The Relationship between ABO Blood Group Distribution and the incidence of Upper Gastric and Duodenal Ulcer in Iraqi Patients

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Abstract

The relationship between blood group antigens and peptic ulcer disease has been widely evaluated in the past, but only one study relating H pylori seroprevalence to ABO blood groups among Iraqi patients with peptic ulcer disease is available. We aimed to evaluate the frequency of peptic ulcer disease among different ABO blood groups in Iraqi patients, and we thought it was worthwhile to try to determine whether these components take some part in disease etiology. One hundred and six patients with peptic ulcer disease (PUD) (43 male and 63 female; mean age: 48 ± 18 years) who attended Baghdad teaching hospital and Al-Yarmouk teaching hospital endoscopy centers were enrolled , and 238 control Subjects. Finger blood samples were used for ABO/Rhesus (Rh) blood group antigen typing. The ABO blood group phenotype frequency in peptic ulcer patients was as follows: 18.9% for blood group A, 15.1% for blood group B, 57.5 % for blood group O and 8.5% for blood group AB. Rh positivity was found in 100% of patients. Significant higher percentage of patients with both gastric and duodenal ulcer disease are those holding blood group O^+ compared to other blood group phenotypes (57.5%)(p= 0.003) .The present study show higher incidence of doudenal ulcer(DU) in patients with blood group O^+ compared to gastric ulcer(GU) patients (65.6%vs 54.1%) , although no statistical difference between both diseases was found,($p > 0.05$) in respect to other blood group phenotypes. Peptic ulcer disease is predominant in patients aged between 50-59 years represents with higher percentage (26.4%) compared to other age groups. Patients with blood group O^+ phenotype presented with a highly significant percentage of Peptic ulcer disease, since those individuals may express a higher inflammatory responses to *H. pylori* with higher levels of lymphocyte infiltration in the gastrointestinal mucosa , and a higher frequency of secretor status . In addition, they do not produce the substance on the surface of blood group O^+ cells that may protect the lining of the duodenum .According to these results, probably ABO/Rh blood group (mainly blood group O+) has an important role in patients with peptic ulcer disease as additional risk . The functional significance of ABO blood group distribution might be associated with biological behavior of Peptic ulcer disease. The impact of blood group on Peptic ulcer disease may be a focus for further studies.

Keywords: ABO/ Rh Blood group system - Upper gastrointestinal disorders –Age & Gender distribution

تقييم العلاقة بين فصيلة الدم مع تقرحات المعدة والاثني عشري عند المرضى العراقيين

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الخلاصة

تم في السابق تقييم العلاقة بين فصيلة الدم الوراثية وامراض تقرحات المعدة والاثني عشري لكن هناك دراسة واحدة فقط تربط العلاقة بين المسبب البكتيري للتقرحات وفصيلة الدم عند المرضى في العراق . لهذا يهدف البحث الى تقييم الترابط والذي حسب اعتقادنا يستحق المحاولة لمعرفة فيما اذا كانت فصيلة الدم عند الانسان تلعب دور كعامل مسبب للمرض .تشتمل الدراسة على 106 مريض(43 ذكر و 63 انثى) من المصابين بقرحة المعدة والاثني عشري الذين تم تحويلهم الى وحدة الناظ ورفي مستشفى بغداد التعليمي و مستشفى اليرموك التعليمي للتشخيص وكذلك 238 من الاشخاص الطبيعيين .و تم تحديد فصيلة الدم من قطرة دم الابهام . كانت نتائج توزيع فصيلة الدم الوراثي عند مرضى تقرحات المعدة والاثني عشري كالاتي :
18,9% لفصيلة الدم A و15,1% لفصيلة الدم B و 57,5% لفصيلة الدم O و 8,5% لفصيلة الدم.AB . وكان جميع المرضى يحملون نوع العامل الريسي (Rh) الموجب . دلت النتائج على نسبة عالية ذات مغزى احصائي لمرض تقرحات المعدة والاثني عشري عند المرضى الحاملين لفصيلة الدم O^+ مقارنة بالمرضى الاخرين الحاملين لباقي انواع فصائل الدم (57,5%) (p= 0.003) .

