Original Article

CORONARY ARTERY DISEASE: A DESCRIPTIVE ANALYSIS OF RISK FACTORS: BEFORE AND AFTER TREATMENT

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ABSTRACT

With the increasing life span of man, the number of ageing people is also increasing, and along with that the number of diseases affecting them is also increasing. Atherosclerotic coronary artery disease is one of them. Coronary revascularization was started in 1960s through the pioneering efforts of David Sabiston and Kolessov. This is a retrospective descriptive study. A total number of 1050 Patients were operated on beating heart surgery from 1998 to Nov. 2002 out of which 852 patients were analysed to know the results and prognostic outcomes.

Mean age was 57.8 years (range 31 - 80years) with M:F ratio of 7:1. The pre-operative parameters studied were DM, HTN, hyperlipidemia, family history of CAD, smoking and past history of MI. other parameters included pulmonary disease, chronic renal failure, CVA, APD, PVD etc. 55.75% patients were diabetic, 53.99% were hypertensive and 24.4% had history of hyperlipidemia. Family history was positive in 12.9% of the patients, 25% were smokers and 44% had history of previous MI. average number of diseased vessels was 2.34 with triple vessel disease being most common. 6.6% had history of pulmonary diseases, 7.4% had pre-operative renal failure and 2% had past history of CV stroke.

Overall in-hospital mortality was 1.4%. relative risk for mortality, morbidity, new onset of renal failure, CVA, arrhythmias, CCF were calculated. Mean hospital stay was 9.83days (range 6 - 41years), mean ICU stay was 74.3 hours (range 73 - 700years). Usage of blood and blood products was significantly less. Freedom from complications was 93%. LVEF<40%, age >70 years, high diastolic PA pressure> 15mm Hg were found to be significant risk factors for mortality. Females were found to be 2.6 times more at risk for mortality and development of complications as compared to males. Patients with previous history of MI were found to be more at risk of developing complications increasing their hospital and ICU stay.

Keywords: CAD, CABG, LVEF, MI

INTRODUCTION

Coronary Artery Disease (CAD) has been called the modern "epidemic" by WHO. It is the cause of 25-30% of deaths in most industrialized countries now. Out of 50.5 million deaths occurring per year worldwide 6.1 million deaths are attributed to coronary artery disease.

In India the prevalence has been found to be 65.4 and 47.8 per 1000 males and females respectively (WHO). In India the incidence has increased from 1.05% in 1960 to 9.67% in 2001 (ST Yavagal, Cardiology society of India, Bangalore). There are some important differences in the prevalence of CAD in India as compared to the Western countries:

1. CAD appears a decade earlier compared with the age incidence in developed countries, peak being between 51 and 60 years[2,3,6].

2. Diabetes and hypertension account for 40% of all cases and heavy smoking is responsible

etiologically as compared to 27-31% in Western literature [5,6,10].

The average gain in life expectancy that would follow a complete elimination of cardiovascular deaths is from 3.4 years to 9.4 years for men and even greater for females.

The advent of Coronary Arteriography by Sones and Shirley in 1962 heralded the onset of interest in surgical revascularization of CAD. Favoloro and Effler at the Cleveland clinic foundation, pioneered this operation though D.Sabiston reported this in 1962. Till 1985 it was being done on Cardio-pulmonary Bypass (CPB). Interestingly the earliest beating heart CABG was reported from USSR by Kolessov et all in 1967.

CABG soon became the most common cardiac operation in the world and the most extensively studied. However, there were concerns about

the deleterious effects of CPB. Brazilian surgeons, Buffalo et al in 1985, reported the beneficial effects of avoiding CPB and re-introduced the concept of beating heart CABG.

This is a descriptive follow up study. It was undertaken to analyze the results and know the prognostic outcomes of the patients with various associated diseases.

MATERIALS AND METHODS

This is a retrospective descriptive study, 852 patients were selected randomly from the patients undergoing off-pump CABG from 1998 to Nov.2002.

