

ORIGINAL ARTICLE

Post-Operative Outcomes of Coronary Artery Bypass Surgery in Young Adults

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ABSTRACT

Background: CABG is extensively studied surgical procedure but the data shows little about younger population. The gold standard for treating TVCAD is coronary bypass surgery with better long-term outcomes and lesser reintervention. Young adults who have coronary arteries revascularized are a specific category of sufferers, with research on cardiovascular proceedings.

Aim: To identify the risk factors and to determine the postoperative outcomes in young patients encountering CABG.

Methodology: This retrospective empirical groundwork was carried out at Peshawar institute of cardiology, included (n=95) adults, who were diagnosed with coronary artery disease and underwent CABG surgery. Data was extracted from electronic medical record (EMR) and by using SPSS version 26.0, the data was analyzed.

Results: Mean age of the patients (43.24±3.940), mean BMI (27.8249±4.32135), mean pulse rate (80.79±13.808), mean systolic BP (134.40±19.168), mean diastolic BP (83.86±13.901). Major risk factors observed were both DM and HTN 33.7%, use of tobacco and HTN20%. Correlation of age showed significant linear relationship with ventilation time, ICU stay, CCS class with NYHA at $P<0.01$. Similarly, previously diagnosed STEMI patients showed significant linear relationship with mortality at $P<0.05$.

Conclusion: According to the consequences of the study it is presumed that in young patient's lower rates of morbidity and in hospital mortality was observed as compared to older counterparts. Furthermore, detailed multicenter study in this area is needed with higher sample size and long-term effects for extended periods of time to confirm better results.

Keywords: Coronary artery disease, Percutaneous coronary intervention, Cardiopulmonary bypass

INTRODUCTION

The most frequent cause of myocardial hypoxia and one of the most prevalent cardiovascular illness in non-industrialized nations, coronary artery disease (CAD) has the highest and most well documented morbidity and mortality rates¹. Modern medicine has made considerable strides in understanding the etiology of arterial indisposition with inadequate atheroma and plaque development. Previously the heart diseases were being associated with elderly patients but now the shift of trend is being observed from elderly to young which is noticeably an alarming situation. Since the young people had low risk of contracting the disease, the statistics and investigations on the existence of ischemic heart disease (IHD), related threat factors together with its consequences, in this young age range have not been analyzed in contradiction to aged mates².

Potential risk factors for CAD include hypertension, diabetes, hypercholesterolemia, malfunctioning lipids, smoking, and family history. Furthermore, obesity and elevated BMI are two of the primary factors of coronary heart disease³. Several studies have revealed that young people with CAD are more likely to have certain cardiovascular risk factors and that their early clinical symptoms may be more severe than older patients⁴.

CABG is extensively studied surgical procedure but the data shows little about younger population. The gold standard for treating TVCAD is still the coronary bypass surgery and it is more long lasting, particularly when arterial grafts are used than minimal invasive procedures such as percutaneous coronary intervention⁵.

Young adults who have their coronary arteries revascularized are in fact a specific category of sufferers, with little research on cardiovascular proceedings, survival, or the need for redo revascularization to date⁶.

While there is a scarcity of information regarding postop morbidity of these young patients, research by Bardakci et al (2015) revealed that 96% of patients under the age of 50 years who underwent CABG recovered without experiencing any severe complications after surgery. These results suggest that there is an extremely minimal chance of any adverse postoperative event.

Similarly, D'Erigo et al also corroborated a low estimate of post-operative mortality in patients under 50 following CABG, with an overall mortality rate of 0.9%⁷.

Renal dysfunction, brain damage, heart failure, hemorrhage, pulmonary failure, are all CABG complications. CABG provides great results in terms of angina alleviation and return to normal activity. In general, surgical revascularization provides more comprehensive and stable revascularization than percutaneous treatment. It is obvious that revascularization results in young patients must be long-lasting to minimize resurgence of manifestations or cardiovascular proceedings, as well as the potential for repeat revascularization⁸.

