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Effect of BMI on Postoperative Outcome, after Off-Pump CABG, A Prospective Observational Study

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Abstract

Background: Obesity and its complications are global health concerns with rising interests, and in Bangladesh, the scenario is not different. This study was designed to analyze the effect of BMI on postoperative outcomes in patients who underwent Off-Pump Coronary Artery Bypass (OPCAB) graft surgery.

Methods: This prospective observational study was conducted from September 2017 to August 2018 in the department of cardiac surgery, NICVD & 90 patients were divided into two groups. 43 patients in group A, with BMI ≥ 25 kg/m^2 and 47 patients in group B, with BMI<25 kg/m^2.

Results: In between groups, homogenous distribution noted in terms of age and sex. Pre-operative risk factors, such as hypertension, dyslipidemia, and sternal wound infection, harvest site infection along with post-operative AF, were significantly higher in group A in comparison to group B.

Conclusion: Obese patients undergoing OPCAB surgery should undergo maximum care. Meticulous tissue handling during OPCAB surgery in obese patients is needed to avoid or minimize sternal, and harvest site wound infection.

Keywords: BMI; Off-pump CABG; Post-operative outcome; Prospective observational study; Bangladesh

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Introduction

Globally, cardiovascular disease is the number one cause of death. An estimated 17.7 million people die from cardiovascular disease every year that represents 31% of all global deaths, and of these deaths, 7.2 million are due to myocardial infarction. About 80% of cardiovascular disease deaths take place in low and middle socioeconomic countries and occur almost equally in men and women. If current trends are allowed to continue, by 2030, an estimated 23.6 million people will die from cardiovascular disease. The prime causes contributing to cardiovascular disease include physical inactivity and unhealthy diet [1]. Coronary Artery Disease (CAD) is a group of diseases that includes: Stable angina, unstable angina, myocardial infarction, and sudden coronary death. In the early 20th century, coronary heart disease ranked 4th as the cause of death in the USA. At present, it is no one as a cause of global death. CAD is the most frequent single cause of death among men under 65 years. A study in India found the prevalence of CAD as 25.4 and 18.3 per 1000 males and females respectively [1]. Recent data indicates that coronary artery disease prevalence is 1.85% to 3.4% in the rural population and 19.6% in an urban population [2]. According to the WHO data (April 2011), coronary heart disease deaths in Bangladesh reached 17.11% of total deaths. Bangladesh ranks 25th position in the world in respect to cause of death due to coronary artery disease [1]. In Bangladesh, as a result of socioeconomic transition and urbanization, lifestyle, as well as the dietary pattern, is changing. There is an increasing prevalence of obesity due to the high intake of processed foods and less physical activity. In general, 21.5% adults (male 21%, female 22%) have Body-Mass Index (BMI) more than 25 kg/m^2. Increased waist circumference is also alarming, especially in women (33.7%) [3]. It is well-known that obesity has a major influence on the development of cardiovascular disease, thus leading to worsening physical function and quality of life [4]. Obesity is a global health concern with rising interests. About 0.5 billion adults are overweight, including 200 million are men and almost 300 million women [1]. Obesity is known as a Body Mass Index (BMI) of 30 or more. The BMI is calculated by weight in kilograms divided by height in meters squared (kg/m^2). Besides, overweight is when a BMI value of 25.0 kg/m^2 to 29.9 kg/m^2. A commonly accepted BMI range for underweight is below 18.5 kg/m^2, and a normal range 18.5 kg/m^2 to 25 kg/m^2. As a consequence of obesity, there is an alteration to the vascular endothelium, including the promotion of atherosclerosis, alteration in cardiac function, and promotion of adverse inflammatory change leading to coronary artery disease [5]. Moreover, obesity is highly and increasingly associated with significant postoperative morbidity and mortality in every surgical aspect. Higher BMI has been positively linked to myocardial dysfunction in patients even without coronary artery disease. There is a direct relationship between diastolic dysfunction and systolic impairment in cases of excessive BMI [6]. Obesity is also associated with increased morbidity in the ICU. It markedly increases the risk of pulmonary and airway complications and hampers tracheal intubation. Mechanical ventilation in this population requires specific ventilatory settings due to the mechanical alterations observed in obesity [7]. In a high BMI group of patients, end-expiratory lung volume is decreased, leading to impairment in the mechanics of the respiratory system, lung and chest wall as well as gas-exchange. These patients may have apparent healthy lungs; however, the pathophysiological changes induced by obesity