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واكدت الدراسة الحالية على نسبة عالية من مرض تقرح المعدة عند مرضى فصيلة الدم O^+ بالمقارنة مع تقرحات الاثني عشري (65,6% مقابل54,1 %) لكن النسبة لم تكن ذو مغزى احصائي بالمقارنة مع باقي فصائل الدم . دلت الدراسة ايضا على ان نسبة تقرحات المعدة والاثني عشري اكبر عند المرضى الذين تتراوح اعمارهم بين 50-59 سنة (26,4%) مقارنة بباقي الفئات العمرية . دلت الدراسة على ان المرضى الحاملين لفصيلة الدم O^+ يمثلون نسبة عالية ذات مغزى احصائي من مرض تقرحات المعدة والاثني عشر وقد يعود الى زيادة التحسس الالتهابي ضد بكتريا *H. pylori* وارتفاع نسبة تجمع اقراص الدم البيضاء (اللمفوسايت) داخل جدار المعدة والامعاء وكذلك زيادة افرازات المعدة والاثني عشر عند هؤلاء المرضى . بالاضافة الى عدم وجود مادة وقائية على سطح كريات الدم الحمراء عند فصيلة الدم O^+ يمكنها حماية غلاف الاثني عشر .نستنتج من هذه الدراسة بان نوع فصيلة الدم (وخاصة فصيلة الدم +O) لها تاثير واضح عند المرضى المصابين بتقرحات المعدة والاثني عشريكجزء من طبيعة تكون المرض مما يمكن اعتمادها كعامل مسبب اخر للمرض . وهذا التاثير يتطلب دراسة اعمق لتوضيح الفكرة .

الكلمات المفتاحية : فصيلة الدم ABO/ Rh - امراض الجهاز الهضمي العليا - توزيع العمر .

Introduction

The relationship between blood group and the incidence of peptic ulcer disease had been evaluated by several references whom provided a new clue to the etiology of the disease [1, 2, 3]. It is well known that *Helicobacter pylori* (*H. pylori*) infection and aspirin/(non steroidal anti-inflammatory drugs (NSAIDs)) are the most important factors predisposing peptic ulcer disease in the community [3]. In addition, the possible relationship between genetic factors and the natural history of peptic ulcer has been Studied [4]. A number of evidence is in favor of both hereditary (ABO blood group) and environmental factors playing a part in the development of bleeding duodenal ulcer [5,6,7] .Some reports postulated that overt bleeding from the gastric mucosa, whether aspirin-induced or not, may be related to ABO blood group and secretor status [8, 9] **.** The association of blood group O with bleeding from duodenal ulcer was also confirmed [10]. Recently it was considered that the life expectancy of persons holding blood group O is less than that of other blood groups , and generally , blood group O holders are more prone to various diseases mainly duodenal ulcer [11]. Similarly, gastric carcinoma was found to be associated with blood group A, but no explanation for this condition was found [12]. In addition**,** type O people may be more vulnerable to the bacteria that can cause peptic ulcers, Helicobacter pylori [13,14]. Many epidemiologic studies had found that non secretors of ABO blood group antigens and individuals of blood group O were overrepresented among patients with peptic ulcers [15, 16]. These studies encouraged many researchers to investigate the relation between ABO blood groups and their secretor status with peptic ulcer [9, 11].

Data concerning the association of ABO blood groups among Iraqi patients with gastric compared to duodenal ulcer was presented in one study only. We aimed to evaluate this association and we thought it was worthwhile to try to determine whether these components take some part in disease etiology.

