

Multivessel Coronary Artery Disease in Diabetes Mellitus Patients

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Abstract:

Coronary artery disease is the most common cardiac disease with a worldwide distribution, and it is responsible for most of the mortalities regarding cardiovascular diseases if not detected early and treated properly. There are many lines in the treatment of coronary artery disease, starting from medical therapy, percutaneous coronary intervention, and coronary artery bypass graft surgery, preference of the choice of the type of the treatment depends on many factors. In fact when coronary artery bypass graft is indicated, although it carries a considerable risk of surgery, but the long-term survival is notably better than the other ways of treatment. This study done to determine that the prevalence of multivessel coronary artery disease is more in diabetic patients than non-diabetic patients. And more in female than male. In this study hundred ninety patients were retrospectively studied, all of them underwent coronary artery bypass graft surgery with or without other concomitant cardiac procedure (like valve surgery), but most of them were coronary artery bypass graft alone. We found that the number of the coronary arteries affected is strongly related to the presence of the diabetes mellitus. And females are more prone to have coronary artery disease than male. Thus diabetes mellitus is the most common risk factor for the development of cardiovascular disease, and the severity of the condition is confirmed by the number of the coronary arteries involved as well as the calcification or multiple stenosis in the same vessel.

Key words: Cardiac surgery, coronary artery bypass graft surgery, diabetes mellitus, multivessel coronary artery disease.

1. INTRODUCTION

Coronary artery disease is the commonest cardiovascular disease, and it is the leading cause of death in the United States in both men and women. Coronary artery disease is caused by the occlusion of the coronary vessels by atherosclerosis. Atherosclerosis is the accumulation and deposition of fat in the wall of arteries and subsequent obstruction of the affected vessel, which is regarded as metabolic disease as far as there are many different biochemical and molecular interaction and responses[1].

Coronary arteries are tertiary arteries that could be involved by these inflammatory processes and subsequent presentation of acute coronary symptoms and myocardial infarction.

There is aggressive progression in the inflammatory process in atherosclerosis arteries in patients with diabetes mellitus, this is more prominent in type two diabetes than type one, although the exact mechanism behind that is not well known, but on pathological and clinical level there is tendency of calcification in these vessels and markedly increased necrotic cores in the plaques of the affected coronary arteries with the presence of macrophages and T-lymphocytes in the inflamed coronary arterial walls, which in turn lead to more severe presentation and even burden on the treatment. In the last few years incidence of cardiovascular diseases increased due to the fact that prevalence of the diabetes is notably increased in the general population [2].

One of the major risk factors for cardiovascular disease is diabetes mellitus, even near controlled blood sugar doesn't seem to reduce these cardiovascular events. This is true for type 2 diabetes mellitus, which carries a very poor outcome in cases of coronary artery disease despite the presence of different modalities of treatments like percutaneous coronary intervention, and coronary artery bypass graft surgery [3], [4].

Blood supply of the heart is composed of right and left coronary arteries arising from right and left coronary sinuses respectively, the RCA gives small branches and continues posteriorly in the inter-ventricular groove, or might bifurcate to be posterior descending artery (PDA) and posterior-lateral vessel (PLV). On the other hand left main stem of variable distance gives rise to left circumflex artery (LCX) and the left anterior descending artery (LAD). There might be some variations in the number of the arteries or the portion of the myocardial supplement, according to the dominance of left or right coronary artery, which means that if the PDA and the PLV arising from the RCA (80%) it's right dominant, if they both arise from LCX (8-10%) it's left dominant, or they might be both dominant [5].

Among other additional branches that could be present include ramus intermedius (RI), diagonal branches (D1, or D2). Each one of these vessels could be of good and acceptable caliber of diameter to be grafted and revascularized in cases of coronary artery bypass graft surgery (CABG). Indication of CABG based on the presence of symptom despite the optimal medical therapy, or who have prognostic indications. According to ESC/EACTS guidelines of 2010 it is emphasized that CABG is indicated in patients with coronary artery disease of left main coronary or proximal left anterior descending artery involvement or three vessels disease, and the patient is symptomatic despite the optimal medical therapy or intolerant to the OMT. On the other hand the prognostic indication can only be justified by the presence of demonstrable ischemia of the myocardium, which should be more than 10% of the myocardial mass. It is important to ensure that all patients should be provided with the optimal medical therapy before the decision of CABG. Evidences from many randomized trials showed that almost 79% of patients with three vessels disease and nearly two thirds of left main artery involvement have long-term survivor and reduced need for repeat of revascularization when they are treated with surgical revascularization CABG in comparison to stent, that is to say CABG is the treatment of choice for those patients [6].