This study of coronary artery bypass (CABG) among young patients was carried out at Peshawar institute of cardiology, KPK. Because of the association of disease with elderly, the literature regarding young patients going through coronary artery bypass surgery (CABG) is deficient. We included all those young adults (male, female) who were diagnosed with coronary artery disease, STEMI, NSTEMI and UA undergoing (CABG). The goal of the research work was to describe the preoperative risk factors and postoperative outcomes of young adults undergoing cardiac surgery at Peshawar institute of cardiology.

METHODOLOGY

This retrospective observational study was executed at Peshawar institute of cardiology, KPK. We included all adults (male, female) (n=95) who were diagnosed with coronary artery disease and analyzed all consecutive patients going through coronary artery bypass surgery (CABG). Data was extracted retrospectively from EMR (electronic medical record). Ethical approval was taken from hospital ethical review board committee (IRB). The trial was accomplished in line with the declarations of Helsinki and on harmonization recommendations for good clinical practices⁹. From all those patients who underwent CABG verbal informed consent was also taken because we collected the data retrospectively and patients were not present in hospital at that time.

Inclusion criteria:

- Young adults (male, female) patients < 50 years.
- Young adults undergone coronary bypass surgery (CABG)

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Exclusion Criteria:

- Patients with valvular and congenital surgery.
- Redo

Data analysis procedure: To conduct the data analysis for our study SPSS 26.0 was utilized. For qualitative variables frequencies with percentage were calculated fore.g., gender, marital status, risk factors, clinical presentations, operation status, vessels involvement and post-operative complications. Descriptive statistics was used to calculate mean and \pm SD. Pearson correlation was performed to find the correlation of the age of patients, risk factors, CCS class, NYHA class, CAD presentations, BMI and post-operative outcomes (VT, ICU stay, CBP and Mortality) at $P < 0.01$ and $P < 0.05$.

RESULTS

The study included total of 95 patients undergone coronary bypass surgery (CABG) after meeting inclusion criteria

Table 1: Clinical baseline traits, Pre-operative and Intra-operative data of the research population (n=95)

Characteristics	Mean	\pm SD
Age (years)	43.24	\pm 3.9
BMI (kg/m ²)	27.82	\pm 4.32
Pulse rate	80.79	\pm 13.8
Systolic BP (mmHg)	134.40	\pm 19.2
Diastolic BP (mmHg)	83.86	\pm 13.9
Pre-operative Data of the patients		
Urea (mg/dL)	12.56	\pm 3.57
Creatinine (mg/dL)	0.99	\pm 0.85
Ejection Fraction	53.47	\pm 8.89
Intra-Operative Data		
Cardiopulmonary bypass times (mins)	102.77	\pm 24.2
Cross Clamp times (mins)	76.07	\pm 21.05
Venous grafts	2.84	\pm 0.78
Arterial grafts	1.79	\pm 0.81

Table 1 illustrate that the mean age of the patients (43.24 \pm 3.940), mean BMI (27.8249 \pm 4.32135), mean pulse rate (80.79 \pm 13.808), mean systolic BP (134.40 \pm 19.168), mean diastolic BP (83.86 \pm 13.901). Pre-operative data shows mean urea (12.4632 \pm 3.56940), mean creatinine (0.9959 \pm 0.84881) and mean ejection fraction (53.47 \pm 8.892). Intra-operative data shows mean Cardiopulmonary bypass times min (102.77 \pm 24.150), Clamp times min (76.07 \pm 21.054), mean Venous grafts (2.84 \pm 0.776) and mean Arterial grafts (1.79 \pm 0.811).

