

Is there a relationship between haematological parameters and postoperative atrial fibrillation in off-pump or on-pump CABG patients?

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Abstract

The aim of our study was to assess the relationship between haematological parameters and development of post-operative AF whether off-pump or on pump CABG cohort. Between December 2011 and May 2015 a total of 346 patients undergoing CABG were analysed for our study. Preoperative MPV values were higher in AF group than those remained in sinus rhythm. Postoperative hematologic parameters showed that MPV, PDW, Lymphocyte count, N/L Ratio were also higher in AF group than those remained in sinus rhythm. In the logistic univariate regression there weren't any hematologic predictors of the development of new-onset AF. In this study, we could not find any relationship between haematological parameters and post-operative development of AF.

Keywords: Hematologic parameters, Postoperative Atrial fibrillation.

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Introduction

Although developing new operative techniques and instruments related with off-pump and on-pump coronary artery bypass grafting (CABG), incidence of the post-operative atrial fibrillation has not decreased yet [1]. Frequency of post-operative AF is associated with a number of clinical factors such as advanced age, duration of hospitalization, male gender, pump time, cross-clamp time and the severity of coronary artery disease [2]. Usually, attempts FOR the prevention of the development post-operative AF, also increase the operative costs [3,4]. Therefore, the determinations of the economic parameters that predict the high risk patients are necessary. Haematological parameters including haemoglobin level, leukocyte, neutrophil and lymphocyte counts and ratios (N/L Ratio) Red Cell Distribution Width (RDW), Platelet Distribution Width (PDW), Mean Platelet Volume (MPV) are demonstrating measure of the general inflammatory activity which remains the attractiveness for researchers [5-7]. It gives economic and fast information about inflammation that is responsible for the pathogenesis of cardiovascular disease. There are several studies about the pathogenesis of atrial fibrillation also pointed out the importance of the inflammation [8]. Essence of the CABG has some risky procedure can trigger atrial fibrillation as a result of the inflammation [9]. The aim of our study was to assess the relationship between haematological parameters and development of post-operative AF whether off-pump or on pump CABG cohort.

Materials and Methods

Between December 2011 and May 2015 a total of 394 patients undergoing cardiovascular operations in the department of cardiovascular surgery of Mevlana (Rumi) University Medical School were analysed for our study. Forty-eight patients who were operated with combined valve replacement/CABG, acute coronary syndrome, ascending aortic replacement, congestive heart failure, prior atrial flutter or fibrillation, peripheral vascular disease, systemic inflammatory disease, infection, malignancy, thyroid disorders, chronic renal or hepatic disease and overt/active haematological disorders or terminal illnesses were excluded from the study. Remaining of 346 patients undergoing off-pump or on-pump CABG for single, double, triple or more vessel disease were considered to be a study patient population. All patients demographic (age, gender, body mass index) features and comorbidities were recorded from medical archives. In addition, perioperative factors such as aortic cross-clamp time, pump time, number of bypass grafts, length of stay in intensive care unit and cardiovascular surgery service data was recorded by examining the operation event records. Also this retrospective study was approved by the local ethics committee.

Hematologic analysis

Pre-operative and post-operative first day 2 ml blood sample was put into tubes containing 3.6 mg tripotassium ethylene diaminetetraacetic acid for evaluation all patients complete

blood count. Analysis of all haematological parameters was used the whole blood count device (KX-21N-TOA Medical electronics, Kobe, Japan). All haematological parameters were recorded for statistical analysis.

Surgical protocol and post-operative follow up

All patients underwent standard anaesthesia protocol consisting of midazolam, fentanyl and isoflurane. The type of CABG technique (off-pump or on-pump CABG) was decided by the operation team. Standard sternotomy was performed for all patients in order to achieve aortic fat pad. When aortopulmonary window was explored aortic cross clamp was placed on the aorta for on-pump procedures. After starting of Cardio Pulmonary Bypass (CBP), the body temperature was drifted 32-34°C by using ice slush and cold cardioplegia. Octopus tissue stabilizer (Medtronic, Inc., Minneapolis, MN, USA) is used for off-pump surgery patients.

The internal mammalian artery usually used to left anterior descending artery stenosis, the other grafts was used to stenosis of right coronary artery, circumflex artery and all branches. For on-pump patients, all proximal anastomoses were performed with aortic cross-clamping. At the end of the operation, all patients were followed with maintaining complete hemodynamic and rhythm monitorization in the cardiac surgery intensive care unit. All patients' blood levels of electrolytes (potassium, calcium) were followed up daily. In the case of the hypocalcaemia and hypopotassemia, supplementation therapy applied immediately. Patients were continuously monitored in this period and monitoring was continued with the telemetric ECG at the cardiovascular service. 12-channel ECG was obtained in case of arrhythmia suspicion.

Cardiovascular surgery service nursing visits was made every 4 hours in the form of a blood pressure and pulse measurement. Paroxysmal AF was defined as new onset AF for the first time at least 20 minutes duration and ended with a spontaneous, medical or electrical cardio version. Patients, who established AF, were treated with oral or intravenous amiodarone after administration of the appropriate loading dose.

