Chronic Diseases Journal

DOI: 10.22122/cdj.v8i4.556 Published by Vesnu Publications

A survey on the effect of oral vitamin C supplementation in patients undergoing coronary artery bypass graft surgery

Golaleh Karbasi[1], Foad Rahimi[1], Mousa Shirmohammadi[2], Saadi Yarahmadi[3]

1 Department Nursing, Faculty of Nursing, Kurdistan University of Medical Sciences, Sanandaj, Iran
2 Department of Intensive Care, Faculty of Medicine, Kurdistan University of Medical Sciences, Sanandaj, Iran
3 Department of Intensive Care, Faculty of Paramedicine, Kurdistan University of Medical Sciences, Sanandaj, Iran

Original Article

Abstract

BACKGROUND: The positive effects of antioxidants in preventing atrial fibrillation (AF) after cardiac surgery and their low side effects have been proven. The aim of this study was to evaluate the effect of oral vitamin C supplementation on preventing post-operative AF in patients undergoing coronary artery bypass graft (CABG) surgery. Vitamin C was given orally to the patients three days before surgery for up to 5 days after surgery. This time difference was based on previous studies and cardiologist's order.

METHODS: In this study, patients who underwent CABG surgery, were divided into two groups. The first group (30 patients), as the intervention group, received oral vitamin C supplementation, and the second group (30 patients), as the control group, did not receive vitamin C supplementation. All patients, during the post-operative period, underwent cardiac monitoring in cardiac intensive care unit (CICU). The inclusion criteria were: being over 50 years old, undergoing cardiac surgery only and no other kinds of surgery, undergoing coronary artery bypass surgery for the first time, and no cardio-respiratory arrest during or after surgery. Data were collected by convenience sampling method and were analyzed using SPSS software.

RESULTS: The results of this study showed that 7 patients in the control group experienced post-operative AF, while 3 patients in intervention group had the same experience. According to the results, the risk of AF in the intervention and control group was, respectively, 10.0% and 23.3%. Vitamin C significantly decreased the risk of AF after CABG surgery by 2 times.

CONCLUSION: According to the results, oral vitamin C supplementation affected the incidence of AF after CABG surgery. Therefore, oral intake of vitamin C supplementation before and after surgery reduces the incidence of AF.

KEYWORDS: Atrial Fibrillation; Coronary Artery Bypass Graft; Vitamin C

Date of submission: 15 July 2019, ***Date of acceptance:*** 19 Sep. 2019

Citation: Karbasi G, Rahimi F, Shirmohammadi M, Yarahmadi S. A survey on the effect of oral vitamin C supplementation in patients **undergoing coronary artery bypass graft surgery.** Chron Dis J 2020; 8(4): 162-7.

Introduction

Atrial fibrillation (AF) is the most common post cardiac operation dysrhythmia after sinus tachycardia.[1] It is estimated that around 800000 open heart surgery will be performed annually in the United States (US).[2] The incidence of AF after cardiac surgery is higher in the elderly patients than others, and at the ages above 40, for every ten years of age, the risk of arrhythmias increases by 50%.[3] This arrhythmia is an independent risk factor for increasing the mortality rate with a risk ratio of 1.5 for men and 1.9 for women.[4]

Generally, AF is the most important cause of increasing complications and mortality after cardiac surgery.[5] In addition, AF after cardiac surgery increases the average length of stay of patients in post-surgical intensive care units (ICUs), as well as the overall length of stay in hospitals, by an average of 1-4 days.[6]

Corresponding Author:
Foad Rahimi; Department Nursing, Faculty of Nursing, Kurdistan University of Medical Sciences, Sanandaj, Iran
Email: foadrahimi63@yahoo.com

Many studies have shown the association between AF and the oxidative process of the heart muscle,[7] which ultimately results in remodeling of the heart atrium (which is the basis of the pathophysiology of AF).[8] Autopsy studies have shown inflammatory evidence such as myocyte necrosis and fibrosis in samples taken from the atrium tissue of patients with AF, while there was no inflammatory evidence in biopsy sample of patients without this dysrhythmia.[9]

