Original Article

EFFECT OF PREOPERATIVE ANEMIA ON OUTCOME AFTER CARDIAC SURGERY

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ABSTRACT:
OBJECTIVE: Good anemic control in pre-operative phase is known to decrease mortality and morbidity after cardiac surgery. Thus, we studied the effect of preoperative anemia on outcome after cardiac surgery.
MATERIAL AND METHODS: This comparative prospective observational study was conducted at Punjab Institute of Cardiology, Lahore from 1st March 2012 to 31st March 2013. Two hundered consecutive patients for cardiac surgery (Ischemic / valvular) aged ≥18 years were studied. All the surgeries were performed using cardiopulmonary bypass (CPB) and in hospital outcomes were recorded.
RESULTS: Out of 200 patients, 140(70%) were male while 60(30%) were female. The mean age of the patients was 50.63±15.33 years and mean hemoglobin level was 12.20±1.98 mg/dl. Patients operated for coronary artery bypass grafting (CABG) were132 (66%) and 68 (34%) patients underwent valvular surgery. The prevalence of anemia was found to be 114(57%). Preoperative anemia was associated with prolonged hospital stay (CABG; 15.0±6.38 vs. 7.93±4.7 and valvular; 17.28±5.7 vs. 8.65±5.31), increased postoperative creatinine levels (CABG; 2.87±0.16 vs. 0.98±0.61 and valvular; 2.76±0.16 vs. 0.86±0.14) and greater blood transfusion rate (CABG;1.67±0.98 vs. 1.26±0.60 and valvular; 1.65±1.07 vs. 1.14±1.06) in cardiac surgery patients. Pre-operative anemic patients had markedly greater chance of suffering an adverse outcome after cardiac surgery. Post operative wound infection (3.03% vs. 2.94%), renal injury (19.69% vs. 10.29%), stroke (3.03% vs. 0), postoperative MI (6.06% vs. 4.41%) and AF (10.6% vs. 8.82%) were found to be higher in CABG patients as compared to valvular patients while re-exploration (4.54% vs. 14.70%) was found to be higher in valvular group as compare to CABG in those patients who had preoperative anemia.
CONCLUSION:In patients undergoing surgery for coronary artery disease and valvular heart disease, pre-operative anemia is associated with increased in-hospital mortality and serious adverse outcomes.
KEY WORDS: MI: Myocardial infarction, CABG: Coronary artery bypass grafting, CPB: cardiopulmonary bypass, HB: Hemoglobin, BT: Blood transfusion.

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INTRODUCTION:

Preoperative anemia is an independent predictor of in-hospital mortality and morbidity after coronary artery bypass grafting (CABG) or valve surgery.[1] CABG and valvular procedure are frequently associated with a substantial blood loss. Patients receive intra-operative blood transfusion (BT), which in turn may increase the risk for postoperative mortality, morbidity and infection[2,3]. Approximately 54.4% of cardiac surgical patients are suffering from anemia.[4]

Thus, preoperative anemia is useful parameter for predicting the risk of receiving blood transfusion[5] and also an increased risk for postoperative complications and lower survival rates after coronary bypass grafting surgery.[6]

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South Asian countries including Pakistan share the highest burden of cardio-vascular diseases worldwide and it is regarded as the leading cause of mortality and morbidity. 3.6 million (45%) out of 7.9 million total NCDs (non communicable diseases) deaths are attributed to Cardiovascular diseases. [7] This study addressed the current trends in terms of post operative outcome associated with pre operative anemia.

MATERIAL AND METHODS:

This was a prospective comparative hospital based study of 200 consecutive patients who underwent cardiac surgery with cardiopulmonary bypass (CPB). This study was conducted at cardiac surgery department of Punjab Institute of cardiology, Lahore over a period of one year from 1st March 2012 to 31st March 2013.

According to the guidelines of the World Health Organization (WHO) classification[8] patients fulfilling the criteria of preoperative anemia were defined as having hemoglobin level <13 g/dl for men and < 12 g/dl for women. Patients who un-

derwent CABG and valvular surgery were included, while patients with repair of complex congenital abnormalities, without cardiopulmonary bypass, patients undergoing urgent or emergency procedures, pre-operative critical state i.e. ventricular tachycardia or fibrillation or aborted sudden death, preoperative cardiac massage, preoperative ventilation before arrival in the anesthetic room, preoperative inotropic support, intra-aortic balloon counterpulsation or preoperative acute renal failure (anuria or oliguria < 10 ml/hour) were excluded from study.

