

Simple platelet markers: Mean platelet volume and congestive heart failure coexistent with periodontal disease. Pilot studies

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Abstract

Background: Conducted pilot study concerning mean platelet volume (MPV) parameter among patients suffering from congestive heart failure and periodontal disease.

Methods: Examination of dynamic changes of platelet and periodontal markers in group of 50 patients before and an average of 6 months subsequent to professional periodontal treatment.

Results: Both platelet and periodontal parameters decreased after periodontal treatment, what is more, the decrease of MPV value due to periodontal disease/mm improvement was shown to be statistically significant ($p = 0.05$).

Conclusions: Improvement of periodontal status may influence decrease of MPV value and increase of congestive heart failure treatment efficacy and effect patient comfort. It is a new, not frequently used pattern of chronic disease treatment optimalization. (Cardiol J 2019; 26, 3: 253–259)

Key words: mean platelet volume, platelets, congestive heart failure, periodontal disease, inflammatory response

Introduction

Numerous papers have documented prognostic value of mean platelet volume (MPV) in cardiovascular pathology [1–7], including published research on correlation between MPV and periodontal disease (PDe) in coronary patients [8]. A thorough search on correlation between MPV and exacerbated heart failure revealed only 2 publications in this area [9, 10]. MPV has not yet been studied in patients with congestive heart failure (CHF), including those with coexistent PDe.

The aim of this study was to assess the dynamics of changes of MPV in CHF patients with diagnosis of PDe. The authors made an attempt to design a clinical pilot study that will verify the following hypotheses: (A) Is MPV an appropriate marker of periodontal parameters change the dynamics? Analyzed BEFORE periodontal intervention; (B) Is MPV an appropriate marker of periodontal parameters change the dynamics? Whether a clinical decrease of some periodontal parameters (CAL/mm, PI, and PD/mm) may result in MPV? Analyzed AFTER periodontal intervention.

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There is a correlation between the decrease of inflammatory process presented by plasma concentration of the following parameters: tumor necrosis factor- α (TNF- α), N-terminal pro-B-type natriuretic peptide (NT-proBNP), C-reactive protein (CRP) and improvement of CHF patient status, including better prognosis [11–17]. Numerous researchers have shown that elimination of inflammation in PDe results in a significant reduction of chronic inflammatory process and may lead to additional benefits including improvement of vascular endothelium [18–22].

Methods

A pilot group of 50 patients aged 36–92 years including 15 women and 35 men (average age 64 years), admitted to the Department of Cardiology of the Medical University of Warsaw with a diagnosis of CHF. Those patients were also diagnosed with PDe that required periodontal treatment.

This pilot study was conducted in accordance with 1964 Declaration of Helsinki and was approved by the Ethics Committee of the Medical University of Warsaw (KB/54/A/2013). All patients have read and signed informed consent forms.

After obtaining their consent, all patients enrolled in the study underwent the following diagnostic assessment:

- Biochemical blood tests on admission day and on average 6 months after periodontal treatment: blood count, iodine and potassium concentration, lipid profile, CRP and TNF- α levels, NT-proBNP and fibrinogen concentration.
- Examination of oral hygiene: approximal plaque index (API) inspected on approximal spaces of the first and third quadrants from the oral aspect and of the second and fourth quadrant from the buccal aspect and bleeding on probing (BOP) probed on 4 surfaces of each tooth (mesial, distal, palatal/lingual, buccal) during initial standard periodontal therapeutic assessment (scaling, root-planing, sanitation of oral cavity as well as treatment of oral mucosa pathologies). Number and status of teeth, number and status of impacted teeth, gangrenous roots, currently used prosthetic restorations, as well as surgical and prosthetic treatment indications were assessed [23].
- Periodontal examination of clinical attachment loss (CAL/mm) and probing depth (PD/mm) in oral cavity with the use of periodontal probe WHO 621 in 6 measurement points around each tooth (mesial buccal, distal buc-

cal, middle of buccal surface, mesial palatal/lingual, distal palatal/lingual, middle of palatal/lingual surface) and dental orthopantomogram radiograph (OPG) in CHF patients following conventional periodontal therapy assessment: removal of bacterial biofilm from tooth surface (scaling) and smoothing (root-planing) to prevent re-accumulation of bacteria, sanitation of oral cavity as well as periodontal reassessment on average 6 months (3–9 months) after treatment.

Study patients were treated in accordance with current CHF treatment guidelines, without need of modifications of pharmacological therapy, and their clinical status was stable throughout the study. Based upon results of initial examination, pilot specialist periodontal treatment was commenced in patients with coexistent CHF and PDe in a reference clinical center.

