

Rhythm Disturbance After Myocardial Revascularization

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ABSTRACT

Introduction: Heart rhythm disorders are common in the post-operative period following surgical myocardial revascularization (CABG). The incidence of any type of arrhythmia in the postoperative period can go up to 85%. While most are transient and short-term, it does not lead to deterioration of the postoperative course, in a smaller number of patients they can be predictors of various events that result in fatal outcome. Arrhythmias occur suddenly and need to be recognized and reacted in time. Standard monitoring consists of 12-channel electrocardiogram (ECG), laboratory findings and, if necessary, 24-hour HOLTER monitoring. Persistent arrhythmias increase overall morbidity and mortality, and costs treatments are increasing enormously. **Patients and methods:** The prospective study analyzed patients of all age groups and sexes in whom angiographically coronary arterial disease was confirmed and who underwent surgery CABG. A total of 60 patients were screened during 2016. All age groups of both sexes in whom no rhythm disorders were previously recorded were included in the study. **Results:** A total of 60 patients undergoing CABG were analyzed. The average age of patients was 63.56 ± 8.55 years. The most preoperative factor was hypertension, which was recorded in 53 (88.33%) patients. The higher number of patients was operated using CPB 75.86%. The most commonly performed 3 aorto-coronary by-pass 45 (75%). The most common form of rhythm disorder was POAF, which occurred in 18 (30%) patients. In 24 patients, a change in heart rhythm was observed in the postoperative period in the group of operated ON pump techniques, while in the case of the application of Off pump technique only 5 patients were present, which was statistically significant ($p < 0.05$). **Conclusion:** Preoperative patient preparation and prophylaxis with good anesthesia monitoring and minimal trauma during surgery are the main preconditions for reducing the incidence of postoperative heart rhythm disorders.

Keywords: myocardial revascularization, rhythm disturbance.

1. INTRODUCTION

Heart rhythm disorders are common in the post-operative period following surgical myocardial revascularization (CABG). The incidence of any type of arrhythmia in the postoperative period can go up to 85%. While most are transient and short-term, and does not lead to deterioration of the postoperative course, in a smaller number of patients, they can be predictors of various events that can lead to unwanted complications and even to fatal outcomes (1-3). Arrhythmias occur suddenly and need to be recognized and reacted in time. Standard monitoring consists of 12-channel electrocardiogram (ECG), laboratory findings and, if necessary, 24-hour HOLTER monitoring. Persistent arrhythmias increase total morbidity and mortality, and treatment costs increase enormously. In the US, the cost per patient who prolongs treatment for 4-5 days due to postoperative atrial

fibrillation (POAF) is about \$ 10,000 (4-6). The arrhythmia also increases the risk of cerebrovascular accident (CVI) by 3-4 times. This type of heart rhythm disorder is the leading cause of re-hospitalization after surgery. An additional problem for our patient is the introduction of anticoagulant therapy in the persistent forms of POAF. The new oral anticoagulants are still expensive and conventional standard oral anticoagulation with vitamin K (Warfarin) antagonists to prevent thromboembolic complications also increases the risk of unwanted bleeding but also an additional burden for the patient because regular INR monitoring is required (International Normalized Ratio) to the nearest health facility (7-11). The causes of arrhythmia may be multiple and relate to pre-existing diseases, intraoperative and postoperative factors. Pre-existing diseases should highlight early CVI, renal insufficiency, chronic obstructive

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tive pulmonary disease (COPD), hyperthyroidism, hyperlipidemia, peripheral vascular disease, and others. The most common intraoperative factors are the long period of the cerebrovascular collapse of the aorta, the use of cardiopulmonary bypass (CPB) and valvular surgery, then intraoperative trauma, hemodynamic stress, perioperative drug administration (especially inotropic), electrolyte status disorders. In the postoperative course, many proarrhythmogenic factors may occur that contribute to the appearance of various types of arrhythmias such as acute myocardial ischemia, electrolyte imbalances, inflammation, acute changes in blood pressure, and subclinical hypothyroidism. Heart rhythm disorders after cardiac surgery, of which the most common POAF is associated with an increased rate of mortality in the early and late postoperative period and amount to about 5%, while in patients with no arrhythmias this rate is significantly lower and amounts to about 2% (10).

