

Risk factors of mortality among patients with Coronary Artery Bypass Grafting attending Cardiac Center of Erbil City; A cross-sectional study.

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ABSTRACT

Coronary artery bypass grafting (CABG) is a major surgical operation where atheromatous blockages in a patient's coronary arteries are bypassed with harvested venous or arterial conduits. Post-CABG mortality has been associated with multiple patient factors such as advanced age, preoperative renal dysfunction, diabetes, low preoperative Ejection Fraction (EF), stroke, carotid artery disease, dysrhythmias, concomitant valvular disease and multiple other comorbidities. To assess the mortality rate and discuss the possible risk factors associated with mortality following CABG. A cross sectional study was conducted in the Cardiac Center in Erbil, Kurdistan region of Iraq from June 2020 to March 2021. Data was collected from case files of 200 patients in the hospital records and follow up data was obtained after a 6-15-month period by interviewing the patients directly. Data were analysed using the Statistical Package for Social Sciences version 23 (SPSS, IBM, Armonk, NY, USA). The mortality rate after CABG was 8.5% in the study duration, with the majority being in the 50-59 age group. Female gender, left ventricular dysfunction, hyperlipidemia, double vessel disease and triple vessel disease, valvular disease and concomitant valve surgery were identified as risk factors for mortality in the postoperative period. More efforts should be directed towards preventing and controlling cardiovascular risk factors to decrease the prevalence and impact of CAD in our community.



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1. Introduction

Noncommunicable diseases (NCDs) kill 41 million people each year, equivalent to 71% of all deaths globally. Of those NCDs, Cardiovascular diseases (CVDs) have been considered a health burden globally [1]. A study by the World Health Organization (WHO) in 2019 shows that there were 17.9 million deaths from CVDs in 2019, representing 32% of all global deaths. Of these deaths, 85% were due to heart attack and stroke. Over three quarters of CVD deaths take place in low- and middle-income countries [2]. Cardiovascular diseases including cerebrovascular, cardiac ischemic, hypertensive diseases, atherosclerosis, rheumatic fever and other heart diseases are currently considered the leading causes of deaths globally [2].

Acute coronary syndrome (ACS), known as the most serious consequence of coronary artery disease, can result in long-term disability and mortality [3]. The standard of care for patients presenting with ACS includes early coronary angiography with a view to revascularization with percutaneous coronary intervention (PCI) or coronary artery bypass surgery (CABG) [4].

Coronary artery bypass grafting (CABG) is a major surgical operation where atheromatous blockages in a patient's coronary arteries are bypassed with harvested venous or arterial conduits. The bypass restores blood flow to the ischemic myocardium which, in turn, restores function, viability, and relieves anginal symptoms. Almost 400,000 CABG surgeries are performed each year making it the most commonly performed major surgical procedure, but surgical trends have decreased as the use of alternative options such as medical treatment and PCI have increased [5].

In general, on-pump and off-pump are the 2 types of CABG surgical procedures with the difference being the use of a cardiopulmonary bypass circuit and an arrested heart to operate during an on-pump CABG. The conduits used as bypass grafts are routinely the left internal mammary artery (LIMA) and the saphenous vein grafts (SVG) out of the lower extremities. Other conduits that may be grafted include the right internal mammary artery (RIMA), the radial artery, and the gastroepiploic artery. The type and location of the grafts depend on the patient's anatomy and the location of the arteries that are occluded. Typically, the LIMA is grafted to the left anterior descending (LAD) artery, and the other conduits are used for the other occluded arteries [6].

According to existing literature, post-CABG mortality has been associated with multiple patient factors such as advanced age, preoperative renal dysfunction, diabetes, low preoperative Ejection Fraction (EF), stroke, carotid artery disease, dysrhythmias, concomitant valvular disease and multiple other comorbidities that lead to death indirectly. For instance, obesity and advanced age lead to deep wound infection that carries a mortality rate of more than 45% [3], [6].

