Original Article :

Complete Blood Counts among chronic patients of Helicobacter pylori infection

Ahmed Mohammed Elnour Elkhalifa[1, 2, *], AbdElhadi M. Agena[2], Abdelhakam G. Tamomh [2], Areej F.A. Hassan[2], Fatima M.H. Albasheer[2], Sakna G.K. Omer,[2] Anass M. Abbas[3], Abozer Y. Elderdery [2, 3].

1. Department of Public Health, College of Health Sciences, Saudi Electronic University, Riyadh, Saudi Arabia
2. Faculty of Medical Laboratory Sciences, University of El Imam El Mahdi, Kosti, Sudan.
3. College of Applied Medical Science, Jouf University, Sakaka, Saudi Arabia

Received on August 23, 2020, Accepted November 27, 2020 dx.doi.org/10.5455/mjhs.2021.02.003

Corresponding Author:
Dr. Ahmed Mohammed Elnour Elkhalifa- Associate Professor
Department of Public Health, College of Health Sciences, Saudi Electronic University, Riyadh, Saudi Arabia
University of El Imam El Mahdi, Faculty of Medical laboratory Sciences, Sudan.
Tel.: 00966501976641, 00249122467181
E-mail: a.alkhalifa@seu.edu.sa ; ahmedelnour2003@yahoo.com

Abstract

Background and Aims:
Helicobacter pylori infection has a suggested association with hematological alterations and common peptic ulcer disease manifestation. This study aims to investigate the influence of H. pylori infection on Complete Blood Counts (CBC).

Methods:
A case-controlled study was carried out in 2018 at National Health Insurance Hospital, Kosti, Sudan. Out of one hundred and thirty recruited participants, 80 had confirmed H. pylori infection categorized as the case group, while 50 healthy participants were enrolled as a control group. All subjects were screened for H. pylori infection. Complete blood count was analyzed from EDTA blood samples of the participants using an automated hematology analyzer (Sysmex KX-21, Tokyo, Japan). Peripheral Blood Picture (PBP) was examined using Romanowsky stains.

Results:
Our findings showed significantly lower mean values of tRBC, Hb, HCT, MCV, and neutrophils count among H. pylori infection patients than the control

الملخص

الخلفية و الاهداف :
تعتبر جرثومة المعدة من الجراثيم ذات معدل انتشار عالي وتسبب تغيرات في صورة الدم الكاملة للمرضي كالأمراض المرتبطة بفقر الدم وتعتبر أيضا مسبب رئيسي لقرحة المعدة.
والتدفئة وتهدف هذه الدراسة لمعرفة صورة الدم الكاملة لدي المرضي المصابون بجرثومة المعدة ومقارنة نتائجهم بصورة دم لأشخاص أصحاء غير مصابين بجرثومة المعدة.

طريقة البحث:
أجريت الدراسة الحالية بمستشفى التامين الصحي بكوستي في ولاية النيل الأبيض بالسودان في الفترة من مايو إلي أكتوبر بمشاركة ثمانون من المرضي الذبين اثبتت التحاليل الطبية اصابتهم بجرثومة المعدة مثلوا مجموعة الدراسة، وتم اختيار خمسون شخص آخر كمجموعة ضابطة متطابقة مع مجموعة الدراسة في الجنس والعمر حيث تم عمل صورة دم كاملة للمجموعتين.

النتائج:
أظهرت نتائج الدراسة أن متوسط قيمة تعداد كريات الدم الحمراء، تركيز الهيموغلوبين، الهيماتوكريت، متوسط حجم الخلية والخلايا العدلية أقل وذات دلالة إحصائية جوهرية مقارنة بالمجموعة الضابطة بينما متوسط تعداد الخلايا الليمفاوية كان أكثر وذو دلالة إحصائية لدي المصابين بجرثومة المعدة مقارنة بتعداد الخلايا الليمفاوية لدي مجموعة الأشخاص الاصحاء. لم يظهر متوسط تعداد كريات الدم البيضاء ومتوسط تعداد الصفائح الدموية ومتبقي عناصر صورة الدم

