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Boban, Marko; Peršić, Viktor; Petričević, Mate; Biočina, Bojan; Sipic, Tomislav; Pehar-Pejčnovic, Vesna; Balen, Sanja; Žulj, Marinko; Včev, Aleksandar

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ARTYKUŁ ORYGINALNY / *ORIGINAL ARTICLE*

Connections between nutritional status and proton pump inhibitor therapy in patients scheduled for cardiovascular rehabilitation after treatment for ischaemic and valvular heart disease

Marko Boban[1, 2], Viktor Persic[1, 2], Mate Petricevic[3], Bojan Biocina[3], Tomislav Sipic[4], Vesna Pehar-Pejcnovic[2], Sanja Balen[1, 2], Marinko Zulj[2], Aleksandar Vcev[2]

[1]Department of Cardiology, University Hospital "Thalassotherapia Opatija", Medical Faculty University of Rijeka, Croatia
[2]Department of Internal Medicine, University Hospital Osijek, Medical Faculty JJ Strossmayer University of Osijek, Croatia
[3]Department of Cardiovascular Surgery, University Hospital Centre "Zagreb", Medical Faculty University of Zagreb, Croatia
[4]Department of Cardiology, University Hospital "Magdalena", Medical Faculty JJ Strossmayer University of Osijek, Croatia

Abstract

Background: Multiple and yet uncertain connections exist between cardiovascular diseases and the nutritional status of patients, particularly in relation to cardiovascular treatments. Proton pump inhibitors (PPI) are among the most commonly used group of drugs.

Aim: To analyse utilisation of PPI in association with nutritional risk of patients scheduled for rehabilitation after treatment for ischaemic and valvular heart disease.

Methods: Retrospective analyses on a consecutive sample of patients, which included drug utilisation of PPI and nutritional risk screening, using a standardised NRS-2002 tool. The patients (n = 536) were divided into groups based on previous cardiovascular treatments and use of PPI.

Results: Nearly half of the patients (244, 46.1%) had PPI in their chronic therapy despite the clinically negligible prevalence of conditions that are their fundamental indications. The odds for using PPI in patients with increased nutritional risk, estimated by logistic regression, were 3.34 (95% confidence intervals [CI] 2.26–4.94), $p < 0.001$. Receiver operating curve analyses also revealed significant differences of PPI utilisation in connection with NRS-2002 > 3: positive likelihood-ratio (LR) 2.35 (95% CI 2.10–2.60); negative LR 0.46 (95% CI 0.4–0.6); area under the curve (AUC) 0.720; $p < 0.001$; as well as the percentage weigh loss history > 6.36% (positive LR 2.22 [95% CI 2.00–2.50]; negative LR 0.41 [95% CI 0.30–0.50]; AUC 0.707; $p < 0.001$).

Conclusions: Utilisation of PPI was found to be of relatively high prevalence and significantly associated with parameters of nutritional risk screening. Furthermore, it was in correlation with the age of patients and the existence of chronic kidney disease, which are well-established predispositions for poor nutritional status. Nutritional risk seems to be additionally negatively challenged by utilisation of PPI due to gastric malabsorption and anaemia.

Key words: nutritional status, nutritional risk, proton pump inhibitors (PPI), ischaemic heart disease, valvular heart disease

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INTRODUCTION

Poor nutritional status is connected with inappropriate nutritional intake, decreased absorption, increased metabolic demands during acute illness, or major invasive treatment, and is frequently found in hospitalised patients [1]. Even more important is the fact that increased nutritional risk is significantly correlated with clinical endpoints such as rate of hospitalisations, duration of hospital stay, prevalence of

Address for correspondence:
Prof. Marko Boban, University Hospital Thalassotherapia Opatija, Department of Cardiology, M. Tita 188/1, 51410 Opatija, Croatia, e-mail: marcoboban@yahoo.com
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hospital treatment complications or infections, decreased quality of life, as well as increased mortality [2, 3]. Conversely to the major global health burden of cardiovascular diseases, studies on the existence and clinical dynamics of nutritional risk are scarce.

Proton pump inhibitors (PPI) are dominantly used for the treatment of peptic ulcers and gastro-oesophageal reflux disease. Optimal treatment endurance should be active for a period of between two and eight weeks [4, 5]. Supplementary indications include short courses of treatments for prevention of stress ulcers in critically ill patients, as well as for primary and secondary prevention of gastrointestinal haemorrhage. Investigations concerning pleiotropic effects of PPIs reported mediation of secretion to the gastrin and insulin [6]. Over the counter and on demand use for alleged control of dyspeptic symptoms is probably the most common source of PPI overuse. Not surprisingly, PPIs are among the most commonly used drugs. Conversely to offered treatment benefits, prolonged courses of therapy with PPI are essentially burdened with several undesirable side-effects. The discontinuation of therapy occasionally causes transitory rebound in symptoms of dyspepsia [7]. Long-lasting PPI treatment is considered to increase risk for hip, wrist, and spine fractures, although there are no unanimously agreed pathophysiological mechanisms [8]. Treatment-induced acid suppression is connected with decreased absorption of iron and vitamin B, with consequent occurrence of anaemia [9, 10]. Meta-analyses on a large scale population reported on escalation of community-acquired pneumonia in a population treated with PPI [11]. The thought-provoking decrease of platelet functional response was observed in patients taking a combination of thienopyridine and PPIs [12]. Hypomagnesaemia, which could be found during prolonged courses of PPI therapy, might be responsible for predilection to arrhythmias, e.g. atrial tachycardias [13].