Statistical analysis

The data analysis was performed using the Statistical Package for the Social Sciences software, version 22 for Windows (SPSS Inc., Chicago, IL). The data are shown as mean ± standard deviation for continuous variables, medians (minimum–maximum) for ordinal variables, and frequencies with per cent for categorical variables. A P-value of <0.05 was considered statistically significant. Continuous variables and dichotomous data were analysed with using unpaired t-test and Mann–Whitney U-test or Pearson's χ^2 test and Fisher's exact tests in terms of distribution, respectively. The categorical variables between groups were analysed using the chi-square test. Logistic regression analysis performed to identify independent predictors of postoperative AF. Odds ratios (ORs)

and 95% confidence intervals (CIs) were calculated for independent associates of AF.

Results

Three hundred and forty-six patients (of 295 with on-pump CABG and 51 with off-pump CABG) were included according the inclusion criteria. Baseline Characteristic's, operative and hematologic variables stratified by development of new onset Atrial Fibrillation were summarized in Table 1. The study population was consisted of 83 (31%) women. Paroxysmal AF was developed in 74 patients (25%) in on-pump surgery group and 9 patients (17%) in off-pump surgery group.

Table 1. Baseline characteristic's, operative and hematologic variables stratified by development of new onset Atrial Fibrillation. The patients who developed paroxysmal AF were older (66.7 ± 9 years vs. 61 ± 8.8 years $p:0.001$) and has a higher body mass index values (29.9 ± 4.5 kg/m² vs. 28.3 ± 4.1 kg/m² $p:0.002$) than those remained in the sinus rhythm. Although duration of pump time and cross clamp time were similar in both groups, intensive care unit follow-up (3.6 ± 3 days vs. 2.3 ± 1.4 days $p:0.001$) and hospital stay (10.5 ± 3.6 days vs. 9.5 ± 2.9 days $p:0.01$) were significantly higher in the paroxysmal AF group. Preoperative and postoperative hematologic parameters stratified by development of AF were summarized in Table 2.

Variables	Atrial Fibrillation	Sinus Rhythm	p- value
Baseline Characteristics			
N	83	263	
Age (years)	66.7 ± 9	61 ± 8.8	0.001
Age>70 years old (n)	33	50	0.001
Male/Female (n)	59/24	204/59	0.145
Body Mass Index (kg/m ²)	29.9 ± 4.5	28.3 ± 4.1	0.002
Operative and postoperative variables			
Cross Clamp Time (minutes)	69 ± 29.1	64.2 ± 20	0.1
Pump Time (minutes)	98.8 ± 41	94.3 ± 28.8	0.29
Stay in hospital (days)	10.5 ± 3.6	9.5 ± 2.9	0.01
Intensive Care Unit period (days)	3.6 ± 3	2.3 ± 1.4	0.001
Beating bypass (n)	9	42	0.16
Number of bypass grafts			
1	5	15	
2	24	55	
3	23	81	
4	18	78	
5	32	42	

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Bolded data are statistically significant.

Table 2. Pre and postoperative hematologic variables according to development AF.

Preoperative Parameters	Hematological	Atrial Fibrillation	Sinus Rhythm	p value
WBC (x10 ³)		8.1 ± 3.24	8 ± 2.1	0.77
Haemoglobin (g/dl)		13.6 ± 1.6	14.2 ± 8.3	0.54
Haematocrit (%)		40.7 ± 4.6	40.7 ± 5.8	0.93
Platelet (x10 ³)		235.1 ± 65.8	241.6 ± 62.5	0.42
MPV (fL)		10.4 ± 0.9	10.1 ± 0.9	0.02
PDW (%)		13.2 ± 2.3	12.7 ± 2.1	0.06
Neutrophil (x10 ³)		5.2 ± 2.5	5.1 ± 1.9	0.33
Lymphocyte (x10 ³)		2 ± 0.6	2.4 ± 3.2	0.32
N/L Ratio (%)		2.9 ± 2	2.7 ± 1.6	0.84
Postoperative Parameters	Haematological	Atrial Fibrillation	Sinus Rhythm	p value
WBC (x10 ³)		11.6 ± 5	11.2 ± 4.4	0.83
Haemoglobin (g/dl)		9.2 ± 1.7	9.5 ± 1.4	0.10
Haematocrit (%)		27.1 ± 4.9	28.3 ± 4.2	0.06
Platelet (x10 ³)		235.1 ± 65.8	241.6 ± 62.5	0.07
MPV (fL)		10.4 ± 0.9	10.1 ± 0.9	0.01
PDW (%)		13.2 ± 2.3	12.7 ± 2.1	0.01
Neutrophil (x10 ³)		5.2 ± 2.5	5.1 ± 1.9	0.62
Lymphocyte (x10 ³)		2 ± 0.6	2.4 ± 3.2	0.03
N/L Ratio (%)		2.9 ± 2	2.7 ± 1.6	0.04

WBC: White Blood Cell, MPV: Mean Platelet Volume, PDW: Platelet Distribution Width, N/L Ratio: Neutrophil/Lymphocyte Ratio. Bolded data are statistically significant.