group. The mean values were (4.2 (±0.7) × 1012/ L vs. 4.8 (±0.3) × 1012/ L; 12.04 (±1.84) g/dl vs. 13.4 (±1.4) g/dl; 34.2 (±6.1) l/l vs. 37.2 (±4.2) l/l; 83.1 (±6.7) fl vs. 86.6 (±4.9) fl; and 49.56±12.23% vs. 53.6 ±7.8 respectively). On the other hand, the mean value of lymphocyte counts was significantly higher in H. pylori-infected patients than in the control group (41.9 ±11.1% vs. 35.7 ±7.3). No significant differences were found between H. pylori infected patients and the healthy control group regarding the counts of total white blood cells (WBCs), platelets, monocytes, and eosinophils. Morphological blood film examination showed oval-shaped teardrops, microcytic hypochromic picture, lymphocytosis, neutropenia, and adequate platelets.

Conclusion:

There were significant effects on some hematological parameters in patients with H. pylori infection.

Keywords:

Helicobacter pylori, Complete Blood Counts, Total White Blood Cell counts, Platelet counts, Anemia, Sudan

الكاملة أي فروقات جوهرية ذات دلالة إحصائية بين المجموعتين. وخلصت الدراسة إلى تأثير واضح وكبير لبعض عناصر صورة الدم الكاملة لدي الأشخاص المصابين بجرثومة المعدة مقارنة مع الأشخاص الأصحاء.

Introduction

Helicobacter pylori is a Gram-negative micro-aerophilic bacterium that is the most common cause of chronic infection in humans worldwide.[1] Approximately 4.4 billion individuals were infected globally with H. pylori during 2015, with the prevalence from 8.7% to 85.5%, increasing with age and large variations regarding race, ethnicity, socioeconomic status, and geographical area, with over 80% being in developing countries [2-7]. Recently many researchers reported H. pylori to be the principal cause of chronic gastritis and a main etiological agent for anemia, gastric cancer, peptic ulcer disease, ischemic cerebrovascular disease, mucosa-associated lymphoid tissue (MALT), lymphoma, dermatologic, neurologic disorders, metabolic and cardiopulmonary diseases. [2,8-12] Furthermore, previous studies reported the association of H. pylori infection with many hematological manifestations, such as vitamin B12 deficiency, iron deficiency anemia (IDA), and Idiopathic Thrombocytopenic Purpura (ITP).

[13-14] The frequency of anemia is high in many countries infected by H. pylori, schistosomiasis, and malaria, particularly in developing countries with serious public health problems. [15, 16-18] Given the high prevalence of H. pylori infection reported in Sudan, as the commonest etiological factor of gastritis,[19] our current study rationale is to explore and establish the effect of these bacteria on the hematological parameters in Sudanese H. pylori-infected patients to help in the management of H. pylori, which is highly recommended for high-risk populations [8, 20].

Methodology

Study design and study setting: A case-control study was carried out at National Health Insurance Hospital, Kosti, Sudan, from May to October 2018.

Participants and sample size: Following exclusion and inclusion criteria, one hundred and thirty participants were randomly recruited in the current study. Eighty participants had H. pylori infection (16 males, 64 females), aged 16-55 years, mean age (32.95±10.39); As a control, we selected 50 healthy persons matched in age and gender without gastrointestinal tract infection, and with negative H. pylori laboratory tests, who attended the National Health Insurance Hospital and agreed to participate.

Data collection:

Data was collected using a structural interviewing questionnaire, including personal and clinical information and laboratory investigations. Three ml of venous blood was taken and collected in sterile dry plastic syringes using standard venipuncture technique from each participant after sterilizing the puncture site with 70% ethanol. The samples were collected in Plain containers to detect antibodies against H. pylori organisms. The former centrifuged at 2000 rpm (revolutions per minute) for 15 minutes. ICT was carried out on the supernatant sera without preservation or delay. The ICT utilizes a combination of Helicobacter pylori antigen-coated particles and anti-human IgG to detect H. pylori antibody selectively and qualitatively in the serum.

