Long-Term Use of Omeprazole: Effect on Haematological and Biochemical Parameters

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ABSTRACT

Background: *Long-term use of proton pump inhibitors (PPIs) is believed to have various potential adverse events. Omeprazole is a part of PPIs most commonly prescribed worldwide; it irreversibly binds to H+-K+ ATPase enzyme system in the gastric parietal cells to reduce secretion of H+ ions into the lumen of stomach. The main objective of the current work is to assess the adverse effects of omeprazole medication on certain haematological and biochemical parameters in patients who were on treatment for one year and more.* ***Methods:*** *We conducted a comparative cross-sectional study between October 2021 and March 2022. A total of 90 participants of both sexes were enrolled in this study, aged between 25-58 years. The participants were categorized into two groups: 40 patients on long-term omeprazole medication (40 mg) as a patients group and 50 healthy subjects as a healthy group who did not use omeprazole. Complete blood count and biochemical parameters were measured for both groups.* ***Results:*** *Patients of a group 1 had remarkable significant reductions in the number of red blood cells (RBCs) ($p<0.001$) and the indices. Omeprazole elevated the cholesterol level ($p<0.001$) and triglyceride ($p<0.001$) as well as low-density lipoprotein ($p<0.01$). However, no impact was found with high-density lipoprotein (HDL) ($p>0.05$). Alkaline phosphatase (ALKP) ($p<0.001$) and aspartate aminotransferase (ASAT) ($p<0.01$) levels were elevated in long-term patients treated with omeprazole. In contrast, no significant change was found in the level of alanine aminotransferase (ALAT) ($p>0.05$). Creatinine level ($p<0.001$) and nitrogen blood urea ($p<0.0001$) were significantly increased in patients group treated with omeprazole medication. The results also showed that group 1 had a high significant decline in serum ferritin ($p<0.0001$), vitamin D3 ($p<0.01$) and calcium levels ($p<0.001$) than that of healthy group.* ***Conclusion:*** *Prolonged use of omeprazole might result in adverse effect on hematological profile, particularly RBCs and their indices leading to develop anemia in patients on this medication. Furthermore, it might result in disturbances in biochemical profile, levels of minerals and vitamins as consequences of affected absorption.*

Keywords: *Omeprazole, blood count, hypocalcemia, vitamin D, kidney function, cholesterol, triglyceride.*

INTRODUCTION

Omeprazole is a member of substituted benzimidazoles class, that inhibits protons pump of the gastric parietal cells.[1] It inhibits gastric secretion by inhibiting the enzyme H+-K+ ATPase that is responsible for gastric acid production.[2] Omeprazole is used to manage and treat several conditions where the gastric acid inhibition can be very beneficial, including gastric ulcers, peptic ulcer, gastroesophageal reflux disease, erosive esophagitis, Zollinger-Ellison syndrome. It is superior to conventional therapies as well as it is used as over the counter drug in uncomplicated heartburn.[3] Side effects are rare when the drug is taken short-term. The probable common side effects include headaches, vomiting or diarrhea stomach upset, and constipation. While the serious side effects are very rare, they include liver problems, joints pain due to subacute cutaneous lupus erythematosus due to long term use and allergic reaction. Other signs of long-term use may include a decrease in the levels of magnesium in the blood after taking omeprazole for more than 3 months. Taking omeprazole for more than a year may increase the chances to develop other side effects such as bone fractures, gastrointestinal infections and vitamin B12 deficiency.[4] Furthermore, it has been found that long-term proton pump inhibitors (PPIs) treatment may affect haematological indices.[5] The change in gastric acidity may also affect the intestinal absorptive ability of microelement nutrients in a way that could result in iron deficiency and a decrease in the concentration of zinc, selenium and copper. Impact of proton pump inhibitors on these important trace elements may reduce their antioxidant activity in the body. However, a previous study has indicated the necessity for further studies about the role of PPI in reducing certain body parameters.

The common therapeutic uses of omeprazole for a wide spectrum of gastric-related health problems, being an over the counter treatment and the development of certain negative health indicators in the patients who were on long-term treatment, is the rationale for the objective of the current work, which is to elucidate the adverse influences of omeprazole medication on certain haematological and biochemical findings in patients who were on treatment for one year and more.