This present study was carried out to assess the mortality rate and discuss the possible risk factors associated with mortality following CABG in patients attending the Cardiac center- Surgical Specialty Hospital in Erbil city, Iraq.

2. Methods and Materials

This is a cross-sectional study that was conducted at the Cardiac center- Surgical Specialty Hospital in Erbil

from June 2020 to March 2021. Data were obtained retrospectively and consecutively from hospital records of the individual patient's case files. All of the patients who underwent CABG in the mentioned time period were included in the study. The exclusion criteria were patients who were lost to follow up as well as patients whose medical profiles were not fit for the study, such as those with insufficient data on their case files.

The data was collected in two steps. Firstly, medical records of the CABG patients within the study period were acquired. A questionnaire was designed that included relevant information such as: age, gender, date of CABG, number and type of graft used, risk factors of CAD and preoperative investigations like echocardiography, to assess the left ventricular status and electrocardiography, to determine presence and type of myocardial infarction.

Next, a follow up questionnaire was formed that addressed the state of the patient's health after a brief amount of time from the operation. The follow up was conducted after a 6-15-month period post-surgery.

2.1 Statistical Analysis

Data were analyzed using the Statistical Package for Social Sciences version 23 (SPSS, IBM, Armonk, NY, USA). Associations between variables were determined using Chi square or Fisher's exact tests. $P < 0.05$ was considered statistically significant.

2.2 Echocardiography

The preoperative echocardiography of the patients was the imaging modality used to assess the status of the left ventricular function and valvular anomalies.

The left ventricular dysfunction status was assessed using ASE/EACVI (American society of echocardiography/ European association of cardiovascular imaging) criteria.

Ejection fraction (EF) of >52 was defined as normal, EF between 41-51% was defined as mild LV dysfunction, EF between 30-40% was defined as moderate LV dysfunction, and EF $<30\%$ was defined as severe LV Dysfunction. NYHA classification was assessed using the New York Heart Association (NYHA) guideline.

2.3 Coronary Angiography

Coronary angiograms were performed using the standard techniques. The extent of the CAD was characterized by single, double, triple or quadruple vessel disease.

3. Results

From June 2020 to March 2021, 200 patients underwent coronary artery bypass surgery in the surgical specialty hospital/Cardiac center in Erbil, Iraq. Of these patients, 57 (28.5%) were female and 143 (71.5%) were male. The mean age \pm SD was 56.9 ± 9.2 years, with an age range of 37-90 years old. Most of the patients (40%) were in the age group (50-59 years).

In regards to the age groups of the dead patient population, it was found that the majority 70.6% of the dead patients were among the age group of (50 to 59), followed by 29.4% of the dead patients among the age group (60 to 69). Interestingly, the > 70 age group all survived the follow up period. This association was significant with a P value of 0.04 using fisher's exact test. As for the mortality, of the total number of patients who underwent surgery (200), 183 (91.5%) survived and 17 (8.5%) died in the one-year study time.

While analyzing the data, it was found that, of all the female patients who had undergone the surgery, 47 (82.5%) had survived and 10 patients (17.5%) had passed away. Of all the male patients who had done the surgery, 136 (95.1%) were alive and 7 (4.9%) had died. To determine whether this association was significant, Fisher's exact test was used and a significant association was determined between the mortality rate and the gender ($P = 0.009$)

Table 1 Baseline characteristics of the study sample (age, gender, and life status)

Characteristics	Frequency	
	No	%
Age groups (yr)		
<39	5	2.5
40-49	34	17
50-59	80	40
60-69	58	29
>70	23	11.5
Total	200	100
Gender		
Female	57	28.5
Male	143	71.5
Total	200	100
Life status		
Alive	183	91.5
Dead	17	8.5
Total	200	100

The risk factors associated with the patients who underwent CABG seen in the sample population were diabetes mellitus (62%), hypertension (63%), hyperlipidemia (58%), smoking history (52%), alcohol consumption (3.5%), family history of CAD (44.5%) and history of other comorbidities (such as renal failure, thyroid disorders, osteoarthritis.. etc) (18%).