Patients and Methods

This study include 106 patients with peptic ulcer disease (PUD) either gastric ulcer (GU) or duodenal ulcer (DU) admitted to Baghdad teaching hospital and Al- Yarmouk teaching hospital for gastrointestinal endoscopy, and 238 control subjects. The database was collected from Octobor 2011 till March 2012. The demographic and clinical characteristics including age, gender, and ABO/ Rh phenotype blood group were recorded. The patients were clinically evaluated and the gastrointestinal signs and symptoms were recorded. Upper gastrointestinal endoscopy was done according to standard medical procedure. Since blood group is not routinely checked in endoscopy clinics, finger blood samples were taken from each patient after endoscopy. ABO blood groups and Rh phenotype evaluations were carried out by standard rapid slide agglutination method (using anti ABO monoclonal kit) [17] .
.The control subjects were clinically disease free.

Statistical analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS) (student version 13, McGraw Hill Company 2006). Chi square test was used to detect statistically significant differences among variables. *P*-values <0.05 were considered significant.

Results

This study includes a total of 344 subjects 106 (30.8%) patients and 238 (69.2%) controls. The demographics and clinical characteristics is shown in table (1).

Table 1: Demographics and clinical characteristics

Variable	Total N (%)	Patients N (%)	Controls N (%)
Subjects	344 (100)	106 (30.80)	238 (69.20)
Gender **Male** **Female**	 146(42.40) 198(57.60)	 43.(40.6) 63(59.4)	 103(43.3) 135(56.7)
Age (Year)			
20 – 29	113(32.8)	14(13.2)	99(41.6)
30 – 39	85(24.70)	19(17.9)	66(27.7)
40 – 49	61(17.7)	22(20.8)	39(16.4)
50 – 59	56(16.3)	28(26.4)	28(11.7)
60 – 69	29(8.4)	23(21.7)	6(2.6)

Table (2) (Figure 1) show that the ABO blood group phenotype distribution in patient and control groups was as follows : 61 (57.5 %) versus 86 (36.1 %) for group O , 20 (18.9 %) versus 71 (29.8 %) for group A, 16 (15.1 %) versus 49 (20.6 %) for group B, and 9 (8.5 %) versus 32 (13.4 %) for group AB respectively. Blood group O was found to have highly significant PUD frequency in patient group than in the other blood group phenotypes (p= 0.003). The Rh positive was in 329 (95.60 %) subjects , and negative was in 15 (4.40%) subjects in all study groups table (1). The Rh positivity was 100% in patient group, and 93.6% in the controls.

Table 2: Blood group distribution between patients and controls

Blood group	Subjects N (%)		*P**
	Patients	**Controls**	
A	20 (18.90)	71 (29.80)	0.003
B	16 (15.10)	49 (20.60)	
AB	9 (8.50)	32 (13.40)	
O	61 (57.50)*	86 (36.10)*	
Total	106 (100)	238 (100)	

