*Original Research Article*

Indian Journal of Anesthesia and Analgesia
January – February 2020; 7(1) (Part - I): 150-154
DOI: http://dx.doi.org/10.21088/ijaa.2349.8471.7120.21

# Prognosticators of Packed Red Blood Cell Transfusion in Patients Undergoing Off Pump Coronary Revascularization

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**Abstract**

*Background:* Coronary revascularization surgery is a procedure associated with higher rate of transfusion. Approximately 20% of all cardiac surgeries require allogeneic blood transfusions. The Red Blood Cells (RBCs) transfusion increases the morbidity and mortality in any surgery. The understanding of preoperative variables pertinent with the Red Blood Cells (RBCs) transfusion will authenticate the risks of transfusion and thus cede the need for productive blood conservancy methods. The intention of this study was to regulate the clinical and demographic variables associated with blood product transfusion in patients undergoing elective off pump coronary revascularization surgery. *Materials and Methods:* This was a single-center retrospective study conducted on 142 patients who had undergone elective off pump coronary revascularization surgery Patients' preoperative clinical and demographic data, were analyzed. The preoperative lab analysis like hemoglobin, hematocrit, renal functions and coagulation profile were cataloged. The primary endpoints of interest was packed red blood cell transfusion. Secondary outcomes analyzes were reoperation rate for bleeding or cardiac tamponed and total postoperative chest tube drainage. Only intraoperative and postoperative (6 days) homologous packed RBC transfusions were recorded. *Results:* A total of 142 patients who underwent isolated off pump coronary revascularization surgery were studied. Blood transfusions were given to 23 of 142 patients (16.19%). Eleven of 41 women (26.8%) needed transfusion, compared with 12 of 101 men (11.9%) ($p < 0.028$). *Conclusion:* In the present study, we conclude preoperative anemia, low hematocrit and female gender were certainly associated with perioperative allogeneic red blood cells transfusion in patients undergoing off pump coronary revascularization surgery.

**Keywords:** Anemia; Blood transfusion; Cardiac surgery; Hematocrit; Off Pump Coronary revascularization surgery (OPCAB); Red Blood Cells (RBC).

**How to cite this article:**
Vijaya Kumara, Harshil Joshi, Guru Prasad Rai D. Prognosticators of Packed Red Blood Cell Transfusion in Patients Undergoing Off Pump Coronary Revascularization. Indian J Anesth Analg. 2020;7(1 Part -I):150–154.

## Introduction

Coronary revascularization surgery is one of the commonest open cardiac surgeries done latterly. It is associated with momentous blood loss and increased extent of blood transfusion.[1] Over and above 20% of all Coronary revascularization surgeries require blood transfusions in the United States.[2] Customarily, coronary revascularization surgery was done using Cardiopulmonary Bypass

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**Received on** 10.10.2019, **Accepted on** 28.11.2019

(CPB) which allows the heart to be arrested and provides an immobile and bloodless field to enable optimal and complete revascularization. Today most of the coronary revascularization surgery are done on beating heart without use of CPB (OPCAB). There are inconclusive differences in terms of postoperative mortality, morbidity and adequacy of revascularization between patients undergoing OPCAB and coronary revascularization surgery with CPB, but the studies show that the patients undergoing coronary revascularization surgery with CPB are transfused more blood than those undergone OPCAB.[3,4] The red blood cells transfusion is associated with profound complications wholly related to transfusion like febrile nonhemolytic reactions, infections, TRALI Graft-*Vs*-Host Disease (GVHD), Transfusion-associated circulatory overload etc.[5] There are several blood conservancy techniques, which could result in reduction in superfluous blood transfusion. Routinely consummated are autologous blood donation, red cell salvage, hemostatic and antifibrinolytic agents and normovolemic hemodilution.[6] The understanding of preoperative variables pertinent with the Red Blood Cells (RBCs) transfusion will authenticate the risks of transfusion and thus, cede the need for productive blood conservancy methods. The intent of this study was to determine the clinical and demographic covariates associated with red blood cells transfusion in patients undergoing elective Off Pump Coronary revascularization surgery (OPCAB).

## Materials and Methods

The study was conducted at a tertiary care hospital using the clinical data of patients who underwent isolated elective off pump coronary revascularization surgery. This was an observational retrospective study conducted between November 2017 and October 2018. Patients who had undergone emergency coronary revascularization surgery surgeries, concomitant cardiac surgical procedure like coronary revascularization surgery with Mitral Valve Replacement (MVR) or coronary revascularization surgery with Aortic Valve Replacement (AVR) and on pump coronary revascularization surgery (using CPB) were excluded from study. Patient's demographic data, preoperative investigations like hemoglobin, hematocrit, renal functions and coagulation profile and perioperative data were collected from hospital data base.