2. PATIENTS AND METHODS

The prospective study in the period 2016-2017 analyzed patients of both sexes and all age groups, in whom angiographically coronary arterial disease was confirmed. A total of 60 patients were divided into two groups. The first group consisted of patients with cardiopulmonary bypass surgery (CPB) disorder and the second group of patients operated without the use of CPB. The study covered all patients with angiographically proven significant lesion on coronary arterial vessels, and the severity or complexity of coronary disease was assessed by Syntax score. The study did not include patients in whom any type of heart rhythm disorder was previously recorded, followed by cardiovascular surgery and preoperatively treated with Digoxin or Dobutamine. Operative procedures were performed in our Center in a standard way, medial sternotomy with or without the use of CPB. In surgical procedures with the use of CPB, myocardial preservation was applied using cold cardioplegic, blood, soluble anterograde route with the addition of ice and cold saline solution. The average volume of cardioplegia was 680-1750 ml. LIMA and RIMA and venous grafts VSM were used for grafting.

3. RESULTS

The study covered 60 patients. The basic characteristics of analyzed patients are shown in Table 1.

From the above data it is evident that the patient's average age was 63.56 ± 8.55 years. Sexual representation was 39/21 for the benefit of men, which is expected as the incidence of the disease is more frequent in the male population. When it comes to body mass index (BMI) of 28.46 ± 2.71 , we can say that this is expected because obesity belongs to risk factors for coronary ischaemic disease. The ratio of smokers and non-smokers is almost the same as 31/29 or 51.67% / 48.33%. The most frequent factor was hypertension, which was verified in 53 patients (88.33%), while 7 (1.67%) patients were registered without hypertension. Hyperlipoproteinemia was present in 45 patients (75%), while 15 (25%) were not recorded. Chronic Obstructive Pulmonary Disease (COPD) is

Characteristics on inclusion		
Age (years)	X ±SD	63.56 ± 8.55
Sex- M / F	n, (%)	39 / 21 (65% vs. 35.00%)
BMI (kg/m ²)	X ±SD	28.46 ± 2.71
Comorbidity-associated diseases and habit		
Smoking status (Yes/No)	n, (%)	31 / 29 (51.67% vs. 48.33%)
Hypertension (Yes/No)	n, (%)	53 / 07 (88.33% vs. 11.67%)
Hyperlipoproteinemia (Yes/No)	n, (%)	45 / 15 (75% vs. 25%)
COPD (Yes/No)	n, (%)	49 / 11 (81.67% vs. 18.33%)
Deabetes mellitus (Yes/No)	n, (%)	30 / 30 (50% vs. 50%)

Legend: Parametes: central value and dispersion measure, X-arithmetic mean; SD-standard deviation, N-absolute number. BMI - body mass index, COPD – chronic obstructive pulmonary disease.

Table 1. Basic characteristics of the qualified sample (n=60).

Characteristics coronary disease		
Single vessel	n, (%)	2 (3.33%)
CHD (type of lesion), Double vessel	n, (%)	17 (28.33%)
Tripple vessel	n, (%)	41 (68.33%)
Operative technique		
On-pump	n, (%)	44 (75.86%)
Off-pump	n, (%)	14 (24.14%)
Total number of grafts (bypasses)		
One graft	n, (%)	2 (3.33%)
Two grafts	n, (%)	12 (20%)
Three grafts	n, (%)	45 (75%)
Four grafts	n, (%)	1 (1.67%)
Duration of hospitalization (min.median, max.)		6, 9, 15
Duration of stay in ICU (min.median, max.)		1, 2, 8

Legend: Parameters are expressed as a central value with the corresponding dispersion measure, N-absolute number and as a percentage. CHD- coronary heart disease; On-pump-with pump; Off-pump-without pump. ICU- Intensive Care Unit.