*Pearson Chi-Square

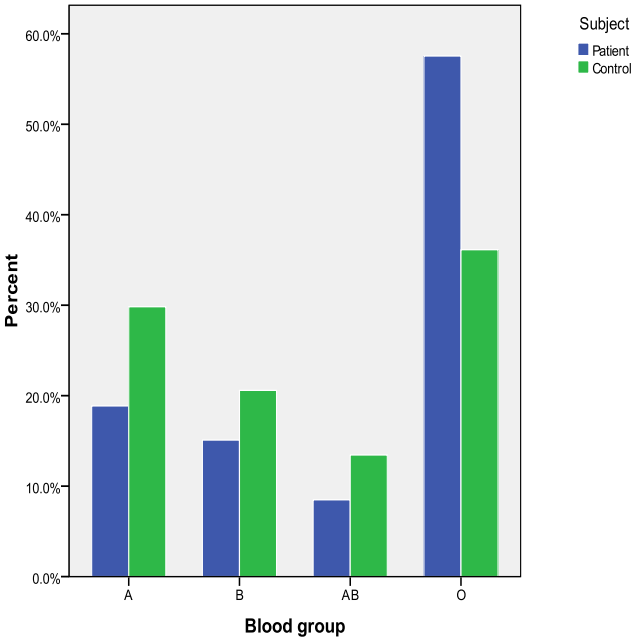

Figure 1 : Blood group distribution between patients and controls

Table (3) **(**Figure 2) show that the distribution of endoscopic findings in patient group were 32 (30.2%) for DU, and 74 (69.8 %) for GU. The frequencies of ABO blood group among endoscopic findings (DU vs GU): 21 (65.6 %) versus 40 (54.1%) for group O, 6 (18.8%) versus 14 (18.9%) for group A, 2 (6.20 %) versus 14 (18.9%) for group B, and 3 (9.30%) versus 6 (8.10%) for group AB respectively.
The higher incidence of DU was in patients with blood group O^+ compared to GU patients (65.6%vs 54.1%) , although no statistical significance was found between both diseases (p > 0.05) in respect to other blood group phenotypes .Table (1) also show that the mean age of control subjects was (39 ±20) years , and in peptic ulcer patients was (48 ±18) . The mean age distribution in patients was as follows : (13.2%) for group 20-29 years , (17.9%) for 30-39 years, (20.8%) for
40=49 years, (26.4%) for 50-59 years , and (21.7%) for 60-69 years. The higher frequency of PUD was found in the fifth decade of age.

Table 3: Association between blood group and endoscopic findings

Blood group	Endoscopic findings N (%)		P*
	GU	DU	
A	14 (18.90)	6 (18.80)	0.401
B	14 (18.90)	2 (6.20)	
AB	6 (8.10)	3 (9.40)	
O	40 (54.10)	21 (65.60)	
Total	74 (100)	32 (100)	

*Pearson Chi-Square.

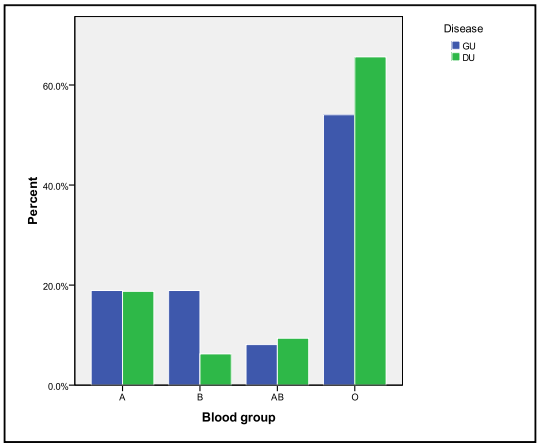

Figure 2: Association between blood group and endoscopic findings

Discussion

The association between the ABO blood group and both gastric cancer and peptic ulcers has been studied previously [18-19]. This study provide an estimation of the extent of such associations in Iraqi patients. In general adult population 22% of all of peptic ulcer (GU&DU) disease were idiopathic and almost 40% of duodenal were H.pylori infection. Obesity is a risk factor for gastric ulcer as for use of low-dose of aspirin [20,21]. Previous studies demonstrated that blood group O is associated with duodenal ulcer disease, while gastric ulcer and gastric carcinoma are associated with blood group A [21,22 , 23].

Also it was concluded that gastric ulcer near the pylorus and those occurring with duodenal ulcer were associated with acid hypersecrtion, these cases were marked in patients with blood group O, while gastric ulcer in body of the stomach occurring in patients in which their duodenum was normal, were characterized by acid hyposecretion and this marked in patients with blood group A, the cause that blood type A is most likely to have gastric cancer [24] .Romshoo *et al*. (1997) reported that, the majority of peptic ulcer patients (56%) had blood group O and it though a risk factor for peptic ulcer [25]. In another study, Bayan *et al*. (2009) finding contributes to the positive correlation between group O and upper gastrointestinal bleeding caused by gastroduodenal ulcers and erosive gastropathy and the blood group O which was found to have higher frequency in patient group than in controls (p = 0.004) [26]. In prospective well-defined cohort study of Swedish and Danish blooddonors have confirmed that individuals with blood group O have a higher risk of peptic ulcers than those with other blood groups [27]. Those findings have been confirmed by many other reports [28,29]. Despite epidemiological evidence of increased peptic ulcer disease in ABO blood group O subjects, and the evidence that H. pylori adhesion to gastric epithelial cells is mediated by blood group epitopes, no significant association between blood groups and H. pylori serological status was detected ($p > 0.05$) [30]. Jaff MS. (2011) showed a significant association between the O blood group and infection caused by *H. pylori* ($P = 0.01$) , the prevalence of seropositivity to *H. pylori* infection was (64.8%) in symptomatic patients in the Kurdistan region of Iraq [31]. In the present study, patients with blood group O phenotype presented with a highly significant percentage of PUD compared to controls (57.5%) vs(36.1%) respectively $p = 0.003$.