METHODS

Study Population and Plan of Work

A comparative cross-sectional study was conducted between October 2021 and March 2022 in Basrah city, Iraq. A total of 90 participants of both sexes aged between 25-58 years were involved in the study. They were categorized into two groups: 40 patients on long-term omeprazole medication (40 mg), as patients group 1 and 50 individuals as healthy group who were healthy and did not take any medications, including omeprazole.

Patients were received and interviewed in an outpatient clinic and selected according to certain criteria. The omeprazole duration medication was one year and more. The study design was reviewed and approved by the Ethics Committee of the Al-Zahraa College of Medicine, University of Basrah, Iraq. The aim of the research was explained for all participants before enrolling in the study and written consents were obtained. The work complied with the Declaration of Helsinki ethical principles. Initially required information of all participants were obtained using a questionnaire form.

Collection of Samples

5 ml of venous blood were drawn from each participant enrolled in this study, 2 ml of blood was collected in anticoagulated test tube with ethylenediaminetetraacetic acid (EDTA). The rest of blood sample was collected immediately in a gel plain tube in order to prepare serum for performing further tests. Haematological and biochemical profiles were performed in a private laboratory.

Clinical Biochemical Analyzes

Clinical biochemical tests were done including lipid profile, alkaline phosphatase (ALKP), alanine aminotransferase (ALAT), aspartate aminotransferase (ASAT), total bilirubin (TBIL), direct (DBIL) and indirect bilirubin (IDBIL) as well as urea and creatinine. Serum samples were analysed by fully automated chemistry analyser smart 150 (Gento TEK, USA).

Determination of Vitamin D3 Levels

Sera from total patients and healthy control subjects were investigated to measure levels of serum circulating 25-hydroxycholecalciferol(25[OH]D) using mini VIDAS (Biomerieux, France).

Quantitative Measurement of Ferritin

Ferritin level was estimated for all participants by an enzyme-linked immunosorbent serologic assay (ELISA) in accordance with instructions provided by the manufacturer (Pointe Scientific Inc, USA).

Serum Calcium Assay

The serum levels of total calcium were measured for both groups using high resolution inductively coupled plasma mass spectrometry ICP-MS (Element 2, Thermo Scientific, Germany). Normal range of serum calcium levels in adult is 8.5-10.5 mg/dL.

Complete Blood Count (CBC) Test

Haematological indices were measured using 2 ml anti-coagulated blood, including red blood cells (RBCs) count, haemoglobin (HGB) concentration (g/dL), mean cell volume (MCV), mean cell haemoglobin (MCH), mean cell haemoglobin concentration (MCHC), total count and differential count (neutrophils, monocytes and lymphocytes) of white blood cells, platelets (PLTs) count and mean platelet volume (MPV). Blood sample was immediately analysed after collection by Emerald Haematology System (Abbott, USA).

Statistical Analyzes

Collected data were inputted in an Excel spreadsheet for all participants. Then, differences between the two groups were assessed using an unpaired t-test. This comparison was carried out through GraphPad Software (Version 8, Software Inc, United States). P-values (<0.05) were used to indicate statistical significance. All values in the tables are presented as mean±SD.

RESULTS

Analysis of data to compare between the two groups of the study patients on long-term omeprazole and healthy group revealed several variations in haematological indices, despite no significant variation in mean age, gender percentage, body mass index (BMI) and healthy status as clarified in **Table 1**.

Statistical analyses have found no variations ($p>0.05$) in WBC count (7.86±2.67 vs. 8.96±2.79 $\times 10^9$/L), neutrophils % (57.04±12.84 vs. 52.53±13.61), monocytes % (9.11±1.76 vs. 8.83±2.34) and lymphocytes % (33.39±11.57 vs. 37.23±12.08) between patients group and healthy group, as illustrated in **Table 2**. On the other hand, significant reductions were seen in red blood cell count (4.15±0.76 vs. 4.55±0.92 ×1012/L; $p<0.001$); HGB concentration (10.13±1.95 vs. 12.38±1.72 g/dL, $p<0.001$); MCV (78.71±10.29 vs. 85.83±12.75 fl, $p<0.01$); MCH (24.39±2.80 vs. 27.32±2.48 pg, $p<0.001$); and MCHC (30.79±2.90 vs. 31.98±1.70 g/dL, $p<0.05$) in patients group compared to healthy

Table 1. General characteristics of the studied groups.