Table 2. Basic characteristics coronary disease (n=60).

also one of the predictors of the occurrence of postoperative rhythm disorders. In our study, 49 (81.67%) were recorded with the manifest COPD.

In 11 (18.33%) patients, pulmonary function was neat. The ratio of diabetics and patients without diabetes was the same and amounted to 30/30 (50% / 50%). The main features of coronary disease are shown in Table 2.

The table shows that the most common three-state coronary disease in 41 (68.33%) patients. A large number of patients were operated using CPB 75.86%, while 24.14% were operated using off-pump techniques. The most commonly performed 3 aorto-coronary bypass 45 (75%). In relation to the applied type of operative technique, Table 3 shows the postoperative characteristics of patients.

In the group of patients operated with the use of CPB in 35 patients, inotropic support in the postoperative course was administered in relation to 5 operated off-pump techniques, which was statistically significant difference ($p < 0.05$). Also, the number of days spent in the intensive care unit (ICU) was overall longer in the CPB group (1-14) compared to patients operated by the off-pump technique (1-11), which represented a statistically

	Type of operation		p value
	On-pump n=30	Off-pump n=30	
Post-OP Inotrops (No/Yes)	12/32	9/5	0.012
IABP support (No/Yes)	40/4	13/1	0.251
Artificial ventilation >24h (No/Yes)	39/5	14/0	0.187
Post-OP MI (No/Yes)	43/1	14/0	0.569
Post-OP CV event (No/Yes)	43/1	14/0	0.569
Post-OP HF (No/Yes)	41/3	13/1	0.316
Post-OP Redo/PCI (No/Yes)	43/1	14/0	0.569
IUC (days) Median (min-max)	2 (1-14)	1 (1-11)	0.0001
Hospitalization Median (min-max)	10 (7-19)	8 (6-16)	0.0001

Legend: Parameters are expressed as a n-absolute number. Median Q1-Q3 – interquartile range; REDO-redo sternotomy. POAF-postoperative atrial fibrillation. IABP-Postoperative Intra-aortic balloon pump. ICU- Intensive Care Unit.

Table 3. Postoperative characteristics and type of operative technique.

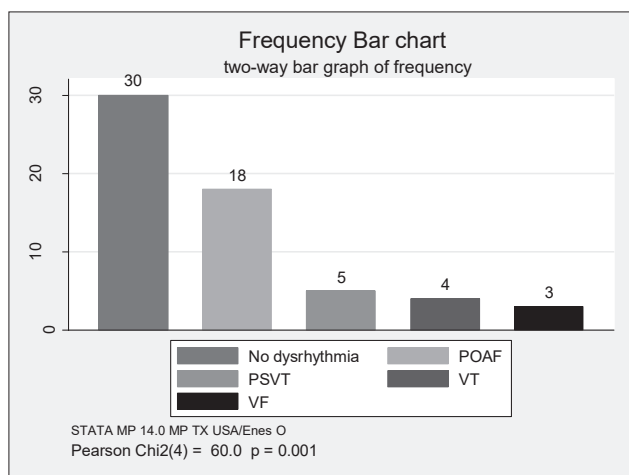


Figure 1. Frequency of changes in the heart rhythm in the postoperative period

significant difference. The total number of hospitalization days was longer in group I than in group II. In Figure 1, changes in heart rhythm are shown in relation to the type of surgery.

The most common POAF was reported in 18 (30%) patients. Table 4 shows the changes in the heart rhythm in the postoperative period in relation to the type of operative technique and the number of embedded grafts.

In 24 patients, a change in cardiac rhythm was observed in the postoperative period in the CPB group, while in the case of the “off-pump” technique, it was present only in 5 cases, which represents a statistically significant difference ($p < 0.05$). There were no statistically significant differences in the incidence of postoperative arrhythmias compared to the number of built-in bypasses.