Surgical procedures were categorized as coronary artery bypass graft (CABG) alone, valvular (single valve procedure, double-valve procedure and CABG + valvular).

Before surgery the purpose of this study was explained and informed consent was obtained from each patient. All patients routinely received 2000 mg tranexamic acid after induction of general anaesthesia. For procedures with high risk of bleeding, tranexamic acid infusion was also administered until the end of surgery. Haemoglobin levels were maintained ≥8.0 g.dl-1 intra- and postoperatively, whilst the transfusion trigger was < 7.0 g.dl-1 during cardiopulmonary bypass.[4]

Parameters of study include demographical and clinical characteristics regarding procedure and perioperative endpoints were collected prospectively.

Clinical outcome or patient's clinical condition regarding mortality and post operative complication were obtained in all patients during hospital stay. In-hospital mortality (defined as any death occurring within 30 days of operation) and post operative complications like wound infection, Superficial Sternal Wound Infection (SSWI) was defined as an infection involving only skin or subcutaneous tissue at the incision site while deep sternal wound infection (DSWI) was defined using the guidelines of the Centers for Disease Control and Prevention, i.e., an infection involving tissue spaces beneath the subcutaneous tissue, and patients meeting at least one of the following criteria were diagnosed as having Deep Sternal Wound Infection (DSWI): (1) an organism was isolated from culture of mediastinal tissue or fluid; (2) evidence of mediastinitis was seen during operation; or (3) chest pain, sternal instability, or fever (>38°C) was present.[9]

Post-operative MI was based on the presence of new Q waves >0.04 ms and/or a reduction in R waves >25% in at least 2 contiguous leads were monitored daily until discharge with continuous electrocardiogram monitoring and rise in CPK-MB% ≥ 10%).10 The renal dysfunction was defined as a serum creatinine 100 μmol/L in women, 110 μmol/L in men (equivalent to 1.1 to 1.2 mg/dl) after surgery (>1 mg/dl). [11]

New onset of postoperative AF was defined as absent P wave before the QRS complex together with irregular ventricular rhythm on the rhythm strips with ≥ 5 min duration within 96 hr at postoperative period on the basis of 12-lead ECG. Postoperative stroke was made if there was evidence of new neurological deficit with morphological substrate confirmed by computed tomography. Re exploration was defined according to Kirklin and Barratt-Boyes criteria.[12] Patient followed up till discharge.

Data was analyzed using SPSS (Statistical Package for Social Sciences) Version 20.0 for Window. Mean ± S.D was given for quantitative variables. Frequencies, percentages were given for qualitative variables. Chi square test and Fisher exact test (if cell frequency was less than 5) was applied to observe the association of the qualitative variables with anemic and non anemic group, while for quantitative variable independent t test was applied. Level of significance was considered ≤5%. All tests applied were two tailed.

RESULTS:

The study included 200 patients. Patients who underwent isolated coronary artery bypass graft surgery were 132(66%) and 68 (34%) patients underwent valvular surgery; 14(7%) underwent single-valve procedures (repair or replacement), 32(16%) underwent mitral valve procedures (repair or replacement), 22(11%) underwent double-valve procedures (repair or replacement).

Out of 200 patients of which 140(70%) were male while 60(30%) were female. Mean Hb level was higher in male as compared to female as (12.87±1.98 vs. 10.63±0.62 mg/dl) table-1. The mean age of the patients was 50.63±15.33 years. The overall prevalence of anemia was 114(57%). Prevalence of anemia among CABG

Table-1: Descriptive statistics with respect to mean Hemoglobin level

variables		Hemoglobin level (Mean ± S.D)	P-value
Gender	Male (n=140)	12.87±1.98	0.001
	Female(n=60)	10.63±0.62	
Procedure	CABG (n=132)	12.48±1.98	0.006
	Valvular(n=68)	11.67±1.88	

Table-2: Demographical and clinical characteristics of anemic and non anemic patients with respect to procedure type.