Parameters	Patients group (N = 40)	Healthy group (N = 50)	P-value
Females%	17 (42.5%)	22 (44%)	NS
Males%	23 (57.5%)	28 (56%)	
Age (years)	(26-58)	(25-55)	
(Mean ± SD)	42.05±9.57	40.75±8.03	NS
Weight (Kg)	88.14±2.07	85.71±2.03	NS
BMI (Kg/m^2)	31.25±5.91	29.62±6.55	NS
Comorbidities			
- Diabetes mellitus		N/A	
- Hypertension		N/A	
- Hyperlipidemia		N/A	
- Other diseases		N/A	

*Significance at level <0.05. NS: non-significant differences.

group. The t-test also did not show any significant changes (P>0.05) in platelets count and MPV values between patients group and healthy group (304.40±70.74 vs. 272.90±83.67 $\times 10^9$/L; 9.27±1.30 vs. 8.98±1.27 fl, respectively).

Regarding biochemical parameters, it has been found that the long-term use could exert a variation in certain parameters. In serum cholesterol levels, we found a significant elevation (p<0.001) in the levels of total cholesterol in patients group (225.45±23.48 mg/dL) in comparison to healthy group (182.69±39.15 mg/dL), alongside significant elevation (p<0.001) of triglyceride levels in patients group (215.46±35.98 mg/dL) compared to healthy group (158.81±48.16 mg/dL). Analysis of lipoprotein parameters such as direct low-density lipoprotein (DLDL) and very low-density lipoprotein (vLDL) showed significant increases (p<0.01) in patients group (152.60±34.82; 47.96±14.73 mg/dL), compared to healthy group (120.92±24.46; 33.20±8.62 mg/dL). However, there were no significant differences (p>0.05) between the two groups in high-density lipoprotein (HDL), as seen in **Table 3**.

Table 2. Comparison of haematological parameters between patients group and healthy group.

Parameters	Patients group (N = 40)	Healthy group (N = 50)	P-value
WBCs ($\times 10^9$/L)	7.86±2.67	8.96±2.79	NS
Neutrophils (%)	57.04±12.84	52.53±13.61	NS
Monocytes (%)	9.11±1.76	8.83±2.34	NS
Lymphocytes (%)	33.39±11.57	37.23±12.08	NS
RBCs ($\times 10^{12}$/L)	4.15±0.76	4.55±0.92	<0.001*
HGB (g/dL)	10.13±1.95	12.38±1.72	<0.001*
MCV (fl)	78.71±10.29	85.83±12.75	<0.01*
MCH (pg)	24.39±2.80	27.32±2.48	<0.001*
MCHC (g/dL)	30.79±2.90	31.98±1.70	<0.05*
PLTs ($\times 10^9$/L)	304.40±70.74	272.90±83.67	NS
MPV (fl)	9.27±1.30	8.98±1.27	NS

*Significance at level <0.05. Data are presented as mean±SD. NS: non-significant differences.

Table 3. Comparison of biochemical parameters between patients group and healthy group.

Parameters	Patients group (N = 40)	Healthy group (N = 50)	P-value
Cholesterol (mg/dL)	225.45±23.48	182.69±39.15	<0.001*
Triglyceride (mg/dL)	215.46±35.98	158.81±48.16	<0.001*
HDL (mg/dL)	46.10±14.73	50.57±19.05	NS
DLDL (mg/dL)	152.60±34.82	120.92±24.46	<0.01*
vLDL (mg/dL)	47.96±14.73	33.20±8.62	<0.01*
ALKP (U/L)	87.23±8.37	72.47±15.89	<0.001*
ALAT (U/L)	27.62±14.76	23.54±26.87	NS
ASAT (U/L)	23.32±4.74	14.73±6.29	<0.01*
Ferritin (mg/dL)	18.19±16.19	69.85±53.70	<0.0001*
Creatinine (mg/dL)	1.39±0.45	0.78±0.25	<0.001*
Urea (mg/dL)	45.75±14.22	26.27±14.77	<0.0001*
Vitamin D3 (ng/ml)	17.30±11.14	25.02±13.47	<0.01*
S. Calcium (mg/dL)	7.81±0.86	9.30±1.78	<0.001*
TBIL (mg/dL)	1.23±1.17	0.89±0.32	NS
DBIL (mg/dL)	0.35±1.00	0.26±0.83	NS
IDBIL (mg/dL)	0.47±0.23	0.45±1.62	NS

*Significance at level <0.05. Data are presented as mean±SD. HDL: high-density lipoprotein; DLDL: direct low-density lipoprotein; vLDL, very low-density lipoprotein; S. calcium: serum calcium; NS: non-significant differences.