This evidence suggests a relationship between inflammatory process and AF.[10] Oxidative stress is inevitably present in patients undergoing cardiac surgery, and the presence of this inflammatory evidence in these patients is a great sign for predicting AF.[11] The strengthening of the antioxidant defense system of the heart muscle seems to be a good way to protect the damage caused by oxidative stress.[12] Ascorbic acid (vitamin C), as a potent antioxidant, probably prevents oxidative stress in these patients.[13]

Studies have shown that the level of vitamin C decreases rapidly after fast peacemaking process in atrium.[14] Vitamin C supplementation results in blockage of electrical impedance due to short-term and fast peacemaking process in atrium. The beneficial effect of vitamin C supplementation is on preventing the reduction of the level of ascorbic acid in the cell, which also reduces the proxynitrite, which is a mediator associated with AF.[4]

Vitamin C, as an antioxidant, also reduces C-reactive protein (CRP) levels that shows the important role of vitamin C in reducing inflammation and its high anti-inflammatory effect.[15] Therefore, there is an urgent need to achieve a way for preventing AF to reduce this huge burden of health system. Prophylactic strategies for AF are predictable in many cases, but these methods are currently inadequate and there is an urgent need for more effective and alternative methods to prevent AF rhythm in susceptible patients.[16]

According to positive effects of antioxidants in preventing AF after cardiac surgery and their low side effects, it seems that the use of vitamin C supplementation, as a prophylactic strategy, in patients who undergo heart surgery is useful and effective, but more studies are still needed to ensure the effectiveness and impact of the drug and its possible side effects.

Materials and Methods

This interventional study was conducted in 2016 for one year. The population included were patients undergoing coronary artery bypass graft (CABG) surgery in cardiovascular specialty and subspecialty center of Tohid Hospital in Sanandaj, Iran. The inclusion criteria were: being over 50 years old, undergoing cardiac surgery only and no other kinds of surgery, undergoing coronary artery bypass surgery for the first time, and no cardio-respiratory arrest during or after surgery. Exclusion criteria were: history of dysrhythmia, AF, having antiarrhythmic medication such as digoxin, history of pacemaker insertion, and chronic diseases.

Data were collected by convenience sampling method, randomly, in such a way that all patients who were admitted to Tohid Hospital for elective CABG surgery were enrolled in the study if they had inclusion criteria and did not have exclusion criteria, and they were divided into intervention and control groups. Considering the intervention and the possibility of operating time for each group, 30 samples were taken as a total of 60 samples.

It was an interventional study in which oral vitamin C supplementation was prescribed to patients undergoing cardiac surgery and its effect on the incidence of AF was measured. Those who did not have inclusion criteria were excluded from the study. Patients were randomly divided into two groups. 12-lead electrocardiogram (ECG) was taken from all the patients who were admitted and their heart rhythm and ECG profile were recorded. Oral vitamin C supplementation (500 mg boiling

tablet, Iran Darou Pharmaceutical Co., Iran) was given to the patients three days prior to surgery, up to 5 days after the operation, at a dose of 500 mg twice a day. All of the patients went under CABG surgery by one team with one surgical procedure, standardly, with cardiopulmonary bypass (CPB) system. Also, all patients' standard drug requirements continued during hospitalization. The overall patient's attachment time to the CPB system from the insertion of the aortic clamp until the stabilizing heart re-perfusion was recorded. After the operation and transferring the patient to the ICU, the patient's vital signs and hemodynamic status were recorded. Patients were under continuous cardiac monitoring during the entire period of hospitalization in the ICU and were monitored directly by the researcher throughout all this time. After transferring to the unit, they were monitored for three days by Holter monitoring and were analyzed by the relevant specialist. Data were analyzed using SPSS software (version 24, IBM Corporation, Armonk, NY, USA) by t-test and chi-square test.

Results

This clinical trial research was conducted on 60 patients who underwent surgical treatment in Tohid Hospital of Sanadaj in order to investigate the effect of vitamin C supplementation on AF after CABG surgery.