			Group		P-value
			Anemic (n=114)	Non anemic (n=86)	
Gender	Male(n=98)	CABG (n=132)	32(32.7%)	66(67.3%)	0.001
	Female(n=34)		34(100.0%)	0	
	Male(n=42)	Valvular (n=68)	22(52.4%)	20(47.6%)	0.001
	Female(n=26)		26(100%)	0	
Age		CABG(n=132)	60.42±7.19	59±8.21	0.291
		Valvular(n=68)	33.70±10.97	31.3±7.96	0.378
Weight (kg)		CABG(n=132)	72.65±17.74	71.51±12.98	0.676
		Valvular(n=68)	55.12±14.92	54.3±7.14	0.185
RBC		CABG(n=132)	4.0242±0.63	4.4121±0.52	0.001
		Valvular(n=68)	4.07±0.59	4.67±0.41	0.001
Urea		CABG(n=132)	31.93±9.78	31.96±13.34	0.988
		Valvular(n=68)	30.62±8.56	26.9±9.25	0.115
Creatinine		CABG(n=132)	2.8718±.16	0.9818±.61	0.207
		Valvular(n=68)	2.76±0.161	0.86±0.14	0.058
CPB time		CABG(n=132)	107.1±30.48	119.2±36.79	0.045
		Valvular(n=68)	126.0±49.56	128.2±49.3	0.786
Cross clamp time		CABG(n=132)	59.31±26.52	63.69±25.84	0.342
		Valvular(n=68)	78.79±34.53	78.0±33.22	0.946
Blood transfusion		CABG(n=132)	1.67±0.98	1.26±0.60	0.019
		Valvular(n=68)	1.65±1.07	1.14±1.06	0.048
Hospital stay		CABG(n=132)	15.0±6.38	7.93±4.7	0.793
		Valvular(n=68)	17.28±5.7	8.65±5.31	0.149

Table-3: Association of in hospital outcome with anemic and non anemic patients according to procedure type.

In-hospital outcomes		Anemia (n=114)	Non-Anemic (n=86)	P-value
Wound Infection	CABG(n=132)	4(3.03%)	1(0.75%)	0.048
	Valvular(n=68)	2(2.94%)	0	0.037
Renal Injury	CABG(n=132)	26(19.69%)	15(11.36%)	0.039
	Valvular(n=68)	7(10.29%)	1(1.47%)	0.041
Re-exploration	CABG(n=132)	6(4.54%)	0	0.012
	Valvular(n=68)	10(14.70%)	2(2.94%)	0.036
Post MI	CABG(n=132)	8(6.06%)	2(1.51%)	0.042
	Valvular (n=68)	3(4.41%)	4(5.88%)	0.048
Stroke	CABG (n=132)	4(3.03%)	1(0.76%)	0.056
	Valvular (n=68)	0	0	1.00
AF	CABG (n=132)	14(10.6%)	4(3.03%)	0.011
	Valvular (n=68)	6(8.82%)	1(1.47%)	0.039
Mortality	CABG (n=132)	2(1.5%)	0	0.039
	Valvular(n=68)	2(2.9%)	0	0.046

(51.5% vs. 48.5%) and valvular (54.2% vs. 45.8%) procedure was higher in women than in men. Mean carpuscular volume was significantly less in the anemic group; CABG (4.02±0.63 vs. 4.45±0.52; P-value=0.001) and valvular (4.07±0.59 vs. 4.67±0.41; P-value=0.001), as compare to non anemic group.

Over all mean Hb level was 12.20±1.98 mg/dl. Mean Hb level was significantly less in the valvular group than CABG (11.67±1.88 vs. 12.48±1.98; P-value=0.006) table-1.

The trend towards blood transfusion was greater in anemic group as compare to non anemic group, CABG (1.67±0.89 vs. 1.26± 0.60; P-value=0.019), valvular (1.65±1.07 vs. 1.14±1.06; P-value=0.056) (table-2).

Patients undergoing cardiac surgery were observed to be at increased risk of postoperative complications, associated with preoperative anemia. In anemic group, post operative wound infection (3.03% vs. 2.94%), renal injury(19.69% vs. 10.29%), stroke (3.03% vs. 0), post surgical MI (6.06% vs. 4,41%) and AF (10.6% vs. 8.82%) were found to be higher in CABG patients as compare to valvular while difference showed statistically significant as (P-value < 0.05). In addition in non anemic group, post surgical MI was more commonly found in valvular group as compare to CABG as (5.88% vs. 1.51%). In anemic group, trend towards Re-exploration was found to be higher in valvular group as compare to CABG (14.70% vs. 4.54%; P-value <0.05) as shown in (table-3).