Aim of our study was to analyse drug utilisation and characteristics of PPI usage in connection with nutritional risk screening and its parameters in patients scheduled for rehabilitation after acute treatment for ischaemic heart disease, as well as a combination of ischaemic and valvular heart disease.

Ethical approval

The study was approved by the ethical committee of the University Hospital "Thalassotherapia Opatija". Patients were included upon signing informed consent. The study was performed in accordance with the Declaration of Helsinki and following good clinical practice guidelines. There were no financial compensations for patients or authors.

METHODS

This study included a sample of consecutive patients scheduled for stationary cardiovascular rehabilitation 0–6 months after treatment for ischaemic or valvular heart disease. Diagnostics covered standard demographics, transthoracic cardiovascular laboratory, 12-channel electrocardiography, and echocardiography exam. Medical records from previous cardiovascular treatments were available for all the patients included. Screening for nutritional risk was performed with the standardised questionnaire Nutritional Risk Screening NRS-2002, approved by the European Society for Clinical Nutrition and Metabolism (ESPEN) [14]. The typical range of NRS-2002 is between 0 and 7, and increased nutritional risk was earlier unanimously defined as NRS-2002 > 3 [14]. Patients with usual acute or chronic contraindications for cardiovascular rehabilitation were not included.

Drug utilisation analyses included prevalence of therapy with: PPI, angiotensin converting enzyme-inhibitor/angiotensinogen receptor blocker, beta-blocker, calcium antagonists, loop diuretic, acetylsalicylate/thienopyridine, statins, antidiabetics, and warfarin. Of other group of drugs, only the relative shares of specific PPIs were presented.

Anthropometrics

Waist and hip circumferences (WC, HC) and ratios were measured by tape measure and expressed in centimetres. Body weight was expressed in kilograms, height in metres, and body mass index (BMI) was calculated [kg/m^2]. The weight of patients at the time of previous hospitalisation for treatment of index cardiovascular cause was available for 85% of the studied population. Weight lost history (%WLH) was expressed as the percentage of lost kilograms from the index cardiovascular treatment.

Cardiovascular risk factors

Medical history included analyses of prevalence for: arterial hypertension, hypercholesterolaemia, chronic renal disease, known diabetes mellitus, glucose intolerance, smoking status, chronic obstructive pulmonary disease, any disturbance of psychological profile, atherosclerotic process and thrombosis, atrial fibrillation, past myocardial infarction, and left ventricular systolic dysfunction (cutoff point set at 50%).

Statistical analyses

The population and studied groups were analysed with descriptive statistics and presented as averages or medians combined with standard deviations and ranges. Analyses of group data were calculated with χ^2 tests, whilst data on numeric variables were tested for differences by Mann-Whitney U test or Kruskal-Wallis. Connections of PPI utilisation with NRS-2002 and other clinical outcomes was done by Spearman Rho. Receiver operating curve (ROC) analyses included percentage WLH and NRS-2002 score in connection with PPI utilisation. Binomial logistic regression models were applied for estimation of association between PPI use and increased nutritional risk (NRS > 3). Odds for PPI utilisation according to patients' comorbidities were calculated in a polynomial logistic

regression model. P < 0.05 was considered significant. Analyses were done by a statistician using Statistica 10 for Windows (StatSoft Inc., Tulsa, OK, USA), MedCalc 12.2 (MedCalc software, Mariakerke, Belgium) and IBM-SPSS12 v 20 (IBM, Chicago, IL, USA).

RESULTS

Patients

The study sample included 536 consecutive patients scheduled for cardiovascular rehabilitation, as presented in Table 1.

Studied cardiovascular aetiologies were as follows: ischaemic heart disease in 449 (83.8%) and combined (ischaemic and valvular) in 87 (16.2%). The treatment part included 46 (8.6%) conservatively treated myocardial infarctions, 223 (41.6%) percutaneous coronary interventions (PCI), and 267 (49.8%) surgical treatments, of which 88 (16.4%) were combined surgical treatments (coronary artery bypass graft and valvular surgery). Analyses of patients' characteristics and clinical diagnostics through the groups of PPI utilisation and type of heart disease are presented in Table 2.

There were no records of clinically overt acute gastrointestinal haemorrhage in the studied population for the period after acute cardiovascular treatment. Peptic ulcer disease between the postoperative period and rehabilitation was documented by endoscopy in six (1.1%) patients. Endoscopy verified Forrest II–III grades, and there was not a single case of Forrest 1.a bleeding. There were no tests applied for establishing diagnose of *Helicobacter pylori* infection in the studied period.