Preoperative variables included Diabetes mellitus, hypertension, smoking, family history, hypercholesterolemia, previous history of MI, LVEF, Carotid disease, renal insufficiency, neurological deficit, age, sex, CCF, NYHA Classification, Pulmonary disease, thyroid disease and presence of MR.

Post-operative parameters recorded included operative time in minutes, hospital stay in days, ICU stay in hours, Ventilation duration, total drainage, blood usage, FFP usage, use of interpose, use of diuretics, presence of metabolic acidosis, number of grafts done, peri-operative MI, temporary ST elevation, renal complications, post-operative CVA, appearance of new arrhythmias requiring intervention, development of any new complication, and death.

PARAMETERS RECORDED

Diabetes Mellitus	No. of diseased Vessels	Operating time
Hyper lipidemia	Previous MI	Total Blood loss
Age	Carotid artery disease	No. of Grafts
Family History	Previous CVA	Hospital Stay
Preop CRF	Mitral incompetence	Intubation time
Hypertension	Temporary ST elevation	Blood Product used
Smoking	Re-exploration	Post of renal
Hypothyroidism	Use of IABP	Failure
PVD	Peri-operative MI	Use of diuretics
COPD		

Relative contradictions for off-pump CABG were high PA pressure intramyocardial LAD, bulky & hypertrophied LV, hemodynamical instability during positioning for OM, presence of large aneurysm and cardiogenic shock except for in two patients.

Ecosprin was stopped one week prior to surgery for all the patients in both the groups whenever possible. All the patients in both the groups underwent operation through a median sternotomy. LIMA was harvested using operating microscope.

I.V. Heparin 1 mg per kg was given prior to division of LIMA in all the patients with supplement does repeated at intervals of one hour reversed with 1:1 protamine after completion of last anastomosis. Ecosprin was restarted on next day for all the patients unless contra-indicated.

Pericardial stay sutures were used for traction. Octopus-III mechanical suction stabilizer was used for stabilizing the coronary target on beating heart. The target coronary artery was occluded proximally & distally with a prolene loop mounted on a red rubber tube.

Preconditioning was done for a period of three minutes. Humidified CO_2 blower was used for good exposure of the lumen of the target coronary artery. Intraluminal coronary shunts were used when retrograde bleeding was excessive or when there were ischemic changes.

LIMA to LAD anastomosis was constructed with 8-0 prolene while other distal anastomosis were constructed with a continuous 7-0 prolene. Proximal anastomosis was done to Aorta using 6-0 prolene under partial clamp or sometimes as a skin graft to other conduit using 7-0 prolene and in one case to innominate artery as Aorta was densely calcified. Deairing was done with needle for venous grafts or by filling the proximal anastomosis with blood before tying. Posterior hole was made in patients receiving multivessel grafts. Postoperative care was taken after by different nurses, anesthetics & Surgeons.

The data was collected retrospectively for the patients operated from 1997 to June 2000 and prospectively for the patients operated from July 2000 to November 2002. The data was entered in Microsoft access database. The data was

analyzed statistically using EPI Info software. P value was calculated using chi square test. A p value <0.05 was considered significant.

RESULTS

The total number of patients analyzed over a period of five years from 1998 to 2002, November was 852. The mean age was 57.88 years, ranging from 31 to 80 years. 22 patients were under 40 years and 57 patients were above 70 years.

The most affected age group was between 50 and 60 years which comprises of 42.37% of all the patients. Out of 852 patients 106 were females and 746 were males. Male to female ratio was 7:1. The risk factors were evaluated as show in Table 2 &3.

Table 1: Age wise distribution of patients

Age (yrs)	Number of Patients	Percentage
< = 40	22	2.58
40 – 50	145	17.02
50 – 60	361	42.37
60 – 70	267	31.34
70 – 80	57	6.69
Mean SD = 8.74 Var = 76.42		

Table 2: Gender wise distribution of Risk Factors

Risk Factors	Number	Percentage	Gender	Odds Ratio
Diabetes	475	55.75	M 403	0.8
			F 72	1.0
Hypertension	460	53.99	M 392	0.8
			F 68	1.0
Hyperlipidemia	208	24.41	M 187	1.26
			F 21	1.0
Family History	110	12.91	M = 98	1.16
			F = 12	1.0
Smoking	213	25	-	-
Previous MI	375	44.01	M 334	1.16
			F 41	1.0

