbA1c in patient group

	Chronic inflammation			F	P
	Mild (n=4)	Moderate(n= 32)	Severe(n= 24)		
Hb A1c					
Min. – Max.	7.60 – 8.70	7.80 – 10.30	7.90 – 12.0	5.665*	0.009*
Mean ± SD.	8.15 ± 0.78	8.93 ± 0.75	10.03 ± 1.28		
Median	8.15	8.75	10.20		
Sig. bet. Grps	p_1=0.311,p_2=0.020*,p_3=0.007*				
r_s(p)	0.524*(0.003*)				

F,p: F and p values for ANOVA test, Sig. bet. grps was done using Post Hoc Test (LSD)
p_1: p value for comparison between mild and moderate
p_2: p value for comparison between mild and severe
p_3: p value for comparison between moderate and severe
r_s: Spearman coefficient
*: Statistically significant at $p \leq 0.05$

Discussion

Patients with diabetes mellitus are often affected by chronic infections. Many studies have evaluated the prevalence of H. pylori infection in diabetic patients and the possible role of this condition in their metabolic control. Some studies found a higher prevalence of infection in diabetic patients with reduced glycemic control while others did not support any correlation between glycemic control and H. pylori infection in diabetic patients. (Devrajani *et al*, 2010) [8].

Vafaeimanesh *et al* 2015 found that the prevalence of H. pylori infection was 65.9% among diabetics while it was 50.5% among non-diabetic subjects, so it was more prevalent among patients with diabetes. This was confirmed in other studies. For example, in Talebi-Taher *et al*.'s study, its prevalence among diabetic and non-diabetic patients were 60% and 26.66%, respectively (*P* = 0.001) (Taher *et al* 2012) and in Bener *et al*.'s study, (Bener *et al*, 2007) [11] it has been reported to be 76.7% versus 64.8% in diabetic and non-diabetic subjects respectively (*P* = 0.009). This finding was confirmed in a study by Candelli *et al*. The strength point of this study was that in 3 years follow-up, the re-infection rate was higher in diabetic patients. (Candelli *et al*, 2018).

On the other hand, on a previous study, they found that H. pylori eradication in patients with diabetes was lower than non-diabetic subjects. (Vafaeimanesh *et al*, 2013) [13] Although, some studies have not supported this association. (Gasbarrini *et al*, 1998) [14] (332) In Anastasios *et al*.'s study, the difference of HP prevalence between diabetics and non-diabetics was not significant (37.3% vs. 35.2%). In Małlecki *et al*.'s study, the rate of H. pylori infection in Hong Kong Chinese subjects with type 2 diabetes was around 50%, which is similar to control subjects. No association was found between H. pylori infection, glycemic status, and diabetes duration with upper gastro-intestinal symptoms in these diabetic subjects.

Although there is no concrete evidence demonstrating that H. pylori plays a role in diabetes, the possibility for a causal relationship is an intriguing issue deserving discussion. There are several lines of evidence to implicate increased susceptibility to infection in diabetic patients. Firstly, a diabetes-induced impairment of cellular and humoral immunity may enhance an individual's sensitivity to H. pylori infection. (Borody *et al*, 2002) [16] Secondly, diabetes-induced reduction of gastrointestinal motility and acid secretion may promote pathogen colonization and infection rate in the gut. Thirdly, altered glucose metabolism may produce chemical changes in the gastric mucosa that promote H. pylori colonization (Luis *et al*, 1998) [17] Finally, individuals with diabetes are more frequently exposed to pathogens than their healthy counterparts as they regularly attend hospital settings. (Gentile *et al*, 1998) [18].

However, there are also indications that H. pylori infection may contribute to the development of diabetes. Pancreatic β-cell function declines gradually over time before the onset of

clinical hyperglycemia as a result of many factors that can be influenced by infection, such as insulin resistance (IR), glucotoxicity, lipotoxicity, β-cell dysfunction, chronic inflammation, and genetic and epigenetic factors (Stumvoll *et al*,2005 and Donath *et al*, 2011) [20, 19].

