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Determining Levels of Some Trace Elements and Electrolytes in Patients with H. pylori Positive Chronic Gastritis

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Abstract

H.pylori (Helicobacter pylori:Gram-negative bacteria,multimedia,microaerophilic),is one of most common pathogens in humans, that causes gastrointestinal disorders like stomach ulcers, stomach cancer and simple gastritis. This research aims to determine levels of some trace elements (pb, Cr, Ni, Cu, Fe, Zn, Mn, and Se), and electrolytes (Sodium, Chloride, Calcium and Magnesium) in group of patients (n:44) with H. pylori chronic gastritis. A total of (40) blood samples of healthy people were collected from consulting clinics as well as control group. Study showed an increase in levels of (Cu, Mn, Ni, Cr and Pb) in serums of patients' group compared to healthy ones, Results also showed a decreased levels of (Zn, Se and Fe) in serums of patients' group, compared with control group. Again , results show levels of electrolytes in patients' group Ca and Mg were significantly lower), (insignificantly lower levels: Na and Cl), compared with control group.

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تقدير مستويات بعض العناصر النزرة والشوارد في مصل دم المرضى المصابين بالتهاب المعدة المزمن الناتج عن العدوى البكتيرية الحلزونية

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مستخلص البحث

تُعد البكتريا البوابية الحلزونية (بكتيريا سالبة الغرام، متعددة الأوساط وحلزونية ومحبة لكميات الهواء القليلة)، المسبب الثاني للإصابة بالأمراض البكتيرية الأغلب شيوعا في الإنسان فضلا عن ذلك فإنها واحدة من أكثر مسببات الأمراض المرتبطة بالمعدة والاثني عشري، تؤدي الى حصول اضطرابات عديدة تصيب الجهاز الهضمي مما ينجم عنها امراض عديدة ومنها سرطان المعدة، قرحة المعدة والتهاب المعدة. يهدف البحث الى تقدير مستويات بعض العناصر النزرة (الرصاص، الكروم، النيكل، النحاس، الحديد، الزنك، المنغنيز والسلينيوم) والشوارد (الصوديوم، الكلوريد، الكالسيوم والمغنسيوم) في مصل دم (٤٤) من المرضى المصابين بالتهاب المعدة المزمن الناتج عن الإصابة بالبكتريا البوابية الحلزونية. تم جمع (٤٠) عينة دم من اشخاص اصحاء ظاهرياً، أظهرت نتائج الدراسة حصول ارتفاع في مستويات كل من (النحاس، المنغنيز، النيكل، الكروم والرصاص) في مصل دم المرضى مقارنة مع مجموعة الأصحاء، فضلا عن حصول انخفاض في مستويات كل من (الزنك، السلينيوم والحديد) في مصل دم المرضى مقارنة مع مجموعة الأصحاء. واظهرت النتائج حصول انخفاض معنوي في مستوى (الكالسيوم والمغنيسيوم)، وانخفاض غير معنوي في مستوى (الصوديوم والكلوريد) في مصل دم المرضى مقارنة مع مجموعة الاصحاء.

الكلمات المفتاحية: البكتريا الحلزونية البوابية، العناصر النادرة، الشوارد، مطيافية الامتصاص الذري.

Introduction:

A gram-negative, microaerophilic human pathogen, *Helicobacter pylori* (*H pylori*) colonizes the stomach mucosa [Obaid *etal*.,2015]. Helicobacter pylori can be described as a pathogenic bacterium that has a spiral-shape that can be seen in the human gastric mucosa. Warren and Marshall were the first scientists who isolated it in 1982 [Obleaga *et al*., 2015; Alewi & Mohammed, 2024]. It is also considered as one of the most global infections humans suffer from gastritis, duodenal ulcers, gastric adenocarcinomas, gastric mucosa-associated lymphoid tissue lymphomas, and chronic gastritis are all brought on by *H. pylori* [Aslan *et al*.,2023]. Gastritis is caused by *H. pylori* infection, which has also been linked to stomach cancer, peptic ulcer disease, and lymphoma. *H. pylori* infection affects all age groups, and once discovered, the condition lasts for a long time. It has been proven that *H. pylori* infection occurs at high levels in developing nations, particularly among poor and lower socioeconomic class individuals [Suha & Saad, 2018]. In developing countries, pylori infection occurs early in life, while hypochlorhydria often occurs in malnourished individuals, leading to recurring gastrointestinal infections with diarrhea [Aburahma & Kadhim, 2023]. If someone catches the disease, then that might lead to inflaming the cells infiltration acutely and chronically which can be observed in *H pylori* gastritis, It is also believed that if thephagocytic cells produce too much of reactive oxygen metabolites (ROMs) then that will cause lesions in the mucosal produced by *H pylori* infection, which are compounds characterized by having high reactive and able to be mixed with DNA in different of genotoxic ways [Hamadi,2016].It is worth mentioning that that reactive oxygen species is capable of to react with the lipid-bilayers w consequently results in discharging peroxidation products such as malondialdehyde. However, these activities may modify or alter the DNA structure, which may then lead to changes in the DNA structure that facilitate mutations and carcinogenesis. Nutritioncan be one of the serious factors that determine the result of interactions made by the host microbe by modulating the reaction of the immune. We can commonly define "*Micronutrient*" or "*trace elements*" as constituting elements, never the less, 0.01 we take into consideration body mass which we need in much smaller amounts. Trace elements can be defined as those elements that can be noted in small though the exact numbers are not actually but not precisely identified inside the living body. However, because of advancements in analytical methods such as atomic absorption