Table 2 Risk factors associated with development of Coronary Artery Disease (CAD) and CABG mortality

Risk factors	No	%	P- value
Diabetes	124	62	0.8
Hypertension	126	63	0.3
Hyperlipidemia	116	58	0.008
Smoking	104	52	0.1

Alcohol	7	3.5	0.1
Family history of CAD	89	44.5	0.2
Other comorbidities	36	18	0.04

Of all the patients who died, 88.2% of them had hyperlipidemia and 11.8% of them did not. This relationship was statistically significant with a P value of 0.008.

Concerning other comorbidities, none of the dead patients had any other comorbidities such as renal failure, osteoporosis, thyroid dysfunction.. etc. This was found to be significant with a P value of 0.04.

Among the dead patients; 64.7% had diabetes mellitus, 52.9% had hypertension, 70.6% were smokers and 29.4% had a family history of CAD. These findings, however, were not significant (P values were 0.8, 0.3, 0.1 and 0.2 respectively).

Regarding the patients' preoperative coronary angiography, 4.5% had single vessel disease, 17% had double vessel disease, 56% had triple vessel disease and 22.5% had quadruple vessel disease.

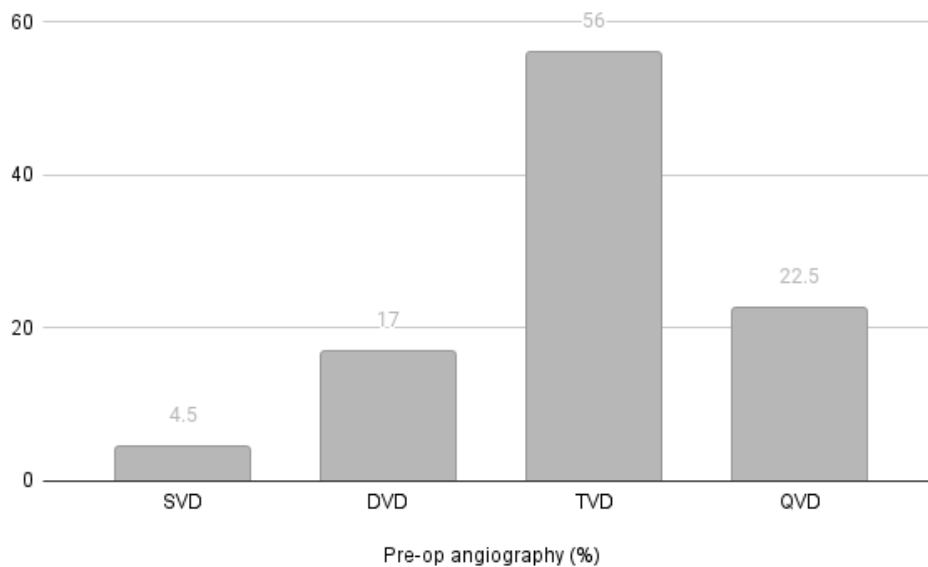


Figure 1 Preoperative angiography: Showing the number of affected vessels among the study population

The most common finding regarding their coronary angiography among both the females and males was triple vessel disease, (56.1% in females and 55.9% in males). However, this finding was not significant. (P = 0.2)

Regarding the association between the number of occluded vessels and mortality; triple and double vessel diseases were found to be the most common in the dead patients as seen from their angiography records, 64.7% and 35.3% respectively. This association between the mortality rate and the number of occluded vessels was statistically significant, P = 0.021.

The preoperative Ejection Fraction (EF) echocardiographic reports showed that 57% of the patients had

normal Left Ventricular (LV) systolic function, 31% had mild Left Ventricular Dysfunction (LVD) and 12% had moderate LVD.

Among the dead patients, mild LVD (64.7%), moderate LVD (23.5%) and normal LV systolic function (11.8%) were observed with a significant relationship and a P value of 0.0001.