In the current study, age of the studied groups of diabetic patients was in the range of 40 to 63 years, with a mean of44.13 years for group A (H. plori positive), anda mean of47.50 for group B (H. pylorinegative). Comparison between the studied groups according to age and gender showed no statistically significant difference.

A study conducted at Abakaliki by Ugwu had shown that majority of Helicobacter pylori infected diabetic patients were more than 60 years of age. (Ugwu *et al* 2008) [21] However, a study by Sargýn *et al*. shows that the mean age of diabetic patients with H. pylori infection is 56 years. (Sargýn *et al* 2003) [22].

Body mass index of the studied groups was in the range of 20 to 30, the mean of BMI in H. pylori positive patients was 25.89, while the mean BMI in H. pylori negative patients was 24.87. Comparison between the studied groups according to body mass index showed no significant difference.There are many studies investigating H. pylori infection and its relation to body mass index. Perdichizzi *et al*. (Perdichizzi *et al*, 1996) [23] determined higher BMI values and waist circumference measurements in H. pylori positive patients than in H. pylori negative patients. However, Kyriazanos *et al*. (Kyriazanos *et al*, 2002) [24] conducted a study and stated that there is no relationship between H. pylori and obesity.

Our study compared serum levels of hemoglobin in patients infected with H. pylori with those uninfected patients and found that patients infected with H. pylori showed significantly lower serum hemoglobin as compared with uninfected patients.

Huang *et al*. reported that the prevalence rate of H. pylori infection was higher in patients with iron deficiency anemia than those without iron deficiency anemia. (Huang *et al*, 2010) [25]. In another study by Choe YH *et al*, they found that H. pylori infection contributed to iron deficiency anemia, and that infection should be suspected when iron deficiency anemia is refractory to oral iron administration. They showed that treatment of H pylori infection was associated with a more rapid response to oral iron treatment than the use of iron alone. (Choe *et al*, 1999) [26] Barabino A *et al*. also showed that the presence of iron deficiency anemia was found to be significantly related to H. pylori infection. (Barabino *et al*, 1999).

In Malik *et al*.'s study, they have shown that the eradication of H. pylori resulted in a significantly better response to oral iron supplementation among H. pylori infected patients with iron deficiency anemia. (R. Malik *et al*, 2011) [27]. Hsiang-Yao *et al*. obtained different results in a study in Taiwan as they showed no significant association between chronic H. pylori infections and anemia (Hsiang *et al*, 2013) [28].

Concerning white blood cell count (WCC) in the patient group in comparison with the control group, the present study showed no significant difference in WCC. Yuka Satoh *et al*. obtained similar data; they found no significant difference in WCC between H. pylori-infected patients and control subjects. (Yuka *et al*, 2012) [29] (348) In contrast, Kondo *et al*. reported that patients with H. pylori infection had increased neutrophilic and monocytic counts in their peripheral blood. (Kondo *et al*, 2004) [30].

In the present study, platelet count was tested in patients infected with H. pylori as compared with uninfected patients. We found that patients infected with H. pylori showed significantly lower platelet count as compared with uninfected patients. García Pérez *et al* (García *et al*, 1999) [31] described the relationship of H. pylori with Idiopathic thrombocytopenic purpura for the first time in 1993 in Spain, reporting a patient with ITP in whom the platelet count was normalized after eradication of H. pylori. Andin the study by Veneri *et al*. investigations for H. pylori had been carried out in patients with ITP, they found that 54.5% of patients were positive for H. pylori and 45.5% of them were negative. (Veneri *et al*, 2011). Liebman *et al*. obtained different data; they reported that the prevalence of H.pylori infection among patients with ITP was not more than in the general population, suggesting that the association between H. pylori and ITP is not certain.) (Liebman *et al*, 2007) [32].