Nutritional Risk Screening

Mean NRS-2002 in the studied population was 3.3 ± 1.6 (range 0.0–6.0). The percentage WLH from indication cardiovascular treatment was 7.1 ± 4.8% (range 0.0–26.1%). The latter was also significantly different in connection with the type of previous treatments; 4.1 ± 4.1% vs. 3.6 ± 2.5% vs. 10.6 ± 3.6% (p < 0.001), for conservative vs. PCI vs. surgical treatments, respectively. NRS-2002 correlated significantly with the age of patients (Spearman Rho correlation coefficient [Rho-CC] = 0.372; p < 0.001) and creatinine (Rho-CC = 0.307; p < 0.001); very weakly with BMI (Rho-CC = –0.094; p = 0.030); and non-significantly with left ventricular ejection fraction (LVEF) (Rho-CC = –0.062; p = 0.155). Percentage WLH showed similar trends in correlations; age (Rho-CC = 0.267; p < 0.001); creatinine (Rho-CC = 0.207; p < 0.001); BMI (Rho-CC = –0.221; p = 0.030); and non-significantly with LVEF (Rho-CC = –0.021; p = 0.637). NRS-2002 was significantly different in accordance with previous cardiovascular treatments with 2.1 ± 1.3 vs. 2.1 ± 1.1 vs. 4.4 ± 1.1 (p = 0.001), respectively, for conservative vs. PCI vs. surgical. Percentage WLH outcomes were also congruent with NRS-2002 dynamics, as follows: 4.1 ± 4.1% vs. 3.6 ± 2.5 vs. 10.7 ± 3.6% (p < 0.001), respectively.

Table 1. Characteristics of studied patients sample (n = 536)

Parameters	Mean ± SD	Range
Age [years]	62.6 ± 10.8	23.4–85.9
Height [m]	1.71 ± 0.10	1.45–1.98
Weight [kg]	83.3 ± 14.8	44.4–135.2
Body mass index [kg/m^2]	28.5 ± 4.0	18.2–45.9
Waist circumference [cm]	101.2 ± 10.2	68.0–134.0
Hip circumference [cm]	105.2 ± 41.0	1.0–1020.0
WHR	1.08 ± 1.69	0.66–31.80
Percentage weight loss history	7.1 ± 4.8	0.0–26.1
NRS-2002	3.27 ± 1.55	0–7
Cardiovascular risk factors	5.1 ± 1.6	0–9
Erythrocyte count [×10^{12}]	4.46 ± 0.59	2.40–6.02
Haematocrit	0.40 ± 0.05	0.27–0.52
Glucose [mmol/L]	6.7 ± 1.8	4.6–16.4
Urea [μmol/L]	7.14 ± 2.61	1.70–20.30
Creatinine [μmol/L]	104.6 ± 38.5	49.0–403.0
Uric acid [mmol/L]	337.3 ± 99.2	83.0–818.0
Triglycerides [mmol/L]	1.67 ± 3.86	0.42–89.00
Cholesterol [mmol/L]	4.36 ± 1.81	1.14–36.00
HDL-C [mmol/L]	1.00 ± 0.44	0.10–3.30
LDL-C [mmol/L]	2.27 ± 1.00	0.23–8.66
LVEF [%]	49.1 ± 8.1	20–65
Parameters	**N**	**%**
Male	390	72.8
Female	146	27.2
Chronic renal disease	83	15.5
Diabetes	150	28.0
Obesity	175	32.7
Glucose intolerance	68	12.7
Non smoker	194	36.2
Active smoker/recent quitter	165	30.8
Former smoker	177	33.0
COPD	125	23.3
Non-fatal MI	390	72.8
Known atherothrombotic disorder*	140	26.1

*History of peripheral artery disease, carotid disease, cerebrovascular stroke, or thromboembolism; SD — standard deviation; WHR — waist-to-hip ratio; NRS-2002 — Nutritional Risk Screening; HDL-C — high-density lipoprotein cholesterol; LDL-C — low-density lipoprotein cholesterol; LVEF — left ventricular ejection fraction; CPOD — chronic obstructive pulmonary disease; MI — myocardial infarction

PPI therapy

Nearly half of the patients, 244 (45.5%), consumed the PPI in their chronic therapy. Utilisation of PPI significantly increased the total number of drugs consumed; 6.2 ± 1.8 vs. 5.8 ± 1.7 (p = 0.030). Relative shares of specific representatives are shown in Figure 1.