Blood group O individuals express a higher inflammatory responses to *H. pylori* with higher levels of lymphocyte infiltration in the gastrointestinal mucosa [32] , a lower level of Von Willebrand's factor [33,34] , and a higher frequency of secretor status [35] , in addition , they do not produce the substance on the surface of blood cells that may protect the lining of the duodenum [36,37] all these together explain the possible cause of these individuals' increased susceptibility to peptic ulceration. Jaff MS. study support this epidemiological view of gastric susceptibility of O blood group to H. pylori infection which is most probably due to high secretor status [31]. This correlation was supported in many reports [38-40]. Bayan et al (2009) showed higher frequency of DU among patients with blood group O with significantly higher H. pylori positivity (p=0.031) compared to other ABO phenotype . Although no statistical difference was noticed in O blood group distribution between DU and GU endoscopic findings [26].The present study show higher incidence of DU in patients with blood group O compared to GU (65.6%vs 54.1%) , although no

statistical difference between both diseases in blood group O in respect to other blood groups , $p > 0.05$. This is probably due to small number of patients enrolled in this study . Most studies stated that stomach ulcers are more likely to develop in older people. This is may be because arthritis be prevented by daily use of aspirin / (NSAIDs) , in addition to age related relaxation of pylorus valve allowing backflow of bile to erode the stomach lining [(41)]. H. pylori Seropositivity increased with age, and was not related to gender[(30)]. This age – related ulcer development was correlated to ABO blood group phenotype in many studies [(42,43)] , including our study . Further studies screening the effect of age on incidence of peptic ulcer disease are warranted to exclude other confounders. According to results, probably ABO/Rh blood group (mainly blood group O+) has an important role in patients with peptic ulcer disease as additional risk . We can conclude that the functional significance of ABO blood group distribution might be associated with biological behavior of PUD. The impact of therapeutic strategy with anti-secretary or H. pyloi irradiation protocols on blood group in PUD may be a focus for further studies.