DISCUSSION:

Our results showed that female group of anemic patients were higher than the non anemic patient indicating that women are at increased risk of preoperative anemia. Karkouti[11] found that anemia in females was 47%. Another study by Hung[13] et al established that anemia is more prevalent in female patients compared to male patients (32.1% vs. 22.8%). Present study demonstrated similar results. Carrascal[8] et al found that there was no significant difference in preoperative anemia between both genders (53.6% vs.46.3). the contradiction may be due to bias in selection of female patient.

Karski[14] et al showed prevalence of preoperative anemia to be 37.3% in patients undergoing cardiac surgery, Carrascal[8] et al found that prevalence of preoperative anemia was 41.9%. Hung[13] et al reported prevalence rate of pre-operative anemia to be 54.4%, we also demonstrated high rate of preoperative anemia in patients undergoing cardiac surgery as (57%). While Karkouti[11] et al found prevalence of preoperative anemia was 26% in cardiac surgery patients. This dissimilarity could be due to differences in the sample size of

the present study.

Hung[13] analyzed that anaemia was associated with blood transfusion (54.1% vs. 22.4%). According to Karski[14] et al scrutinized that preoperative anemia was associated with an increased risk of peri–operative blood transfusion (75% vs. 25%). Our study highlights the particular importance of preoperative anemia as a risk factor in the cardiac surgery setting where it often necessitates RBC transfusions, exposing patients to the additional risks of RBC transfusions. Carrascal[8] et al determined that preoperative anemia was not an independent risk factor for perioperative transfusion (P-value = 0.931)

Carrascal[8] et al also demonstrated that hospital stay was longer in anemic group than non anemic as (15.65±14.52 vs. 3.64± 10.61 days), but not significantly different. A study by Miceli[15] et al recognized that pre-operative anemia was significantly associated with prolonged hospital stay > 7 days as (54% vs. 36.7%).

Carrascal[8] et al determined in-hospital mortality and postoperative complications were found to be high in anemic group as compare to non-anemic group as (18.9% vs. 9.0%) and (46.3% vs. 43.1%). Complications in anemic group were AF 18.9%, MI and wound infection was 4.2%, low cardiac output 12.6% while in non anemic group, AF was 15.9%, MI 1.5% and wound infection 3.7% and low cardiac output was 9.8%.

Another study by Karkouti[11] et al recognized that pre-operative anemic patients had markedly greater predictor of suffering an adverse outcome i.e. death (6.6 vs. 1.4%), stroke (2.8 vs. 1.1%), or acute kidney injury (10.6 vs. 3.6%) than non-anemic patients.

In the study performed by Cladellas[16] et al determined that rates of death were increased by four-fold and major complications increased by 2.5-fold in anemic patients. Miceli[15] et al found significantly high mortality (4.6 vs. 1.5%) and morbidity rate in anemic patients than non anemic as AF (36.7vs. 33%), renal injury (18.5 vs. 6.5%), stroke (1.9% vs. 1.1%)and MI (2 vs. 1.9%).

Baron[17] et al showed that preoperative anemia is associated with adverse outcome. In the study performed by Kulier[6] et al observed that preoperative anemia showed strong correlation with non-cardiac complications. For the hemoglobin concentrations, each decrease by 1 g/dl below 14 g/dl led to an increase adverse events. Bell[18] et al showed preoperative hemoglobin less than 10 g/dL appears univariately as an independent risk factor for mortality in CABG-only surgical patients. In multivariate analyses, however, preoperative hemoglobin is not significant as an independent risk factor for mortality and is only mildly significant for morbidity.

Our study did have certain limitations. Preoperative anemia in cardiac surgery deserves considerable attention. Corrective measures should be tested in adequate randomized trials, in order to define the margin of correction of this risk factor.

We can conclude that anemic patients are at significantly at greater risk of death or serious postoperative complication when compared with non-anemic patients after cardiac surgery.

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