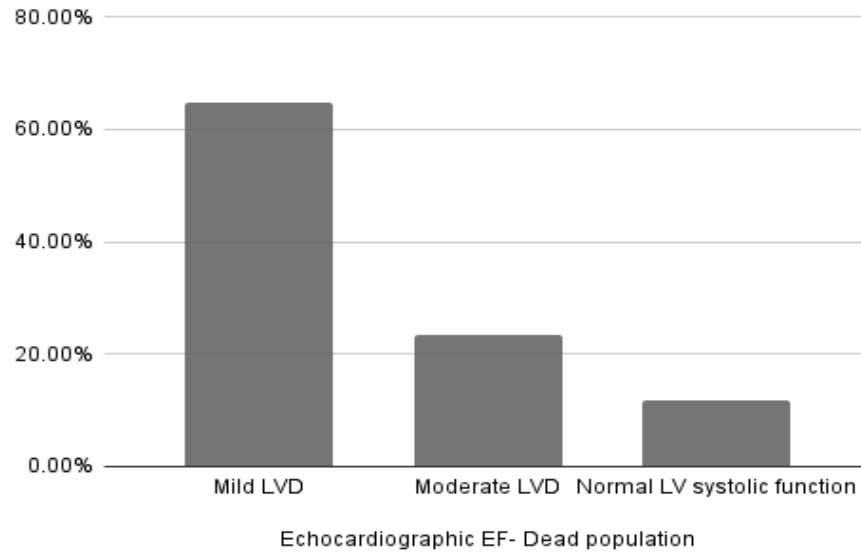


Figure 2: Echocardiographic findings among the dead patient population.

Concerning the relationship between individual risk factors and number of vessels occluded; 68.9% of the patients who had quadruple vessel disease and 67% of those with triple vessel disease had diabetes mellitus. Followed by those with double vessel disease (47.1%) and single vessel disease (22.2%). This finding was statistically significant with a P value of 0.01. In contrast, 67.5% of those with double vessel disease were found to have hypertension. This finding, however, was not significant. (P = 0.9)

100% of the patients who had single vessel disease on their angiography were found to be smokers. 52.7% of the triple vessel disease patients, 51.1% of the quadruple vessel disease and 38.2% of the double vessel disease were smokers. This was significant with a P value of 0.008.

Regarding valvular involvement, 17.5% of the patients from the sample had associated valvular disorders in addition to their coronary artery disease. Within these patients, 25.7% of them succumbed to the disease in the follow up period. This showed a significant relationship with a P value of 0.001.

Table 3 Showing the distribution of associated valvular disorders among the cases

Associated valvular disease		
Presence of a valvular disease	No	%
Yes	35	17.5

No	165	82.5
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The majority of the patients (185, 92.5%), underwent CABG without any other associated surgery. Only 15 (7.5%) patients underwent CABG associated with mitral valve replacement.

Among those who performed valve replacement surgery, 23.5% died during the study time. This was a significant association with a P value of 0.027.

4. Discussion

Coronary artery disease is widely prevalent both in the developed and developing countries and continues to be a leading cause of mortality despite recent advances in diagnostic facilities and treatment modalities [7]. This presented study sample included 200 patients with more men than women (143 and 57 respectively). The age of our patients ranged from 37-90 years with a mean (SD) of 56.9 ± 9.2 years which was similar to that studied by [8], [9] [55.5 ± 10.4 and 52 ± 10.8] respectively.

Although the number of male patients undergoing CABG exceeds that of the female patients, the mortality was higher among female gender, on the contrary, a study by [10] showed that mortality was higher among male patients. Our findings support what was mentioned in existing literature as in the past, female gender was reported to be an independent predictor for early and late mortality after CABG and were reported to have women have a higher operative mortality CABG surgery than men. Suggested contributing factors have included women's increased age, advanced disease, comorbidities, and smaller body surface area (BSA) [11], [12].

