Original Research Article

Comparison of acute normovolemic hemodilution effect on the amount of bleeding in the first 48 hours after coronary artery bypass grafting

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ABSTRACT

Background: Cardiovascular disease is one of the most common causes of mortality in developed countries, as well as in the whole world. In this regard, autologous transfusion is a topic that can be useful and valuable, especially in complex surgery such as heart surgery and organ transplantation. One of its variants is Acute Normovolomic Hemodilution (ANH). Therefore, the aim of this study was to compare the effect of ANH on the amount of bleeding in the first 48hours after coronary artery bypass grafting.

Methods: In this clinical trial, 100 patients were selected from all heart patients referred to Imam Khomeini Hospital in Ardebil for CABG surgery in the years 2016-17. They were selected by simple random sampling as a statistical sample and They were divided into intervention (50 ANH recipients' people) and control groups (50 without ANH people).

Results: Based on the findings, in the ANH recipients' group, the mean of bleeding volume was 59.1±7.3ml in the first day and 55.6±4.2ml in the control group and the difference between the two groups was not significant on the first day. The mean of bleeding volume on the second day was 46.1±2.8ml in the ANH group and 42.7±2.9ml in the control group. Although it was somewhat higher, it was not statistically significant. Of all samples 45% were female and 55% were male. The most common type of blood group was 33 (33%) in the blood group O. The highest age group (61%) was over the 60 years old. The pump time varied with an average of 122.2±21.5minutes. The lowest value was PT 11 and the highest was 15 with an average of 13.02±0.9seconds. The mean of PTT was 32.5±2.6seconds and the mean INR was 1.1±1.0. The average plt was 251170±64124. The mean ACT was 596 / 6±183/7seconds.

Conclusions: The results showed that in the mean of bleeding volume between the intervention and control groups (p = 0.41), bleeding volume by age (p = 0.3), bleeding volume by gender (p =0.54) and bleeding volume by blood group (p=0.48) was not significant difference. Based on these results, it is suggested that more studies be done on the more number of samples.

Keywords: Acute normovolemic hemodilution, Bleeding, Coronary artery bypass grafting

INTRODUCTION

Today, heart diseases are the common cause of mortality in developed countries and also in the world and according the prediction of WHO, it will be the main cause of the death in the world at 2020.[1]

Atherosclerosis often causes angina (chest pain) and myocardial infarction which was one of the most commonly diagnoses in patients admitted to industrialized countries.[2]

This disease in compare with other diseases, deal to more mortality, disability and cost, so that in all age groups in

ischemic heart disease it was the common cause of death among men and women.[3]

Doing coronary artery bypass graft (GABG) related to the symptom severity, coronary anatomia and left ventricular function. Candidate patients for CABG had difficult or debilitating symptoms that weren't controlled with medical treatment and or could not tolerate the medical treatment and they want to have more active life or in several coronary arteries have severe stenosis. When patient have disorder in left ventricular function or have severe stenosis in several coronary arteries and or in patients who the invasive methods had high risk and side-effect, CABG can increase the life duration and quality of life in patients.[3,4]

According recent studies, there were more effective causes on CABG contaminations included: female gender, low BMI, left ventricular week function, history of BP, more blood fatty, DM, HB, peripheral vascular involvement, low HC before surgery, emergency surgery, three vessel conflicts and left main coronary artery (LMCA).[4-7]

But in some studies, female gender had not affected on rate of contaminations and rate of mortality in women was more than men.[8-11]

The term acute normovolemic hemodilution (ANH) refers to taking blood from a candidate for surgery, immediately before or immediately after induction of anesthesia, with the replacement of crystalloid or colloidal fluid and the blood being taken back to the patient. ANH divided in two groups limited and extreme that in limited type the HC level decrease and reach to 28% and in extreme type it reaches to 20%. Similar to other techniques, ANH is a technique that used for decreasing need to allogenic RBC and transfusion side-effects.[12]