Concerning erythrocyte sedimentation rate (ESR), our results showed that ESR levels were significantly related to H. pylori infection. We found that ESR levels were significantly higher in diabetic patients infected with H. pylori compared to uninfected ones.

In the study by Luis *et al*. they tested ESR level in H. pylori-positive diabetic patients compared to H. pylori-negative diabetic patients. They found that ESR level was significantly higher in diabetic patients infected with H. pylori compared to uninfected patients. These results indicated a possible association of H. pylori infection and the development of coronary heart disease, thrombo-occlusive cerebral disease, or both, in diabetic patients. (Luis *et al*, 1998) [17]. While in Jamshid Vafaeimanesh *et al*'s study, H. pyloripositive and H. pylori negative groups had no significant difference regarding ESR. (Vafaeimanesh *et al*, 2014) [35].

The present study found a significant relation between H.pylori infection and serum level of urea in diabetic patients incorporated in the study in absence of any history of renal disease. Many authors mentioned that, serum urea nitrogen level was significantly associated with H. pylori prevalence but there is no significant evidence that H. pylori infection is directly associated with progression of renal dysfunction (Shousha *et al*, 1990 and Eiyas *et al* 2009) [36, 37]. On the other hand, Magtooph *et al*., found no relationship between H. pylori colonization and serum urea.

Our results showed that there was no statistically significant difference in serum creatinine, serum alanin transaminase (ALT) and serum aspartate transaminase (AST) levels between the patients group as compared with the control group. Hack-Lyoung *et al* obtained similar data; they reported that there was no significant relationship between H. pylori infection and both creatinine and serum ALT levels. (Hack *et al*, 2011) [39].

The present study is concordant with most of the world literature, where no significant correlation of fasting blood glucose with Helicobacter pylori status was reported. (Zafar *et al*, 2016) [40]. There was no statistically significant difference between the two groups.

Fasting blood glucose levels are subject to changes of daily

activities, such as diet content, fasting and amount of exercise before examination. Such fluctuations may confound results of any evaluation of the association between chronic H. pylori infection and glucose regulation. HbA1c level appears to be a more reliable marker for average glycemia inthe last two to three months and it seems to be a better measurement for the evaluation of the effect of chronic H. pylori infection on glucose metabolism. However, Rafat *et al* had different data in their study; as they found significant difference between H. pylori positive and negative patients where those with H. pylori positive had significantly higher FBG and 2H PPBG. (Rafat *et al*, 2015) [41].

The current study found a positive association between H. pylori status and HbA1c levels (a valid and reliable biomarker for long-term blood glucose level) in diabetic patients group. As Hemoglobin A1c levels were significantly higher in Helicobacter Pylori positive patients than in H. Pylori negative ones. These results are coherent with many researches in literature about the relation between H. pylori and HbA1c in diabetic patients; Yu Chen *et al* obtained similar results as Hb A1c was higher in H. pylori positive diabetic patients than H. pylori negative ones. They also observed decrease in level of HbA1c and better glycemic control after H. pylori eradication. (Chen *et al*, 2012) [42]. Also, in 2060 Chinese diabetic participants, HbA1c levels were significantly higher in those who are H. pylori infected, especially in elderly patients. (Hsieh *et al* 2013) [43].

Bajaj *et al* also found that increased levels of HbA1c were associated with H. pylori infection among type 2 diabetes group. As the glycemic control improved, the prevalence of H. pylori decreased. Mean HbA1c among diabetics with H. pylori infection was significantly greater than H. pylori-negative diabetics. It may be possible that a good glycemic control could hinder H. pylori colonization.(Bajaj *et al*, 2014) [44].

On the contrary, Demir *et al* made a study on 141 type 2 DM patients; as they compared HbA1c values in infected cases to non-infected controls, no differences of fasting blood glucose and HbA1c levels were encountered, although neuropathy was more frequent in infected cases.. (Demir *et al*, 2008) [45].