This paper presents statistical analysis of a relationship between dynamic MPV changes in relation to PDe and oral hygiene status.

Blood samples were collected from all 50 study patients on admission day (examination-1), and then 3–9 months (on average 6 months) after periodontal treatment was completed (examination-2). Blood samples were centrifuged and serum was tested for blood count including diagnostic parameters of platelet count and volume, which were the subject of the study and were further analyzed. A standard blood work-up kit (R&D Systems, Inc., Minneapolis, USA) was used in accordance with manufacturer instructions in the Central Laboratory Department of Hematology, Oncology and Internal Diseases of the Medical University of Warsaw.

The status of CHF was examined before and after periodontal therapy by two experienced cardiologists blinded to the periodontal therapy outcomes and indices.

The periodontal study was conducted at the Department of Oral Medicine and Periodontal Disease of the Medical University of Warsaw, with the use of periodontal probe WHO 621. During the examination antibiotics were administered prophylactically. All patients received Augmentin[®] (amoxicillinum, acidum clavulanicum) 1.0 g (1 d/every 12 h), and for those with penicillin intolerance Dalacin C[®] (clindamycinum) 0.3 g (1 d/every 8 h) was prescribed. For periodontal examination, patients received single, prophylactic dose (Augmentin[®] — 2 g; Dalacin C[®] — 0.6 g) according to guidelines concerning examination of such patients issued by the Polish Society of Periodontology. API/% and

BOP/% were assessed, scaling, root-planing and orthopantomogram radiograph were performed. Detailed instructions for daily oral hygiene were provided. The above described activities were termed as periodontal intervention.

Following periodontal assessment, also with antibiotic administration, examination of clinical attachment loss (CAL/mm) as well as probing depth (PD/mm — probing depth), degree of furcation involvement, and 3-stage Hall's tooth mobility scale, where stage 1 represents lingual or buccal/palatal mobility, no more than 1 mm; stage 2 — lingual or buccal/palatal mobility between 1 and 2 mm; stage 3 — vertical and horizontal mobility that interrupts proper articulation was performed [24, 25]. Each tooth was examined and mean parameters values were calculated for individual patients.

All patients received standard periodontal therapy: scaling and root planing with sanitation of oral cavity including extraction of gangrenous roots under antibiotic prophylaxis regimen. For periodontal treatment full antibiotic therapy was administered (Augmentin® — 14 doses/7 days; Dalacin C® — 15 doses/5 days) according to the same guidelines. Recommended oral hygiene at home included brushing teeth twice a day, in the morning and in the evening, as well as antiseptic mouth rinsing. Patients were encouraged to stay in touch with researchers in case of any doubts regarding their oral cavity status and hygiene routine.

Statistical analysis

Obtained results underwent statistical analysis in order to assess the influence of treatment on MPV with reference to selected periodontal parameters. Following statistical tests were performed to verify stated hypotheses.

Statistical analysis was performed with Mann-Whitney test for dependent groups to verify differences between observations and Wilcoxon test to assess differences between selected study groups (H.B. Mann, D.R. Whitney [1947] “On a test of whether one of two random variables is stochastically larger than the other”. *Annals of Mathematical Statistics*, 18, 50–60).

Results

All patients were diagnosed with severe chronic generalized periodontitis (CAL > 5 mm and PD > 7 mm) according to American Academy of Periodontology 2000 classification [26].

Pilot study of 50 CHF patients with coexistent PDe on admission day has shown that mean

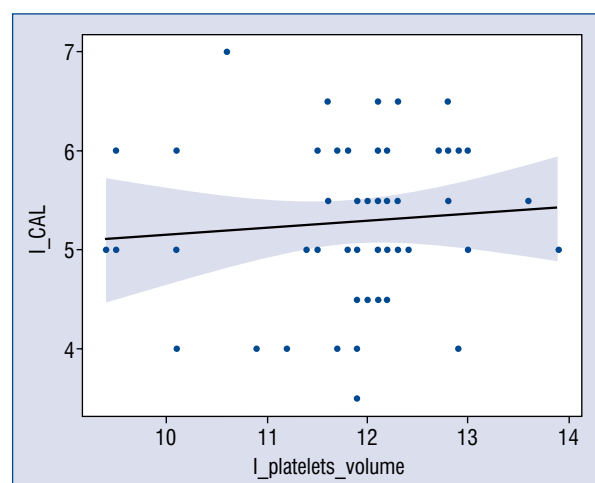


Figure 1. The values of mean platelet volume (MPV) vs. clinical attachment loss (CAL/mm) before periodontal intervention (MPV \pm SD 0.91; CAL/mm \pm SD 0.39); SD — standard deviation.