Table 3: Pre-Operative Risk Factors

Associated Diseases	Number	Percentage
CV A	17	2.0
Epilepsy	6	0.7
COPD	48	5.6
Pulm TB	8	0.9
Eosinophilia	4	0.5
Brochitis	1	0.1
CRF	63	7.4
PVD	6	0.7
Hypothyroid	11	1.3
CCF	12	1.4
APD	23	2.7
Sev. Carotid Artery Disease	10	1.2
Varicose Veins	2	0.2
Filariasis	4	0.5
Aorto arteritis	1	0.1

78 patients did not have any risk factors. 78(f=8) patients had all 3 three risk factors – DM, HTN and hypercholesterolemia. 170 (f=15) patients did not either of three. Other pre-operative associated diseases were evaluated as shown in Table 3.

57 patients had pulmonary disease. Out of 63 patients having chronic renal failure, two were on renal dose of dopamine pre-operatively. Out of 10 patients having severe carotid artery disease, one patient was operating simultaneously and three patients underwent stenting before operation. All the patients having history of CV stroke had fully recovered by the time of surgery and had no residual defects.

Table 4: Distribution of LVEF

LVEF	Number of Patients	Percentage
> 60	22	2.58
50 - 60 yrs.	145	17.02
35- 50 yrs.	361	42.37
< 35 yrs.	267	31.34
Mean SD = 8.74 Var = 76.42		

Mean weight was 63.60Kg (range 34 – 112Kg) with SD = 9.22. most of the patients were in class II NYHA (n=397) followed by class III (n=269). 77 patients were having unstable angina. 31 were in class I NYHA. 78 were asymptomatic, out of which 11 had tight left main disease (LMCA) and 9 were in CCF.

The mean ejection was 58.77% (SD = 10.83, Var = 117.29) ranging from 20% to 81%.

The average number of diseased vessels was 2.34. Triple vessel disease was most prevalent, affecting 430 patients (% = 51.53) followed by double vessel disease in 265 (% = 31.10) and single vessel in 148 (17.37%) patients. 49 patients had tight left main disease (5.75%)

Table 5: Distribution of patients according to diseased vessels

Diseased Vessels	Number of Patients	Percentage
LMCA	49	5.75%
Single	148	17.37
Double	265	31.10
Triple	439	51.53

Presence of MR was evaluated based on echo. For 117 patients the data was not available as it is a retrospective study. 140 pts. Had Trivial MR, 124 patients mild MR, 5 had mod MR & I had Severe MR.

Mean number of grafts was 2.27 ranging from 1 to 4 (SD = 0.93, var. = 0.87). Highest number of vessels grafted was 2 (n = 293, 34.98%) followed by 3 (n = 276, 32.16%). Single graft was done in 199 (23.36%) patients. 79 (9.27%) patients received four grafts. Intramyocardial LAD was present in 38 patients (4.46%).

Mean operating time was 185.23 minutes, ranging from 85 to 550 minutes (SD = 50.56, Var = 2555.84). Number of patients requiring < 180 minutes 439 (51.53%). 89 patients required >240 minutes (10.45%).

LIMA was grafted in 771 patients. SVG in 526 patients and Radial in 326, 140 patients received total arterial grafts. Out of 199 patients receiving single grafts, 176 received LIMA, 4 Radial and others SVG.

Table 6: Conduits Used

Conduits	Number	Conduits	Number
LMA only	176	LMA, RAD	140
RAD only	4	LMA, SVG	281
SVG only	60	LIMA,RAD,SVG	170
LIMA Total	771	RAD, SVG	7
RAD Total	326	SVG Total	576

Mean PA pressure was 9.40 with 74 (8.69%) patients having PA more then15 and 131 patients more than 12 ranging from 1 to 31.

Mean drainage was 667.93ml (min + 140, max =2940ml) SD = 315.4345, var =99498.92). 256 patients had less than 500 ml of Drain (30%).