Preoperative criterion analyzed were age, sex, Body Surface Area (BSA), stenosis of left main coronary artery > 50%, antiplatelet medications within seven days before operation, preoperative heparin therapy, history of recent myocardial infarction (within 6 months), Left Ventricular Ejection Fraction (LVEF), prior cardiac surgery, chronic renal failure, cerebrovascular disease, antifibrinolytic drugs and last preoperative hematocrits. Number of distal anastomoses performed, use of Left Internal Mammary Arteries (LIMA), lowest intraoperative hematocrits and transfusion of blood products were documented intraoperatively.

The primary endpoints of interest was packed red blood cell transfusions, reoperation rate for bleeding or cardiac tamponed and total postoperative chest tube drainage. Only intraoperative and postoperative (6 days) homologous packed RBC transfusions were recorded.

### *Anesthesia Technique*

All patients were given general anesthesia with intravenous induction agents using fentanyl, midazolam and propofol according to patients' clinical requirement. Inhalational agent isoflurane was used for maintenance of anesthesia in all patients. To maintain stable hemodynamics, noradrenaline was used as and when required. One gram of antifibrinolytic agent (inj. tranexamic acid) was given to all patients before the skin incision. OPCAB was done with midline sternotomy incision. Variable number of grafts were anastomosed depending on patients' clinical conditions using left internal mammary artery grafts and saphenous vein grafts. Anticoagulation was achieved with intravenous heparin 200–300 IU/kg to the target Activated Clotting Time (ACT) of 250–350. Anticoagulation was partially reversed with intravenous protamine 1 mg/100 units of heparin after completion of last anastomosis. All patients were electively ventilated for 2–4 hours postoperatively. Postoperative hemodynamics, chest tube drain and allogenic PRBC transfusion if any were charted. Institutional Research Committee and Institutional Ethical Committee clearance were taken prior to conducting the study and the study compiles with current ethical consideration.

### *Data Analysis*

All quantitative data were coded and transformed into an excel master sheet for computer programming. A Chi-square test was used to evaluate categorical variables for analysis. For

all practical analyses, $p < 0.05$ was accepted to be statistically significant. Statistical analysis of the data was done using SPSS (version 16) package.

## Results

Total 194 patients underwent coronary revascularization surgery November 2017 to October 2018. We excluded 52 patients who underwent concomitant procedures and on pump coronary revascularization surgery leaving 142 patients who underwent isolated off pump coronary revascularization surgery for study. Preoperative patient demographics have been detailed in Table 1. Blood transfusions were given to 23 of 142 patients (16.19%). Eleven of 41 women (26.8%) needed transfusion, in comparison with 12 of 101 men (11.9%) ($p < 0.028$). Preoperative hemoglobin and hematocrit are compared in Table 2, preoperative hemoglobin and preoperative hematocrit were significantly associated with intraoperative blood transfusion. Perioperative details are given in Table 3. Number of distal grafts more than 3 was associated with increased requirement of intraoperative blood transfusion. In present study, diabetes mellitus, hypertension, age of patients, preoperative heparin therapy and recent MI had no association with increase in transfusion requirement in patients undergoing off pump coronary revascularization surgery.

**Table 1:** Preoperative demography characteristics

| Covariates | Without transfusion ($n$ = 119) | Transfusion ($n$ = 23) | $p$ - value |
|---|---|---|---|
| Age (mean) | 58 | 64 | |
| Sex Male | 89 (88.1%) | 12 (11.9%) | |
| Female | 30 (73.2%) | 11 (26.8%) | 0.028 |
| **Comorbidities** | | | |
| Diabetes Yes | 105 (83.3%) | 21 (16.7%) | |
| No | 14 (87.5%) | 2 (12.5%) | 0.65 |
| Hypertension Yes | 110 (84%) | 21 (16%) | |
| No | 9 (81.8%) | 2 (18.2%) | 0.085 |
| Smoking | 28 (90.3%) | 3 (9.7%) | 0.26 |
| CVA | 3 (100%) | 0 | |
| CKD | 6 | 0 | 0.27 |

**Table 2:** Comparing preoperative hemoglobin and hematocrit

| | Without transfusion ($n$ = 119) | Transfusion ($n$ = 23) | $p$ - value |
|---|---|---|---|
| **Preoperative Hb** | | | |
| < 11 gm/% | 3 | 11 | 0.02 |
| > 11 gm/% | 116 | 12 | |
| **Preoperative Hct** | | | |
| < 34% | 10 | 15 | 0.03 |
| > 34% | 109 | 8 | |