API and BOP values were very high, respectively: API: 74% in women and 81% in men; BOP: 100% in women and 90% in men. Mean PD/mm values both for women and men were 5.7 mm. Mean CAL/mm values were 5.2 mm for women and 5.3 mm for men. Among women the average number of teeth in the upper arch was 12 and in lower arch — 11. In the group of men the average number of teeth in maxilla was 11 and in mandible — 10.

A. Study results show that as far as first hypothesis is concerned, patients before periodontal intervention, high values of MPV parameter have shown correlation with high values of the following parameters: CAL/mm, plaque index (PI) and PD/mm obtained during the first assessment (examination-1).

A.I. MPV vs. CAL/mm (examination-1)

Statistical analysis has shown that higher MPV value is associated with higher CAL/mm value. Presented model did not show statistically significant relationship. The numerical relationship was positive. The following results were obtained: statistical value W: 0.3694; p: 0.5462 (Fig. 1).

A.II. MPV vs. PD/mm (examination-1)

Statistical analysis has shown that PD/mm values are subtle. In addition: although there is no clear trend in relationship between these parameters a positive trend is present, the highest MPV values are for patients with PD/mm 7 mm (the highest) value obtained (Fig. 2).

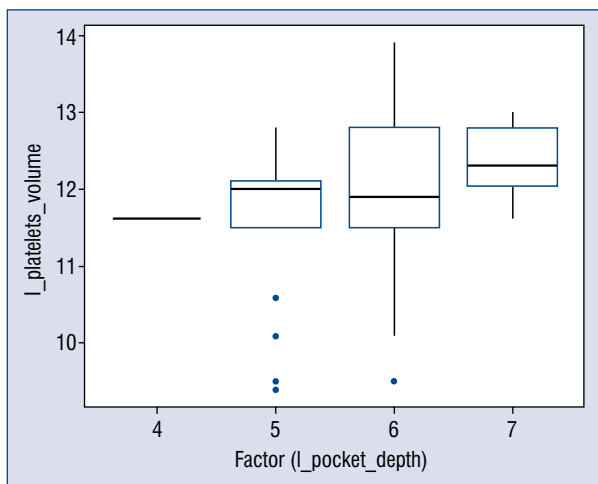


Figure 2. The values of mean platelet volume (MPV) vs. probing depth (PD/mm) before periodontal intervention (MPV \pm SD 0.91; PD/mm \pm SD 0.60); SD — standard deviation.

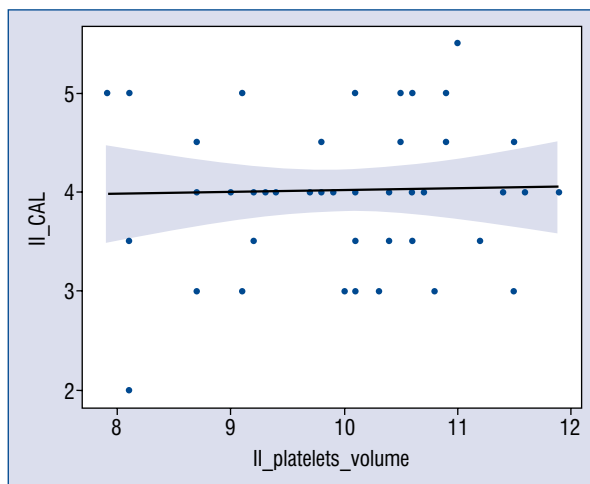


Figure 3. The values of mean platelet volume (MPV) vs. clinical attachment loss (CAL/mm) after periodontal intervention (MPV \pm SD 0.98; CAL/mm \pm SD 0.80); SD — standard deviation.

B. Study results show that as far as second hypothesis is concerned in patients after periodontal intervention high values of MPV parameter have shown correlation with high values of the following parameters: CAL/mm, PI and PD/mm, obtained during the second assessment (examination-2).

B.I. MPV vs. CAL/mm (examination-2)

Statistical analysis has shown that there is virtually no relationship between CAL/mm and MPV value after periodontal intervention. The presented model did not show any statistically significant relationship. The following results were obtained: statistical value W: 0.03385; p: 0.8548 (Fig. 3).

B.II. MPV vs. PD/mm (examination-2)

Statistical analysis has shown that PD/mm values are subtle. In addition: there is a positive trend (higher PD/mm is associated with higher MPV value), and the highest MPV values are for PD/mm 5 mm (the highest) (Fig. 4).