spectrometry, it is now feasible to identify and characterize these elements, highlighting their activities as well as the traits of their excess and deficient circumstances. Cases that deal with deficiencies are usually carried out in clinics. Those cases with "high-calorie parenteral therapy or enteral nutrition, and congenital abnormalities of element metabolism" are explained consecutively. Accordingly, it becomes necessary to know and be familiar with those clinical aspects and procedures involved in trace elements [Sonnenberg et.al., 2017]. It well known that trace minerals are vital and indispensable for life. They comprise of the following minerals: iron (Fe), zinc (Zn), copper (Cu), nickel (Ni) and selenium (Se). They are crucial cofactors of enzymes and organize cell molecular structures, such as mitochondria with their membrane. The influence immune is affected by micronutrients homeostasis deficiencies which in turn influence those infection-that lead to morbidity and mortality. It is worth mentioning that some Micronutrients such as selenium, copper and others are classified as antioxidants that are powerful with substantial effect on those diseases and infections that cause humans' death. Biological and immune functions usually become weak due to subclinical deficiencies within the host. Antioxidants are also important in gastric mucosal defense because they protect damage made due to producing too much oxygen resulting free radicals [Aslan *et al.*, 2023]. Antioxidants may have anti-carcinogenic properties as they can prevent or limit the production of N-nitrosamines, a key factor in gastric cancer development. Furthermore, gastric inflammation can lead to dysfunction in various processes transitioning from acute to chronic gastritis, ultimately causing gastric atrophy/intestinal metaplasia. This could be due to decreased [Yao-Bin *et al*., 2018].

Materials and Methods:

A total of 44 patients with H. pylori gastritis who were sent to the gastroenterology department of the Ibn-Sina teaching hospital in Mosul were included in the current study. The ages of each patient ranged from 24 to 68. The patients' diagnoses were made using clinical manifestation, endoscopy, pathological examination results, serum antibodies against H. Pylori, and rapid urease testing. Participants underwent a comprehensive medical history, including personal history, symptoms, duration, risk factors, dietetic, medication, and family history of gastrointestinal issues. The forty members of the control group are all in good health. Participants having a history of cancer, patients under treatment, people with a history of inflammation or any other particular

condition, and people who had previously used medicine to address the disease's symptoms were also eliminated.

Collection of Blood Samples:

Blood samples from patients and controls were collected, coagulated for 15 minutes at room temperature, and then separated by centrifugation at four thousand times the speed of light for ten minutes. It was then kept at -20 degrees Celsius until analysis.

Methods:

Lead(Pb), Chromium (Cr), Nickel (Ni), Copper (Cu) Iron (Fe) , Zinc (Zn) and Manganese (Mn) in serum was assayed by using atomic absorption spectroscopy technique, Serum Selenium, calcium , magnesium were measured by colorimetric method using kit manufactured by Biolabo (France) ,Sodium and Chloride in serum were determined using flam emission spectrometry.

Statistical analysis:

The statistical software SPSS-17 was employed to calculate the mean and standard deviation (SD). The P-value was used to ascertain whether there was a significant difference between the values of two variables, as indicated by the t-test ($P \leq 0.05$) (Hinton, 2004).

Results :

Table (1): shows the percent of participants in study each included demographic characteristic and presents the results. In this study, 40 normal, healthy participants (23 men, 17 females) and 44 H. pylori-positive patients (25 males, 19 females) participated. In the ill group, the mean age was 48.6±5.4 years, whereas in the healthy control group it was 47.5± 6.8 years.