Usage of blood was significantly less. Mean usage of blood was 0.67 (SD= 1.15, var=1.33). 466 patients did not receive any blood (54.70%), 269 patients received only one unit of blood. Only 11 patients required more then 3 units of bold (max= 21). Mean units of FFP used was 1.o1 (maximum being 8) while 447 (52.46%) patients did not required FFP and 282 patients (33.10%) did not receive any blood product.

Mean Hospital stay was 9.83 days (ranging from 6to41 days, SD = 2.69, var = 7.26). 398 patients had stay of less than 10 days. Mean ICU stay was 74.32 hours (SD=45.18, var=2041.23) ranging from 23 to 700 hrs (32.86%). 280 patients has less than 48 hours of

ICU stay. 259 patients had more than 72 hours of ICU stay (30.40%).

Mean ventilation time was 18.98 hours ranging from 4 hours to 140 hrs. (SD = 11,76, var – 138.358) 57 patients more than 24 hrs. (6.69%) were on ventilation for more than 24 hours.

793 patients were free of complications and 59 had various complications.

15 (1.88%) patients had neurological complications out of which 7 had CV stroke and 9 had delirium. Out of 7 patients having CV stroke one was a known case of CVA prior to surgery (It hemiplegia – one year ago) one was a known epileptic and two had severe carotid artery disease (Gr 5 right side). One patient had undergone stenting on right side 2 weeks prior to surgery. Out of the 9 patients having delirium, one was hypothyroid and other had history of CVA earlier.

Total number of patients requiring diuretics was 327 (38.28%), out of which 32 patients were known case of renal impairment preoperatively. Out of these 5 patients required Lasix infusion, 293 required Inj.Lasix and others (19) oral medication.

Table 7: Parameters Study

Parameters	No. of Patients	Percentage	Parameters	Mean	Standard Deviation
Pts. Not Req. Blood	466	54.7	Hosp Stay	9.825	SD = 2.69 Var. = 7.26
1 unit of blood	269	31.57	Ventil time	18.98	SD = 11.76 Var.=138.358
FFP not used	447	52.46	Blood usage	0.67	SD = 1.5 Var = 1.33
Inotropes	262	30.75	PA Pressure	9.40	SD = 4.50 Var = 20.22
Diureties	330	38.73	ICU Stay	74.82	SD = 45.18 Var = 2041.23
Blood Products not used	282	33.1	Drain	667.93	SD = 315.43 Var = 99498.92
Freedom from complication	793	93.08	Mean FFP	1.01	SD 1.36 Var 1.86

Table 8: Post Operative Complications

Complication	Number of Patients	Percent
Renal	28	3.29
CV Stroke	7	0.82
Neurological	9	1.06
ARF	10	1.17
Periop MI	5	0.59
Dialysis	2	0.23
Peptic Perforation	1	0.1
Arrhythmias	93	10.92
ST Elevation	132	15.26
IABP	36	3.87
Re-exploration	22	5
Death	15	1.94
Metabolic Acidosis	165 (DM = 94)	1.94
Acid Peptic Disease	23	2.7

28 patients had renal complications out of which 10 patients had ARF. There were known case of CRF, one was on lasix injection preoperatively; two were on renal dose of dopamine preoperatively. Five patients required lasix infusion and 16 required dopamine in renal dose. 3 patients were already on dopamine preoperatively. 12 patients required lasix or other diurectrics in immediate post operative period. Two patients under went dialysis and both patients died because of renal failure.

Seven patients had pulmonary complications out of which one was hypothyroid and one was a known case of Br.Asthma. Five patients required re-intubation out of which one died because of low C.O., four patients were treated with Aminophyllin infusion and 2 had severe bronchospasm postoperatively. Out of 42 patients with bronchial asthama 4 patients required > 24 hrs. ventilation & 6 patients were in ICU for more than 96 hrs. and 2 died.

Out of 23 patients having Acid-peptic disease one had peptic perforation and was taken up for emergency surgery. The patient recovered completely.

Out of 17 patients having History CVA, only one developed CVA postoperatively and one had delirium. Out of 11 pts having one had delirium and one was on ventilation for long duration because of pulmonary complications.