B.III. MPV change vs. CAL/mm change

Assessment whether CAL/mm parameters change observed before and after periodontal intervention is associated with MPV. For CAL/mm change at 1.5 mm MPV is higher and characterized with grater variability. Following results were obtained: statistical value W: 306.5; p: 0.3076 (Fig. 5).

Results show that this difference is not significant. It should be noted that for greater CAL/mm change MPV distribution towards higher values

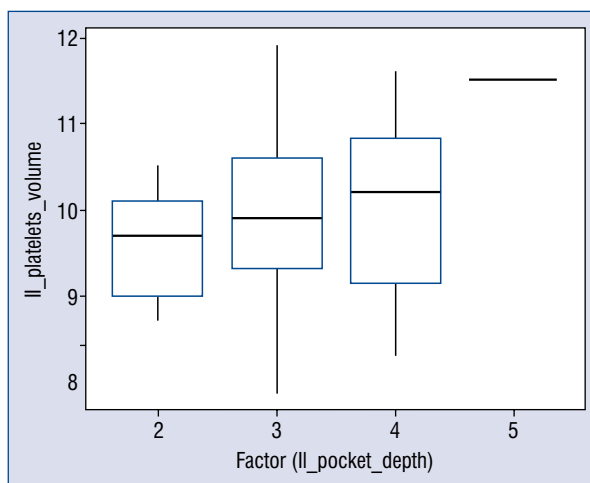


Figure 4. The values of mean platelet volume (MPV) vs. probing depth (PD/mm) after periodontal intervention (MPV \pm SD 0.98; PD/mm \pm SD 0.74); SD — standard deviation.

was observed. It is therefore justified that the change of CAL value has influenced an increased MPV distribution.

B.IV. MPV change vs. PD/mm change

Correlation between PD/mm parameter change before and after periodontal intervention and MPV was tested. PD/mm value changes are subtle, and importantly values 1 and 4 are scarce and will not be further analyzed. The following results were obtained: statistical value W: 0.3694; p: 0.5462 (Fig. 6).

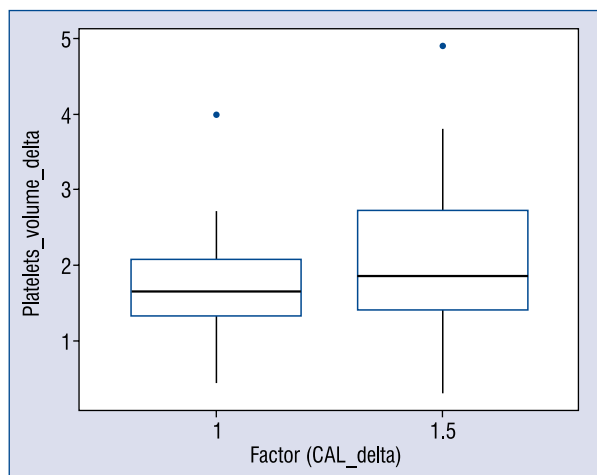


Figure 5. The values of Δ mean platelet volume (Δ MPV) vs. Δ clinical attachment loss (Δ CAL/mm) during experiment observation (Δ MPV \pm SD 14.58; Δ CAL/mm \pm SD 53.51); SD — standard deviation.

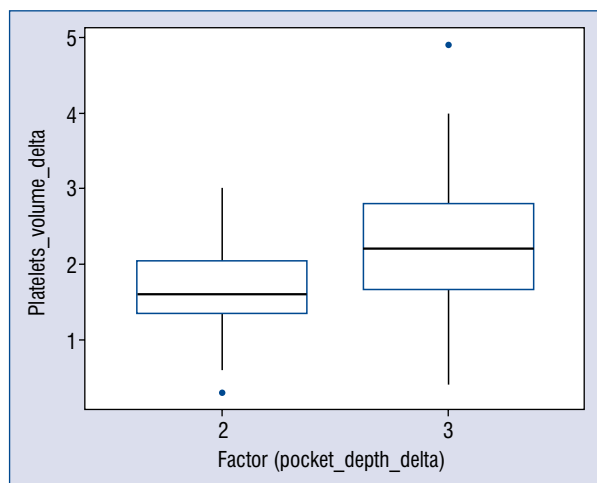


Figure 6. The values of Δ mean platelet volume (Δ MPV) change vs. Δ probing depth (Δ PD/mm) during experiment observation (Δ MPV \pm SD 14.58; Δ PD/mm \pm SD 7.42); SD — standard deviation.