The blood samples were collected in Ethylenediaminetetraacetic Acid (EDTA) containers were used for determination of Complete Blood Counts (CBC) using hematology-automated analyzer (Sysmex KX-21, Tokyo, Japan). Peripheral Blood Picture (PBP) was examined after staining with Romanowsky stains.

Stool samples were collected in clean, dry containers, which were examined immediately by mixing small stool amounts with ICT antigen solution. One drop of this mixture was thoroughly mixed and incu-

bated for 1 minute and then read.

Inclusion and Exclusion Criteria:

All included participants reported gastritis symptoms, had a laboratory-confirmed diagnosis of H. pylori infection and attended Kosti National Health Insurance Hospital. Patients were excluded from participation if they had been diagnosed with blood diseases, cardiovascular disease, or hemorrhagic disease. Also excluded were patients taking medication affecting blood parameters, those with gastric malignancy or malignant diseases, and those with other causes of thrombocytopenia. Finally, some patients who refused to participate were also excluded.

Statistical analysis:

Laboratory results were analyzed by IBM SPSS (Statistical Package for the Social Sciences) version 25. Descriptive statistics and frequency distribution were performed. Mean (M) and standard deviation (±SD) were calculated, and a comparison was made with a two-tailed Student's t-test to explore any significant difference between H. Pylori infected patients and healthy individuals' control group. The alpha error of 0.05 and P-value ≤0.05 was considered significant.

Informed consent:

Before collecting the blood samples, each participant completed the informed consent form. Parents completed and signed an informed consent form for patients below 18 years old.

Ethical approval:

This was obtained from the research and ethics committee of El Imam El Mahdi University, Faculty of Medical Laboratory Sciences.

Results:

80% of the current study participants were female, 20% were male amongst both the case and control groups, 40% and 46% of the patients and controls were aged between 25-34 years old. 28.7% and 26% were between 35-44 years old, 23.8% and 20% were 45-55 years old, while 7.5% and 8% were aged between 15-24 years old. The mean age for the H. pylori infection group was 32.95±10.39 years old and 31.36±8.75 for the control group, with no statistically significant difference between the two groups (p-value = 0.900) (Table 1).

Table 1. H. pylori infected patients and control group age and gender

Parameter	Category	H. pylori infected N=80	Control group N=50	t	P-value
		Frequency (%)	Frequency (%)		
Gender	Male	16 (20)	10 (20)		

Parameter	Category	H. pylori infected N=80	Control group N=50	t	P-value
		Frequency (%)	Frequency (%)		
Gender	Female	64 (18)	40 (80)		
	Total	80 (100)	50 (100)		
Age distribution	15-24 years old	6 (7.5)	4 (8)		
	25-34 years old	32 (40)	23 (46)		
	35-44 years old	19 (23.8)	10 (20)		
	45-55 years old	23 (28.7)	13 (26)		
	Mean ± SD	32.95±10.39 years old	31.36±8.75 years old	0.90	0.37

Table 2 shows red cells indices of H. pylori infected and control group while Table 3 shows the white cells parameters in these groups.

Table 2. Red blood cell indices of the participants

Variable	H. pylori infected patients (%) N=80	Control group N (%) N=50
Hb		
<13.5 g/dl	56 (70%)	29(58%)
13.5-17.5 g/dl	24(30%)	21(42%)
>17.5 g/dl	0(0%)	0(0%)
PCV		
<40 l/l	71(88.7%)	40(80%)
40-52 l/l	8 (10%)	10 (20%)
>52 l/l	1(1.3%)	0(0%)
RBCs		
<4.5 x 10^{12}	56 (70%)	1 (2%)
4.5-6.5 x 10^{12}	23(28.7%)	49(98%)
>6.5 x 10^{12}	1(1.3%)	0(0%)
MCV		
<80 fl	22(27.4%)	4(8%)
80-95 fl	53(66.3%)	45(90%)
>95 fl	5(6.3%)	1(2%)
MCH		
<27 pg	17(21.3%)	2(4%)
27-34 pg	60 (75%)	48(96%)
>34 pg	3(3.7%)	0(0%)
MCHC		
<20%	0(0%)	0(0%)
20-35%	52(65%)	30 (60%)
>35%	28(35%)	20(40%)

Key: Hb = Haemoglobin concentration; PCV= Blood Cell Volume; RBCs = Red Blood Cells Count; MCV= Mean Cell Volume; MCH = Mean Cell Haemoglobin; MCHC= Mean Cell Haemoglobin Concentration.