Table 2. Characteristics of the studied groups

	Drug utilisation groups		Mann Whitney U
	Not using PPI N = 292 (54.5%)	Using PPI N = 244 (45.5%)	
Age [years]	60.5 ± 11.4	65.2 ± 9.5	**< 0.001**
Height [m]	1.72 ± 0.09	1.69 ± 0.10	**< 0.001**
Weight [kg]	86.1 ± 14.9	80.1 ± 13.9	**< 0.001**
Body mass index [kg/m^2]	28.9 ± 4.1	27.9 ± 3.7	**0.002**
Waist circumference [cm]	102.0 ± 10.4	100.3 ± 9.9	**0.038**
Hip circumference [cm]	104.5 ± 8.0	102.9 ± 7.8	**0.020**
Waist to hip ratio	1.06 ± 1.41	0.97 ± 0.08	0.594
Percentage weight loss history	5.6 ± 4.2	8.9 ± 4.8	**< 0.001**
NRS-2002	2.7 ± 1.4	3.9 ± 1.5	**< 0.001**
Cardiovascular risk factors	5.2 ± 1.6	5.1 ± 1.7	0.646
Erythrocytes count [$\times 10^{12}$]	4.7 ± 0.5	4.2 ± 0.6	**< 0.001**
Haematocrit	0.42 ± 0.04	0.38 ± 0.05	**< 0.001**
Mean corpuscular volume [fL]	88.2 ± 10.8	89.7 ± 4.9	0.181
Leukocytes [$\times 10^{12}$]	7.6 ± 2.0	8.3 ± 2.5	**< 0.001**
Platelets [$\times 10^{9}$]	267.2 ± 83.6	344.0 ± 146.3	**< 0.001**
Glucose [mmol/L]	6.6 ± 1.8	6.8 ± 1.8	**0.013**
Urea [μmol/L]	7.06 ± 2.71	7.22 ± 2.51	0.125
Creatinine [μmol/L]	102.9 ± 40.3	106.6 ± 36.3	**0.017**
CGCC [mL/min]	85.6 ± 30.9	68.2 ± 26.2	**< 0.001**
Uric acid [mmol/L]	341.4 ± 94.0	332.6 ± 104.9	0.199
Triglycerides [mmol/L]	1.47 ± 0.75	1.90 ± 5.64	0.057
Cholesterol [mmol/L]	4.27 ± 2.16	4.47 ± 1.27	**0.006**
HDL-cholesterol [mmol/L]	1.04 ± 0.46	0.95 ± 0.41	**0.038**
LDL-cholesterol [mmol/L]	2.15 ± 0.94	2.42 ± 1.05	**0.002**
Left ventricular ejection fraction [%]	48.8 ± 8.3	49.3 ± 7.9	0.538
Total number of drugs	5.8 ± 1.7	6.2 ± 1.8	**0.030**

Data presented as mean with standard deviations. Statistically significant values presented in bold. PPI — proton pump inhibitors; NRS-2002 — Nutritional Risk Screening; CGCC — Cockcroft-Gault formula estimated creatinine clearance; HDL — high-density lipoprotein; LDL — low-density lipoprotein

Use of PPIs showed significant differences with the studied group of treatments; the highest prevalence was found in patients treated by surgery 178 (72.1%), whilst PCI treatments and conservatively treated myocardial infarctions represented only a minor share ($p < 0.001$). The lowest level of not consuming the PPI were found in the group of PCI treatments 177 (61.2%). Odds for PPI usage depending of the treatment applied were calculated using a polynomial logistic regression model; PCI = 0.63 (0.08–4.94); conservative = 2.21 (0.28–7.60); surgery = 4.74 (0.59–38.12); $p < 0.001$.

There was no statistical difference between PPI users vs. controls for: gender, prevalence of arterial hypertension, dyslipidaemia, chronic kidney disease, diabetes, glucose intolerance, peripheral artery disease, and atrial fibrillation (all $p > 0.05$). Complete analyses of patients' characteristics and pharmaceutical treatments for the studied groups are shown in Table 3.

PPI utilisation showed significant correlation with the age of patients (Rho = 0.198; $p < 0.001$), WC (Rho = –0.090; $p = 0.037$), HC (Rho = –0.101; $p = 0.019$), BMI (Rho = –0.137; $p = 0.002$), weight (Rho = 0.206; $p < 0.001$), percentage unintentional WLH (Rho = 0.338; $p < 0.001$), NRS-2002 (Rho = 0.386; $p < 0.001$), creatinine (Rho = 0.103; $p = 0.017$), estimated creatinine clearance (Rho = –0.295; $p < 0.001$), total cholesterol (Rho = 0.120; $p = 0.006$), high density lipoprotein (Rho = –0.090; $p = 0.038$); gamma glutamic transpeptidase (Rho = 0.135; $p = 0.002$), and thyroid-stimulating hormone (Rho = 0.096; $p = 0.029$). There was no correlation with LVEF ($p > 0.05$). Odds for PPI utilisation according to patients' comorbidities were significant in polynomial logistic regression model: diabetes mellitus 1.02 (0.68–1.52), chronic obstructive pulmonary disease 1.15 (0.75–1.74), chronic kidney disease 1.16 (0.71–1.91), dyslipidaemia 1.51

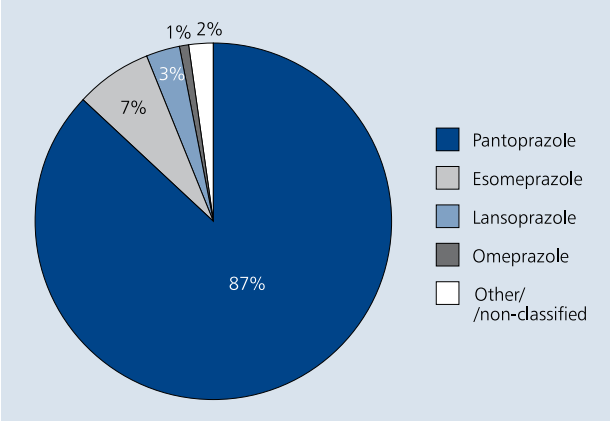

Figure 1. Structure of prescription for representatives of proton pump inhibitor (PPI) group (n = 244). Utilisation of different PPIs: pantoprazole 213 (87.3%); esomeprazole 18 (7.4%); lansoprazole 7 (2.9%); omeprazole 2 (0.8%); other/non-classified 4 (1.6%). Data presented for number of patients (percentages)