There is positive relationship between PD/mm change and MPV change. PD/mm value change after value 1 and 4 were deleted is shown on the box plot. For larger PD/mm value changes increased MPV value change occurred. The test has shown a statistically significant difference of 5%.

Periodontal assessment was performed after PDe treatment (the so called periodontal intervention) was completed. The number of patients remained constant during whole study. API values decreased to 28% among women and 30% among

men. BOP also significantly decreased to 36% in women group and 41% in men. Both gender groups resulted in CAL/mm value 4.0 mm and PD/mm 3.3 mm. After oral cavity sanitation, the average number of remaining teeth in women was 10 for maxilla and 9 for mandible, among men 9 and 8, respectively.

Discussion

Fifty patients \leq 92 years (age: 36–92; mean age: 64 years) with CHF and PD diagnosis were enrolled into this pilot study. It was found that MPV measurements on admission day as well as clinical periodontal assessment (examination-1) are different from results obtained after standard periodontal treatment (examination-2). A statistically significant decrease of PD value over a of mean of a 6 month observation period (3–9 months) was noted.

In addition to a decrease of BOP and PI values in all study patients, mean increase in CAL/mm values of 1.5 mm was noted showing advantage of restoration over destruction processes within alveolar bone of maxilla and mandible. It should be noted that no highly specialized Guided Bone Regeneration (GBR) and/or Guided Tissue Regeneration (GTR) procedures were performed, justifying potential likelihood of including this type of therapy into CHF treatment standard.

Significant correlation between a decrease of clinical PD/mm values and increased MPV value change and decrease should be noted. Statistical analysis has shown that the decrease in PD/mm value which is much easier to obtain by basic dental care, has resulted in better effects in study group patients than CAL/mm decrease that can be mainly obtained only by highly specialized, expensive periodontal procedures.

In this pilot study group during a 6-month observation no signs of heart failure exacerbation were observed, and pharmacological therapy that was in accordance with current CHF treatment guidelines, required no modifications of each medication dose and type (Tables 1 and 2).

Authors of this paper have focused their research on the relationship between PDe and heart disease. Current studies and observations as well as published results referred patients who were hospitalized due to acute coronary syndromes [11–15, 27]. Results of this pilot study have shown that proper and complex oral hygiene may influence blood serum levels of CRP, NT-proBNP and TNF- α which are all markers of inflammation [18, 28–32]. Individualized patterns of CHF patient

Table 1. Clinical characteristics of study population.

Gender	Age (av.)	NYHA class/ /mean EF	Myocardial infarction	Hypertension	CAD	Dislipidemia	Diabetes
Women (n = 15)	64	II–III/38 ± 9%	8 (53%)	13 (87%)	8 (53%)	7 (47%)	2
Men (n = 35)	63	II–IV/38 ± 11%	21 (60%)	32 (91%)	27 (77%)	18 (51%)	4

CAD — coronary artery disease; EF — ejection fraction; NYHA — New York Heart Association

Table 2. Pharmacological treatment.

Gender	ACEI, sartans	Beta-antagonists	Aldosterone antagonists	ICD/CRT	Statins
Women (n = 15)	100%	100%	93%	13%	80%
Men (n = 35)	100%	100%	94%	11%	80%

ACEI — angiotensin converting enzyme inhibitors; CRT — cardiac resynchronization therapy; ICD — implantable cardioverter-defibrillator

care, seems obvious and also results in prognosis improvement, increased treatment efficacy and patient comfort [33–35].

Limitations of the study

The main limitation of the study was the small group of patients included. Secondly, was the absence of a control group. However, it is very difficult to create such a control group for two reasons. One — patients could not be found with CHF and a healthy peridontium in among the general population. Secondly, it would be ethically controversial to treat PDe only in a subgroup of patients. Therefore, after taking into consideration the Ethics Committee opinion on this study, we have decided to perform it in this form and call it a pilot study.

Conclusions

Results of this pilot study should be verified in a larger patient cohort. The results of this study show that:

- decreases of PD/mm results in significantly better results of MPV (p = 0.05) than reduction of CAL/mm value;
- specialist periodontal treatment may result in decreased MPV value in patients with coexistent CHF and PDe;
- examed platelet parameter may have prognostic value in CHF, periodontal treatment of CHF and PDe patients might improve their long-term prognosis, but it ought to be verified in a prospective study;

- the above conclusions are, to the authors’ best knowledge, first published conclusions in this area and require verification on a larger patient population.

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Conflict of interest: None declared

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