Indicators of liver functions were also compared between the groups (**Table 3**). Significant increases in ALKP ($p<0.001$) and ASAT ($p<0.01$) levels were detected in patients group (87.23±8.37; 23.32±4.74 U/L) compared to healthy group (72.47±15.89, 14.73±6.29 U/L). Whereas, no significant change ($p>0.05$) in ALAT level (U/L) was found.

Renal function parameters were compared between patient and healthy groups. As shown in **Table 3**, creatinine level was significantly increased ($p<0.001$) in patients group (1.39±0.45 mg/dL) in comparison to healthy group (0.78±0.25 mg/dL). Likewise, significant differences ($p<0.0001$) were observed in levels of blood urea between patients group (45.75±14.22 mg/dL) and healthy group (26.27±14.77 mg/dL).

Moreover, patients group had significantly lower ($p<0.0001$) serum levels of ferritin (18.19±16.19 mg/dL) than healthy group (69.85±53.70 mg/dL). Serum calcium concentration in long-term patients group (7.81±0.86 mg/dL) was lower ($p<0.001$) than healthy group (9.30±1.78 mg/dL). Similarly, a significant decline in the levels of vitamin D3 ($p<0.01$) was found in patients group (17.30±11.14 ng/ml) compared to healthy group (25.02±13.47 ng/ml) as illustrated in **Table 3**.

No significant changes were noticed between the groups in the levels of TBIL, DBIL and IDBIL (1.23±1.17 vs. 0.89±0.32 mg/dL, $p>0.05$; 0.35±1.00 vs. 0.26±0.83 mg/dL, $p>0.05$; 0.47±0.23 vs. 0.45±1.62 mg/dL, $p>0.05$, respectively) (**Table 3**).

DISCUSSION

Over recent years, the focusing on the adverse effects of using PPI medications for long-term therapy has gained increasing concerns. Omeprazole is commonly used for treating multiple acid-dependent gastrointestinal disorders. The present study was planned to detect the adverse effects of prolonged use of omeprazole on haematological and biochemical parameters. The result of this study demonstrated that omeprazole might interfere with the blood profile in patients with long-term treatment.

In order to reveal if long term omeprazole use may exert an adverse effect on hematological indices or not, blood test was performed for 40 outpatients who were on omeprazole medication and visited a private clinic. We found that the means of RBCs and HGB in these patients as well as other RBC indices were significantly lower than those in healthy group. These findings are similar to what were reported by previous studies.[6,7]

A retrospective cohort study has examined the impact of PPIs use on haematological indices among individual patients who received PPI medications for over 1 year. The study revealed a significant reduction in values of haemoglobin, haematocrit and mean corpuscular volume and suggested that the chronic use of PPIs may cause iron mineral deficiency, long-term therapy may reduce absorption of non-heme iron.[8] Another study conducted in a group of patients using PPI medications for long-term period, Kaczmarczyk et al. showed that using of PPIs might cause a reduction in the number of RBCs and levels of HGB and some serum micronutrients. This suggested that prolonged use of PPIs might give rise to iron deficiency anemia.[7] Iron absorption usually occurs in the proximal small intestine, and this process is facilitated by gastric acid secretion which is necessary to convert the iron mineral from ferric state to ferrous state.[9] Two biological mechanisms have been put forward that chronic use of PPIs causes anemia. One of these mechanisms is the suppression of absorption of iron in the small intestine is due to inhibition of H+-K+ ATPase and increase the pH of stomach.[10] The another mechanism contributes in the development of anemia is the suppression of absorption of vitamin B12, food-bound vitamin B12 is liberated in the acidic medium and is bound to the glycoprotein haptocorrin for readily absorption in the ileum.[11] Proton pump inhibiters are powerful agents that inhibit production of gastric acid, a reduction in gastric acid production as a result of PPIs use may influence the absorption of minerals and vitamins in the gastrointestinal tract. A consequence of iron and vitamin B12 deficiency is anemia.[6] Means of MCV, MCH and MCHC were low in patients group in compare to healthy group. It is likely that these patients developed iron deficiency anemia because omeprazole may suppress secretion of gastric acid and thence

inhibit absorption of iron minerals.