(0.59–3.92), atrial fibrillation 1.65 (0.96–2.84), and increased nutritional risk (NRS-2002 ≥ 3) 3.10 (2.07–4.63); $p < 0.001$. Odds for using PPI in patients with increased nutritional risk, estimated by binomial logistic regression, were 3.34 (95% CI 2.26–4.94); $p < 0.001$. ROC analyses also revealed significant differences of PPI utilisation in connection with NRS-2002 > 3 (positive likelihood-ratio [LR] = 2.35, 95% CI 2.10–2.60; negative LR = 0.46, 95% CI 0.4–0.6; $p < 0.001$; area under the curve [AUC] 0.720); as well as the percentage WLH > 6.36% (positive LR = 2.22, 95% CI 2.00–2.50; negative LR = 0.41, 95% CI 0.30–0.50; $p < 0.001$; AUC 0.707).

Significant correlations were found with complete blood count analyses; erythrocytes counts (Rho = –0.365; $p < 0.001$), haematocrit (Rho = –0.407, $p < 0.001$), leukocyte counts (Rho = 0.156; $p < 0.001$), and platelets counts (Rho = 0.295; $p < 0.001$), whilst there was no significance for mean corpuscular volume (Rho = 0.058; $p = 0.180$). Critical value of haematocrit ≤ 0.38 was found to be a clinically significant discriminative predictor for PPI prescription using ROC analyses; sensitivity = 59.4 (95% CI 52.9–65.5); specificity = 80.0 (95% CI 74.8–84.4); positive LR = 2.96 (2.60–3.30); negative LR = 0.51 (0.40–0.70); AUC = 0.735 (0.696–0.772); $p < 0.001$. Subanalyses of complete blood count in relation to PPI utilisation for the studied groups of cardiovascular treatments are shown in Table 4.

DISCUSSION

The current study for the first time analysed the connections of nutritional status and PPI utilisation in patients recovering from acute cardiovascular treatment due to ischaemic or combined (ischaemic and valvular) heart disease. The dominant part of studied patients was in the sub-chronic clinically stabile phase after interventional or non-interventional treatment.

The combined prevalence of active gastroenterological indications was at a relatively low level. Nevertheless, 244 of 536 patients had a PPI in chronic pharmacotherapy [15]. Even more interesting was the fact that consumption was in positive correlation with age of patients, despite the potentially less favourable side-effects profile in older patients [16]. PCI were liaised with the least consumption of PPI, in comparison with conservative treatments or surgery, respectively [17]. The existence of chronic renal disease increased utilisation of PPIs in the studied group of patients, which was in line with positive correlation of creatinine concentrations with drug consumption [18].

Attention-grabbing connections of PPI utilisation were found with anthropometrics and nutritional status of patients. Most of the patients using PPI weighed less in comparison with the group that did not use the drug. Furthermore, patients on PPI had a greater extent of unwillingness to lose weight after cardiovascular treatment and more pronounced nutritional risk [19]. Nutritional risk analysis by NRS-2002 was different on basis of cardiovascular treatments as well. Surgical treatments were liaised with significant increase in nutritional risk, while PCI and conservative treatment were of close output range and lesser extent. NRS showed overall significant difference, as well as significant differences of unintentional loss of weight among studied treatments. Renal function and the age of patient increased the outputs of NRS, as well as the increased PPI consumption patterns [20]. Associations of PPI utilisation with anthropometrics and increased nutritional risk seem to represent clinically underscored primary prevention of mucosal lesions and gastrointestinal haemorrhage [21]. Although a high proportion of patients used acetylsalicylates, the PPI utilisation profile was divergent to the consumption of nonsteroidal anti-inflammatory drugs (NSAIDs) and influenced more by the particular cardiovascular treatment. The least consumption of PPI was found in the group of patients treated with PCI and mandatorily related to acetylsalicylates therapy. Conversely, increased utilisation was found with surgical patients. In both ways, the combined "gastro-angio-cardio" protection approach using acetylsalicylic acid and PPI might even alter for the worse NSAID-induced enteropathy and dysbiosis [22].

The combined effects of PPIs on the haematopoietic system were found as well, bearing in mind the fact that there was no history of recent bleeding in the studied group of patients. Analysis of PPI use revealed a decrease in erythrocyte counts and haematocrit, while the mean corpuscular volume of erythrocyte was unchanged. Later was in line with earlier observations about PPI-mediated changes in metabolism of vitamin B and gastric absorption of iron [23]. Both aetiologies might be even more pronounced in patients with increased nutritional risk or in patients of advanced age [23].