Table 3: TWBC, PLT, and Differential White Blood Cell Counts group.

Variable	H. pylori infected patients (%) N=80	Control group N (%) N=50
TWBC		
<4×10^3 /l	9(11.3%)	2(4%)
4-11×10^3 /l	68(85%)	47(94 %)
>11×10^3 /l	3(3.7%)	1(2%)
PLt		
<150×10^3 /l	1 (1.3%)	0(0%)
150-400×10^3 /l	70(87.4%)	45(90%)
>400×10^3 /l	9(11.3%)	5(10%)
Neutrophil		
<40%	16(20%)	2(4%)
40-80%	2(2.5%)	2(4%)

Variable	H. pylori infected patients (%) N=80	Control group N (%) N=50
>80%	62(77.5%)	46(92%)
Lymphocyte		
<20%	1(1.3%)	0(0%)
20-40%	35(43.7%)	44(88%)
>40%	44(55%)	6(12%)
Monocyte		
<4%	10(12.5%)	6(12%)
4-10%	70(87.5%)	42(84%)
>10%	0(0%)	2(4%)
Eosinophil		
1%	18(22.5%)	2 (4%)
2-4%	41(51.3%)	26(52%)
>4%	21(26.2)	22(44%)

Key: TWBC = Total White Blood Cells Counts; PLt = Platelets count

The mean of red blood cell counts (RBCs), haemoglobin (Hb), Haematocrit (Hct), mean cell volume (MCV), neutrophil and lymphocyte were 4.2×1012/L (± 0.7) vs. 4.8×1012/L (±0.3); 12.0 g/dl (±1.8) vs. 13.4 g/dl (±1.4); 34.2 l/l (±6.1) vs. 37.2 l/l (±4.2); 83.1 fl (±6.7) vs. 86.6 fl (±4.9); and 49.6% (±12.2) vs. 53.6% (±7.7) and 41.9% (±11.1) vs. 35.7% (±7.3) in cases with H. pylori and controls respectively. Our findings show that some hematological parameters, RBCs, Hb, Hct, MCV, and neutrophil were significantly decreased among the case group compared to the control group (p values = 0.001, 0.001, 0.003, 0.002, and 0.001 respectively) except lymphocyte count, which was significantly elevated in H. pylori infected patients over controls, with p-value <0.01, as shown in Table 4,5.

Table 4. Results of red cell indices among H. pylori infected patients against control samples

Parameter	Patient M (±SD) (N=80)	Control M(±SD) (N=50)	P-value
Hb g/dl	12.04 (±1.84)	13.4 (±1.4)	<0.001*
PCV l/l	34.2 (±6.1)	37.2 (±4.2)	<0.003*
RBCs × 10^6/ L	4.2 (±0.7)	4.8 (±0.3)	<0.001*
MCV fl	83.1 (±6.7)	86.6 (±4.9)	<0.002*
MCH pg	28.8 (±7.3)	30.4 (±2.2)	0.062
MCHC%	34. (±2.5)	34.9 (±1.9)	<0.185

Key: - M=Mean; *Significance at the level ≤0.05

Table 5: Results of TWBC, PLT, and Differential White Blood Cell Count among H. pylori infected patients against control samples

Parameter	Patient M (±SD) (n=80)	Control M(±SD) (N=50)	P-value
TWBC ×103/l	6.0 (±2.09)	6.4 (±1.9)	0.818
PLt×103/l	284.9 (±77.3)	292.4 (±69.4)	0.556
Neutrophil%	49.56±12.23%	53.6 (±7.8)	<0.001*
Lymphocyte%	41.9 (±11.1)	35.7 (±7.3)	<0.004*

Parameter	Patient M (±SD) (n=80)	Control M(±SD) (N=50)	P-value
Eosinophil%	3.4 (±2.2)	4.7 (±2.4)	0.673
Monocyte%	5.4 (±3.0)	6.2 (±2.7)	0.113