262 patients required inotropic support, 53 required dobutamine, 42 adrenaline, 222 dopamine and 5 petressin.

Out of 63 patients having pre-operative renal dysfunction, one required dialysis for ARF and expired because of that, two patients required lasix infusion, 32 required diuretics and two patients required renal dose of dopamine. Out of 63 patients 13 had moderate LV dysfunction and 7 had severe dysfunction.

Out of 17 patients having previous history of CV stroke, one patient developed CV stroke postoperatively and one developed delirium.

Out of patients having hypothyroid, one had delirium and one was on ventilation for long time because of pulmonary complications.

Overall there were 14 deaths, out of which 12 were early deaths and 2 were late deaths. At the time of going to the press, the total number was 1005 with a morality rate of 1.4% and an early mortality rate of 1.2%. Out of the two late deaths, one died of CRF during dialysis after two months one died of septicemia following digital and dilatation for faecal impaction. Out of these 14 patients, two were having unstable angina and one had tight left main disease. Out of the 12 early deaths, two died of mediastinitis, one of caecal perforation, one of leptospirosis and low cardiac output, five of acute cardiac failure and one had sudden cardiac arrest, one of bleeding from side branch of the venous graft and one of acute aortic dissection after 48 hours.

Relative risk for mortality was calculated for age, sex, presence of MR, LVEF, previous history of MI and preoperative PA pressure.

The relative risk for mortality was higher in females (2.58) but was not statistically significant (p value = 0.1). Relative risk was found to be highest in patients above 70 yrs. of age (P value = 0.05) and the risk increased with increasing age.

Out of 14 patients, five patients had trival MR, one had in MR, one had moderate MR and six had normal mitral valves. The relative risk for patients with MR was 2, but it was not statistically significant (p value = 0.2) six patients had PA pressures more than 15 mm Hg

and the relative risk for these patients was 9.2 which was statistically highly significant (P value = 0.0001).

MODES OF DEATH

Acute Cardiac failure	5
Sudden Cardiac Arrest	1
Bleeding	1
CRF	1
Mediastinitis	2
Caecal Perforation	1
Septicemia	1
Leptospirosis	1
Acite Aortic Dissection	1
Septicemia following digital anal dilatation for faecal impaction	1

Nine out of fourteen deaths had previous history of MI and these patients were at relative risk of 2.5 for mortality, though it was not found to be statistically significant (P value = 0.07).

Six out of fourteen patients were having LVEF less than 40%. Patients with LVEF less than or equal to 50% were 15.8 times more at risk for death in comparison to patients with LVEF more than 50 (P value = 0.001, statistically significant).

Total number of patients requiring IABP was 36, out of which five were females and 31 males. The relative risk for males was 1.7 which was not statistically significant. Out of 36, twenty one patients had previous history of MI, three were in CCF and four had tight left main CAD. Four patients had mild MR, one had moderate MR, nine had trivial MR, and fifteen had normal mitral valves. Five patients out of 36 died.

There was no difference according in age and sex for the use of LABP. Patients with LVEF less than or equal to 50% were at 5.2 relative risk for use of iABP (P value = 0.001). Twelve patients were in CCF preoperatively out of patients which two had rights left main CAD. All of them were males and most of them were in 50 to 60 years age group (8 out of 12) and three were more than 70 years. Nine patients required inotropes postoperatively, three required IABP, five had arrhythmias and three dried.

Out of 28 patients who developed renal complications, three were known patients of CRF. Patients with LVEF less than 50% were at 6.4 relative risk for developing postoperative renal complications (P value = 0.001).