The same is true regarding lesion in the left main stem, as far as lesions in LMS is equivocal to the three vessel disease, when it has been tried to be treated by stenting it carries the risk of restenosis, and the occlusion in the LMS is like occlusion in multiple vessels, carrying high mortality and bad long-term outcome. The reason why the coronary artery bypass graft surgery is superior to the percutaneous coronary intervention in patients with three vessel disease

regarding the long-term benefit, is in the fact that three vessel disease usually formed by proximal lesions and the surgical revascularization puts the graft on the mid-coronary artery which in turn nullifies any lesions proximal to the anastomosis regardless of the severity or nature of the stenosis. Furthermore when such lesions are treated with PCI there is possibility of development of de novo disease in the artery whether proximal or distal to or even within the stent, while the treated similar vessel with CABG will reduce the effect of that de novo disease or the development of proximal lesions, in reverse to the use of stent in PCI which is only suitable for culprit proximal lesions when they are technically suitable for stenting, and has no prophylactic effect on proximal lesions at all. So CABG is regarded as standard care for three vessel disease, if considering reduction of cerebrovascular accidents or major adverse cardiac events, which might happen when three vessel disease is treated with PCI stent [6], [7].

2. METHODS AND MATERIALS

A retrospective cross sectional study design approach was used for the implementation of the study. We conducted a retrospective chart review for 190 patients whom underwent coronary artery bypass graft surgery (CABG), majority of the patients underwent CABG alone, but some of other patients in addition of CABG had other cardiac procedure like valve surgery. All of the included patients in the study were surgically approached through median sternotomy incision. Internal mammary artery on the left side harvested whenever left anterior descending artery was among the diseased coronary arteries and needed to be revascularized.

Patient data were collected from April 2012 to September 2013, at Sulaimani Hospital for Cardiac Disease, Sulaimani, Kurdistan, Iraq. Patient ages were between 44 years to 70 years. All of the surgeries were conducted after obtaining informed consent of the patients, basic information were collected such as, age and gender. The researcher then reviewed clinical data of patients' records regarding the presence of type two diabetes mellitus (T2DM), and the numbers of the coronary vessels revascularized. All of the patients with diabetes were treated with hypoglycemic agents and/or insulin, to have a good control of the diabetes preoperatively. All of the patients in this study did the cardiac surgery with the help of cardiopulmonary bypass machine and aortic cross clamp, no one of them was done by off-pump CABG. This study has not included data to determine the outcome of the cases postoperatively like any morbidity or mortality.

Data were analyzed using the SPSS version 25.0. Frequency and percentages were calculated to determine characteristics. All data were coded, using the appropriate table. Analyses were applied to assess the association between different variables at significance level (P value) of 0.05.

3. RESULTS

In our study we have noticed that majority of the patients needed coronary artery bypass graft surgery were female. (73.6%) that is to say 140 patients out of the total number of the cases 190, were female. And 132 cases out of the total number of cases (190 cases) were having diabetes mellitus (69.5%). In our study patient ages were between 44 years to 70 years, with an average of 57.8 years. Cases were sub grouped to age groups of five years intervals we found that the commonest age group needed coronary artery bypass graft surgery in our study is 55-59 years, it was 63.2%. All of the above mentioned descriptive data are shown below in table (1).