Table (1): Demographic characteristics of study population

	Healthy controls (n = 40)	Patients (n = 44)
Sex (males %) (females %)	 23 17	 25 19
Age (years)	47.5 ± 6.8	48.6±5.4
BMI (kg/m2)	22.9±1.31	23.1±1.27

Table (2): shows the results of Copper (µg/dL), Zinc (µg/dL), Selenium (µg/dL), Iron (mg/dL), Manganese(µg/dL), Nickel(µg/dL), Chromium(µg/dL), and Lead(µg/dL) among study group. The results revealed that Copper (µg/dL) was higher in patients group (107±3.5 µg/dL) than healthy controls (103.4±3.4 µg/dL). With Zinc (µg/dL), the results shows a significant lower at $p < 0.01$ of

Zinc in patients group (57.8±2.8 µg/dL) than healthy control (68.8±2.7 µg/dL). Also with Selenium (µg/dL), the results shows a lower of Selenium in patients group 30.8±2.5 µg/dL) than healthy control (32.4±2.9 µg/dL). With Iron (mg/dL), the results shows a high significant lower at $p < 0.001$ of Iron in patients group (91.6±9.7 mg/dL) than healthy control (113.1±8.3 mg/dL). In contrast, the results of Manganese(µg/dL) and Nickel(µg/dL) were higher in patients group 0.9±0.02, 0.29±0.05 µg/dL respectively than healthy controls0.8±0.03, 0.27±0.08 µg/dL respectively. With Chromium (µg/dL), the results shows a significant higher of Chromium at $p < 0.01$ in patients group (2.1±0.04 µg/dL) than healthy control (0.7±0.05µg/dL). Furthermore, the results revealed a higher significant of Lead at $p < 0.001$ in patients group (17.3±2.4µg/dL) than healthy control (7.4±0.8 µg/dL). See table 2.

Table 2: the level of trace elements in patients and control subjects

Trace elements	Control group (n=40)	Patient group (n=44)
Copper (µg/dL)	103.4±3.4	107±3.5
Zinc (µg/dL)	68.8±2.7	57.8±2.8**
Selenium (µg/dL)	32.4±2.9	30.8±2.5
Iron (mg/dL)	113.1±8.3	91.6±9.7***
Manganese(µg/dL)	0.8±0.03	0.9±0.02
Nickel(µg/dL)	0.27±0.08	0.29±0.05
Chromium(µg/dL)	0.7±0.05	2.1±0.04*
Lead(µg/dL)	7.4±0.8	17.3±2.4***

***Significant difference different between H. pylori positive and control group ($p< 0.001$).

** Significant difference between between H. pylori positive and control group ($p< 0.01$).

* Significant difference between between H. pylori positive and control group ($p< 0.05$)

Table (3): shows the levels of electrolytes in patients and healthy controls group. The results revealed that Sodium (mmol/L) and Chloride(mmol/L) were lower in patients group 139±6.3 mmol/L, 102±6.9 respectively than healthy controls group 141±4.3 mmol/L, 103±5.6 respectively. with Calcium (mmol/L), and Magnesium(mmol/L), the results showed that Calcium (mmol/L), and Magnesium(mmol/L) lower significantly at ($p< 0.05$) in patients group 1.7 ±0.11 mmol/L, 0.8 ±0.05 mmol/L respectively than healthy controls group 2.1±0.12 mmol/L, 1.1 ±0.06 mmol/L respectively (table 3).

Table 3: the levels of electrolytes in patients and control subjects

Electrolytes	Control group (n=40)	Patient group (n=44)

Sodium (mmol/L)	141±4.3	139±6.3
Chloride(mmol/L)	103±5.6	102±6.9
Calcium (mmol/L)	2.1±0.12	1.7 ±0.11*
Magnesium(mmol/L)	1.1 ±0.06	0.8 ±0.05*

* Significant difference between H. pylori positive and control group ($p< 0.05$)

Discussion:

H. pylori infections can cause stomach inflammation, leading to gastritis, peptic ulcer disease, atrophy, intestinal metaplasia, and gastric cancer. Additionally, hypochlorhydria is a side effect of *H. pylori*-related gastritis. The absorption of trace elements may be impacted by changes in the gastrointestinal environment [WuMc et al., 2014]. Janjetic *et al.* suggest that gastric *H. pylori* infection may cause increased serum copper levels in adults, despite previous studies showing no significant difference in copper levels between infection and non-infection [Janjetic et al., 2010; Gerig et al., 2013]. Research indicates no significant difference between individuals who tested positive for *H. pylori* and those who tested negative for the infection. Furthermore, research has shown that blood copper levels did not exhibit any discernible variations between groups who had successful and unsuccessful H. pylori eradication, even following *H. pylori* eradication medication [Nurinnisa *et al*., 2015]. A study by Janjetic *et al*. have shown that there is no correlation between a serum zinc level and stomach *H. pylori* infection [Chasapis et al., 2012]. However, this element, zinc, has an impact on adults because it modulates oxidative stress in the stomach mucosa. A zinc shortage increases this sensitivity and can cause inflammation-related mucosal damage [Akcam et al., 2007]. Another study examining the impact of zinc on human health has demonstrated that adequate zinc levels prevent According to reports, individuals with gastritis, peptic ulcers, and gastric cancer have considerably lower blood zinc levels, which may indicate injury to the stomach mucosa [Marjanovic et al., 2010]. Moreover, an additional investigation indicated that exposure of stomach tissue to zinc concentrations seemed to modulate the level of inflammation in *H. pylori*-induced gastritis. Zinc content reduction in stomach mucosa increases *H. pylori* infection, with *H. pylori*-positive individuals having lower serum zinc levels than *H. pylori*-negative patients [Zhang et al., 2012]. Many diseases, including cancer, immunological dysfunction, cardiovascular disease, and reproductive disorders, are caused on by a deficiency in selenium [Mehdi et al., 2013].