Our study identified several risk factors for mortality in patients undergoing coronary artery bypass grafting with cardiopulmonary bypass. The most common factors included the female gender, age group 50-59, hyperlipidaemia, history of ischemic heart disease, as well as valvular disease associated with the CAD. In the presented study, the presence of multiple comorbidities significantly increased the risk of mortality. Similar findings were observed in a study by [13]. Reasonably, the difference in mortality rate becomes greater as the number of risk factors increases.

In this study, the mortality rate was 8.5%, close to that recorded by (9.2 %) [14], [10] who analyzed 1,674 patients undergoing cardiac surgery for coronary artery bypass grafting with cardiopulmonary bypass (CPB) at Hospital de Base (HB), São José do Rio Preto, and found that the mortality rate was 8.7%. Higher rate was recorded by [15] who investigated 2,809 patients undergoing CABG alone or combined with valve replacement and reported that the mortality rate was 10%. Interestingly, our study found that the performance of combined surgery increases the risk of mortality. This finding was observed in other studies on CABG that showed that addition of a valve surgery with CABG increases the mortality [10], [15].

One of the findings that were distinct is that these mortality rates are even higher than countries like the United States (0.3%) [16], this finding can be attributed to multiple factors, that can include the fact that there are alarmingly higher rates of CAD in Iraq [8]. Besides that, factors such as much lower rates of early detection in Iraq can heavily contribute to this difference. In addition to that, in Iraq's culture as in certain other cultures, obesity is perceived as a sign of wealth and well-being which is an established risk factor for the development of CAD [8]. Hypertension and diabetes mellitus were recorded in 63% and 62% of the cases presenting for coronary artery bypass operation respectively. Similar high percentages were reported by [17]. Hypertension and diabetes mellitus are considered to be two of the highly significant risk factors

for cardiovascular diseases, for that, it was expected to be seen in most of our study sample [18].

In this study, smoking was heavily associated with mortality after undergoing CABG. This is supported by the fact that more than 70% of the dead patient population were current or past smokers before undergoing the procedure. The same observation was seen and discussed by in their paper [19]. In addition to this, a significant correlation was found between smoking and affected vessels in the dead patient population. All of the patients with single vessel disease in the dead patient population were current or past smokers at the time of the procedure. While It was seen that 52.7% of the triple vessel disease, 51.1% of the quadruple vessel disease and 38.2% of the double vessel disease were smokers. This finding is statistically significant. This can be attributed to the fact that smoking is a major contributing risk factor of cardiovascular disease [20].

Another interesting finding in this study is the association of the patient's family history with the outcome of the procedure. We found that of the selected patient population, nearly 30% of all the patients who died after undergoing the procedure had a relevant family history of coronary artery and cardiac diseases. This finding was also seen in another study by [21]. This can be explained by genetic factors that contribute to the development of certain diseases, such as atherosclerosis-related ischemic heart disease.

The patient's preoperative history is considered vital in any treatment plan involving a surgical approach, including CABG. This is especially important when looking at the type of cardiovascular problems that patients have. In this specific patient population, it was seen that 4.5% of the patients had single vessel disease, 17% had double vessel disease, 56% had triple vessel disease and 22.5% had quadruple vessel disease. This can be explained by the fact that the more vessels occluded, the higher risk of being on the receiving end of severe ischemic attacks. In the study done by [22], a different observation was seen. A lower percentage of the population with three-vessel disease (21%) was seen within the follow up time interval chosen. This difference is significant and can be explained by the fact that the populations studied differed in many ways especially with respect to the geographical differences. In our patient population, the most common finding among both the female and male population was the prevalence of triple vessel disease: 56.1% of the female population presented with triple vessel disease, while 55.9% of the male population presented with triple vessel disease. However, among the dead patients population of this study, triple and double vessel diseases were found to be the most common, 64.7% and 35.3% respectively. This association between the mortality rate and the number of occluded vessels was significant. This can be understood because the complications of the procedure can increase as the number of the occluded vessels increase. Similar findings were seen in a study by [23].