Table 9: Relative risk for mortality

Parameters	Criteria	Dead	Alive	Relative Risk	95% C.I.	P Value
Sex	M	4	102	206	0.8-7.9	0.1
	F	10	736	1.0		
MI	+	9	365	2.5	0.9-7.4	0.07
	-	5	472	1.0		
PA Pressure mmHg	> 15	6	68	9.2	3.4-24.6	0.0001
	< 15	8	770	1.0		
MR	+	7	263	2.0	0.7-5.9	0.2
	-	6	459	1.0		
LVEF	> 50	8	68	15.8	6.1-41.1	0.001
	< 50	6	774	1.0		

Patients above 70 years were 4.9 times more a risk of developing renal complication postoperatively. Out of 10 patients who developed ARF, five had EF less than 50% and 5 had EF more than 50% patients with EF less than 50% were 6.4 times more at risk of developing ARF (P value = 0.0001).

Table 10: Relative Risk of Age for Mortality

Age (yrs.)	Dead	Alive	Relative Risk	95% C.I.	P Value
<50	1	166	1.0	-	
50 - 60	5	356	2.3	0.3-19.6	0.7
60 - 70	5	262	3.7	0.5-30.9	0.3
>=70	3	54	8.8	0.9-82.8	0.05

Table 11: Relative Risk for Development of Renal Complication

	Criteria	Renal Complication	No Renal Complication	Relative risk	95% CI	P Value
LVEF%	<= 50	13	83	6.4	3.1-12.9	0.0001
	>50	15	741	1.0		
Age (Years)	< 50	3	167	1.0		
	50-60	12	361	1.9	0.5-6.3	0.4
	60 - 70	9	267	1.9	0.5-6.7	0.5
	>=70	5	57	4.9	1.1-18.6	0.03

Increasing age was a risk factor for development of arrhythmias, the risk increased exponentially. Patients above 50 yrs of age were more at risk to develop arrhythmias and patients above 70 yrs were 10.5 times more at risk for developing arrhythmias (P value = 0.0001) patients with LVEF less than 50% were 4.6 times more at risk for developing new arrhythmias postoperatively.

DISCUSSION

First described by Kolessov and Favaloro in 1967, beating heart surgery was revived by Benetti and Buffolo in 1980s but it demands a steep learning curve and great technical skills for an optimum anastomosis. With the advent of mechanical stabilizers and other technical skills it has become possible to operate without CPB on high risk patients and elderly patients also. Beginning with single vessel disease (usually LAD) most of the surgeons operating on beating heart have been able to do complete revasuclarisation for multivessel disease also. Recently CABG is being done on MIDCAB and

with robot assistance also. Though initially MIDCAB was done only for single vessel disease to LAD, now it is done for multivessel disease.

Table 12: Relative Risk for Development of New Arrhythmias

		ARR	NO	Total	RR	95% C.I.	P Value
Sex	M	13	93	106	1.0	-	-
	F	82	664	746	09	0.5-1.5	0.7
EF	<= 50	35	61	96	4.6	3.2-6.6	0.0001
	>50	60	696	756	1.0	-	-
MI	+	44	331	375	1.1	0.8-1.6	0.6
	-	51	426	477	1.0	-	-
Age	< 50	7	160	167	1.0	-	-
	>50-60	34	327	361	2.3	1.02-4.9	0.03
	60-70	36	231	267	3.2	1.5-7.0	0.002
	>=70	25	32	57	10.5	4.8-22.8	0.0001
LMCA	+	9	40	49	1.7	0.9-3.2	0.09
	-	86	17	803			

Several advantages have been claimed by many authors in favour of beating heart CABG. These include cost-effectiveness, lesser blood loss, lesser blood usage, lesser hospital stay, lesser ICU stay, lesser postoperative complications like stroke, renal failure, and reduced mortality.

In our institute also the trend has changed in favour of beating heart CABG with only 16.4% of coronary artery bypass surgery done on pump this year. This is a retrospective descriptive study. The patients included in this study were taken from the year 1997 when we first began beating heart CABG to November 2002.

Our most of the patients were between 50 to 60 year age group (mean 57.88±8.74), almost a decade younger than other study groups from the western countries. We did not have any patient more than 80 years. This represents the trend of atherosclerotic disease and the average life span (64 years) in India. Most of our patients were males (m:f=7.1) which can be a baised result because of the sample size.