The present study provides evidence that H. pylori infection is associated with atherogenic lipid profile among patients with type 2 diabetes. H. Pylori infected group had statistically significant higher levels of total cholesterol, triglyceride and LDL than non-infected group. Concerning serum HDL-C level in the patient group in comparison with the control group, the present study showed a decrease in the HDL-C level in patient group than control group but without statistical significance.

Systemic inflammatory response to the bacterium induces changes in lipid and lipoprotein metabolism. Although previous studies on the association between H. pylori infection and lipid profiles showed contradictory results, there is a general agreement that H. pylori infection itself modifies serum lipid profiles.(Jia *et al*, 2009 and Kucukazman *et al*,2009) [46]

Although some data showed that virulent strains of H. pylori, such as cytotoxin-associated gene (CagA+) are associated with many extra-digestive manifestations such as type 2 diabetes mellitus and it's complications due to an immune-mediated injury at the level of the endothelium caused by a systemic immune-mediated response to the infection. However, we did not deal with this issue in our study. (Migneco *et al*, 2003) [47].

Bajaj *et al* reported that diabetic patients infected with H. pylori showed an atherogenic lipid profile characterized by an increase in LDL cholesterol or decreased HDL cholesterol compared to uninfected diabetic patients. (Demir *et al*, 2008) [45]. Satoh *et al* obtained similar data; they reported that adjusted mean values of LDL cholesterol and HDL cholesterol in men were significantly higher and lower in H. Pylori-sero-positive than negative subjects, respectively. Whereas these associations were not significant in female subjects. This study showed that H. Pylori infection is significantly associated with high LDL-cholesteremia and low HDL-cholesteremia in Japanese male subjects. (Satoh *et al*, 2010) [48].

Sung *et al* found that H. Pylori infection in healthy Korean adults was associated with atherogenic lipid profile (increase in total cholesterol, triglyceride, LDL cholesterol, and decrease in HDL cholesterol). (Sung *et al*, 2005) [49] (369)According to Kanbay *et al*., H. pylori infection affected lipid metabolism in a way that increased the risk of atherosclerosis and has been regarded as an independent risk factor for coronary artery disease.(Kanbay *et al*,2005) [50].

Ansari *et al* reported similar results. (Ansari *et al*, 2010) [51] The study of Hoffmeistrer *et al*. also showed that the cholesterol level was increased. Same results were shown by Mendall work's too. Also results were obtained by Niemela *et al*. were in agreement with our findings. (Niemelä *et al*, 1996) [52]. Also Moghimi *et al*., found that H. pylori eradication has been reported to modify some parameters of lipids and homeostasis (Moghimi *et al*, 2007) [53].

Association of H. Pylori infection with atherogenic lipid profile may be due to lipo-polysaccharides present in this gram-negative bacteria which stimulate the production of many cytokines including TNF- α, which inhibit lipoprotein lipase activity leading to mobilization of lipids from the tissues and elevated serum triglycerides. (Sung *et al*, 2005) [49]. However, Dursen *et al*., found insignificant differences in lipid profile between H.pylori infected and non-infected diabetics, thus affirming the metabolic neutrality of H.pylori infection in terms of serum lipids. (Dursun *et al*, 2004) [54].

In the present study, we graded the severity of H. pylori inflammation according to the Updated Sydney System score in patients infected with H. pylori versus uninfected patients. We found that patients infected with H. pylori had significantly higher grades of inflammation in the gastric mucosa compared to uninfected patients according to Updated Sydney system. Neutrophil infiltration, chronic inflammation, glandular atrophy, intestinal metaplasia and H. pylori density were all significantly higher in H. pyloripositive than on H. pylorinegative studied groups.

Study of Yamaoka *et al*. showed similar results, they found that there was an association between H. pylori infection and histological severity of gastritis. They reported that grades of inflammation in the gastric mucosa were significantly higher in patients infected with H. pylori as compared to uninfected patients. (Yamaoka *et al*, 1997) [55].

