

# Association of Perioperative Whole Blood Transfusion with Troponin I Release after Off-Pump Coronary Artery Bypass Surgery

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## Abstract:

**Background:** Increased postoperative levels of Troponin I (TnI) after Off-pump Coronary Artery Bypass Grafting (OPCABG) surgery can often be observed in patients in the absence of significant perioperative hemodynamic instability or any evident intra-operative technical problems or signs of graft failure. A study undertaken by Biancari and his colleagues (2012) found that Red Blood Cell transfusion was associated with increased TnI release after elective OPCABG<sup>1</sup>. Serum TnI level is an established indicator of myocardial injury. This prospective observational study was conducted in the Department of Cardiac Surgery, National Institute of Cardiovascular Diseases and Department of Cardiac Surgery, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, from January 2015 to December 2016 to assess whether intraoperative and immediate postoperative Whole Blood Transfusion resulted in increased release of TnI after isolated OPCABG operation.

**Materials & Methods:** A total of 40 patients (34 males and 6 females) undergoing OPCABG were consecutively enrolled in the study, 20 patients in the transfusion recipient group and 20 patients in the non-transfusion recipient group. The groups were compared for pre-operative baseline characteristics and co-morbidities, per-operative techniques and events, and postoperative or end-point variables including Postoperative TnI level measured 12 hours at the end of surgery and a number of other clinical outcomes.

**Results:** Both transfusion recipient and non-transfusion recipient groups had statistically indifferent baseline characteristics, co-morbidity counts, operative techniques and operative events. No significant difference ( $p = 1.000$ ) was noted in case-counts with increased Postoperative TnI level between the groups (85% in the transfusion recipient group versus 90% in the non-transfusion recipient group). All other clinical outcomes were also found to be similarly distributed with no statistical difference between the groups.

**Conclusion:** In contrast to Red Blood Cell transfusion in several other studies, perioperative Whole Blood transfusion was not associated with increased postoperative Troponin I (TnI) release after isolated off-pump coronary artery bypass grafting (OPCABG) operation.

**Key words:** Blood transfusion, Troponin I, OPCABG.

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## Introduction:

Nearly half of the patients undergoing coronary artery bypass grafting (CABG) are exposed to Red Blood Cell (RBC) products. Although large volumes (3+ units) of transfusions are typically given to preserve life in cases of acute blood loss, smaller quantities may be potentially avoidable.<sup>2</sup>

Published researches suggest that patients exposed to even 1 to 2 units of RBCs may have a 2.44 times unadjusted & 1.86 times propensity adjusted increase in mortality. In addition, sternal wound infection, stroke, renal failure, new-onset dialysis, atrial fibrillation, reoperation for bleeding, prolonged ventilation time >24 hours, total intensive care unit stay > 24 hours, postoperative length

of stay > 7 days were also found to be significantly associated with perioperative blood transfusion.<sup>3</sup>

In addition, RBC transfusion has been found to be associated with pneumonia,<sup>2</sup> blood stream infections<sup>4</sup>, low-output graft heart failure,<sup>5</sup> increased hazard of graft occlusion.<sup>6</sup>

Myocardial injury after coronary artery bypass graft surgery (CABG), as measured by cardiac biomarkers is associated with a significantly higher risk of early and late mortality.<sup>7</sup> In particular, cardiac Troponin I (TnI) seems to be the most accurate biomarker of myocardial injury after cardiac surgery.<sup>8,9</sup>

A study undertaken by Biancari and his colleagues (2012) found that Red Blood Cell transfusion was associated with increased TnI release after elective Off-pump CABG (OPCABG) surgery, independent of haemoglobin and haematocrit nadirs.<sup>1</sup>

Pathophysiological explanation is that, the reduced deformability of stored RBCs, which may result in occlusion of the microcirculation by nondeformable RBCs is ineffective in salvaging ischaemic myocardium.<sup>1</sup> In addition, stored RBCs have lower adenosine triphosphate (ATP) levels and impaired ability to release it in the micro-circulation. Therefore, the potent ATP-related vasodilatory effect is suboptimal.<sup>10</sup> The high free haemoglobin

concentrations measured in stored RBC may further affect microcirculation because free haemoglobin has a potent nitric oxide (Endothelium Derived Relaxation Factor) scavenging ability, and this may induce vasoconstriction and worsen the ischemic injury.<sup>11</sup>

The present research is aimed at observing whether similar phenomenon of increased TnI release takes place when Whole Blood is transfused instead of RBC during the perioperative period of OPCABG.