The results showed a significant statistical difference between variables mentioned in the control and intervention groups and indicated that there was no significant statistical difference in the quantitative indexes of patients in the two groups. Moreover, the results showed that the probability of the effect of the quantitative indexes in post-operative AF was similar in the two groups and in the cases where there was a possibility of interference with other effective factors and the underlying and confounding factors on AF after the cardiac operation, the effect of the two groups was similar (Table 1).

The results showed that both control and intervention groups were completely similar in terms of clinical features and demographic characteristics. The last column of table 2 reflects the results of the chi-square test on the probability of a significant statistical difference between the variables mentioned in the control and intervention groups. The results indicated that there was no statistically significant difference between the qualitative variables studied in patients and the possibility of their effect on AF after cardiac surgery. The results also showed that both control and intervention groups in terms of clinical and paraclinical characteristics, during the operation of the heart surgery, were completely similar and the effect of these variables on the incidence of post-operative AF was similar in both of the groups.

Table 1. Comparison of quantitative statistical indices relative to demographic and paraclinical characteristics of patients in two groups of control and intervention

Variable	Control group	Intervention group	t	P
	Mean ± SD	Mean ± SD		
Age (year)	61.70 ± 7.30	60.07 ± 6.01	0.811	0.421
LVEF (%)	43.30 ± 8.54	44.50 ± 7.80	0.632	0.243
LVESD (cm)	2.88 ± 0.57	2.94 ± 0.59	-0.368	0.715
LVEDD (cm)	4.61 ± 0.83	4.26 ± 0.61	1.810	0.075
LAD (cm)	18.40 ± 2.48	19.30 ± 2.39	-1.320	0.191
ESR (mm/h) (before surgery)	7.34 ± 6.05	7.34 ± 6.02	1.220	0.213
WBC ($\times 10^3$) (before surgery)	0.27 ± 0.44	0.27 ± 0.44	0.630	0.314
Hb (g/dl) (before surgery)	0.51 ± 0.41	0.51 ± 0.41	1.250	0.950
HCT (before surgery)	0.07 ± 1.24	0.07 ± 1.25	0.620	0.517

LVEF: Left ventricular ejection fraction; LVESD: Left ventricular end-systolic diameter; LVEDD: Left ventricular end-diastolic diameter; LAD: Left atrial diameter; ESR: Erythrocyte sedimentation rate; WBC: White blood cell; Hb: Hemoglobin; HCT: Hematocrit; SD: Standard deviation

Table 2. Distribution of absolute and relative frequency of demographic and clinical characteristics of patients in control and intervention groups

Variable		Control group [n (%)]	Intervention group [n (%)]	Total [n (%)]	P*
Gender	Female	8 (26.7)	6 (20.0)	14 (23.3)	0.542
	Male	22 (73.3)	24 (80.0)	46 (76.7)	
HTN	Yes	8 (26.7)	8 (26.7)	16 (26.7)	> 0.999
	No	22 (73.3)	22 (73.3)	44 (73.3)	
History of smoking	Yes	5 (16.7)	5 (16.7)	10 (16.7)	> 0.999
	No	25 (83.3)	25 (83.3)	50 (83.3)	
History of MI	Yes	5 (16.7)	5 (16.7)	10 (16.7)	> 0.999
	No	25 (83.3)	25 (83.3)	50 (83.3)	
DM	Yes	6 (20.0)	5 (17.2)	11 (18.6)	0.786**
	No	24 (82.8)	24 (80.0)	48 (81.3)	
Hypercholesterolemia	Yes	2 (6.7)	2 (6.7)	4 (6.7)	> 0.999
	No	28 (93.3)	28 (93.3)	56 (93.3)	
Taking beta blocker before surgery	Yes	3 (10.0)	5 (16.7)	8 (13.3)	0.448
	No	27 (90.0)	25 (83.3)	52 (86.7)	
Taking statin before surgery	Yes	2 (6.7)	2 (6.7)	4 (6.7)	> 0.999
	No	28 (93.3)	28 (93.3)	56 (93.3)	
Taking nitrates before surgery	Yes	12 (40.0)	8 (26.7)	20 (33.3)	0.410
	No	18 (60.0)	22 (73.3)	40 (66.7)	

* Chi-square test, ** Degree of freedom (df) = 1
HTN: Hypertension; MI: Myocardial infarction; DM: Diabetes mellitus

The last column of the table represents the results of independent chi-square test on the probability of a significant statistical difference between the variables mentioned in the control and intervention groups. The results indicated that there was no statistically significant difference between these indices in both of the groups and they were completely similar (Table 2).