Serum selenium levels, however, have not been linked to individuals with *H. pylori* infection, according to reports [Toyonaga et al., 2012]. Nevertheless, Ustundag *et al.* discovered that the accumulation of selenium in stomach tissue in instances of *H. pylori*-related antral inflammation decreased significantly after the effective eradication of *H. pylori* [Ustundag et al., 2001]. Several studies have revealed different theories on the mechanism linking *Helicobacter pylori* to iron deficit and iron deficiency anemia. For instance, Baysoy et al.'s research revealed that *H. pylori* patients have decreased blood iron levels and gastric ascorbic acid levels, along with physiological and histological abnormalities to the stomach [Baysoy et al., 2004 ; Hinda *et al*., 2022]. Atrophic gastritis and achlorhydria are caused by *H. pylori* infection, and individuals with iron deficient anemia who have this infection also have elevated blood gastrin levels and intragastric pH [Ebule et al., 2013]. Contrary to what Haung et al. had shown, another investigation revealed that *H. pylori* eradication improved the condition of patients with iron deficient anemia [Huang et al., 2010]. The investigation by Nakagawa et al. [Nakagawa et al., 2013] revealed that individuals infected with *H. pylori* had markedly reduced serum ferritin levels. Furthermore, a separate study on the same topic has shown that people with chronic gastritis linked to *H. pylori* infection have elevated serum levels, leading to compromised iron absorption and iron deficiency anemia [Helena et al., 2013]. Although nickel is a mineral that the human body requires in very minute amounts, excessive intake or exposure can be harmful to health. Nickel exposure can cause liver, kidney, spleen, brain, tissue, vesicular eczema, lung, and nose cancer, but blood nickel levels are not linked to *H. pylori* [Poonkothai & Vijayavarhi, 2012]. Increased salt concentration has been shown to have an impact on *H. pylori's* growth, cell morphology, survival, and expression of virulence factors. These findings are consistent with studies on chloride and its functions and reactions in the human body. Furthermore, the strain variations observed among individuals provide strong evidence that an individual's diet and, consequently, the strain of *H. pylori* they carry may have a significant impact on the course of their illness [Peter *et al.,* 2023]. One form of mineral that is present in many meals is calcium. Additional advantages of calcium for the human body include its role in helping blood arteries carry blood throughout the body and in facilitating the production of hormones and enzymes that impact nearly every bodily function [Kakehasi et al., 2009; Al-Nuaimi *et al.*2022,]. Acid secretion may be impacted by gastric mucosal atrophy brought on by an *H. pylori* infection. Bone mass, calcium homeostasis, and calcium absorption are all impacted by hypochlorhydria in

the stomach [Kalkan et al., 2016]. Magnesium is a crucial cofactor in over 300 enzyme systems, regulating various metabolic activities and playing a vital role in the functioning of biochemical pathways essential for bacterial growth and survival in central metabolism [Yalamecha, 2020]. For instance, Mg^{2+} is crucial to H. pylori's ability to metabolize phosphate and catabolize phosphonates, which are thought to be a vital source of phosphorous sand and phosphorous storage. Phenyl phosphonate is one of the phosphonates that *H. pylori* may break down so that it can be utilized as the only source of phosphate, it is important to talk about a few of the current study's shortcomings. First, there were very few patients. Additionally, we did not test the trace elements in the stomach mucosa; instead, we only measured the quantities of vitamins and trace elements in plasma. Third, following eradication therapy, the plasma levels of vitamins and trace elements were not measured [Ford et al., 2010].

Conclusion:

The study found significant differences in zinc, iron, chromium, and lead levels between patients with H. pylori infection and healthy control individuals, despite no significant changes in serum Cu and Se status. Since illnesses have the potential to impact trace element nutritional absorption in those who are already at risk, it is indicated that any trace element discrepancy in these patients be considered a serious outcome. Future studies should compare blood and tissue Cu, Se, and other micronutrients to better understand the precise association between these variables and H. pylori outcomes.

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