Table 3. Patients' characteristics according to studied groups of treatments and proton pump inhibitor (PPI) therapy

		Drug utilisation groups		χ^2
		Not using PPI	Using PPI	
Age group	< 44	22 (7.6%)	3 (1.2%)	
	45–64	165 (57.1%)	117 (47.4%)	**< 0.001**
	> 65	102 (35.3%)	127 (51.4%)	
Obesity	BMI < 30 kg/m^2	182 (63.0%)	178 (72.4%)	**0.021**
	BMI ≥ 30 kg/m^2	107 (37.0%)	68 (27.6%)	
Any psychological disturbance	No	161 (55.7%)	116 (47.0%)	**0.043**
	Yes	128 (44.3%)	131 (53.0%)	
Coronary artery disease	No	34 (11.8%)	51 (20.6%)	**0.005**
	Yes	255 (88.2%)	196 (79.4%)	
Nonfatal MI	No	50 (17.3%)	96 (38.9%)	**< 0.001**
	Yes	239 (82.7%)	151 (61.1%)	
Disease	Ischemic	254 (87.9%)	195(78.9%)	**0.005**
	Combined	35 (12.1%)	52 (21.1%)	
Treatments	Conservative	23 (8.0%)	23 (9.3%)	
	PCI	177 (61.2%)	46 (18.6%)	**< 0.001**
	Surgery	89 (30.8%)	178 (72.1%)	
NRS-2002 ≥ 3	No	129 (44.6%)	48 (19.4%)	**< 0.001**
	Yes	160 (55.4%)	199 (80.6%)	
Acetylsalicylic acid	No	34 (11.8%)	32 (13.0%)	0.676
	Yes	255 (88.2%)	215 (87.0%)	
Warfarin	No	244 (84.4%)	186 (75.3%)	**0.008**
	Yes	45 (15.6%)	61 (24.7%)	
ACE inhibitor	No	67 (23.2%)	108 (43.7%)	**< 0.001**
	Yes	222 (76.8%)	139 (56.3%)	
Beta-blocker	No	26 (9.0%)	33 (13.4%)	0.108
	Yes	263 (91.0%)	214 (86.6%)	
Calcium channel blockers	No	222 (76.8%)	197 (79.8%)	0.411
	Yes	67 (23.2%)	50 (20.2%)	
Diuretic	No	226 (78.2%)	150 (60.7%)	**< 0.001**
	Yes	63 (21.8%)	97 (39.3%)	
Statin	No	46 (15.9%)	101 (40.9%)	**< 0.001**
	Yes	243 (84.1%)	146 (59.1%)	

Statistically significant values presented in bold. BMI — body mass index; MI — myocardial infarction; PCI — percutaneous coronary intervention; NRS-2002 — Nutritional Risk Screening; ACE — angiotensin-converting-enzyme

Table 4. Relationship of proton pump inhibitor (PPI) use with the complete blood count for studied groups of treatments. Data presented as mean with standard deviation.

	Conservative		Percutaneous coronary intervention		Surgery	
	Not using PPI	Using PPI	Not using PPI	Using PPI	Not using PPI	Using PPI
Erythrocytes [$\times 10^{12}$]	4.6 ± 0.5	4.6 ± 0.5	4.7 ± 0.4	4.5 ± 0.6	4.6 ± 0.6	4.1 ± 0.6
Haematocrit	0.42 ± 0.04	0.41 ± 0.04	0.42 ± 0.04	0.40 ± 0.04	0.41 ± 0.05	0.36 ± 0.04
Mean corpuscular volume [fL]	90.9 ± 5.5	89.3 ± 4.5	88.1 ± 11.5	89.9 ± 5.1	87.7 ± 10.4	89.7 ± 4.9
Leukocytes [$\times 10^{12}$]	8.12 ± 2.41	8.08 ± 2.28	7.67 ± 1.99	8.13 ± 2.08	7.26 ± 1.78	8.44 ± 2.57
Platelets [$\times 10^{9}$]	269.2 ± 80.8	272.3 ± 91.1	258.2 ± 69.4	286.4 ± 89.1	284.6 ± 105.7	368.3 ± 156.8

Quantitative analyses revealed statistically significant increase in platelet counts in patients using PPIs. However, the effect was, in subgroup analyses, found to be more powerfully connected with cardiovascular treatments. Less invasive treatments were related with no change, or minimal increase in platelets counts, conversely to the significant increase seen after surgical treatments. The latter might, in part, explain the confounding results of earlier studies of interactions with clopidogrel [24].

Interestingly, the operated patients exhibited the least number of pharmaceuticals in chronic therapy, despite the fact that they had an equal background of ischaemic heart disease. Relative share of PPI in the total quantity of pharmacotherapy in the postoperative group was higher and even on the expense of statin treatment underutilisation. The differences in cholesterol concentrations observed between groups according to PPI therapy correspond more with consumption of antilipemics, which was differently distributed within the studied groups of cardiovascular treatments. A significantly increased utilisation of PPI was found in patients who were taking warfarin as well. Consumption of warfarin was higher in the group of surgical treatments, mostly due to the proportion of patients with combined ischaemic and valvular disease. There were no significant relations between PPI utilisation and acetylsalicylic acid or thienopyridine in our patients.

CONCLUSIONS

In conclusion, utilisation of PPI was significantly associated with parameters of nutritional risk screening. Furthermore, it was in correlation with the age of patients and the existence of chronic kidney disease, which are known predispositions for nutritional risk. Nutritional risk might be additionally negatively challenged by utilisation of PPI due to the side-effects profile, including gastric malabsorption and anaemia.