4. DISCUSSION

Postoperative arrhythmias are frequent complications after cardiac surgery. Their occurrence in the post-operative period significantly influences the length of hospitalization and increases the overall costs of treatment (10). Atrial fibrillation is the most common type of rhythm disorder in the postoperative period. The American Association for Cardiology and Heart Attenuation

Type operation		Heart rate		p value
		Regular rhythm	Dysrhythmia	
Type operation	On-pump	20	24	0.220
	Off-pump	9	5	
Number of grafts	One bypass	1	1	0.675
	Double bypass	7	5	
	Triple bypass	21	24	
	Quadruple bypass	1	0	

Legend: Parameters are expressed as a n-absolute number. Median Q1-Q3 – interquartile range; REDO-redo sternotomy. POAF-postoperative atrial fibrillation. IABP-Postoperative Intra-aortic balloon pump. ICU- Intensive Care Unit.

Table 4. Postoperative characteristics and type of operative technique.

Working Group, AHA/ACC/HRS, published guidelines for the treatment of patients with atrial fibrillation in 2014. In our study, we focused on risk factors related to surgery. It is well-known that trauma and inflammation are common causes of postoperative arrhythmias. Cumming et al. in their study indicate that congestion of the epicardial fatty layer significantly reduces postoperative atrial fibrillation. Atrial trauma due to cannulation can also be one of the causes of POAF(12-15). In our study, we proved the superiority of off-pump techniques in relation to conventional CABG surgery. The total clamping time also contributes to the development of POAF in the post-operative period. The type and amount of cardioplegic solution used can significantly affect the occurrence of POAF. The use of B-blockers is also interesting. Discontinuation of therapy before surgery was associated with an increased rate of postoperative supraventricular tachycardia. The use of inotropic drugs increases the automation of SA nodes and reduces the conduction speed from the AV node. It has also been proven that (16-18) Dobutamine stimulates ventricular ectopic activity in 3% -15% of patients. Electrolytic status is one of the most common causes of postoperative arrhythmia. The most significant are hypokalemia and hypomagnesaemia. Hypokalemia is more often associated with ventricular tachyarrhythmias, and the development of perioperative ventricular arrhythmias. One of the tasks of this study was how to prevent the occurrence of POAF (19). The most common drug used to treat POAF in our institution is Amiodarone. Our research has also shown that the use of Amiodarone in preventing POAF is effective if administered preoperatively by oral route. The correct definition of POAF is of paramount importance (20). Namely, POAF refers to that which occurs within 30 days of the OP treatment, lasts at least 15 minutes and requires treatment, and an AF occurrence that lasts shorter than 15 minutes and leads to hemodynamic instability, and also requires treatment. The use of anti-thrombin therapy in the postoperative course was performed in accordance with the 2008 ACCP guides and ACC/AHA guides from 2004.

In statistical data processing, parametric and nonparametric tests with adequate measures of central tendency were applied (standard deviation and X2 test). Statistical

hypotheses were tested at the level $\alpha = 0.05$, or the difference between the groups was considered significant if $p < 0.05$.

5. CONCLUSION

Preoperative patient preparation and prophylaxis with good anesthesia monitoring and minimal trauma during surgery are the main preconditions for reducing the incidence of postoperative rhythm disorders. Continuous post-operative monitoring of patients allows timely treatment in the onset of heart rhythm disorders. The duration of hospitalization is significantly longer in patients who develop postoperative atrial fibrillation, including staying in the intensive care unit resulting in significantly increased treatment costs.

- **The authors contribution in sentences:** The study's conception and design were did by Nedzad Kadric and Enes Osmanovic gave contribution to acquisition of data. The analysis and interpretation of data and the article drifting were did by Nedzad Kadric and Enes Osmanovic. Finally critically revising the article was did by Nedzad Kadric and Enes Osmanovic.
- **Conflict of interest statement:** The authors declare no conflict of interest