References

1. Mourant AE, Domaniewska-Sobczak K, Kopec AC. Blood Groups and Diseases: A Study of Associations of Diseases with Blood Groups and Other Polymorphisms. Oxford, United Kingdom: Oxford University Press; 1978.
2. Denk H, Tappeiner G, Holzner JH. Independent behavior of blood group A- and B-like activities in gastric carcinomata of blood group AB individuals. Nature. 1974;248(447): 428–430.
3. Rockey DC. Gastrointestinal bleeding. In: Sleisenger and Fordran's Gastrointestinal and Liver Disease, Pathophysiology / Diagnosis / Management. 8th ed. W.B. Saunders Company; 2006; 1 :255–299 .
4. Amundadottir L, Kraft P, Stolzenberg-Solomon RZ, et al. Genome-wide association study identifies variants in the ABO locus associated with susceptibility to pancreatic cancer. Nat Genet. 2009; 41(9):986–990.
5. Kanbay M, Gur G, Arslan H, et al. The relationship of ABO blood group, age, gender, smoking, and *Helicobacter pylori* infection. Dig Dis Sci. 2005; 50:1214– 1217.
6. Lissowska J, Groves FD, Sobin LH, et al. Family history and risk of stomach cancer in Warsaw, Poland. Eur J Cancer Prev.1999; 8(3) :223–227.
7. Seyda T, Derya C, Füsun A, Meliha K. The relationship of *Helicobacter pylori* positivity with age, sex, and ABO/Rhesus blood groups in patients with gastrointestinal complaints in Turkey. *Helicobacter*. 2007;12(3):244–250.
8. Mentis A, Blackwell CC, Weir DM, Spiliadis C, Dailianas A, Skandalis N. ABO blood group, secretor status and detection of *Helicobacter pylori* among patients with gastric or duodenal ulcers. *Epidemiol Infect.* 1991;106: 221–229.
9. Dickey W, Collins JSA, Watson RGP, Sloan JM, Porter KG. Secretor status and *Helicobacter pylori* infection are independent risk factors for gastroduodenal disease. Gut. 1993;34:351–353.
10. Alkout AM, Blackwell CC, Weir DM. Increased inflammatory responses of persons of blood group O to *Helicobacter pylori*. J Infect Dis. 2000;181:1364– 1369.
11. David. J. Anstee . The relationship between blood groups and disease. J.BLOOD, 2010 ; 115 (23) : 4635-4643 .
12. You WC, Ma JL, Liu W, et al. Blood type and family cancer history in relation to precancerous gastric lesions. Int J Epidemiol. 2000; 29(3):405–407.
13. Keller R, Dinkel KC, Christl SU, Fischbach W Interrelation between ABH blood group O, Lewis (B) blood group antigen, *Helicobacter pylori* infection, and occurrence of peptic ulcer. Z Gastroenterol. 2002; 40: 273–276.
14. de Mattos LC, Cintra JR, Sanches FE, et al. ABO, Lewis, secretor and non- secretor phenotypes in patients infected or uninfected by the *Helicobacter pylori* bacillus. Sao Paulo Med J. 2002;120: 55–58
15. Martins LC, de Oliveira Corvelo TC, Oti HT, et al. ABH and Lewis antigen distributions in blood, saliva and gastric mucosa and *H. pylori* infection in gastric ulcer patients. *World J Gastroenterol*. 2006 ; 12(7):1120–1124.
16. Lee HH, Wu HY, Chuang YC, et al. Epidemiologic characteristics and multiple risk factors of stomach cancer in Taiwan. Anti-cancer Res. 1990; 10(4):875–881.
17. Barbara H. Estridge, Anna P. Reynolds, Norma J. Walters .Basic Medical Laboratory Techniques (2000) Cengage Learning ,4th ed. p 171.
18. Su M, Lu SM, Tian DP, et al. Relationship between ABO blood groups and carcinoma

of esophagus and cardia in Chaoshan inhabitants of China. World J Gastroenterol. 2001; 7(5):657–661.

19. Wolpin BM, Chan AT, Hartge P, et al. ABO blood group and the risk of pancreatic cancer. J Natl Cancer Inst. 2009; 101(6):424–431.

20. Maton, Anthea; Jean Hopkins, Charles William McLaughlin, Susan Johnson, MaryannaQuon Warner, David LaHart, Jill D. Wright. Human Biology and Health. Englewood Cliffs, New Jersey, USA: Prentice Hall. (1993) ISBN0-13-981176-1.

21. Garratty G. Blood groups and disease: a historical perspective. Transfus Med Rev. 2000;14(4):291–301.

22. Edgren G, Hjalgrim H, Tran TN, et al. A population-based binational register for onitoring long-term outcome and possible disease concordance among blood donors and recipients. Vox Sang. 2006; 91(4):316–323.

23. Kremer Hovinga I, Koopmans M, de Heer E, Bruijn J, Bajema I. "Change in blood group in systemic lupus erythematosus". Lancet , 2007; 369 (9557): 186–7.

24. Dkeet A. C: Gastric ulceration and Pyloric Sphincteric cylinder; The pyloric Sphincteric cylinder in Health and disease , 4th edition;1998 ch29, p138.

25. Romshoo, G.J., M.Y. Bhat, G.M. Malik, A.R. Rather, B.A. Naikoo, J.A. Basu, T. Hussain and S. Rashid. Helicobacter pylori infection in various ABO blood groups of Kashmiri population. Diagnostic Therapeut. Endosc. 1997; 4: 65-67.