make these patients prone to perioperative complications, such as hypoxemia, hypercapnia, and atelectasis. Finally, intraoperative respiratory changes extend to the postoperative period and subsequently necessitate the use of more supplementary oxygen. There is an increase in the need for respiratory physiotherapy or non-invasive ventilation and delay in discharge from the intensive care unit. Besides, obese patients more frequently develop ICU-acquired infections [8]. Obesity also increases the incidence of other risk factors notably diabetes, dyslipidemia, hypertension, and the prothrombotic state [9]. Estimates from the global burden of disease study suggest that by the year 2020 the South Asian part of the world will have more individuals with atherothrombotic cardiovascular disease than any other region [10]. Treatments of coronary heart disease include lifestyle changes, conservative management with medications, interventions, and surgery. When conservative management fails, both angioplasty and Coronary Artery Bypass Grafting (CABG) are used to treat diseased coronary arteries for revascularization accounting for 1.4% of all operating room procedures performed in 2016. Coronary artery bypass grafting reduces symptoms and improves long-term survival in patients with severe coronary artery disease [11]. The 2004 ACC/AHA CABG guidelines state that CABG is the preferred treatment for diseases of the Left Main Coronary Artery (LMCA), triple vessel (LAD, LCX, and RCA) coronary artery diseases, a diffuse disease not amenable to be treated with a PCI, and other high-risk patients with severe ventricular dysfunction (i.e. low ejection fraction), or diabetes mellitus. Coronary Artery Bypass Grafting (CABG) is the definitive cardiac surgical procedure of coronary artery revascularization, which improves symptoms and provides long-term survival in coronary heart disease patients [11]. There are two popular options of CABG, one is the Conventional on-pump CABG, and the other is Off-Pump Beating Heart CABG (OPCAB). In conventional CABG, the patient undergoes Cardiopulmonary Bypass (CPB) that has adverse effects, such as neurological assault, renal impairment, respiratory dysfunction, postoperative myocardial infarction, and postoperative bleeding. In OPCAB, the harmful consequence of cardiopulmonary bypass is detached from postoperative outcomes making this procedure much more advantageous than on pump cases [12]. Significant technological advances made in the last decades have allowed OPCAB to be performed with good success rates without the risks related to CPB. As awareness of the potential morbidity of cardiopulmonary bypass increased and as surgical tools and techniques were improved, OPCAB gained widespread acceptance and entered the mainstream of clinical practice. OPCAB is a part of the procedural armamentarium of a growing proportion of surgeons worldwide. It was primarily developed in the early 1990s by Dr. Amano Atsushi. Several retrospective studies have reported that OPCAB associated with lower incidences of renal dysfunction, pulmonary complication, neurologic complications, bleeding, and death [3]. Study shows that in case of patients undergoing CABG, the risk of sternal wound infection, leg wound infections and atrial arrhythmias were more than twice as high among the overweight and nearly three times higher among the obese [13,14]. Overweight patients appear less likely to be selected for surgery than normal-weight patients, and obese patients may have been kept in hospital longer as a precaution after postoperative period [11]. Furthermore, in comparison of patients to a normal BMI, patients having high BMI have more visceral adipose tissue, which prolongs the operative time and causes more blood loss during various cardiac and thoracic surgery. During the bypass grafting, anastomosis of the distal grafts become difficult in high BMI patients due to the abundant epicardial fat [15]. Another review described that a high BMI group experienced a greater degree of postoperative renal failure, mediastinitis, and prolonged ventilation. All these patients had prolonged ICU days with an increased hospital stay [5]. Birkmeyer et al. [13] showed although obesity was not associated with increased mortality or postoperative CVA, risks of sternal wound infection were substantially increased in the obese and severely obese. As the number of patients of this particular group is increasing day by day, further research is needed to understand the effects of higher BMI on postoperative outcomes after off-pump coronary artery bypass surgery. National Institute of Cardiovascular Diseases (NICVD), Sher-E-Bangla Nagar, Dhaka, Bangladesh, is performing a crucial role in the field of cardiac surgery countrywide since its birth (1978). At NICVD, off-pump CABG is one of the most common surgical procedures, including patients with normal BMI and high BMI. At NICVD, a study was performed on conventional on-pump CABG; however, no study on the effect of body mass index on postoperative outcomes after OPCAB. Therefore, we completed this study to analyze the effects of body mass index on postoperative outcome after off-pump coronary artery bypass grafting.