Our series is similar to that of Puskas et al[5], Arom et al[1], Buffolo et al[2]. in our study the incidence of diabetics was more than in other available studies. In our study it was 55.75% while in a study done by Wen Cheng [10] (31.7%) and John D. Pukas et al[5] (27.5%), the incidence was much lower. Incidence of hypertension was lower than other studies. In our study it was 53.99%, while Marco Ricci et al[8], John D.Puskas et al[5] and Wen Cheng[10] reported and incidence of 83.5%, 72.0% and 60.0% respectively. Incidence of hyperlipidemia was 24.4% and only 13% had positive family history. Smoking was a risk factor in 25% of patients in our series compared to 51.6% in Wen Cheng[10] series.

The incidence of patients having history of previous MI was 44% in our series comparable to Puskas et al[5] (40%) and Stamou et al[9] (48%) series. It was much lower in Wen Cheng et al[10] (29.2%) series. Incidence of preoperative renal impairment in our series (7.4%) was similar to John D. Pukas et al [5] (7.5%) and Wen Cheng et al [10] (8.6%) series. In James C.Hart et al series (5.3%) and Ricci et al [8] series (1.0%) it was much lower. Incidence of previous history of stroke was 2.0% in our series which was much lower than other series. Ricci et al[8] – 33%, John D. Puskas – 9%, Wen Cheng[10] – 8.8%. Mean EF in our series was 58.77±10.83%, comparable to Wen Cheng et al[10] (53±14%), James C. Hart et al (55.5%). In Kit V Arom et al [1](52%) and Ricci et al [8](49.7%) series it was lower. In our series most of the patients had multivessel (51.5%) disease.

Our mean number of grafts was 227±93, similar to Benetti et al series (2.2), Kit V. Arom et al [1]series (2.1±1.1) and Puskas et al[5] (2.5±1.1), while Bouchard[3] (2.8) has slightly higher mean number of grafts, the mean number of grafts in our series was higher than Buffolo[2] (1.7), Ricci et al[8] (1.8), James Hart et al (1.96), Anil Bhan et al (1.7±0.3) and Wen Cheng et al [10](1.9±0.8).

Our mean operating time (185.23±50.56 minutes) was similar to Raimando Ascicone et at [6,7](176.73±42.5 min) and E.Covino et al (196+35 min) series. Kit V.Arom et al[1] (171 min). Our mean average blood loss

(667.93±315.43 ml) was higher than Wen Cheng[10] (511±438 ml.) and E.Covino et al (562±381 ml.) series. It was similar to Raimondo Ascicone et al[6,7] (687 ml). Our mean hospital stay (9.8±2.69 days) was higher than other series (5.2 to 7.7 days) but similar to Alber Pfister[4] (10.45+5.45 days) and Ricci et al [8](9.1 days) series. Our ICU stay (4.32+45.18 hours) was much higher than all other studies probably due to the absence of step down. Our mean intubation time (18.98 hours) was also higher than all other series (7.16 to 13.1 hours).

Our usage of blood was significantly less (0.67±1.15 units) which was similar to that reported by Buffollo et al[2] (0.6 units), E.Covino et at (0.47±0.6 units) and higher than Raimando Ascicone et al[6,7] (0.28±0.5 units).Usage of FFP (1.01%) was similar to John D.Puskas[5] series (1.5%) and higher than Raimando Ascicone [6,7](0.07±0.46 units) series. In our series 54.7% did not receive any blood which was much lower than other series (Raimando Ascicone et al[6,7] 77%, James Hart et al 79%), Alber Pfister et al[4] 72.7% but, higher than Wen Cheng et al [10](42.2%). 93.1% of our patients were fee of complications which is similar to Benetti et al (96%) series while Ricci and Wen Cheng[8,10] reported a freedom of 85.6% and 72% respectively.

Mortality in our series was 1.76% similar to that of Alber Pfister[4] (1.4%). It was much lower than Ricci (10.3%)[8], Buffolo (2.5%)[2], Kit V.Arom et al [1](3.4%), Wen Cheng et al[10] (2.5%) and higher than John D. Puskas (1.0%)[5], James Hart et al (0.26%) series.