Numbers of white blood cells in patients group were not significantly affected by chronic use of omeprazole medication in comparison to healthy group. Omeprazole medication demonstrated a non-significant reduction in the number of WBC. Although, this result differed from some published studies,[7,12] it was consistent with those of other studies.[13,14] We also found no statistical variation between the groups in the numbers of platelets. Our results did not show any reduction in the numbers of the platelets due to use of omeprazole. Literature data regarding the influence of PPIs on platelet numbers are conflicting. The present findings seem to be consistent with other researches which found no differences in the numbers of platelets between PPIs user and control group as well as having platelet counts which were within normal range in PPIs user.[7,13] On the other hand, only one case report has described the role of omeprazole medication in inducing thrombocytopenia.[15] A few number of studies over the past two decades have demonstrated thrombocytopenia with various types of PPIs therapy.[6,16,17]

Suppression of gastric acid secretion is linked with alterations in the digestion process of dietary lipids. It has been demonstrated that using omeprazole result in increased lipid absorption. Process of lipid absorption is associated with the underlying mechanism gastric acidity suppression resulting from using omeprazole, thereby increasing the lipolytic activities of gastric juices that lead to increased absorption of lipid in the small intestine.[18] Proton pump inhibitors might be involved in metabolism of cholesterol.[19,20] This fact may explain the findings of the current study, cholesterol level is significantly increased in patients with long-term use of omeprazole medication compared to healthy group, alongside significant elevation in triglyceride plasma level and LDL in patients group. These results are consistent with what were reported by other researches.[21-24]

Plasma concentration of minerals must be maintained within stable range, so that cellular metabolism processes can work properly. Our results showed that plasma concentration of calcium decreased in patients with long-term treatment of omeprazole. This finding is consistent with reduction in intestinal calcium absorption.[25-27] Acidic environment is necessary for absorption of intestinal calcium mineral, as this process is inhibited by omeprazole intake via blocking the gastric H+-K+ ATPase enzyme system that is located in the apical membrane of stomach parietal cells, which cause achlorhydia. Maintenance low gastric acid reduces lipolysis which is essential for calcium absorption in the gastrointestinal region and hence reduced absorption of calcium mineral in the gut causing hypocalcemia. Additionally, dietary protein increases the intestinal calcium solubility and absorption efficiency.[28,29] Hypocalcemia possibly mediates cardiovascular adverse events of omeprazole. It has been shown that hypocalcemia was observed in patients with long-term treatment of PPI.[30,31] It may cause life-threating arrhythmias and heart failure. Hypocalcemia is usually accompanied with hypomagnesemia and both these mineral abnormalities can give rise to cardiovascular instability.[32,33]

Measurement of liver function biomarkers revealed a marked raised in serum ASAT and ALKP levels in patients group compared to healthy group, with no significant changes in ALAT and bilirubin levels, visible in **Table 3**. Aminotransferases and alkaline phosphatase are enzymes that exist primarily in the hepatic parenchymal cell. Increased levels of these enzymes in the bloodstream are indicators of tissue damage of the liver.[34] A case study illustrated that liver clinical markers including serum level of ASAT, ALAT and γ-glutamyl transferase of old age patient suffering from gastroesophageal reflux disease receiving omeprazole (20 mg) and ranitidine were increased. However, levels of these enzymes were decreased and returned to normal values after cessation of omeprazole and replaced by herbal products as well as regulation of diet.[35] Recently, effect of PPIs treatment on possible complication and prognosis in liver cirrhosis patient without acute-on chronic liver failure has been investigated. Each of ASAT and ALAT significantly decreased in patients with liver cirrhosis in comparison to the group who did not receive PPIs. Also, there was no significant

change in bilirubin level between these two groups.[14] Although, there were significant changes in the levels of ASAT and ALKP between patients group and healthy group, these changes in the concentrations of these enzymes were within normal limits.

In the current study, significant elevations in serum creatinine and blood urea concentrations in patients group were observed in comparison to the healthy group. Similar findings were observed in previous researches as well. Deterioration of kidney function tests was demonstrated in users of PPIs compared to nonusers with marked elevation of serum creatinine and blood urea levels.[36,37] Decreased serum creatinine clearance is not associated with H2-receptor blockers and other PPI nonusers.[37] Despite of the results, these clinical markers are not optimal for detecting kidney diseases, as they are often used to find out whether patients have developed kidney diseases or not. Reduction of glomerular filtration rate leads to accumulation of nitrogen waste products in circulation, evidenced by abnormal increase in serum creatinine and blood urea levels.[38] The precise mechanisms between PPIs and adverse kidney outcomes are unclear.[37] Our results contradict those of Mélo and colleagues which found that level of serum creatinine did not change, while blood urea level was decreased in group treated with omeprazole compared with control group.[21] Omeprazole may be associated with development of kidney diseases by increasing levels of serum creatinine and blood urea.