Methods

This prospective observational study was conducted in the department of cardiac surgery, National Institute of Cardiovascular Diseases (NICVD), Sher-E-Bangla Nagar, Dhaka, from September 1st, 2017 to August 30th, 2018. Patients who underwent Isolated OPCABG in the department of cardiac surgery at NICVD included in this study and sampling was done by convenient purposive sampling. Combined CABG and valve and other congenital heart surgery, conversion to on-pump CABG, redo CABG, urgent or emergency CABG, pre-operative COPD patient, patient with peripheral vascular disease, patient with renal impairment, patients with preoperative AF, left ventricular ejection fraction ≤ 35%, body mass index less than 18.5 kg/m^2 were excluded from the study. A total of 90 patients prospectively allocated into two groups: Group A included 43 patients with BMI ≥ 25 kg/m² whereas 47 patients were in Group B with BMI<25 kg/m². Ethical approval was taken from the Ethical Committee of NICVD. The participants and their legal guardians were explained about the study, including the purpose and the importance. Informed written consent was taken from the participants or their guardians by preserving the right to withdraw himself or herself from the study at any time during the study period. Patients' interests were given the highest priority with maintaining full confidentiality. Variables were measured and recorded in all participants by a standard medical scale. BMI was calculated, categorized and recorded accordingly. All patients underwent off pump CABG. Post operatively patients were evaluated in the ICU. Standard ICU protocol used at ICU and shifted to HDU and then to ward. Post-Operative Atrial Fibrillation (POAF) monitored from the day of surgery up to 4th POD. If there was incidence of POAF then ECG was done for documentation. Post-operative pulmonary complication evaluated both clinically and by radiological method. Neurological assault evaluated clinically by GCS scale. In hospital outcomes were observed and recorded with one-month follow-up data along with it. Total ICU & post-operative hospital stay, incidence of sternal and harvest site infection of the patients were also recorded. A structured data sheet was developed containing all the variables of interest. Data were collected by monitoring in ICU & HDU up to 5th post-operative days, at discharge & one month after discharge.

Data processing and statistical analysis

Collected data were analyzed statistically by SPSS software version 24.0. Continuous variables were expressed as mean ± standard deviation and compared using Student's *t*-test. Categorical variables were expressed as frequencies with percentages and compared using Chi-square test when and where appropriate. P<0.05 was considered significant. The summarized data were presented in the form of tables.

Results

Out of 90 patients the mean age was 50.5 ± 8.0 years (range 35 to 68 years). The mean age of group A patients were 50.0 ± 7.6 years (range 37 to 61 years) and group B patients were 50.8 ± 8.3 years (range 35 to 68 years); which was not statistically significant (*p*=0.863) (Table 1). Among the study population male female ratio was about 5.4:1. In group A 35 (85.7%) and group B 41 (92.3%) were male and the rest 8 (18.6%) and 6 (12.7%) were females in group A and group B respectively; which was not statistically significant (*p*=0.417) (Table 1). The mean BMI of the study population was 24.9 ± 3.20 kg/m² (range 19.37 kg/m² to 32 kg/m²). The mean BMI of group A patients were 28.5 ± 2.28 kg/m² (range 25 to 32 kg/m²) and group B patients were 22.9 ± 1.4 kg/m² (range 19.37 to 24.99 kg/m²), which was statistically significant in between groups (*p*=0.001) (Table 1). In group A 24 (55.8%) patients had hypertension, 17 (39.5%) had diabetes and 26 (60.4%) had dyslipidemia and in group B 11 (23.4%) patients had hypertension, 10 (21.2%) had diabetes and 7 (14.9%) patients had dyslipidemia. There was statistically significant (*p*=0.001) difference between group A and group B patients in term of hypertension and dyslipidemia. Regarding extent of coronary artery disease, single vessel disease was none in both groups, whereas double vessel disease was 11 (25.5%) and 9 (19.1%) in group A and group B respectively and triple vessel disease was 32 (74.4%) and 38 (80.8%) in group A and group B respectively and it was not significant statistically (*p*=0.594) (Table 2). The mean ventilation time (hour) of group A patients were 18.2 ± 9.3 h (range 7 h to 85 h) and in group B patients were 13.2 ± 4.5 h (range 5 h to 96 h) which was not statistically significant (*p*=0.265) (Table 3). Post-operative AF in group A and in group B was l2 (26%) and 4 (8.7%) respectively and it was significant statistically (*p*=0.015). The mean ICU stay (days) of group A patients was 5.5 ± 2.1 days, (range 2 to 11 days) and group B patients was 6.2 ± 3.7 days (range 2 to 20 days); which was not statistically significant (p>0.05). The mean hospital stay (days) of group A, patients were 10.2 ± 62.5 days, (range 5 to 15 days) and group B patients were 8.3 ± 3.7 days (range 6 to 21 days), and there was no statistically significant (p>0.05) difference between groups (Table 3) in this regard. In group A, patients, other morbidity was found as follows, 6 (13.9%) neurological problem, 1 (2.3%) re-intervention, 18 (41.8%) sternal wound infection, 15 (34.8%) harvest site infection, 6 (13.9%) pulmonary problem. In group B patients, morbidity was found 4 (8.5%) neurological problem, 1 (2.1%) re intervention, 4 (8.5%) sternal wound infection, 2 (4.2%) harvest site infection, 5 (10.6%) pulmonary problem and the differences were not statistically significant (p>0.05) between groups, except sternal wound infection and harvest site infection which were statistically significant (p<0.05). Out of 90 patients, mortality was found 2 (6.5%)