#### Methods:

This prospective observational study was performed at the Department of Cardiac Surgery, National Institute of Cardiovascular Diseases (NICVD) and the Department of Cardiac Surgery, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, from January 2015 to December 2016. A Total of 40 patients undergoing isolated OPCABG, 20 in the *transfusion recipient group* and 20 in the *non-transfusion recipient group* were enrolled consecutively. TnI levels were measured for all patients 12 hours after the end of operation. Statistical analysis was done using SPSS version 19.

#### Results:

There were no statistically significant differences between the two groups in any of the baseline, preoperative or postoperative characteristics.

**Table-I**  
*Baseline Characteristics*

Variable	Transfusion recipient (n=20)	Non-transfusion recipient (n=20)	P value
Age (years) <sup>#</sup>	55.85 ± 8.34	55.50 ± 8.847	0.898
Age > 60years <sup>2%</sup>	5 (25.0%)	5 (25.0%)	1.000
Female Sex	4 (20.0%)	2 (10.0%)	0.661
Body Mass Index (kg/m <sup>2</sup> ) <sup>#</sup>	24.72 ± 3.16	23.74 ± 3.01	0.325
Obese (BMI <sup>&gt;</sup> 30)	1 (5.0%)	1 (5.0%)	1.000
Hypertension <sup>2%</sup>	11 (55.0%)	9 (45.0%)	0.342
Respiratory disease	0 (0.0%)	2 (10.0%)	0.487
Diabetes mellitus <sup>2%</sup>	11 (55.0%)	8 (40.0%)	0.342
History of cardiogenic shock	0 (0.0%)	0 (0.0%)	n/a
NYHA III/IV status <sup>2%</sup>	14 (70.0%)	12 (60.0%)	0.507
EuroSCORE II <sup>&amp;!</sup>	2.00 (IQR 0.99 – 2.70)	1.55 (IQR 0.94 – 2.05)	0.185
Impaired LVEF(30-49%) <sup>2%</sup>	7 (35.0%)	8 (40.0%)	0.744
Single Vessel Disease	0 (0.0%)	0 (2.0%)	n/a
Double Vessel Disease <sup>2%</sup>	5 (25.0%)	6 (30.0%)	0.723
Triple Vessel Disease <sup>2%</sup>	15 (75.0%)	14 (70.0%)	0.723
e <sup>&gt;</sup> 50% left main stenosis	4 (20.0%)	4 (20.0%)	1.000

# Data analyzed using Student's t test.&! median and interquartile range (IQR) are given due to skewed distribution of data. Data analyzed using Mann-Whitney U test.<sup>2%</sup>Data analyzed using Chi-square test. Data analyzed using Fisher's exact test.

**Table-II**  
*Preoperative Troponin I, Haemoglobin and Haematocrit levels*

Variable	Transfusion recipient (n=20)	Non-transfusion recipient (n=20)	P value
Troponin I (ng/ml)& <sup>!</sup>	0.0175 (IQR 0.0100 – 0.0207)	0.0178 (IQR 0.0100 – 0.0280)	0.580
Haemoglobin (gm/dl) <sup>#</sup>	11.6 ± 1.34	12.1 ± 3.02	0.232
Haematocrit (%) <sup>#</sup>	34.9 ± 4.02	36.3 ± 2.79	0.231

&! median and interquartile range (IQR) are given due to skewed distribution of data. Data analyzed using Mann-Whitney U test. # Data analyzed using Student's t test.

**Table-III**  
*Peroperative variables*

Variable	Transfusion recipient (n=20)	Non-transfusion recipient (n=20)	P value
Total number of grafts & <sup>!</sup>	3.3 (IQR 3.0 – 4.0)	3.2 (IQR 3.0 – 3.0)	0.437
Operation time (min) & <sup>!</sup>	240.0 (IQR 211.2 – 253.7)	240.1 (IQR 225.7 – 253.7)	0.329
IABP use <sup>ˆ</sup>	0 (0.0%)	0 (0.0%)	n/a
Conversion to CPB <sup>ˆ</sup>	0 (0.0%)	0 (0.0%)	n/a
Cardiac Arrest <sup>ˆ</sup>	0 (0.0%)	0 (0.0%)	n/a

&! median and interquartile range (IQR) are given due to skewed distribution of data. Data analyzed using Mann-Whitney U test. ˆ Data analyzed using Fisher's exact test.