**Table 3:** Perioperative assessment

| | Without transfusion ($n$ = 119) | Transfusion ($n$ = 23) | $p$ - value |
|---|---|---|---|
| Recent MI | 14 (70%) | 6 (30%) | 0.071 |
| Preoperative heparin | 18 (78.3%) | 5 (21.7%) | 0.25 |
| **Ejection fraction** | | | |
| > 50% | 91 (81.2%) | 21 (18.8%) | 0.11 |
| 35–50% | 17 (89.5%) | 2 (10.5%) | 0.47 |
| < 35% | 10 (100%) | 0 | 0.14 |

| | Without transfusion ($n$ = 119) | Transfusion ($n$ = 23) | $p$ - value |
|---|---|---|---|
| **Extent of coronary artery disease** | | | |
| Single vessel disease | 3 (75%) | 1 (25%) | 0.62 |
| Double vessel disease | 17 (85%) | 3 (15%) | 0.86 |
| Triple vessel disease | 92 (83.6%) | 18 (16.4%) | 0.92 |
| LMCA | 36 (78.3%) | 10 (21.7% | 0.89 |
| **Nos. of grafts** | | | |
| 1 | 1 (100%) | 0 | |
| 2 | 9 (90%) | 1 (10%) | 0.86 |
| 3 | 52 (98.1%) | 1 (1.9%) | 0.92 |
| 4 | 47 (79.7%) | 13 (20.3%) | 0.13 |
| 5 | 8 (50%) | 8 (50%) | 0.09 |

## Discussion

Blood transfusion in cardiac surgeries is enormous, followed by orthopedic surgeries. Patients undergoing cardiac surgery require higher rates of transfusions than patients undergoing noncardiac surgeries.[6] Blood transfusion during cardiac surgeries is primarily from hemodilution from pump priming or to correct coagulopathy and blood loss during surgery. This observational retrospective study was undertaken to determine variable risk-factors for allogeneic red blood cell transfusion in patients undergoing off pump coronary revascularization surgery, which is associated with a major blood loss.

According to the guidelines of Society of Thoracic Surgeons and other reports suggests blood transfusion rate diversifies significantly between surgeons and institutions.[7,9] Allogeneic red blood cell transfusion rates of 8–100% have been proclaimed during coronary revascularization surgery in many studies.[10,11] This extensive inconstancy may be explained by a variety of facts which include differences in patient populace among the study centers, preoperative medication with antiplatelet agents and anticoagulants and several surgical and procedure-related factors.[12,13] Many studies have compared the transfusion requirement in on pump and off pump coronary revascularization surgery. Recently off pump coronary revascularization surgeries done more frequently than on pump coronary revascularization surgery because of improvement in surgical skills and technology, but the blood transfusion requirement is still high compared to noncardiac surgeries.

Recent studies have reported anemia as a considerable predictor for requirement of transfusion. However, it is still unclear what hemoglobin level indicates the need for transfusion. The Society of Thoracic Surgeons latest guidelines for blood transfusion and conservation in cardiac surgery recommends a hemoglobin level of < 7 g/dl for PRBC transfusion. However, the level of evidence is 'C' with a recommendation of 'Class 2a', which means that supporting evidence is still insufficient.[14,15] Recent reports have determined poor results when transfusion is due to preoperative anemia or blood dyscrasias.[16,18] In 2014, Engoren et al. evaluated late mortality in 922 patients who underwent isolated coronary revascularization surgery during a 3.5-year period. They established that patients with preoperative anemia who received intraoperative transfusion had an increased rate of death compared with those without anemia and transfusion.[19] Numerous strategies exist for dealing with preoperative anemia in patient undergoing coronary revascularization surgery. In patients with delayed surgery with known risk-factors for transfusion, optimization with erythropoiesis-stimulating agents should begin before surgery.

### *Limitations*

The limitations in this study include, it's a retrospective, descriptive in nature and small cohort size. More prospective long-term studies must be designed to explore the risk-factors of blood transfusion in OPCAB and to validate our current findings.

## Conclusion

In denouement, our study showed that preoperative anemia, low hematocrit and female gender wereunquestionably associated with perioperative allogeneic red blood cell transfusion in patients undergoing OPCAB.

### *Conflict of Interests*

The writer declared no conflicts of interest with regards to the analysis, authorship and/or publication of this article.

### *Acknowledgment*

The writer would like to express their acknowledgement to the Hospital Records Department at Kasturba Hospital for providing access to case reports.

### *Financial disclosure*

There is no financial disclosure.

### *Funding/support*

The authors received no financial support for the research, authorship and/or publication of this article.

Institutional ethics committee has been taken (Approval no: IEC 48/2019).

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