Table 2 manifest that patients undergone (CABG) age < 50 included 71.6% male and 28.4% female among them 97.9% were married and only 2.1% were unmarried. 95.8% of the operations were elective and 4.2% were emergency cases. On pump CABG accounted for 96.8% vs 3.2% OPCAB. The most frequent risk factor was a combination of HTN and DM 33.7%, followed by use of tobacco 20%, HTN 16.8%, DM 7.4%, Hypertension, Diabetes Mellitus and family history 5.3%, use of tobacco 4.2%, DM, HTN and Smoker 4.2%, Family History of CAD 2.1%, HTN, Smoker and Family history (FX) 2.1%, DM, HTN, Smoker and FX 1.1%. CCS class shown that most patients were CCS-III 57.9% after that CCS-II 34.7%, CCS-IV 7.4% respectively. NYHA class shown that most of the patient was NYHA-III 55.8%, NYHA-II 36.8%, NYHA-I 7.4%. CAD presentations illustrated that most of the patients were NSTEMI 81.5% and STEMI 18.9% with stable angina 69.5% and unstable angina 30.5%. Triple vessel disease was the most prevalent one in patients undergone for (CABG) 81.1% following that was double vessel disease 16.8% and single vessel disease 2.1% respectively. Post-operative outcomes show hospital stay (4.21 \pm 1.10) and mean mortality rate (1.99 \pm 0.11). Regarding Post-operative complications, no complications were recorded in (72.6%) Wound infection (2.1%), GI complications (1.05%) Atrial fibrillation (14.7%), bleeding (2.1%), AKI (1.05%), Re-open (2.1%),

stroke (1.05%) and Re-admission (3.2%). Similarly mean ventilation time (5.47 \pm 0.97) hours and mean ICU-stay (25.64 \pm 4.50) hours. Left internal mammary artery was used in 95 patients 100% cases.

Table 2: Demographic profile, risk factors, clinical presentations of the patients and post-operative outcomes (n=95)

Variables	Frequency	%age
Gender		
Male	68	71.6%
Female	27	28.4%
Marital Status		
Married	93	97.9%
Unmarried	2	2.1%
Operation Status		
Elective	91	95.8%
Emergency	4	4.2%
CABG		
ON Pump CABG	92	96.8%
OPCAB	3	3.2%
Risk factors		
Hypertension	16	16.8%
Diabetes mellitus	7	7.4%
Use of tobacco	4	4.2%
Family History of CAD	2	2.1%
Both Hypertension and Diabetes Mellitus	32	33.7%
Hypertension, Diabetes Mellitus and family history	5	5.3%
Use of Tobacco and Hypertension	19	20%
DM, HTN and Smoker	4	4.2%
DM, HTN, Smoker and FX	1	1.1%
HTN, Smoking and FX	2	2.1%
No risk factors	3	3.2%
CCS Class		
CCS-I	0	0%
CCS-II	33	34.7%
CCS-III	55	57.9%
CCS-IV	7	7.4%
NYHA Class		
NHYA-I	0	0%
NHYA-II	35	36.8%
NHYA-III	53	55.8%
NHYA-IV	7	7.4%
CAD Presentations		
STEMI	18	18.9%
NSTEMI	77	81.5%
Unstable angina	29	30.5%
Stable angina	66	69.5%
Diseased Vessels		
Single	2	2.1%
Double	16	16.8%
Triple	77	81.1%
Post-operative outcome		
Variables	Mean	\pmSD
Ventilation time (Hrs.)	5.47	\pm 0.97
ICU-stay (Hrs.)	25.64	\pm 4.50
Hospital-stay (Days)	4.21	\pm 1.10
Mortality rate	1.99	\pm 0.11
Post-operative complications		
Variables	Frequency	%age
No complications	69	72.6%
Wound Infection	2	2.1%
GI complications	1	1.05%
Atrial fibrillation	14	14.7%
Bleeding	2	2.1%
AKI	1	1.05%
Re-open	2	2.1%
Stroke	1	1.05%
Re-admission	3	3.2%
LIMA		
LIMA	95	100%

Table 3: Correlation matrix between: AgeRFCCS classNYHA classSTEMINSTEMIBMIVTICU stay CBPMortality (n=95)

Characteristics	1	2	3	4	5	6	7	8	9	10	11
Age	1										
RF	-.091	1									
CCS class	.056	-.003	1								
NYHA class	.042	.059	.941**	1							
STEMI	.002	-.021	-.088	-.104	1						
NSTEMI	.022	.094	.114	.128	-.931**	1					
BMI	.015	-.075	-.036	.004	-.080	.106	1				
VT	.559**	-.089	-.031	-.086	-.041	.012	-.079	1			
ICU-stay	.402**	-.143	-.117	-.150	.033	-.014	.003	.024	1		
CBP	.181	-.129	-.051	-.062	.076	-.052	.097	.045	.080	1	
Mortality	-.152	-.042	.127	.122	.213*	-.229*	-.028	-.056	-.239*	-.087	1