In the present study, hemoglobin A1c levels and the degree of

H. pylori chronic inflammation in diabetic patients positive for H. Pylori were correlated, and there was a statistically significant positive correlation between hemoglobin A1c level and the severity of HP chronic inflammation in infected diabetic patients. Similarly, Hsieh *et al* found a significant association between chronic H. pylori infection and high levels of HbA1c levels as well as decreased insulin secretion in a Chinese population. They also found that the prevalence of type 2 diabetes was higher in subjects with chronic H. pylori infection than those without chronic H. pylori infection. They recommended that Proper screening of H. pylori infection combined with monitoring blood glucose and HbA1c levels might be important for early detection of glucose dysregulation. (Hsieh *et al* 2013) [43].

This sudy also found that there was a statistically significant positive correlation between HbA1c and the degree of intestinal metaplasia in our biopsy specimens of cases group. We demonstrated a number of 2 patients from cases group with mild degree of dysplasia and high HbA1c levels. Also there was positive correlation between level of HbA1c and both neutrophil infiltration and glandular atrophy. Ikeda *et al* obtained similar results as they conducted a study of 2603 Japanese subjects with H. pylori and aged ≥40 years were stratified into four groups according to baseline hemoglobin A1c (HbA1c) levels and followed up prospectively for 14 years. During the follow-up, 97 subjects developed gastric cancer. They found evidence that those with higher levels of HbA1c were more susciptable for intestinal metaplasia and gastric cancer. (Ikeda *et al*, 2009) [56].

Concerning the relationship between degree of gastritis as graded by Updated Sydney System and the lipid profile, our results showed a statistically significant relation with triglycerides levels. These results support the theory that H. pylori infection affects lipid metabolism and can increase the risk of atherosclerosis and cardiovascular events, while total cholesterol, LDL-C and HDL-C had no significant relation with the degree of gastritis. However, in a study by Kucukazman *et al*, they found moderate correlation between LDL-C levels and Updated Sydney system score. This shows that LDL-C levels increase as H. pylori infection becomes more severe, and they demonstrated no difference in HDL-C and triglyceride levels between groups. (Kucukazman *et al*, 2009).

Kanbay *et al*. demonstrated that successful eradication of H. pylori is associated with increase in HDL-C and decrease in C-reactive protein (CRP) levels. They found no effect on LDL-C and triglyceride levels. (Kanbay, *et al*, 2005) [50]. Aslan *et al*. (Aslan *et al*, 2008) [57] expressed decrease in HDL-C and, in part, to increased oxidative stress and inflammatory condition induced by H. pylori infection. The effect of H. pylori on HDL-C and triglyceride is still controversial and further studies are needed.

One of the mechanisms for the difference in lipid profile in our study may be that H. pylori is a bacterial infection. (Gallin *et al*, 1969) [58] Demonstrated that some infections may induce disturbances in serum lipids. Another mechanism may be that H. pylori generates a persistent, low-grade inflammatory stimulus. (Marz, *et al*, 2004) Showed that low grade systemic inflammation is associated with changes in lipid profiles.

Conclusion

Results of this work have shown that

1. Helicobacter Pylori infection affects glycemic control in T2 DM patients as it was correlated to elevated levels of Hb A1c.
2. Infection with H. Pylori is associated with an atherogenic lipid profile in diabetic patients; it can cause lipid metabolism disorders that may act as risk factors for cardiovascular diseases.
3. Helicobacter Pylori plays a role in inducing atherosclerosis by elevating LDL cholesterol and triglycerides levels.
4. Infection with H. Pylori is linked to higher degrees of chronic inflammation and intestinal metaplasia in gastric mucosa.
5. Severity of chronic inflammation, intestinal metaplasia, glandular atrophy and neutrophil infiltration induced by Helicobacter Pylori infection are positively correlated to higher levels of HbA1c in diabetic patients.

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