Table 1: Number and percentage of cases to the corresponding variables

		Frequency	Percent
Gender	Male	50	26.3%
	Female	140	73.7%
	Total	190	100%
DM	non DM	58	30.5%
	DM	132	69.5%
	Total	190	100%
Age groups	44-49	11	5.8%
	50-54	17	8.9%
	55-59	120	63.2%
	60-64	18	9.5%
	65-70	24	12.6%
	Total	190	100%

There is a strong relation between the number of affected coronary arteries by atherosclerotic changes, which need to be revascularized and the presence of type two diabetes mellitus. From the 121 cases of multivessel CABG, 117 cases (96.7%) got diabetes mellitus. While out of 69 cases of single or double vessel CABG, only 15 cases (21.7%) got diabetes. With p-value far less than 0.05, the correlation is regarded to be significant. Shown in table (2)

Table 2: Multivessel coronary artery disease in relation to diabetes mellitus

		non DM	DM	Total	P-value
Single or double vessel CABG	Count	54	15	69	0.000
	%	78.3%	21.7%	100%	
Multivessel CABG	Count	4	117	121	
	%	3.3%	96.7%	100%	
Total	Count	58	132	190	
	%	30.5%	69.5%	100%	

There were also a significant correlation between the number of the coronary vessels needed to be revascularized and gender. More numbers of arteries needed to be revascularized in female than in male. From those 121 cases of multivessel CABG, 119 cases (98.3%) were female patients. Whereas 30.4% of single or double vessel CABG were female, that is to say 21 cases out of 69 cases. And the p-value was far less than 0.05 indicating a significant correlation between female gender and multivessel CABG. As shown in table (3)

Table 3: multivessel coronary artery disease in relation to gender

		Male	Female	Total	P-value
Single or doublevessel CABG	Count	48	21	69	0.000
	%	69.6%	30.4%	100%	
MultivesselCABG	Count	2	119	121	
	%	1.7%	98.3%	100%	
Total	Count	50	140	190	
	%	26.3%	73.7%	100%	

4. DISCUSSION

The severity of the situation or the affected percentage of myocardium by ischemia is correlated to the amount of the coronary artery involved, or other structural damages to the heart like involvement of the cardiac valves. Many factors affect the severity of the symptoms at the time of presentation or CABG indication, including age, gender, T2DM, smoking, etc. and it is obvious in our study that we found the relation between the indication of the coronary artery bypass graft surgery and some of those common risk factors, patients referred for CABG surgery were female (140 cases out of total 190 cases, 73.7%) than being male (50 cases out of 190 cases, 26.3%), in addition most of the total number of the patients were with T2DM, more significantly from the total number of the female patients, large percentage of them having T2DM. Although in our study we couldn't compare these values with previous ones as far as there is no such a study conducted in our hospital so far. Studies emphasize that most of hospital admissions for acute myocardial infarction, stroke, PCI, and CABG surgery, are still high among female patients with type two diabetes mellitus, precisely comparing similar findings with previous ones, and showing that the increasing rate of CABG among diabetic male patient was increased five folds 5.01 [4.59-5.05], whereas increasing rate of CABG among diabetic female patient was increased 6.2 folds 6.24 [5.66-6.88]. However the definite risk is higher in men [8].

Age presentation of coronary artery disease varies from study to another, as far as there many factors involved as notable risk factors for it, but when it happens in younger age groups is more severe and need special attention regarding the main causative factor and/or the strong family history. In our study the youngest age presentation at the time of CABG surgery was 44 years, and the oldest age was 70 years, mean age of 57.8 years. Although we have not included those patients younger than this figure, whom could be treated with other modalities of treatment for acute coronary syndrome like medication and/or percutaneous coronary intervention and stenting, and we haven't included smoking index in our study to evaluate it as a dependent risk factor, but many other studies showed that there is possibility of occurrence of coronary artery disease at early age of 35 years or less, in which smoking was found to be commonest association with such an early presentation of coronary artery disease (71%), although the same study showed that 23.5% of them were with completely normal coronary angiogram, and the majority were treated conservatively 54.5%, while other 45.5% of them needed percutaneous coronary intervention (PCI) or coronary artery bypass graft surgery (CABG) [9]. As mentioned earlier our study does not include patients over the age of 70 years did coronary artery bypass surgery, as far as we had not such an age presentation at the given period of time of the study. But studies showed that patients underwent coronary artery bypass graft surgery over the age of 80 years, analyzing the outcome of the revascularization surgery. In the current study data were collected from 51 patients over the age of 80 years underwent coronary artery bypass graft surgery, their mean age was 81.7 years. The outcome of surgery in such an age depends on many factors that those patients could have them like hypertension in 76.5%, renal impairment in 62.7% [10].