Table 1: Distribution of Age, Body mass index in study population.

	Group A (n=43)	Group B (n=47)	Total (n=90)	*p* value
Age	50.0 ± 7.6 (37-61)	50.8 ± 8.3 (35-68)	50.5 ± 8.0 (35-68)	0.863
Sex No (%)	35 (81.4%)	41 (87.2%)	Male	0.417
	8 (18.6%)	6 (12.7%)	Female	
BMI	28.5 ± 2.28 (25–32)	22.9 ± 1.4 (19.37-24.99)	24.9 ± 3.20 (19.37-32)	0.001

Mean ± SD (range) or Number (Percentage)

Table 2: Distribution of associated preoperative patient characteristics in both groups.

	Group A (n=43)	**Group B (n=47)**	**Chi Value**	**Df**	**p value**
	No (%)	No (%)			
Hypertension	24(55.8)	11 (23.4	11.11	1	0.001
Diabetes	17(39.5)	10 (21.2)	2.77	1	>0.05
Dyslipidaemia	26(60.4)	7 (14.9)	17.93	1	0.001
Single vessel	-	-0.0			
Double vessel	11(23.8)	9 (19.1)			0.594^{ns}
Triple vessel	32 (74.4)	38 (80.8)			

Mean ± SD (range) or Number (Percentage)

Table 3: Distribution of Ventilation time, ICU stay and hospital stay of patients.

	Group A (n=43)	Group B(n=47)	p value
Ventilation time in hours	18.2 ± 9.3	13.2 ± 4.5	0.265
ICU stay in days	5.5 ± 2.1	6.2 ± 3.7	0.289
Hospital stay in days	10.2 ± 2.5	8.3 ± 3.7	0.489

Mean ± SD (range) or Number (Percentage)

Table 4: Distribution of postoperative morbidity and mortality after CABG in both groups.

	Group A (n=43)	Group B (n=47)	p value
	No (%)	No (%)	
Neurological Problem	6 (13.9)	4 (8.5)	0.458^{ns}
Postoperative AF	12 (27.9)	4 (8.5)	0.015^{s}
Re exploration	1 (2.3)	1 (2.1)	0.651^{ns}
Death	2 (4.6)	3 (6.3)	0.807^{ns}
Sternal wound infection	18 (41.8)	4 (8.5)	0.016^{s}
Harvest site infection	15 (34.8)	2 (4.2)	0.010^{s}
Pulmonary problem	6 (14.2)	5 (10.6)	0.450^{ns}

Mean ± SD (range) or Number (Percentage)

and 3 (10.3%) in group A and group B respectively and the difference was not statistically significant (p>0.05) between group A and group B patients in chi square test (Table 4).