**Table-IV**  
*Postoperative TnI levels*

Variable	Transfusion recipient (n=20)	Non-transfusion recipient (n=20)	P value
Raised TnI <sup>ˆ</sup>	17 (85.0%)	18 (90.0%)	1.000

ˆ Data analyzed using Fisher's exact test.

**Table-V**  
*Postoperative adverse clinical outcomes*

Variable	Transfusion recipient (n=20)	Non-transfusion recipient (n=20)	P value
Reopening <sup>ˆ</sup>	1 (5.0%)	0 (0.0%)	1.000
Cardiac arrest <sup>ˆ</sup>	0 (0.0%)	0 (0.0%)	n/a
Perioperative MI <sup>ˆ</sup>	0 (0.0%)	0 (0.0%)	n/a
Renal failure/ Dialysis <sup>ˆ</sup>	1 (5.0%)	0 (0.0%)	1.00
Respiratory complication <sup>ˆ</sup>	2 (10.0%)	0 (0.0%)	0.487
High inotrope support <sup>ˆ</sup>	2 (10.0%)	1 (5.0%)	1.000
IABP support <sup>ˆ</sup>	0 (0.0%)	0 (0.0%)	n/a
Arrhythmia <sup>ˆ</sup>	3 (15.0%)	1 (5.0%)	0.605
Wound infection <sup>ˆ</sup>	3 (15.0%)	2 (10.0%)	1.000
Ventilation time (hr) <sup>#</sup>	12.71 ± 2.12	11.95 ± 2.40	0.292
Prolonged ventilation > 24 hr. <sup>ˆ</sup>	1 (5.0%)	0 (0.0%)	1.000
ICU stay (hr.)& <sup>!</sup>	46.16 (IQR 28.75 – 47.18)	39.74 (IQR 26.83 – 45.37)	0.279
Prolonged ICU stay > 48 hr. <sup>ˆ</sup>	4 (20.0%)	2 (10.0%) <sup>†</sup>	0.661
Postoperative hospital stay (days)& <sup>!</sup>	7.7 (IQR 7.0 – 7.7)	7.3 (IQR 7.0 – 7.0)	0.394
Prolonged Postop length of stay > 7 days <sup>ˆ</sup>	5 (25.0%)	3 (15.0%)	0.695
Readmission within 30 days <sup>ˆ</sup>	1 (5.0%)	0 (0.00%)	1.000

# Data analyzed using Student's t test.

ˆ Data analyzed using Fisher's exact test.

&! median and interquartile range are given due to skewed distribution of data. Data analyzed using Mann-Whitney U test.

### Discussion:

In the present study, in off-pump coronary artery bypass grafting operation, perioperative Whole Blood Transfusion was not found to be associated with increased postoperative TnI release than non-transfusion, as measured by its level on first postoperative day.

This finding was in contrast to the findings of Biancari, et al. (2012) who found RBC transfusion to be significantly associated with increased TnI release after OPCABG. Operation time in the present study was  $240.02 \pm 35.68$  minutes while in Biancari's (2012) study it was  $211 \pm 49$  minutes. The mean number of grafts in the present study was  $3.25 \pm 0.54$  while in Biancari's (2012) study it was  $3.8 \pm 1$ .

Similar to Biancari's (2012) study, none of the patients needed conversion to cardiopulmonary bypass. 15% of patients in the present study experienced low output syndrome similar to 15% of patients in Biancari's (2012) study.

In Biancari's (2012) study, the postoperative release of TnI on first postoperative day positively correlated significantly with the units of packed RBCs transfused ( $\rho = 0.188$ ,  $p = 0.026$ ). Similarly, a significant correlation was observed in the present study between TnI release and Whole Blood Transfusion.

In discordance with the study conducted by Horvath, et al. (2013) transfusion was not significantly associated with wound infection.

### Conclusion:

The inference drawn from the results of this study disproves our study hypothesis that, transfusion of Whole Blood during the perioperative period of OPCABG is associated with significant increase in immediate postoperative troponin I level. In contrast to other similar studies, in which cases only Packed RBCs were transfused, Whole Blood seem to have less detrimental effect on postoperative myocardium. While packed RBCs tend to clog the microcirculation resulting in diminished blood flow to the myocardium, whole blood is less dense and more physiological in its constituent proportions.

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