*. Correlation is significant at the 0.05 level

**.. Correlation is significant at the 0.01 level

DISCUSSION

The most frequent cause of myocardial hypoxia and one of the most prevalent cardiovascular illness in non-industrialized nations, coronary artery disease (CAD) has the highest and most well documented morbidity and mortality rates¹. Modern medicine has made considerable strides in understanding the etiology of arterial indisposition with inadequate atheroma and plaque development. Previously the heart diseases were being associated with elderly patients but now the shift of trend is being observed from elderly to young which is noticeably an alarming situation². Since the young people had low risk of contracting the disease, the statistics and investigations on the existence of ischemic heart disease (IHD), related threat factors together with its consequences, in this young age range have not been analyzed in contradiction to the aged mates³.

According to the findings of the research work the average patients age was 43.24 which indicates that the most adult started developing CAD in early 40's. Mean BMI was 27.8249(kgm²) which indicates that most of the patients were overweight. Mean systolic BP134.40mmHg, which is a borderline and mean diastolic BP83.86mmHg.

Our study shows that patients undergone (CABG) included 71.6% male and 28.4% female which depicts that as compared to young men, female ratio was less. Majority of the patient population was married which is 97.9%. Triple vessel disease was the most prevalent one in patients undergone for (CABG) 81.1% following that was double vessel disease 16.8% and single vessel disease 2.1% respectively. Most of the patients were presented in elective settings 95.8% and underwent ON pump CABGsurgery 96.8% as compared to OPCAB 3.2%.

Discussing about the risk factors the most prevalent was the combined hypertension and diabetes mellitus 33.7% which depicts that these two factors make one more prone to develop CAD. In a previous study it was discovered that compared to heart attack or stroke those with T2DM or HTN were more likely to have coronary artery disease. Participants with both HTN and DM had a higher CVD risk than participants with only HTN, similarly CVD risk was seen higher in HTN individual than T2DM participants¹⁰.

Our study also found out that the usage of tobacco and hypertension were the second biggest agents in developing the heart disease 20%. Following these risk factors, the next in series is the hypertension alone 16.8%. According to previous literature hypertension (HTN) affects an enormous section of the globe's community and is responsible for the highest number of mortality and morbidity rates, causing more than 7.5 million fatalities annually. Individuals with high blood pressure (BP) are more sensitive to ischemic heart disease, with studies showing that these patients have a six-fold increased risk of myocardial infarction¹¹.

In our study we found out that DM alone was contributing 7.4%, Hypertension, Diabetes Mellitus along with family history contributed 5.3%, Use of tobacco and DM, HTN and Smoker contributed 4.2% towards the risk factors for developing CAD.

CVD is increased by smoking. However, depending on a number of other factors, the magnitude of this risk increase varies

dramatically. Fresh smokers and those who keep on smoking are found to be at risk of contracting CVD as compared to the nonsmokers and people who had formerly given up smoking¹².

Comparing the family history in study with previous literature it shows that the possibility of coronary artery disease in young individuals gets double by positive family history as compared to the elderly one's. According to the published study, metabolic or other genetic factors have a major role in the relationship between familial background and the occurrence of CVD in young people¹³.

No risk factors contributed about 3.2 % in patients developing CAD which means that the development of heart diseases needs to be further explored and some other factors must be included to improve the understanding of early and premature development of CAD in young patients.

The result of intra-operative data showed that the mean CBP time was 102.77. Several studies revealed that longer bypass times are correlated with an increase in mortality and morbidity¹⁴. Mean cross clamp time was 76.07. Mean venous grafts used were 2.84 and mean arterial grafts 1.79.D.W. Gordon Murray is credited with being the first to describe the use of arterial grafts during 1953 in the coronary circulation and following that in 1955, saphenous vein was first harvested by Sidney Smith¹⁵.