Discussion

Obesity is considered to be a high-risk factor in patients undergoing OPCABG surgery. A high BMI (BMI>25 kg/m^2) and especially obesity (BMI>30 kg/m^2) are attended with the presentation of co-morbidity, like cardiovascular disease, diabetes mellitus, dyslipidemia, hypertension, etc. With increasing BMI, the co-morbidity increases. Obesity alters the pulmonary function causing an increase in functional residual capacity and a decrease in vital capacity and maximum voluntary ventilation. In several score systems, obesity is not recognized as a variable needed for risk stratification, and several authors suggest that obesity does not influence mortality although there is an increased risk of in-hospital and early postoperative morbidity after CABG surgery. In our study, the mean age in the non-obese group requiring CABG is slightly higher than the obese group that is statistically not significant. Similar results were observed in/the several studies [13,14]. A male preponderance was observed in both obese and non-obese groups with overall male female ratio of 5.4:1. In other series, obese patients were more likely to be men [10]. Obese patients were more likely to have hypertension and dyslipidemia in our study, compared to non-obese patients. In the non-obese group, only 23.4% were hypertensive, with dyslipidemia in 14.9%. There was a statistically significant difference between the obese and non-obese groups in terms of hypertension and dyslipidemia. This observation coincides with a similar study [14]. In this series, preoperative patient characteristics like the extent of coronary disease showed no statistically significant difference between the obese and non-obese groups. This study had shown that obesity was not a risk factor for in-hospital mortality. In the obese group, mortality was 4.6%, whereas 6.3% mortality in the non-obese group that is in concurrence with some studies [16,17]. Another similar study found a significant increase in in-hospital mortality in obese patients who had a BMI higher than 35 kg/m^2. They found that moderate obesity (BMI>35 kg/m^2) was associated with a slight but statistically significant increase in risk-adjusted increase in mortality, and those with extreme obesity (BMI>40 kg/m^2) had a nearly 50% increase in risk-adjusted mortality [18]. However, in this study, there was no study population having BMI 35 kg/m^2. Therefore, the relationship between moderate obesity and mortality could not be assessed. Here, mild obesity may be protective of the stress response and give energy in the postoperative period as mentioned in a previous study. This study found that obesity only increases the risk of wound infections that is statistically significant. There is an increased risk of AF as another form of morbidity among obese patients undergoing CABG compared to non-obese patients that are significant as well. Besides, the hospital stay is more in obese patients but not significant statistically. In this study, sternal wound infection was present in 41.8% of patients in the obese group compared to 8.5% of non-obese patients. It was statistically significant. Regarding conduit harvest site infection, 34.8% of obese patients developed infections, whereas in non-obese group infections found in 4.2% of patients. The difference in infection between the two groups was statistically significant. The increase in wound infections was also noted in several other studies [17-19]. A previous study found that obesity is an independent preoperative risk factor for sternal wound complications after CABG [20]. Schwann suggests that this higher risk of wound infections may be due to a decreased perfusion of adipose tissue and increased incidence of diabetes in obese patients. There is also a relative increase in operating time in obese patients. That suggests an increased open-chest exposure to the environment and may result in an increased incidence of sternal wound infections. Our study has suggested that diabetes mellitus was associated with a postoperative wound infection after coronary artery bypass surgery. This study did not reveal any significant difference for a postoperative neurological problem, re-intervention, or pulmonary problem. In the obese group, morbidity was found in the form of a 13.9% neurological problem, 2.3% re-intervention, 14.2% pulmonary problem, and in the non-obese group neurological problem was 8.5%, re-intervention 2.1%, pulmonary problem 10.6%. All are a little bit higher in the obese group but statistically not significant. This study is in concurrence with other studies. Ventilation time was found more in the obese group with a mean duration of 18.2+9.3 h compared to the non-obese group where the mean duration of mechanical ventilation was 13.2 ± 4.5 h, but it is statistically not significant. It corresponds with other studies. Prolong mechanical ventilation could be due to impaired respiratory function as a result of relatively decreased vital capacity and depression of respiratory drive due to the slow release of anesthetic agents stored in fatty tissue into the blood stream [22]. The duration of ICU stay and total hospital stay showed no significant difference between groups. In the obese group, mean ICU stay was 5.5 ± 21 days with a mean hospital stay of 10.2 ± 2.5 days. In the non-obese group, the mean duration of ICU and hospital stay was 6.2 ± 3.7 days and 8.3 ± 3.7 days respectively. A little more hospital stay in the obese group may be due to the direct effect of increased wound infections that were not statistically significant. Keeling et al. [21-23], at a retrospective review of 6,801 patients showed a significant decrease in in-hospital mortality, stroke, new-onset renal failure, and prolonged ventilation for patients with a body mass index <25. Despite a higher risk profile, patients with a body mass index <25 who underwent off-pump coronary artery bypass grafting experienced a significant reduction in in-hospital mortality [23]. Ilir Hysi et al. [2] found that severe obesity did not influence postoperative mortality, but the interaction between preoperative renal failure and severe obesity was a crucial mortality prognostic factor. Severe obesity was associated with higher mediastinitis rates, superficial wound infections [24,25]. Feridoun et al. [12] investigated 1,120 patients who underwent OPCAB, and an important correlation between the underweight/low BMI group and mortality was observed. Postoperative stroke, postoperative Atrial Fibrillation (AF), and Intra-Aortic Balloon Pump (IABP) use were not associated with BMI. A significant correlation between low BMI, reintubation, ICU stay time, and intubation time was noted. Re-exploration for bleeding was significantly correlated with BMI. They found that low BMI was notably associated with reintubation, prolonged intubation time and ICU stay time. The obese group was also associated with postoperative atelectasis and fever [12]. All patients who survived in this study were followed up. There were no post discharge mortality and major adverse cardiac events (a new MI, the return of angina pectoris, congestive cardiac failure, rhythm disturbance, and stroke) in both obese and non-obese groups, and hence statistical analysis was not done.