ANH technique is more effective in decreasing the need for transmission RBC in patients under CABG but the potential role of complete and fresh autologous blood transfusion in reducing postoperative bleeding is still not fully understood. Multiple mechanisms are involved in compensating for acute hemoglobin abnormality, the best of which is the increase in cardiac output. The cause of an increase in cardiac output in ANH is the reduction of viscosity of blood, which is evident in the most severe reduction in viscosity in hematocrit, between 30% and 45%. Decreased viscosity causes increased venous return and post load reduction.[13-16]

Another benefit of ANH is a significant increase in coronary and myocardial blood flow, that the CABG and reduction vascular resistance are the factors in increasing the flow of coronary arteries. The remarkable point is that compensatory mechanisms during ANH are largely independent of age and left ventricular ejection fraction (EF).[16-18]

It has also been observed that the amount of oxygenation in the hematocrit level was tolerated about 17% and in some cases such as renal failure, and severe and obstructive pulmonary disease, ANH had contraindicated. Other cases of contraindication are coagulation disorders - thrombocytopenia or platelet dysfunction.[19-21]

For diagnosis the coagulation disorders the best way was use of thromboelastography (TEG) which noninvasively examines the patient's blood sample for hemostatic coagulation and shows the coagulation status of the patient as hypo, normal or hyper in the form of quantitative or qualitative and in addition show the lysis and platelet dysfunction.[22-23]

The aim of this study was to comparison of acute normovolemic hemodilution effect on the amount of bleeding in the first 48 hours after coronary artery bypass grafting.

METHODS

This is a one blind randomized clinical trial study that had been done on 100 patients referred to Ardabil city hospital for CABG. Patients divided randomly in two case and control groups based on the week days and the date of admission. After induction of anesthesia in the operating room and before the patient is connected to the blood circulation pump, the blood is taken from the patients in the intervention group, which was replaced with a crystalloid serum.

Inclusion criteria

- Candidate patients for CABG without unknown coagulation disorders and
- Unused the drugs for this disorder such as heparin, coumarin, plavix entered the study.

Exclusion criteria

- Patients with Hb <1, p.c >20, platelet and FFP receivers
- Plavix and transamine drugs and patients with platelet low than 100000.

Data collection and follow-up patients

The patients in case group receive the previously blood takin from own and another group not receive any blood. Patients be transferred to ICU after surgery and the checklist which included information such as sex, BT, bloodletting, pump time, platelet number, ACT in the end of pump, INR, PTT, PT and rate of bleeding completed for each patient.

All patients in two groups were matched in more variables and all variables were in normal range but the patients only compared in variables such age, sex, blood type and rate of bleeding.

The rate bof bleeding in first 48hours in ICU were measured 24times at distance two hour by graded drains (mm).

Statistical analysis

Collected data analyzed by statistical methods in SPSS version 21. The p <0.05 was set as significant.

Ethical approve

Also, all patients completed the consent form and this study approve by university ethical committee by code IR.ARUMS.REC.2016.47 and registered in IRCT by code 2017041933529N1.

RESULTS

In this study 100 patient candidate for CABG that in 50 patients authors have done ANH (interventional group) and in 50 patients authors select as control group without any intervention. Of all patients, 45% were female and 55% were male. Most of them had blood type O (33%).

The age of patients ranged from 40 to 80 and most of cases with 61% were in age group up 60 years. There wasn't significant difference between two groups in terms of variables such as age (p=0.12), gender (p=0.07), blood type (p=0.6), pump time (p=0.2), PT (p=0.7), PTT (p=0.3), INR (p=0.8), plt (p=0.29) and ACT (p=0.4) and two groups are similar in baseline.

In the group receive ANH, the mean of bleeding in first day was 59.1±7.3ml and in control group was 55.6±4.2ml and the difference between two groups wasn't significant.

At 48hours after receiving ANH, the rate of bleeding was 46.1±2.8ml which compare to the control group with 42.7±2.9ml it was so more but the difference wasn't statistically significant. It can be saying that ANH hasn't significant effect on bleeding rate after 48hrs.

Table 1: Compare the bleeding rate in ANH group and control group.