Key: - M=Mean; *Significance at the level ≤0.05

No significant differences between our study groups were observed in the following parameters: TWBCs, platelet, monocyte, and eosinophil counts. They were 6.0 ×103/l (±2.1) vs. 6.4 ×103/l (±1.9); 284.9×103/l (±77.3) vs. 292.4 ×103/l (±69.4); monocyte 5.4 % (±3.0) vs. 6.2 (±2.7)%; eosinophil 3.4 (±2.2)% vs. 4.7 (±2.4)%; MCH 28.8 pg (±7.3) vs. 30.4 pg (±2.2) and MCHC 34.4% (±2.5) vs. 34.9% (±1.9) respectively, as shown in Tables 4,5. Peripheral blood picture of most H. pylori infection patients was microcytic hypochromic RBCs. Macro-ovalocytes, anisocytosis, poikilocytosis with teardrop, target red cells, and Echinocyte were observed. However, the normocytic and normochromic picture was observed in some patients with H. pylori infection. White blood cell morphology of H. pylori infection patients showed lymphocytosis and neutropenia.

Discussion

H. pylori are closely related to hematological disorders such as iron deficiency anemia (IDA) and primary immune thrombocytopenia (ITP). [11] The current study aims to detect the effects of H. pylori infection on hematological parameters among Sudanese patients attending Kosti health insurance hospital and compare their results with those of healthy individuals. Our findings were in accordance with recent studies that were conducted in other ethnic groups [21, 22] and another study done in Sudan [12], which stated a decrease in some hematological parameters (Hb, Hct, MCV, and neutrophil counts) in H. pylori patients. Our findings were, however, not in agreement with the results of the study done in Saudi by Nahla KI and co-workers who found no association between H. pylori and hematological parameters. [23] Furthermore, a retrospective study was conducted between 2012 to 2016 in China by MeiYX et al. [24], who found that H. pylori infection may reduce the level of Hb and, in turn, may be responsible for causing anemia in a Chinese population. In contrast, previous studies were carried out in a Nigerian tertiary educational institution by Benjamin OE and co-workers [25] who mentioned a non-significant difference in MCV values and another study done among Palestinian adult patients infected with H pylori by Saleh NM and Wesam MA[26] who conclud-

ed similar results regarding MCV which was not the same as that found here. Our results are in agreement with the previous study done by Waleed S et al. [27] in 2016 in Taif City, Saudi Arabia and the study done by Saleh NM and Wesam MA [26] , while inconsistent with the study by Ashraf AT, et al. [28], in 2015 in Egypt who reported insignificant difference in RBCs counts. Our results are consistent with the previous study done in Palestine by Saleh NM and co-workers [26], who reported a low level of MCH and MCHC in patients with H. pylori infection [12, 27]. On the other hand, our current findings are consistent with the study done by Elham AI et al. [12] in Sudan and inconsistent with other studies that concluded high total WBCs count in patients with H. pylori infection patients compared to controls [26,27]. Concerning Platelet counts, our results revealed no statistically significant difference between H. pylori infection patients and the control group; this finding was in line with other studies [26, 28]. Regarding the Neutrophil counts and the lymphocyte counts, our findings were with other studies [29, 30], which indicated that H. pylori infection may be related to anemia with high neutrophil and low lymphocyte counts. The significant increase in lymphocyte count may be due to inflammations caused by H. pylori infection. The possible reasons for the differences and similarities in blood parameters with other mentioned studies may include the degree of severity of H. pylori infection, the demographic data such as the age of the participants, and the sample size. Our findings concerning the highly variable peripheral blood film morphology are consistent with earlier studies [12, 31] that reported oval-shaped, teardrops, microcytic hypochromic pictures among H. pylori infection patients.

Conclusion

From this study, we conclude that some hematological parameters, including Hb, Hct, MCV, and neutrophil counts, were decreased among H. pylori-infected patients. In contrast, lymphocyte counts were found to be higher among these patients. Therefore, H. pylori infection is a cause of anemia and must be considered while investigating and managing anemic patients (especially with the acid-peptic disease).