Conclusion

Nowadays, Coronary revascularization by OPCAB is usually performed in most of the patients, including patients with increased BMI, and the number of overweight individuals undergoing such procedure will likely increase substantially in the future. We have shown that patients who have a high body mass index appear to have a greater and statistically significant risk of sternal wound infections and harvest site infection regarded as an adverse postoperative outcome. Patients with a high BMI are also at increased risk of postoperative atrial fibrillation. So, obese patients undergoing coronary artery bypass surgery should be treated carefully in the postoperative period.

Study Limitation

This study had a few limitations. First of all, the surgeries in both groups were not performed by the same surgical team though the same protocol was followed. Secondly, the study population was small. If it was a large-scale study, it would be more representative. Due to a small population, the correlation of diabetes mellitus, hypertension, dyslipidemia, and postoperative infection in the obese and no obese group was not possible.

Recommendations

Proper peri-operative soft tissue handling and good post-operative care may reduce the morbidity in the obese group. A prospective randomized trial and long term follow up are necessary to confirm our findings and to define the long term clinical and functional results of both groups.

Study Definitions

BMI (Body Mass Index): BMI = Weight in kg/(Height in meter)^2. The BMI is an attempt to quantify the amount of tissue mass (muscle, fat, and bone) in an individual, and then categorize that person as underweight, normal weight, overweight, or obese based on that value [1].

Cardiopulmonary Bypass (CPB): Cardiopulmonary bypass is a process by which systemic venous blood is taken from the patient, transferred to a pump oxygenator and delivered back to the arterial circulation of the patient [25]. Conventional CABG: Surgical procedure involving bypass of coronary artery blockages with variety of conduits provided by cardioplegic arrest. Conduits commonly includes Internal mammary artery (both right & left), Radial artery, Saphenous vein etc [25].

High Dependency Unit (HDU): A high dependency unit is an area in a hospital, usually located close to the intensive care unit, where patients can be cared for more extensively than on a normal ward, but not to the point of intensive care [25].

Intensive Care Unit (ICU): The intensive care unit is a designated area of a hospital facility that is dedicated to the care of patients who are seriously ill [25].

Off-Pump Coronary Artery Bypass (OPCAB): Surgical procedure involving bypass of coronary artery blockages with variety of conduits provided without cardioplegic arrest on beating heart. Conduits commonly includes Internal mammary artery (both right & left), Radial artery, Saphenous vein etc [25].

Level of significance: It is the point of demarcation between chances of by chance (sampling error) and not by chance for an observation to occur.

Prospective study design: Prospective means forward looking. This study moves from exposure to outcome by measuring the exposure of population at the start & then waiting for the outcome to develop in future.

Prolonged ventilation: Prolonged postoperative mechanical ventilation support more than 24 h.

Urgent/emergency CABG: ACC/AHA guidelines provide a class I recommendation for CABG in the context of an ST-Segment Elevation Myocardial Infarction (STEMI) in cases where PCI has been impossible to perform or has failed and the patient has persistent pain and ischemia threatening a significant area of myocardium despite medical therapy. Other class I indications for emergency open heart surgery in the setting of STEMI include the following: Ventricular septal defect related to MI, Papillary muscle rupture, Free wall rupture, Ventricular pseudo aneurysm, Life-threatening ventricular arrhythmias, Cardiogenic shock (ACC/AHA and ESC/EACTS guideline for CABG, 2016).

Postoperative hospital stay: Defined as the duration of postoperative stay of patient in ICU and ward. Normally it is ≤ 7 days. However, if there is indication for discharge on or before 7th day, yet the patient prefers to prolong his/her stay for personal convenience then it will not be considered as a prolonged hospital stay.

Purposive sampling: In this sampling process the judgment of researcher is used and exercised exclusively to select the sample which researcher thinks to be most appropriate for his research.

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