After demonstrating the similarity of quantitative and qualitative indices of clinical and paraclinical factors and demographic characteristics, at base and during the operation in both control and intervention groups, the role of oral vitamin C supplementation in the incidence of AF after CABG surgery will be explained.

The results showed that the average length of stay in ICU in the control group was 5.70 ± 0.41 days, and the average length of stay in ICU in the intervention group and after oral administration of vitamin C supplement was 4.60 ± 0.34 days that means duration of hospitalization in ICU in intervention group was less. Also, the average length of stay in the hospital after operation (including the total length of stay in the ICU and the surgery ward) in the control group was 0.55 ± 0.46 days, and in the intervention group was 0.67 ± 5.40 days, which showed that the two groups did not have much difference.

Discussion

This study showed that oral intake of vitamin C supplement before and after open heart surgery reduced the incidence of AF after surgery. The results of this study indicated that oral intake of vitamin C supplement before and after this operation reduced 2 times the incidence of AF. In this clinical trial study that was performed on 60 patients in control and study groups (30 in each group), the incidence of AF in the control and intervention groups was 23.3% and 10.0%, respectively.

In a similar clinical trial which was done by Borzak et al. on a total of 100 patients undergoing cardiovascular transplantation, the role of post-operative vitamin C in reducing the

incidence of AF has been studied.[17] The results of this study are in line with their results. However, the incidence of AF in their study was lower than the present study, and in the intervention group, the incidence of AF decreased.

Another study showed that the incidence of AF after open heart surgery following intravenous (IV) ascorbic acid was 61.2% in the control group and 54.47% in the intervention group. In this study, the incidence of AF after open heart surgery has been reported very high in control group (61.2%); this study has been done on a larger number of samples.[18]

In the present study, it has been shown that the intake of oral vitamin C supplement, in addition to the effect on AF, reduces the length of stay of patients in the ICU. The results indicated that the average duration of stay in ICU in control group was 5.7 days, while in the intervention group and after oral administration of oral vitamin C supplement, it was 4.6 days. This means that taking vitamin C supplement in the intervention group reduces the duration of hospitalization in ICU. In a similar study, the duration of stay of patients with AF after surgery in the ICU was 3.2 days and in patients with sinus rhythm, it was 3.2 days. This period of hospitalization in ICU in patients with AF is more than the results of the present study.[12] Other study showed that duration of hospitalization in ICU was 2.7 days in patients with AF and 2 days in patients with sinus rhythm, which is consistent with the results obtained in this study.[19]

In this study, although there was a significant difference in duration of stay of patients after surgery in both intervention and control groups, the difference, compared to other studies, was not much. The reason for this is that there was no difference between the length of stay of patients with AF who underwent CABG and those with other reasons because these patients did not undergo continuous cardiac monitoring after transferring to general ward. They were checked daily by ECG. In many cases, AF occurs in a very short time that doctors or nurses do not notice it; therefore, patients are not under certain treatment to control it. However, most of the cases of AF are self-limiting and patients need no treatment.

Conclusion

The results of this study, which are in line with extensive studies in order to achieve an effective drug or surgical method, and more importantly, an effective prophylactic method for the prevention of post-cardiac surgery arrhythmias, specifically AF, have been promising a new solution to prevent and treat this arrhythmia. These results require more trials to fully understand its effect and long-term adverse effects. The study's limitations included the need for patients' follow-up and timely intervention in administration of vitamin C in patients with postoperative AF.

Conflict of Interests

Authors have no conflict of interests.

Acknowledgments

This study was approved by Research Committee of Kurdistan University of Medical Sciences, Sanandaj. We appreciate Deputy of Research and Technology of Kurdistan University of Medical Sciences for supporting this research financially and spiritually. Also, the authors would like to acknowledge all of the patients that participated in this study. This article is derived from a research project approved and financially supported by Kurdistan University of Medical Sciences (project number: 1394/364).