Funding:

None.

Conflict of Interest:

The authors declared no conflict of interest.

Acknowledgment:

The authors thank all participants in this study.

References:

1. Hooi JK, Lai WY, Ng WK, Suen MM,

Underwood FE, Tanyingoh D, Malfertheiner P, Graham DY, Wong VW, Wu JC, Chan FK. Global prevalence of Helicobacter pylori infection: systematic review and meta-analysis. Gastroenterology. 2017 Aug 1;153(2):420-9.

2. Campuzano-Maya G. Hematologic manifestations of Helicobacter pylori infection. World journal of gastroenterology: WJG. 2014 Sep 28;20(36):12818.

3. Valliani A, Khan F, Chagani B, Khuwaja AK, Majid S, Hashmi S, Nanji K, Valliani S. Factors associated with Helicobacter pylori infection, results from a developing country-Pakistan. Asian Pac J Cancer Prev. 2013 Jan 1;14(1):53-6.

4. Yahya RZ, Rudainee MH, Alshammari SA, Alshammari A, Ahmari, AS, et al. Helicobacter pylori and Upper Gastrointestinal Diseases. EC Microbiology SI. 2017; 1:23-30

5. Tamokou J, Guimtsop YA, Ndebi ME, Nzesseu VL, Djokge AK, Kuiate J. Effect of Helicobacter pylori Infection on Selected Biochemical Parameters of Hypertensive Patients at Dschang District Hospital in Cameroon. International Journal of Tropical Disease and Health. 2017; 26(1): 1-8.

6. Carabotti M, D'Ercole C, Iossa A, Corazziari E, Silecchia G, Severi C. Helicobacter pylori infection in obesity and its clinical outcome after bariatric surgery. World Journal of Gastroenterology: WJG. 2014 Jan 21;20(3):647.

7. Lv ZF, Wang FC, Zheng HL, Wang B, Xie Y, Zhou XJ, Lv NH. Meta-analysis: Is combination of tetracycline and amoxicillin suitable for Helicobacter pylori infection? World Journal of Gastroenterology: WJG. 2015 Feb 28;21(8):2522.

8. Yagura T, Egawa S, Okano A, Mizukoshi K. Chronic Gastritis Due to Helicobacter pylori Associated with Increased Serum Levels of CA54/61: A Report of Three Cases. The American journal of case reports. 2018; 19:951.

9. Goni E, Franceschi F. Helicobacter pylori and extragastric diseases. Helicobacter. 2016; 21(S1):45-8.

10. Yokota S, Konno M, Fujiwara S, Toita N, Takahashi M, Yamamoto S, et al. Intrafamilial, Preferentially Mother-to-Child and Intraspousal, Helicobacter pylori Infection in Japan Determined by Mutilocus Sequence Typing and Random Amplified Polymorphic DNA Fingerprinting. Helicobacter. 2015; 20(5):334-42.

11. Darvishi M, Ziari K, Mohebbi H, Alizadeh K. Association between iron deficiency anemia and Helicobacter pylori infection among children under six years in Iran. Acta Med Iran. 2015; 53: 220– 224.

12. Elamin EA, Suliman MA, Azoz ME,

Ali EW, Olerile LD, Jiao Y, Zhao Y. Effect of Helicobacter pylori Infection on Haematological Parameters in Kosti Teaching Hospital, Sudan. Iranian Red Crescent Medical Journal. 2018 Feb 1;20(2).

13. Rocha AM, Botelho LF, Rocha DM (2014) Improvement of thrombocytopenia after treatment for Helicobacter pylori in a patient with immunologic thrombocytopenic purpura. Rev Bras Hematol Hemoter 36:162–164

14. Humeida AT, Abdalla MH. Association of Helicobacter pylori Infection and Vitamin B12 Level among Sudanese Patients. IOSR Journal of Dental and Medical Sciences. 2017; 16(3): 12-4.