Our postoperative pulmonary complications (6.69%) were similar to Bouchard[3] (7.5%), lower than Stamou et al[9] but higher than other authors (0 to 3.2%). Incidence of postoperative stroke was significantly less (0.82%) in our series but higher than Benetti (0.18%) and James Hart (0.26%) while other authors reported an incidence of 1.1 to 1.8% (Buffolo et al[2], Arom et al[1], Puskas et al[5], Wen Cheng et al[10]. 1.06% of our patients had delirium, while in Albert Pfister et al [4]series, 4.2% had delirium.

Incidence of postoperative renal complications in our series (3.29%) was higher than other groups (Ricci et al[8] – 2.1%, Puskas et al[5]-2%), lower than Arom et al (5%). 1.17% of our patients had ARF and o.23% required dialysis (Wen Cheng et al[10] 0.9, Ricci et al[8] – 4%).

Percentage of our patients requiring inotroes (30.75%) was much higher than other authors. (Benetti et al, Puskas et al[5], Raimando et al[6,7], Hart et al), lower than E.Covino et al series (61.9%) only. As in our series (10.9%) was

similar to Hart et al (12.8%), and Puskas et al [5](12.5%), Arom et al (14%) series[1], while it was higher in Stamou et al[9] and Bouchard et al (20%) series. Buffolo et al [2] reported a much lower incidence of AF (5.5%). Five of our patients had preoperative MI (0.59%) similar to Arom et al (0.6%)[1], Puskas et al (1.0%) series[5]. It was higher in anil Bhan et al (2.5%) and Wen Cheng (35.9%) series [10].

We calculated relative risk for mortality according to age, previous MI, gender, PA pressure and EF. Risk for mortality was higher for patients above 70 yrs (Buffolo et al), PA pressure (diastolic) > 15mm Hg and LVEF<40%. Females and patients with previous history of MI were 2.6 (p value-0l1) and 2.5 (p value-0.07) times more at risk respectively. Patients above 70 years of age (p value-0.001), PA pressure (Diastolic)> 15 mm Hg (p value-0.0001) and patients with EF<40% (p value-0.001) were significantly more at risk.

Patients with LVEF<50% and above 70 yrs. of age were at more risk of developing renal complications. LVEF<50% and increasing age was a risk factor for developing new arrhythmias.

CONCLUSION

This study is comparable to Puskas et al, Arom et al, Wen Cheng et al, Benetti et al Raimando et al series[1,5,6,7,10]. Our series shows a significant reduction in operating time, blood usage, preoperative MI, reduction in incidence of postoperative stroke, mortality, freedom from complications but our study did not show much advantage in hospital stay, ICU stay and intubation time.

This study also shows that LVEF< 50% , age <70 yrs. Are significant risk factors for development of arrhythmia and renal complications, LVEF<40%, age >70 years, high diastolic PA pressure> 15mm Hg are significant risk factors for mortality. Our study also shows increased risk for mortality for females (2.6 times more, p value-NS) and patients with previous history of MI (2.5 times more, p value-NS).

Our conclusion is that beating heart surgery is a safe procedure with less morbidity and mortality but decision for patients with LVEF<50%, high PA pressures and patients above 70 yrs. of age should be taken judiciously.

ABBREVIATIONS
ARR -Arrhythmia

CAD – Coronary artery disease

CABG –Coronary artery bypass graft

CI –Confidence interval

CCF –Congestive cardiac failure

COPD –Chronic obstructive pulmonary disease

CPB – Cardiopulmonary bypass

CRF –Chronic renal failure

CVA – Cerebral vascular accident

DM – Diabetes Mellitus

FFP –Fresh frozen plasma

HTN -Hypertension

IABP – Intra-arterial balloon pump

LAD –Left anterior descending artery

LCX – Left circumflex artery

LIMA –Left internal mammary artery

LMCA –Left main coronary artery

LVEF –Left ventricle ejection fraction

MI – Myocardial Infarction

MR – Mitral valve regurgitation

OM - Obtuse marginal artery

PVD –Peripheral vascular disease

RCA – Right coronary artery

RR - Relative risk

SD - Standard deviation

SVG - Saphenous vein graft

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