The results of the post-operative outcome show that mean ventilation time was 5.47 hours and mean ICU stay was 25.64 hours which is comparable for young patients. Following cardiac surgery, critical medical care is a common constituent of the therapy. Long stays in the ICU are correlated with substandard long-term diagnosis, increased in hospital death rate and morbidity, long duration of hospital stays and as a result increased cost and expenses which is quite difficult for the developing nations¹⁶.

According to the analysis of the research study average hospital stay of the young patients after surgery was 4.21 days and mean mortality rate was 1.99 which shows that death rate in younger patients is very low as compared to elderly patients undergoing CABG. According to a recent Oregon study, patients under the age of 45 had worse long-term mortality outcomes than patients in several older age groups¹⁷.

The outcomes for the post-operative complications showed that most of the patients had no complications. Similarly, the surgery data of our study showed that (LIMA) graft was used in all patients 95(100%). Today, it is common practice to use LIMA during CABG surgeries. Anastomosis's convenience, good rate of patency, patients' prolonged survival, and reduced death rate has made it advantageous to CABG techniques and it has been stressed in a number of research studies¹⁸.

The incidence of GI problems after cardiac surgery varies between research studies, varying between 3% to 5.5% with an average prevalence of around 1.2%¹⁹. Atrial fibrillation is estimated to be present in about (11-40%) patients after receiving cardiac surgery and is considered to have low consequence on long term follow-up as the patients recover to normal sinus rhythm. However, it has been discovered in multiple studies that POAF is an independent predictor of a number of unfavorable outcomes, such as 2- to 4-fold greater risk of renal or respiratory failure, stroke,

cardiac arrest, reoperation for bleeding, cerebral problems and infections²⁰.

For patients who have undergone surgery, postoperative complications continue to substantially boost morbidity and suffering. The effect of consequences following surgery is mostly assessed from the viewpoints of survival and cost. It is unknown how patients' quality of life will be affected by the postoperative complications in the long run. However long term follow up is needed further to provide better insight in avoiding these complications and to manage the cost associated with these complications effectively²¹.

The correlation result shows that age displays statistically significant linear relationship with ICU stay and ventilation time $r=0.402$, 0.559 $P<0.01$ which depicts that as the patient age ventilation time and ICU stay becomes long. Previous studies also showed that the age is a predictor of long ventilation time, ICU stay and as a result longer hospital stays²². Similarly, CCS class shows significant linear relationship with NYHA class and same goes for NYHA with CCS class: $r=0.941$, $P<0.01$. ST elevation myocardial infarction (STEMI) patients had a statistically significant linear relationship with mortality $r=0.213$, $P<0.05$ which shows that in previously diagnosed young STEMI patients' mortality rate will be high as compared to NSTEMI patients. However previous studies showed that mortality in STEMI patients after CABG depends on age²³. Similarly, another study showed that overall, in hospital mortality among young individuals who underwent CABG was 1.76; patients admitted with STEMI had a considerably greater mortality rate than those admitted with NSTEMI (3.37% vs 1.58%)²⁴.

Limitations of the study: Regardless of the fact that the researchwork was conducted at a single center and involved patients from a diverse demographic. It was retrospective study and included only young adults age <50 years. All of the patients were symptomatic and under investigation for suspected cardiac ischemia. The young adults presented for CABG constitute a limited sample size and the data for other relative remedial modalities was not compared. Similarly, due to lack of information on long-term outcome and procedure related morbidities the patients were not followed up on.

CONCLUSION

It was previously assumed that CAD is associated with only old patients but the high frequency of disease in young patients has been observed from past few years. The outcomes were impressive and low in hospital mortality and morbidity was observed as compared to older counterparts. The major risk factors observed among these young patients were hypertension, diabetes mellitus, use of tobacco, smoking and family history. We recommend further detailed multicenter study with higher sample size and long-term outcomes to confirm better results.

Authors Contribution: MT: Conceptualized and designed the study, WMM: Literature Search, KJ: Manuscript preparation, KU: Data acquisition, AHK: Data analysis, AN: Manuscript editing, SSAS: Manuscript review, MW: Manuscript critical review,

Conflict of Interest: All authors have approved the final draft.

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