Preoperative haematological parameters showed that WBC, Neutrophil, Lymphocyte, Platelet counts and RDW, PDW, N/L Ratios were similar in both groups. MPV values (10.4 ± 0.9 fL vs. 10.1 ± 0.9 fL p:0.02) were higher in AF group than those remained in sinus rhythm.

Postoperative hematologic parameters showed that MPV (10.4 ± 0.9 fL vs. 10.1 ± 0.9 fL p:0.01), PDW (13.2 ± 2.3% vs. 12.7 ± 2.1% p:0.01), Lymphocyte count (2 ± 0.6 × 10³ vs. 2.4 ± 3.2 × 10³ p:0.03), N/L Ratio (2.9 ± 2% vs. 2.7 ± 1.6% p:0.04) were also higher in AF group than those remained in sinus rhythm. When a logistic univariate regression analysis was performed on preoperative and post-operative hematologic variables, including Haemoglobin, WBC, Neutrophil, Lymphocyte, Platelet counts and RDW, PDW, N/L Ratio there were any hematologic predictors of the development of new-onset AF. (Table 3a and Table 3b).

Table 3a. Preoperative hematologic variables examined in the logistic regression analysis.

Preoperative Variables	OR	95% CI	P value
WBC (× 10 ³)	-0.003	-0.534	0.398
Hemoglobin (g/dl)	-0.002	-0.013	0.916
Hematocrit (%)	0	-0.019	0.642
Platelet (× 10 ³)	0	-1.001	0.93
MPV (fL)	0.05	-0.189	0.867
PDW (%)	0.003	-0.081	0.32
Neutrophil (× 10 ³)	0.005	-0.134	0.877
Lymphocyte (× 10 ³)	-0.007	-0.035	0.893
N/L Ratio (%)	0.009	-0.086	0.409

OR: Odds Ratio, CI: Confidence Interval

Table 3b. Postoperative hematologic variables examined in the logistic regression analysis.

Preoperative Variables	OR	95% CI	P value
WBC (x10 ³)	0.204	-0.998	0.645
Hemoglobin (g/dl)	-0.058	-0.064	0.315
Hematocrit (%)	-0.237	-0.09	0.331
Platelet (x10 ³)	0	-1.001	0.379
MPV (fL)	0.11	-0.202	0.348
PDW (%)	0.047	-0.091	0.348
Neutrophil (x10 ³)	-0.13	-0.163	0.766
Lymphocyte (x10 ³)	-0.139	-0.261	0.174

OR: Odds Ratio, CI: Confidence Interval

Discussion

Herein, we showed that there are no relationships between preoperative and postoperative haematological parameters and new onset AF in off-pump and on-pump surgery patients. Although some hematologic parameters (preoperative MPV and postoperative MPV, PDW, lymphocyte count and N/L ratio) was higher in AF patients than sinus rhythm patients, in the logistic regression analysis there were no parameters predicting new onset AF. In the literature, there are similar studies also available regarding to hematologic parameters such as association between N/L ratio and new onsets AF in on-pump surgery patients [10]. On the other hand, there are many studies showing the relationship between haematological parameters and the development post-operative AF.

Recently, Erdem et al. [11] reported an association between MPV and post-operative new onset atrial fibrillation. They found that MPV was an independent predictor for the development AF. Also we found that MPV values were higher in AF group than sinus rhythm group but there were no association between MPV and AF in the logistic regression analysis. Even though the study by Erdem et al. reported strong results, there were some problems that need to be discussed.

First, this study consisted of only on-pump CABG patients. Another problem was the lack of data related hospital length of stay, intensive care unit period and surgical variables (blood transfusion, cross clamp time) that affected the patient's general inflammatory status and development of AF.

Recently published study by Alameddine et al. [12] stated that perioperative blood transfusion may be associated with AF following CABG. Postoperative hematologic variables may be affected operative conditions such as blood transfusion, cross-clamp time and pump time. We also analysed relationship between operative conditions and the development of AF. Another study published by Ertaş et al. [13] stated that preoperative RDW was an independent predictor for postoperative AF. In this study, the rate of off-pump surgery is unclear. The studies performed to investigate whether off-pump and on-pump techniques effects on the development of postoperative AF have shown that off-pump surgery patients have developed less AF.

According to the literature, our off-pump patients have developed less AF than on-pump patients. (17% off-pump vs. 25% on-pump). Blood sample storage, blood analysis environment, storage temperature are important parameters which influence the results. Also the examination of whole blood count without blood activation is extremely important for reliable results. Some studies reported different incubation temperatures and length of the blood sample stay which may affect platelet morphology and counts [14,15].

So far most of the hematologic studies to search the development of post-operative atrial fibrillation were made in kind of retrospective cohorts. Retrospective analysis were consisted of some raw data's which is formed beyond of the researcher control. In light of all these information, we think that new prospective trials are necessary to set the relationship between hematologic parameters and the development of AF. There are some difficulties of the evaluation of the retrospective studies due to standardization of hematologic results.

Conclusion

In this study, we could not find any relationship between haematological parameters and post-operative development of AF. However, prospective studies with larger populations are needed to reveal the relationship between the haematological parameters and the development of AF.

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