Moreover, the study showed a relationship between individual risk factors such as certain chronic diseases and number of vessels occluded. It was observed that the majority of the patients who had quadruple vessel disease (68.9%) and triple vessel disease (67%) had diabetes mellitus. Followed by those with double vessel disease (47.1%) and single vessel disease (22.2%). In the study done by [24], they concluded that the mortality rate post-CABG with patients who have a diabetic background is much higher than those of no diabetic background. This was similar to the outcomes we observed in our study. Similar observations were found relating hypertension and the increased mortality rate in the study conducted by [25]. They observed that patients with a history of hypertension had an increased risk of death in hospital and an increased risk of a non-cardiac death post-CABG. Among survivors after 5 years, they found that patients with a history of hypertension tended to have a higher prevalence of symptoms equivalent to angina pectoris. This relationship between hypertension and the increased mortality rate was prevalent in our patient population, which in return indicates that such major risk factors that lead to ischemic heart disease can be used to

estimate the risk of operation for certain patients who fit this profile. Furthermore, a history of hyperlipidemia was not found during the investigation period of the dead patient population. This significant finding in our study contradicts findings found in other studies such as the study conducted by [26] in which they found a significant relationship between both Diabetes mellitus and Hyperlipidemia with the long term risks that can be seen in patients after they undergo the CABG procedure. This indicates that the common risk factors that can be the leading causes of developing acute coronary syndrome can be used to determine the mortality risk for patients undergoing the CABG procedure [27].

Regarding preoperative echocardiographic assessment, It was found that of the dead patient population, mild Left Ventricular Dysfunction (LVD) was seen in 64.7% of the patients, moderate LVD in 23.5% and normal LV function in (11.8%). On the other hand, a study conducted by [28] found that 39.9% of a population of 1,214 patients had mild to moderate LVD while more than 50% of patients had normal preoperative LV function. This is important to note as the preoperative LV function can be used as an indicator for surgery outcome and studies have shown that worsening preoperative ejection fraction is associated with a higher mortality post-operatively in patients undergoing CABG [28].

Valvular involvement also has a role in the post-CABG conditions of the selected patient population. It was found that 17.5% of the patients from the sample had associated valvular disorders in addition to their coronary artery disease. Within these patients, 25.7% of them passed away in the follow up period. The majority of the patients (185, 92.5%), underwent isolated CABG while 15 (7.5%) patients underwent CABG associated with mitral valve replacement. Among those who performed a concomitant valve replacement surgery, 23.5% died during the study time. Similar findings were observed in multiple studies, such a study conducted by [29] which showed that the presence of coronary artery disease and its severity heavily influences long-term survival after combining valve repair and CABG. Another study by [30] showed that the addition of a concomitant mitral valve surgery increased the risk of early mortality and complications in patients. In conclusion, the addition of another procedure at the time of CABG can further complicate the initial procedure.

5. Limitations

As limitations of this study it is important to mention that this study is not randomized and the study sample was small. In addition to that, the study was conducted over a short period of time and in a single center in Erbil, Kurdistan. However, this study is crucial due to the paucity of similar studies in our country where mortality from CAD is alarmingly high and the identification of risk factors can support interventions aimed at the planning and implementation of new preventive strategies, and reduce the complications associated with this surgery.

6. Conclusion

In This study we concluded the mortality rate of CABG in SSH-Cardiac Center of Erbil Iraq, and found that the patients with CAD requiring CABG tends to occur at an earlier age in our study sample. Although its incidence is higher in males, the mortality was higher in females. Female gender, LVD, hyperlipidemia, DVD and TVD, valvular disease and concomitant valve surgery were identified as risk factors for mortality in the postoperative period. More efforts should be directed towards preventing and controlling cardiovascular risk factors to decrease the prevalence and impact of CAD in our community.

List of Abbreviations: -

CABG= Coronary artery bypass graft

CAD= coronary artery disease

DVD= double vessel disease

LVD= Left ventricular dysfunction

TVD= Triple vessel disease

ASE/EACVI= American society of echocardiography/ European association of cardiovascular imaging.

PCI= percutaneous coronary intervention.

ACS =Acute coronary syndrome

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