References

1. Saxena R, Lewis S, Berge E, Sandercock PA, Koudstaal PJ. Risk of early death and recurrent stroke and effect of heparin in 3169 patients with acute ischemic stroke and atrial fibrillation in the International Stroke Trial. Stroke 2001; 32(10):

2333-7.
2. Singer DE, Albers GW, Dalen JE, Go AS, Halperin JL, Manning WJ. Antithrombotic therapy in atrial fibrillation: The Seventh ACCP Conference on antithrombotic and thrombolytic therapy. Chest 2004; 126(3 Suppl): 429S-56S.
3. Go AS, Hylek EM, Phillips KA, Chang Y, Henault LE, Selby JV, et al. Prevalence of diagnosed atrial fibrillation in adults: National implications for rhythm management and stroke prevention: The AnTicoagulation and Risk Factors in Atrial Fibrillation (ATRIA) Study. JAMA 2001; 285(18): 2370-5.
4. Kannel WB, Wolf PA, Benjamin EJ, Levy D. Prevalence, incidence, prognosis, and predisposing conditions for atrial fibrillation: Population-based estimates. Am J Cardiol 1998; 82(8A): 2N-9N.
5. Morris DC, Clements SD, Bailey JM. Management of the, patient after cardiac surgery. In: Fuster V, Alexander RW, O'Rourke RA, Roberts R, King SB, Nash IS, et al., Editors. Hurst's the heart. New York, NY: McGraw-Hill; 2004.
6. Chung MK. Cardiac surgery: Postoperative arrhythmias. Crit Care Med 2000; 28(10 Suppl): N136-N144.
7. Hakala T, Hedman A. Predicting the risk of atrial fibrillation after coronary artery bypass surgery. Scand Cardiovasc J 2003; 37(6): 309-15.
8. Oral H. Mechanisms of atrial fibrillation: Lessons from studies in patients. Prog Cardiovasc Dis 2005; 48(1): 29-40.
9. Maisel WH, Rawn JD, Stevenson WG. Atrial fibrillation after cardiac surgery. Ann Intern Med 2001; 135(12): 1061-73.
10. Creswell LL, Schuessler RB, Rosenbloom M, Cox JL. Hazards of postoperative atrial arrhythmias. Ann Thorac Surg 1993; 56(3): 539-49.
11. Ommen SR, Odell JA, Stanton MS. Atrial arrhythmias after cardiothoracic surgery. N Engl J Med 1997; 336(20): 1429-34.
12. Eslami M, Badkoubeh RS, Mousavi M, Radmehr H, Salehi M, Tavakoli N, et al. Oral ascorbic acid in combination with beta-blockers is more effective than beta-blockers alone in the prevention of atrial fibrillation after coronary artery bypass grafting. Tex Heart Inst J 2007; 34(3): 268-74.
13. Lloyd-Jones DM, Wang TJ, Leip EP, Larson MG, Levy D, Vasan RS, et al. Lifetime risk for development of atrial fibrillation: The Framingham Heart Study. Circulation 2004; 110(9): 1042-6.
14. Van Wagoner DR. Recent insights into the pathophysiology of atrial fibrillation. Semin Thorac Cardiovasc Surg 2007; 19(1): 9-15.
15. Wolf PA, Abbott RD, Kannel WB. Atrial fibrillation as an independent risk factor for stroke: The Framingham Study. Stroke 1991; 22(8): 983-8.
16. Andrews M, Nelson BP. Atrial fibrillation. Mt Sinai J Med 2006; 73(1): 482-92.
17. Borzak S, Tisdale JE, Amin NB, Goldberg AD, Padhi D, Higgins RS. Atrial fibrillation after bypass surgery: Does the arrhythmia or the characteristics of the patients prolong hospital stay? Chest 1998; 113(6): 1489-91.
18. Hurst JW. Hurst's the Heart. New York, NY: McGraw-Hill; 2004.
19. Almassi GH, Schowalter T, Nicolosi AC, Aggarwal A, Moritz TE, Henderson WG, et al. Atrial fibrillation after cardiac surgery: A major morbid event? Ann Surg 1997; 226(4): 501-11.