

A COMPARISON OF TOTAL AMOUNT OF BLOOD NEEDED IN PATIENTS TAKING AUTOLOGOUS OR HOMOLOGOUS BLOOD TRANSFUSION IN CORONARY ARTERY BYPASS GRAFTING: A Clinical Randomized Case-Control Trial

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ABSTRACT

Objective: The aim of this clinical case-control trial was to compare the total amount of blood needed in patients taking autologous or homologous blood transfusion in coronary artery bypass grafting (CABG) surgery.

Methodology: Sixty patients scheduled for CABG were randomly allocated to ANH (Acute Normovolemic Hemodynamic) group (A group) or control group (B group). Hematocrit before operation and 24 hours after the operation were checked. The amount of the total blood needed in each group was measured at the end of the operation.

Result: There was no significant difference between the two groups as regards post operational hematocrit. The mean total blood infused to the control and ANH group was 2010ml and 1815ml respectively. However there was significant difference between the two groups as regards the total amount of the blood needed during operation.

Conclusion: Our randomized, double blinded case control study demonstrated that autologous blood, beside carrying lower risks for hemolytic and nonhemolytic transfusion reactions decrease the total amount of blood needed for CABG. However larger studies with more patients are needed to confirm the results.

KEY WORDS: CABG surgery, Blood requirement, Autologous, Homologous blood transfusion.

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INTRODUCTION

Coronary artery bypass graft (CABG) surgery is one of the most common surgical procedures performed in the United States, with about

300,000 performed annually.¹ It is estimated that approximately 20% of all blood transfused in North America is associated with cardiac surgical procedures.² Consensus recommendations are to consider intraoperative transfusion of packed cells if the hematocrit level decreases to less than 19% intraoperatively in cardiac surgery.^{3,4} There are several studies that have demonstrated that normovolemic hemodilution (NH) technique would limit postoperative homologous blood transfusion requirements.⁵⁻⁷ Risks of allogenic transfusion therapy mainly involve hemolytic and nonhemolytic transfusion reactions, alloimmunization and immunomodulation in the recipient, and the transmission of blood-

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borne infections.⁸⁻¹¹ Several auto transfusion techniques have evolved and major blood conservation achievements have been accomplished by predonation of autologous blood,¹² pre-bypass removal of autologous blood with isovolumetric substitution¹³ reinfusion of the volume remaining in the extracorporeal circuit¹⁴ and postoperative auto transfusion of the shed mediastinal drainage blood.¹⁵⁻¹⁹ Although there is a consensus regarding the safety of autologous blood transfusion, still there is a debate with respect to the effectiveness of autologous blood transfusion in reducing the amount of the total blood needed in CABG.

The aim of this clinical case-control trial was to compare the total amount of blood needed in patients taking autologous or homologous blood transfusion in coronary artery bypass grafting (CABG).

METHODS

Study Design: A randomized, double blind case-control trial was performed in two general hospitals affiliated with Shiraz University of Medical Sciences, with all consecutive patients scheduled for coronary artery bypass grafting (CABG) during a 6-month period. After written informed consent was obtained, patients were randomized to two groups. All data were registered by an independent investigator, and the intensive care unit (ICU) staff on the ward, was blinded for the randomization. The hospital medical ethical committee approved our study design. This was a trial where patients entered the study when they discontinued receiving aspirin at least 7 days before surgery.

Patients: Sixty patients scheduled for CABG were included in the study after they met the following criteria: age between 55 and 75 years, normal left ventricular function test result (tested by echocardiography), and an adequate hemoglobin level (at least 13g/dl) and weight to allow withdrawal of at least 500ml of whole blood. Exclusion criteria were any other medical or surgical problems rather than their current coronary artery disease. The patients in the two groups were matched regarding sex, age, and left ventricular function, the

number of coronary artery involved and baseline hemoglobin level.