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References

1. Milaneschi Y, Tanaka T, Ferrucci L. Nutritional determinants of mobility. Curr Opin Clin Nutr Metab Care, 2010; 13: 625–629. doi: 10.1097/MCO.0b013e32833e337d.
2. Correia MI, Waitzberg DL. The impact of malnutrition on morbidity, mortality, length of hospital stay and costs evaluated through a multivariate model analysis. Clin Nutr, 2003; 22: 235–239. doi: 10.1016/S0261-5614(02)00215-7.
3. Wedick NM, Barrett-Connor E, Knoke JD et al. The relationship between weight loss and all-cause mortality in older men and women with and without diabetes mellitus: The rancho bernardo study. J Am Geriatr Soc, 2002; 50: 1810–1815. doi: 10.1046/j.1532–5415.2002.50509.x.
4. Niimi K, Fujishiro M, Goto O et al. Prospective single-arm trial of two-week rabeprazole treatment for ulcer healing after gastric endoscopic submucosal dissection. Dig Endosc, 2012; 24: 110–116. doi: 10.1111/j.1443-1661.2011.01178.x.
5. Heading RC, Monnikes H, Tholen A, et al. Prediction of response to ppi therapy and factors influencing treatment outcome in patients with gord: a prospective pragmatic trial using pantoprazole. BMC Gastroenterol, 2011; 11: 52. doi: 10.1186/1471-230X-11-52.
6. Singh PK, Hota D, Dutta P et al. Pantoprazole improves glycemic control in type 2 diabetes: A randomized, double-blind, placebo-controlled trial. J Clin Endocrinol Metab, 2012; 97: E2105–E2108. doi: 10.1210/jc.2012-1720.
7. Niklasson A, Lindstrom L, Simren M et al. Dyspeptic symptom development after discontinuation of a proton pump inhibitor: a double-blind placebo-controlled trial. Am J Gastroenterol, 2010; 105: 1531–1537. doi: 10.1038/ajg.2010.81.
8. Yang YX, Lewis JD, Epstein S et al. Long-term proton pump inhibitor therapy and risk of hip fracture. JAMA, 2006; 296: 2947–2953. doi: 10.1001/jama.296.24.2947.
9. McColl KE. Effect of proton pump inhibitors on vitamins and iron. Am J Gastroenterol, 2009; 104 (suppl. 2): S5–S9. doi: ajg200945 [pii] 10.1038/ajg.2009.45.
10. Sarzynski E, Puttarajappa C, Xie Y, Metz DC. Association between proton pump inhibitor use and anemia: A retrospective cohort study. Dig Dis Sci, 2011; 56: 2349–2353. doi: 10.1007/s10620-011-1589-y.
11. Laheij RJ, Sturkenboom MC, Hassing RJ et al. Risk of community-acquired pneumonia and use of gastric acid-suppressive drugs. JAMA, 2004; 292: 1955–1960. doi: 10.1001/jama.292.16.1955.
12. Focks JJ, Brouwer MA, van Oijen MG et al. Concomitant use of clopidogrel and proton pump inhibitors: Impact on platelet function and clinical outcome: a systematic review. Heart, 2013; 99: 520–527. doi: 10.1136/heartjnl-2012-302371.
13. Hess MW, Hoenderop JG, Bindels RJ et al. Systematic review: Hypomagnesaemia induced by proton pump inhibition. Aliment Pharmacol Ther, 2012; 36: 405–413. doi: 10.1111/j.1365-2036.2012.05201.x.
14. Kondrup J, Rasmussen HH, Hamberg O et al. Nutritional risk screening (nrs 2002): a new method based on an analysis of controlled clinical trials. Clin Nutr, 2003; 22: 321–336. doi: 10.1016/S0261-5614(02)00214-5.
15. Moayyedi P, Leontiadis GI. The risks of ppi therapy. Nat Rev Gastroenterol Hepatol, 2012; 9: 132–139. doi: 10.1038/nrgastro.2011.272.
16. Desilets AR, Asal NJ, Dunican KC. Considerations for the use of proton-pump inhibitors in older adults. Consult Pharm, 2012; 27: 114–120. doi: 10.4140/TCP.n.2012.114.
17. Quenot JP, Thiery N, Barbar S. When should stress ulcer prophylaxis be used in the icu? Curr Opin Crit Care, 2009; 15: 139–143. doi: 10.1097/MCC.0b013e32832978e0.
18. Brewster UC, Perazella MA. Proton pump inhibitors and the kidney: critical review. Clin Nephrol, 2007; 68: 65–72. doi: 10.5414/CNP68065.
19. Ali T, Roberts DN, Tierney WM. Long-term safety concerns with proton pump inhibitors. Am J Med, 2009; 122: 896–903. doi: 10.1016/j.amjmed.2009.04.014.
20. Singh H, Houy TL, Singh N et al. Gastrointestinal prophylaxis in critically ill patients. Crit Care Nurs Q, 2008; 31: 291–301. doi: 10.1097/01.CNQ.0000336814.04548.ec.
21. Struijk M, Postma DF, van Tuyl SA et al. Optimal drug therapy after aspirin-induced upper gastrointestinal bleeding. Eur J Intern Med, 2012; 23: 227–230. doi: 10.1016/j.ejim.2011.10.004.
22. Wallace JL, Syer S, Denou E et al. Proton pump inhibitors exacerbate nsaid-induced small intestinal injury by inducing dysbiosis. Gastroenterology, 2011; 141: 1314–1322, e1311–e1315. doi: 10.1053/j.gastro.2011.06.075.
23. Howden CW. Vitamin b12 levels during prolonged treatment with proton pump inhibitors. J Clin Gastroenterol, 2000; 30: 29–33.
24. Bhurke SM, Martin BC, Li C et al. Effect of the clopidogrel-proton pump inhibitor drug interaction on adverse cardiovascular events in patients with acute coronary syndrome. Pharmacotherapy, 2012;32: 809–818. doi: 10.1002/j.1875-9114.2012.01112.x.