We found a significant decline in vitamin D3 in patients group compared to the healthy group. Interestingly, this result is the first finding demonstrating the role of long term omeprazole use in causing vitamin D deficiency. It is well known that vitamin D plays a significant role in homeostasis of calcium through regulating calcium absorption from the gastrointestinal tract, therefore, it maintains serum level of calcium within normal range.[39] It has been found that vitamin D insufficiency could contribute to the development of secondary hyperparathyroidism, osteoporosis, and in elderly, reduced muscle strength. This category of people is more likely to be at risk of bone fracture due to reduced mineral density.[40] Although, the main mechanism underlying the relation between long-term use of PPIs and increased of bone fracture risk is still unclear, several studies have focused on two possible mechanisms. One of these mechanisms focuses on serum calcium homeostasis. Calcium ion is insoluble in an alkaline environment. Acidic pH is mandatory for dissolution of calcium salts to be absorbable in the small intestine.[41] Blockage of H+-K+ ATPase by PPIs renders the stomach parietal cells incapable to secrete gastric acid thereby increasing risk of bone fractures.[42] Moreover, hypergasterinemia induced by PPIs can give rise to hyperparathyroidism, and consequently, increased rate of bone resorption.[43,44] The other possible mechanism of clinical fracture induced by using PPIs focuses on the cells of the bone, particularly the osteoclasts.[45] PPIs directly affect metabolism of bone via inhibition of vacuolar H+-ATPase, specific proton pumps that are located on the cell membrane of osteoclasts.[46] These pumps are responsible to create acidic environment for bone resorption. Bone matrix resorption occurs at the convoluted ruffled border membrane of osteoclasts by lowering the pH.[47] It has been indicated by a previous clinical article about the necessity of calcium and vitamin D intake by elderly who were treated with long-term PPIs, especially with high-doses.[48]

We also found a significant reduction in the levels of serum ferritin in patients group treated with omeprazole medication in comparison to healthy group. This finding is matched with those observed in earlier studies. In an open label prospective study on 250 adult participants, administration of PPIs (omeprazole, esomeprazole, lansoprazole or pantoprazole) for one year resulted in significant reduction in iron body stores (levels of ferritin).[49] On the other hand, in an early study, it was reported that serum ferritin levels were decreased in 3 of 34 patients with esophageal reflux due to use of omeprazole medication continuously over a long-term period. The study suggests that ferritin shortage seldom occurs, even when using of PPIs for long-term period.[50] The results may indicate that decreased absorption of iron in the gastrointestinal tract is due to use omeprazole medication, therefore, it

may reduce levels of serum ferritin and storage of iron as ferritin in the body tissues. Low levels of serum ferritin may be clinically indicative of iron deficiency anemia.

Although the study has successfully demonstrated the impact of long-term use of omeprazole on blood parameters, it has certain limitations in terms of lack of information particularly the relation between PPIs use and vitamin D. Another limitation is the relatively small number of the enrolled patients. Additionally, levels of serum iron were not investigated, a biomarker of iron deficiency which might have also confirm the results of the current study beside measurement of serum ferritin levels.

CONCLUSION

In this study, the objective was to assess the effect of long term omeprazole medication on blood parameters. Omeprazole is very effective in controling gastric acid secretion. Accumulating data suggest that long-term use of omeprazole may lead to a reduction in the numbers of circulating RBCs and their indices, ultimately leading to anemia. We have demonstrated for the first time that long-term use of omeprazole causes vitamin D deficiency. Low level of vitamin D is due to inhibited production of gastric acid which is necessary for calcium mineral absorption, consequently resulting in hypocalcemia. Both hypocalcemia and hypomagnesemia may affect the cardiovascular system, therefore, levels of serum magnesium should also be measured to evaluate any abnormality in the serum mineral levels and their relation with cardiovascular health. Omeprazole may be associated with development of kidney functional disorders, therefore, physicians should be cautious when prescribing PPIs because of their adverse effects. A further study with higher number of enrolled patients could assess the various long-term adverse effects of omeprazole medication on the organ systems by performing comprehensive blood and biochemical tests.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest in this work.

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