Interventions: There were two treatment arms: an ANH (Acute normovolemic hemodilution) group (A group) and a control group (B group). In the ANH group, after induction of anesthesia and before the initiation of the cardiopulmonary machine and administration of heparin, the blood intermittently was withdrawn from the patients and were stored in a routine suspension to prevent clotting. At the end of operation and after separating the patients from the cardiopulmonary machine, the collected blood was returned to the patients. For both groups, normal aseptic guidelines were followed during harvesting. The blood was kept at room temperature to keep the platelet function as optimal as possible. Three times the amount of the collected blood was replaced by crystalloid fluids to the patients in ANH group. The targeted hematocrit level for hemodilution for all patients was 25%. The need for fluid infusion was closely monitored by the attending anesthesiologist; if necessary homologous blood was infused. During the operation the blood pressure and pulse rate and also EKG was monitored. In the control group, there was no auto transfusion and just heterogeneous blood was used as needed.

Hematocrit before operation and 24 hours after the operation were checked. The amount of the total blood needed in each group was measured at the end of the operation. Independent sample t-test was used to compare means between the two groups. P-value below 0.05 was considered significant.

RESULTS

Eighty percent of patients were male. The average age was 61.9 and 58.5 years in ANH group and control group respectively. The control group was matched with the ANH group regarding sex, age and cardiac function status. Measured data are included in Table-I. Twenty four hour post operational mean hematocrit was 37 ± 2 and 36 ± 1.5 in the control and ANH group respectively. There was no significant difference between the two

Table-I: The patients' baseline characteristics.

	Case (ANH) group	Control group
Age (y)	61.9(8.1)	58.3(8.1)
Weight (kg)	84(7)	86(8)
Plasma sodium (mmol/L)	139(2)	141(3)
Plasma creatinine (mmol/L)	100(16)	97(14)
Hemoglobin(g/dl)	14.1(0.5)	14.5(0.4)

groups in this regard ($P=0.21$). This indicates that blood supply has been appropriate in the two groups.

The mean total blood infused to the control and ANH group was 2010ml and 1815ml respectively. There was significant difference between the two groups regarding the total amount of the blood needed during operation ($P=0.02$). Of the 1815 ml blood needed in the ANH group, 870ml (47.9%) was homologous and 945(52.1%)ml was autologous.

DISCUSSION

This study demonstrated that the use of fresh autologous blood, administered during the operation with citrate anticoagulation, is effective in reducing the need for total and homologous blood.

In a review of literature we found that there is a debate with regard to the effectiveness of autologous blood transfusion in reducing the amount of the total blood needed. Kaplan et al.²⁰ in a study on one hundred patients concluded that the amount of blood needed in the

Table-II: 24 hour post operation hematocrit and mean total blood used in each group

	ANH Group	Control Group	P value
24 hour post operation Hematocrit	36.5±1.5	37±2	0.217
Mean total blood used	1815	2010	0.024
Mean total homologous blood used	870	2010	----
Mean homogenous total blood used	945	----	----

group taking autologous blood was 18% less than the control group. Some randomized trials^{21,22} focused retrospectively during their analysis on the question of whether intra operative blood sequestration was beneficial in regard of lower amount of blood needed intra operationally in a group of patients undergoing CABG, found positive effect. Scezs and associates²³ and Kochamba and associates²⁴ reported a positive effect of fresh blood auto transfusion. The need for allogeneic blood was reduced to 40% and 45%, in the two studies, respectively. Postoperative blood loss was reduced in these trials, with 24% and 28% compared with control subjects. The value of reducing blood loss and use of allogeneic blood was recently reappraised by Michalopoulos and colleagues.²⁵ They found that the use of allogeneic blood has a deleterious effect on survival after CABG. The mortality rate increased if blood donations were needed in conjunction with inotropic agents in the immediate postoperative period.

However, Ramnath et al²⁶ demonstrated that the use of fresh autologous blood, administered during the operation with heparin or citrate anticoagulation, is not effective in reducing either the need for allogeneic blood or the postoperative blood loss. There are also some other studies that found that autologous blood, administered during the operation is not superior to heterogeneous blood as regards the total amount of blood needed for an operation.^{27,28}

In conclusion, our study demonstrated that autologous blood, beside carrying lower risks for hemolytic and nonhemolytic transfusion reactions, alloimmunization, immunomodulation and the transmission of blood-borne infections, decrease the total amount of blood needed for CABG. However larger studies with more patients are needed to confirm the results.

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