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Związek między stanem odżywienia a stosowaniem inhibitorów pompy protonowej u pacjentów poddawanych rehabilitacji kardiologicznej po leczeniu niedokrwiennej i zastawkowej choroby serca

Marko Boban[1, 2], Viktor Persic[1, 2], Mate Petricevic[3], Bojan Biocina[3], Tomislav Sipic[4], Vesna Pehar-Pejcnovic[2], Sanja Balen[1, 2], Marinko Zulj[2], Aleksandar Vcev[2]

[1]Department of Cardiology, University Hospital "Thalassotherapia Opatija", Medical Faculty University of Rijeka, Chorwacja
[2]Department of Internal Medicine, University Hospital Osijek, Medical Faculty JJ Strossmayer University of Osijek, Chorwacja
[3]Department of Cardiovascular Surgery, University Hospital Centre "Zagreb", Medical Faculty University of Zagreb, Chorwacja
[4]Department of Cardiology, University Hospital "Magdalena", Medical Faculty JJ Strossmayer University of Osijek, Chorwacja

Streszczenie

Wstęp: Istnieją liczne i nieustalone w pełni powiązania między chorobami sercowo-naczyniowymi a stanem odżywienia chorych, zwłaszcza w przypadku stosowania leków działających na układ sercowo-naczyniowy. Do grupy najczęściej wykorzystywanych preparatów należą inhibitory pompy protonowej (PPI).

Cel: Celem badania było przeanalizowanie zależności między stosowaniem PPI a ryzykiem związanym ze stanem odżywienia pacjentów poddawanych rehabilitacji kardiologicznej po leczeniu choroby niedokrwiennej i zastawkowej serca.

Metody: Przeprowadzono retrospektywną analizę kolejnych prób chorych obejmującą stosowanie PPI i badanie przesiewowe w kierunku ryzyka związanego ze stanem odżywienia, wykorzystując wystandaryzowane narzędzie NRS-2002. Pacjentów (n = 536) podzielono na grupy w zależności od wcześniejszego leczenia chorób sercowo-naczyniowych i stosowania PPI.

Wyniki: Prawie połowa chorych (244 osoby, 46,1%) przyjmowała PPI w ramach długookresowej terapii, mimo że zaburzenia stanowiące podstawowe wskazania do ich stosowania występowały u niewielkiego (nieistotnego klinicznie) odsetka badanych. Prawdopodobieństwo stosowania PPI u chorych obciążonych zwiększonym ryzykiem związanym ze stanem odżywienia oszacowane metodą regresji logistycznej wynosiło 3,34 (95% przedział ufności [CI] 2,26–4,94), $p < 0,001$. Analiza krzywej ROC również wykazała istotną różnicę w stosowaniu PPI w związku z NRS-2002 > 3: iloraz prawdopodobieństwa (LR) otrzymania wyniku dodatniego: 2,35 (95% CI 2,10–2,60); LR otrzymania wyniku ujemnego: 0,46 (95% CI 0,4–0,6); pole pod krzywą (AUC): 0,720; $p < 0,001$; oraz procentowa utrata masy ciała > 6,36% (LR wyniku dodatniego: 2,22 [95% CI 2,00–2,50]; LR wyniku ujemnego: 0,41 [95% CI 0,30–0,50]; AUC: 0,707; $p < 0,001$.

Wnioski: Stwierdzono, że leki z grupy PPI były wykorzystywane stosunkowo często. Terapia tymi preparatami wiązała się istotnie z parametrami oceny ryzyka związanego ze stanem odżywienia, a także korelowała z wiekiem pacjentów i obecnością przewlekłej choroby nerek, będących uznanymi czynnikami predysponującymi do złego stanu odżywienia. Wydaje się, że stosowanie PPI dodatkowo zwiększa ryzyko związane ze stanem odżywienia ze względu na zmniejszenie wchłaniania w żołądku i niedokrwistość.

Słowa kluczowe: stan odżywienia, ryzyko związane ze stanem odżywienia, inhibitory pompy protonowej (PPI), choroba niedokrwienna serca, choroba zastawkowa serca

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Adres do korespondencji:
Prof. Marko Boban, University Hospital Thalassotherapia Opatija, Department of Cardiology, M. Tita 188/1, 51410 Opatija, Croatia, e-mail: marcoboban@yahoo.com
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