REFERENCES

1. Aglio LS, Stanford GG, Maddi R. et al. Hypomagnesemia is common following cardiac surgery. *Journal of Cardiothoracic and Vascular Anesthesia*. 1991; 5(3): 201-8.
2. Amar D, Shi W, Hogue C.W Jr. Clinical prediction rule for atrial fibrillation after coronary artery by-pass grafting. *Journal of the American College of Cardiology*. 2004; 44(6): 1248-53.
3. Buxton AF, Josephson ME The role of P wave duration as a predictor of postoperative atrial arrhythmias. *Chest*. 1981; 80(1): 68-73.
4. Camm AJ, Kirchhof P, Lip GY European Heart Rhythm Association, European Association for CardioThoracic Surgery. Guidelines for the management of atrial fibrillation the task Force for the Management of atrial Fibrillation of the European Society of Cardiology (ESC). *European Heart Journal*. 2010; 31(6): 2369-2429.
5. Chung E, Martin D. Management of postoperative arrhythmias. *Surgical Intensive care Medicine*. 2010;
6. Cummings JE, Gill I, Akhrass R. et al. Preservation anterior fat pad paradoxically decreases the incidence of postoperative atrial fibrillation in humans. *Journal of the American College of Cardiology*. 2004; 43(6): 994-1000.
7. Eagle KA, Guyton RA, Davidoff R. ACC/AHA 2004 guideline update for coronary artery bypass graft surgery summary article. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee to Update the 1999 Guidelines for Coronary Artery Bypass Graft Surgery). *Journal of the American College of Cardiology*. 2004; 44(5): 213-310.
8. Geidel S, Ostermeyer J, Laß M Permanent atrial fibrillation ablation surgery in CABG and aortic valve patients is at least as effective as in mitral valve disease. *The Thoracic and Cardiovascular Surgeon*. 2006; 54: 91-5.
9. Ho K.M, Tan J.A Benefits and risks of corticosteroid prophylaxis in adult cardiac surgery a dose response meta analysis. *Circulation*. 2009; 119(4) 1853-66.
10. Kim MH, Deeb GM, Morady F. Effect of postoperative atrial fibrillation on length of stay after cardiac surgery (The Postoperative Atrial Fibrillation in Cardiac Surgery study [PACS]). *The American Journal of Cardiology*. 2001; 87(7): 881-5.
11. Kollar A, Lick SD, Vasquez KN. et al. Relationship of atrial fibrillation and stroke after coronary artery bypass graft surgery: when is anticoagulation indicated? *The Annals of Thoracic Surgery*. 2006; 82(2): 515-23.
12. Kowey PR, Stebbins D, Iqbalbhashian I. Clinical outcome of patients who develop PAF after CABG surgery. *Pacing and Clinical Electrophysiology*. 2001; 24(2): 191-3.
13. Lindsay BD. Atrial fibrillation: new drugs, devices and procedures. *Cleveland Clinic Journal of Medicine*. 2012; 79(8): 553-9.
14. Maisel WH, Rawn JD, Stevenson WG. Atrial fibrillation after cardiac surgery. *Annals of Internal Medicine*. 2001; 135(12): 1061-73.
15. Myers MG, Alnemri K. Rate control therapy for atrial fibrillation following coronary artery bypass surgery. *Canadian Journal of Cardiology*. 1998; 14(11): 1363-136 .
16. Patel AN, Hamman AN. Epicardial atrial defibrillation: successful treatment of postoperative atrial fibrillation. *The Annals of Thoracic Surgery*. 2004; 77(3): 831-7.
17. Pisters R, Lane DA, Nieuwlaet R. et al. A novel user-friendly score (HASBLED) to assess 1-year risk of major bleeding in patients with atrial fibrillation the Euro heart survey. *Chest*. 2010; 138(5): 1093-1100.
18. Reddy P. Does prophylaxis against atrial fibrillation after cardiac surgery reduce length of stay or hospital costs? *Pharmacotherapy*. 2001; 21(3): 338-44.
19. Tadic M, Ivanovic B, Zivkovic N. Predictors of atrial fibrillation following coronary artery bypass surgery. *Medical Science Monitor*. 2011; 17(1): 48-55.
20. Villareal RP, Hariharan R, Lin BC. et al. Postoperative atrial fibrillation and mortality after coronary artery bypass surgery. *Journal of the American College of Cardiology*. 2004; 43(5): 742-8.