Day	Groups	Mean±SD	p-value
First day	ANH	59.1±7.3	0.67
	Without-ANH	55.6±4.2	
Second day	ANH	46.1±2.7	0.41
	Without-ANH	42.7±2.9	

Table 2: Compare the bleeding rate in ANH group and control group by age groups in first and second day after surgery.

Age groups	Group	Mean±SD (first day)	p-value	Mean±SD (second day)	p-value
40-50	ANH	64.6±4	0.001	48.5±19.1	0.09
	Without-ANH	112.5±2.5		66.6±5	
50-60	ANH	46.7±6.3	0.027	50.1±23.7	0.45
	Without-ANH	71.1±3.3		42.6±22.1	
>60	ANH	65.7±4.5	0.07	42.6±17.2	0.3
	Without-ANH	47±2.4		40.6±20.8	

Table 3: Compare the bleeding rate in ANH group and control group by sex in first and second day after surgery.

Sex	Group	Mean±SD (first day)	p-value	Mean±SD (second day)	p-value
Female	ANH	52±5.9	0.29	44.4±14.5	0.54
	Without-ANH	52.3±2.8		41.2±22	
Male	ANH	63±4.6	0.29	46.9±22.4	0.54
	Without-ANH	58.4±3.2		42.2±20.4	

Table 4: Compare the bleeding rate in ANH group and control group by blood type in first and second day after surgery.

Blood type	Group	Mean±SD (first day)	p-value	Mean±SD (second day)	p-value
A	ANH	28.7±1.4	0.006	45±15.7	0.4
	Without-ANH	54±2.5		38.3±15.8	
B	ANH	50.9±3.1	0.2	54.4±17.7	0.2
	Without-ANH	65.1±1.1		41.5±18	
AB	ANH	67±3.1	0.3	42.6±18.9	0.6
	Without-ANH	54.5±2.7		44.3±24	
O	ANH	76±7.5	0.02	41.1±22.7	0.8
	Without-ANH	50.1±4.1		42.3±25.1	

There wasn't significant difference between two groups in rate of bleeding in first and second day after CABG (Table 1).

In compare the effect of ANH on bleeding rate in first day and 48hours after surgery by age the difference was significant in first day in age groups 40-50 and 50-60 and authors can say that ANH had significant effect on bleeding rate within some of age groups (Table 2).

Results showed that the effect of ANH on bleeding rate by sex between two groups wasn't significant (Table 3).

Results showed that the effect of ANH on bleeding rate by blood type between two groups was significant in blood type A and O in first day but in the second day the difference wasn't significant between two groups (Table 4).

DISCUSSION

In Naddafnia H et al, study, there wasn't significant difference between two groups in term of transfusion rate in ICU, operation room and chest drainage at first 6hours but the rate of second transfusion the chest drainage in 6hours was significant (p=0.001) and the result is in line with our study.[20] Mahoori A et al, in a study showed that the removal and suctioning of about one autologous blood unit did not have any effect on post-operative bleeding or platelet counts which in line with present study results.[21]

Or TH et al, in a study showed that ANH in CABG could decrease the need for the blood bank components such as PRBC, FFP and platelet counts during surgery that this study results wasn't confirmed by present study.[22]

Casati V et al, in a study on the assessment of ANH effect on decreasing need for allogenic blood and removal blood in patients undergoing elective open heart surgery, showed that the ANH in low rate hadn't significant effect on allogeneic blood and bleeding after surgery that the results of this study is in line with our study results.[23]

Helm RE et al, in a study showed that removal and returning maximum volume of new autologous blood hadn't significant effect on bleeding rate after surgery or platelet and injected coagulation factors that in line with present study results.[24]

Virmani S et al, in a study showed that ANH in low volume hadn't significant effect on need for allogeneic blood in elective open-heart surgery that in line with present study results.[25]

CONCLUSION

The result of this study showed that ANH hadn't significant effect on rate of bleeding in 48hours compare to the baseline. Due to lack of influence of ANH on bleeding rate 48hours after CABG in two case and control group, it was recommended to doing another study in future with big sample size.

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