15. McLean E, Cogswell M, Egli I, Wojdyla D, de Benoist B. Worldwide prevalence of anemia, who vitamin and mineral nutrition information system, 1993-2005. Public health nutrition. 2009; 12:444-454

16. Kumari R, Bharti RK, Singh K, et al. prevalence of iron deficiency and iron deficiency anaemia in adolescent girls in a tertiary care hospital. J Clin Diagn Res. 2017; 11(8): BC04- BC06.

17. Al-Shehri H, Stanton MC, LaCourse JE, Atuhaire A, Arinaitwe M, Wamboko A, Adriko M, Kabatereine NB, Stothard JR. An extensive burden of giardiasis associated with intestinal schistosomiasis and anaemia in school children on the shoreline of Lake Albert, Uganda. Transactions of the Royal Society of Tropical Medicine and Hygiene. 2016 Oct 1;110(10):597-603.

18. White, NJ 2018. Anaemia and malaria. Malar. J 17: 371.

19. Awad-Elkareem A, Khalid OM, Zobaida M, Elfadil M. Alaa A, Fatima A. Evaluation of serum vitamin B12 and ferritin levels in H pylori-associated gastritis. Pharm Biol Sci. 2016; 11(1):1–5.

20. Hagymasi K, Tulassay Z. Helicobacter pylori infection: New pathogenetic and clinical aspects. World J Gastroenterol. 2014; 20(21):6386-99.

21. John S, Baltodano JD, Mehta N, Mark K, Murthy U. Unexplained iron deficiency anemia: does Helicobacter pylori have a role to play? Gastroenterology report. 2018 Aug;6(3):215-20.

22. Demerdash DME, Ibrahim H, Hassan DM, Moustafa H, Tawfik NM. Helicobacter pylori associated to unexplained or refractory iron deficiency anemia: An Egyptian single-center experience. Hematology, transfusion, and cell therapy. 2018;40:219-225

23. Ibrahim NK, Al-Sayes FM, Alidrous FA, Alahmadi MM, Bakor SH, Aljohani AF. Helicobacter pylori: Prevalence and Relationship to Hematological Parameters of Symptomatic Patients who Conducted Gastroscopy at King Abdulaziz University

Hospital, Jeddah. Journal of Advances in Medicine and Medical Research. 2018:1-9.

24. Xu MY, Cao B, Yuan BS, Yin J, Liu L, Lu QB. Association of anaemia with Helicobacter pylori infection: a retrospective study. Scientific reports. 2017 Oct 18;7(1):1-7.

25. Eledo BO, Allagoa DO, Onuoha E, Okamgba OC, Ihedioha AU, Ugwu IM. Evaluation of some haematological parameters among Helicobacter pylori infected students in a Nigerian tertiary educational institution. Biotechnological Research. 2018; 4:34-39

26. Mwafy SN, Afana WM. Hematological parameters, serum iron, and vitamin B12 levels in hospitalized Palestinian adult patients infected with Helicobacter pylori: a case-control study. Hematology, transfusion, and cell therapy. 2018 Jun;40(2):160-5.

27. Samy W EG, Issa LF, Sedik W. Prevalence of Helicobacter pylori infection and its correlation with complete blood count parameters in adult males at Taif city, Saudi Arabia. SAS J. Med., 2016; 2(3):49-54

28. Abou-Taleb A, Allam A, Elsamman MK. Association between Helicobacter pylori infection and iron deficiency anemia among school-age children in Sohag university hospital, upper Egypt. Open Journal of Blood Diseases. 2016; 7:36-46

29. Guclu M, Faruq Agan A. Association of severity of Helicobacter pylori infection with peripheral blood neutrophil to lymphocyte ratio and mean platelet volume. Euroasian Journal of hepato-gastroenterology. 2017; 7:11-16

30. Nagata A, Sekiguchi N, Kurimoto M, Noto S, Takezako N. Significance of lymphocyte counts at diagnosis in the management of ITP: the relationship between lymphocyte counts and treatment success in H. pylori-infected patients. International Journal of Hematology. 2015 Mar 1;101(3):268-72.

31. Kujovich JL. Evaluation of anemia. Obstetrics and Gynecology Clinics. 2016 Jun 1;43(2):247-64.