26. Bayan, K., Y. Tuzun, S. Yilmaz, M. Dursun and F. Canoruc. Clarifying the relationship between ABO/Rhesus blood group antigens and upper gastrointestinal bleeding. Dig. Dis. Sci. 2009; 54: 1029-1034.

27. Gustaf Edgren*, Henrik Hjalgrim, Klaus Rostgaard, Rut Norda, Agneta Wikman, Mads Melbye, and Olof Nyren . Risk of Gastric Cancer and Peptic Ulcers in Relation to ABO Blood Type: A Cohort Study. American Journal of Epidemiology . 2010; 11:1-6.

28. Rasmi Y., Sadreddini M., Peirovi T., et al. Frequency of ABO Blood Group in Peptic Ulcer Disease in Iranian Subjects. Pakistan Journal of Biological Sciences, 2009; 12: 991-993.

29. Petrovic M, Artiko V, Novosel S, et al. Relationship between *Helicobacter pylori* infection estimated by 14C-urea breath test and gender, blood groups and Rhesus factor. Hell J Nucl Med. 2011;14:21–24

30. Robertson MS, Cade JF, Savoia HF, Clancy RL. Helicobacter pylori infection in the Australian community: current prevalence and lack of association with ABO blood groups. Intern Med J. 2003; 33(4):163-7.

31. Jaff MS . Relation between ABO blood groups and *Helicobacter pylori* infection in symptomatic patients . Clin Exp Gastroenterol. 2011; 4: 221–226.

32. Abdulhamid M, Alkout C, Blackwell C, Weir DM. Increased inflammatory responses of persons of blood group O to *Helicobacter pylori*. J Infect Dis. 2000;181:1364–1390.

33. Franchini M, Capra F, Targher G, Montagnana M, Lippi G. Relationship between ABO blood group and von Willebrand factor levels: from biology to clinical implications. Thromb J. 2007;5:14.

34. Bowen DJ. An influence of ABO blood group on the rate of proteolysis of von Willebrand factor by ADAMTS13. J Thromb Haemost. 2003;1:33–40

35. Jaff MS. Higher frequency of secretor phenotype in O blood group – its benefits in prevention and/or treatment of some diseases. Int J Nanomedicine. 2010; 5:901–905.

36. Lanas A, Garcia-Rodriguez LA, Polo-Tomas M, et al. Time trends and impact of upper and lower gastrointestinal bleeding and perforation in clinical practice. Am J Gastroenterol .2009;104: 1633–1641.

37. Bardhan KD, Royston C. Time, change and peptic ulcer disease in Rotherham, UK. Dig Liver Dis. 2008; 40:540–546.

38. Boren T, Falk P, Roth KA, Larson G, Normark S. Attachment of *Helicobacter pylori* to human gastric epithelium mediated by blood group antigens. *Science* 1993; 262:1892–1895.

39. Atherton JC, Tham KT, Peek RM Jr, Cover TL, Blaser MJ. Density of *Helicobacter pylori* infection in *vivo* as assessed by quantitative culture and histology. J Infect Dis. 1996;174:552-556 .

40. Heneghan, M.A., A.P. Moran, K.M. Feeley, E.L. Egan, J. Goulding, C.E. Connolly and C.F. McCarthy. Effect of host Lewis and ABO blood group antigen expression on Helicobacter pylori colonisation density and the consequent inflammatory response. Immunol. Med. Microbiol. 1998; 20: 257-266.

41. Seyda T, Derya C, Füsun A, Meliha K. The relationship of *Helicobacter pylori* positivity with age, sex, and ABO/Rhesus blood groups in patients with gastrointestinal complaints in Turkey. Helicobacter. 2007;12:244–250

42. Jaff MS. ABO and rhesus blood group distribution in Kurds. J Blood Med. 2010;1:143–146.

43. Jafarzadeh A, Ahmadi-Kahanali J, Bahrami M, Taghipour Z. Seroprevalence of anti-*Helicobacter pylori* and anti-CagA antibodies among healthy children according to age, sex, ABO blood groups and Rh status in south-east of Iran. Turk J Gastroenterol. 2007;18:165–171.