In our study most of the cases were multivessel diseases coronary artery, the few numbers of the single vessel involvement notably presented in younger age groups, between the age of 44 years and 58 years. Among all of the cases only 6 cases were having single vessel coronary artery involvement, five of them were having diabetes mellitus, which gives an impression of the development of coronary artery disease early in age when the patient already have diabetes mellitus. But the small number could not be dependable for such an explanation, but possibly if larger sample were collected we will be able to find out the relation between early age presentation and the presence of diabetes mellitus. On the other hand studies showed a correlation between smoking and early age indication of CABG, not the presence of diabetes mellitus [9]. Nevertheless in our study this relation could be possible due to the fact that inflammatory reaction with complex cellular and biochemical responses, could happen in the wall of the arteries of the coronaries, that is strongly associated with diabetes mellitus presence [1], [2].

Regardless of the presence of diabetes mellitus, single vessel coronary artery disease rather than multivessel disease could happen in younger age group, but was not the case in our study, sample was small in number and most of them were having diabetes. Studies reported that single vessel coronary artery disease occurs more frequently than multiple vessel involvement in younger ages, but the long-term prognosis in young patients having myocardial infarction is unfavorable [10]. Supporting the fact that the outcome of the coronary artery bypass graft surgery is not favorable in young age patients, other study reported that the quality of life is significantly improved in patients underwent CABG surgery between the age of 60-69 years, also age group of 50-59 got similar outcome regarding the quality of life but to a lesser extent [11].

Throughout the period of our study and from the data collected we have noticed that female patients with CABG need more than three vessels to be revascularized rather than single or double vessel coronary artery disease, which there was a significant correlation between the female gender and the number of the involved coronary artery to be revascularized, this is the reverse as noted in a study done in 2017 enrolling 106,881 coronary angiographies done for significantly diseased coronary artery disease patients. In case of single vessel disease, females were less likely to perform PCI. On the other hand those with three-vessel disease or left main stem involvement, males are less likely to undergo PCI. In another meaning coronary artery bypass graft were notably common in female rather than male [12]. Moreover, older women (70 ± 12.7 vs. 63.8 ± 12.9 years), got higher risk profile in cardiovascular disease, for which there were admitted to the coronary care unit with unstable angina or non ST-elevation myocardial infarction (MI). Data analyzed from multicenter registry of 64,932 acute coronary syndrome patients from 2004-2008 [13].

Obtaining such a significant number of diabetic patients with absolute indication of coronary artery bypass graft surgery in our study is due to the fact that they have been referred by the cardiologists for better long-term benefits by CABG surgery, rather than treating them with PCI. That is because many studies especially most recent published ones have proven over all superiority of CABG surgery in patients with diabetes mellitus together with other comorbidities like cardiac failure, renal disease [14]. In our study we haven't collected data from those cases with multivessel coronary artery disease and diabetes treated with other modalities of treatments like PCI to compare the outcome of both groups (PCI versus CABG), but study showed that diabetic patient and multivessel disease better to be revascularized surgically rather than PCI, this has been reported in individual level data meta-analysis in 2018 [14]. This fact is applicable even for PCI with drug-eluting stents also, which is confirmed by a study that coronary artery bypass graft surgery provides much more significant benefit for diabetic patients and multivessel disease when it is presented with acute coronary syndrome, in comparison to that kind of stents. In the same study shown that patients randomized to CABG surgery had reduced death rate and myocardial infarction compared to percutaneous coronary intervention [15].

5. CONCLUSION

In our study it has been confirmed that patients with type two diabetes mellitus, as well as female gender have higher risk than non-diabetic and male patients of having coronary artery disease indicating CABG. That's why it is crucial to diagnose the diabetes in the patient as early as possible, to be well prepared and predict the development of unfavorable cardiovascular events other than coronary artery disease like cerebrovascular accidents, stroke, and others. On the other hand it is necessary to assess any chest pain or suspicion of acute coronary syndrome thoroughly in patients aged between 55-60 years, as far as it has been confirmed in our study that the commonest age group of CABG was in that range of years of age.

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