

ORIGINAL ARTICLE

Postoperative adverse events in patients with coronary artery bypass grafting for left main coronary stenosis

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Objective. To determine the immediate adverse postoperative events in patients with left main coronary stenosis submitted to coronary artery bypass grafting. **Material.** This was an observational, transverse analytical and retrospective study. Two hundred and two patients with significant left main coronary stenosis submitted to coronary artery bypass grafting in our institution between January 2018 to December 2018 were included, and postoperative complications were documented. **Results.** Of the 232 patients 80.2% were men, with an average age of 64 years; diabetes mellitus 52.6%, dyslipidemia 74.6% and chronic kidney failure 4.7%. The main postoperative complications were renal failure 18.9%, atrial fibrillation 11.3% and global mortality 2.9%. Factors associated with complication were female sex with OR=2.89 (95% CI 1.4-5.6, p = 0.002), age of 64.43 ± 8.87 p = 0.019, dyslipidemia OR 2.17 (95% CI 1.15-4.11, p = 0.016), and chronic kidney failure OR 15 (95% CI 1.9-120, p = 0.001). Complicated patients required mechanical ventilation for 19.4 hours, inotropic use for 38.34 hours and intensive care stay of 74.66 hours, (p=0.01). **Conclusions.** Factors associated with complications with statistical significance were female sex, age, history of dyslipidemia, chronic kidney disease Chronic renal failure was the most important factor associated with complications. The presence of a complication was associated with a longer time in mechanical ventilation, use of inotropic and intensive care stay.

Key words: Left main coronary stenosis; Coronary artery bypass grafting; Surgical complications.

Objetivo. Determinar los eventos adversos posquirúrgicos inmediatos de bypass coronario en pacientes con lesión de tronco coronario izquierdo significativo. **Material.** Estudio observacional transversal, analítico y retrospectivo. Se incluyeron 232 pacientes adultos con lesión de tronco coronario izquierdo significativo sometidos a bypass coronario en nuestro hospital en el periodo enero 2018 a diciembre 2018. Se documentaron variables demográficas, clínicas, así como complicaciones posquirúrgicas. **Resultados.** De los 232 pacientes; 80.2% fueron hombres, el promedio de edad de 64 años. Presentaban antecedentes de diabetes mellitus 52.6%, dislipidemia 74.6% y falla renal crónica 4.7%. Las principales complicaciones posquirúrgicas fueron; falla renal 18.9%, fibrilación auricular 11.3% y mortalidad global de 2.9%. Los factores que se asociaron a complicación fue el sexo femenino con OR=2.89 (IC95% 1.4-5.6, p=0.002), edad 64.43 ± 8.87 p=0.019, dislipidemia OR=2.17 (IC95% 1.15-4.11, p=0.016) y falla renal crónica OR=15 (IC95% 1.9-120, p=0.001). Pacientes complicados requirieron de ventilación mecánica en promedio de 19.4 horas, uso de inotrópicos 38.34 horas y estancia de cuidados intensivos 74.66 horas con una p=0.01. **Conclusiones.** Se encontró que los factores asociados a complicación con significancia estadística fue el sexo femenino, la edad, antecedente de dislipidemia, enfermedad renal crónica. La enfermedad renal crónica fue el factor más importante asociado a complicaciones. La presencia de una complicación se asocio a un mayor tiempo en ventilación mecánica, uso de inotrópicos y estancia de cuidados intensivo.

Palabras clave: Tronco coronario izquierdo; Revascularización coronaria; Complicaciones posquirúrgicas.

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Ischemic heart disease is one of the major causes of death and disability in developed countries. Although death rates from this disease have declined worldwide in the past four decades, it is still responsible for approximately a third or more of all deaths in people older than 35 years. It has been estimated that almost half of all men and one third of women in the United States will develop some manifestation of ischemic heart disease [1]. Significant left main coronary artery stenosis (defined as angiographic narrowing greater than 50 percent) is found in 4% to 6% of all patients who undergo coronary arteriography. This degree of injury puts patients at high risk for cardiovascular events, since occlusion of this vessel compromises the flow of at least 75 percent of the left ventricle, and is an indication for surgical revascularization. Without revascularization, the three-year survival is as low as 37% [2]. Coronary bypass surgery to treat ischemic heart disease is one of the most expensive surgical procedures, its average cost is approximately \$ 45,358 dollars, this surgery is associated with high rates of short-term hospital readmission, generating higher expenses, calculated at \$ 78.6 million dollars at 10 years [3].

In general, the operative mortality rate for coronary artery bypass graft surgery is low, between 2-3%. However, complication rates may be as high as 20-30%, and cardiogenic shock increase in-hospital mortality rate [4].

Coronary artery bypass graft surgery remains as a well-established treatment for this disease, and most of these procedures are performed in multi-vessel disease [5].

As life expectancy increases, revascularization becomes necessary for an ever increase number of patients with high surgical risk. These patients have an increased risk of morbidity and mortality after surgery [6].

These complications are associated with an increase in morbidity, postoperative stay, higher economic costs and late or early mortality [7].

Risk factors for perioperative morbidity and mortality after coronary bypass can be divided into 3 categories: patient characteristics, characteristics of the health care provider, and postoperative factors [2].

Among the characteristics of the patient we can find such factors as older age, female sex, African American ethnicity, greater body surface area and myocardial infarction prior to the week of the procedure. Among the health care provider factors these include number of 100 cases per year as well as the hospital mortality rate. Postoperative risk factors include referring to nursing homes or rehabilitation centers, admission to intensive care and length of hospital stay > 5 days [2].

Most complications associated with coronary bypass graft surgery can be anticipated by considering the bases of the preoperative medical history, characteristics and demographics of each and every patient [8]. These factors can be divided into several categories; namely, factors with an impact on how good is the tolerance to invasiveness of the coronary bypass (eg, age, COPD, renal function), factors that identify the progression of the disease (eg, acute coronary syndrome, left ventricular function, NYHA and CCS classification), factors that impact the complexity of the procedure (eg, previous surgery, emergency surgery, the presence of acute ischemic mitral regurgitation), and factors influencing the postoperative period (eg, diabetes, neurological disability, reduced mobility) [9].

One of the most devastating complications is postoperative stroke, whose etiology is predominantly ischemic [6]. It is important to consider when evaluating patients, the wide variety of causes of complications, which can lead the patient to the emergency room [10].

There are a variety of surgical complications secondary to coronary artery bypass graft, one of which is renal failure, which is defined by consensus criteria that include an increase in serum creatinine of ≥ 0.3 mg / dL in relation to a known reference value within 48 hours, or an increase of ≥ 1.5 times the known or assumed reference value within seven days, or a decrease in urine volume to < 3 ml / kg for six hours. Other complications that appear more frequently in the emergency medical services are postoperative infection, congestive heart failure and chest discomfort. The term postoperative infection encompasses surgical site infections, pneumonia, urinary tract infections, and deep sternal wound infections, including the latter in turn, mediastinitis, pericarditis, and myocarditis. Sternal wound infections are relatively rare. They appear only in 1-2% of all patients undergoing cardiac surgery; however, if presented, they confer a high risk to the postoperative patient of coronary bypass surgery, presenting a mortality of 6-30%, a much higher mortality than the estimated mortality of 2% in patient undergoing cardiac surgery. Sternal wound infections confer approximately a 2.5-fold increase in late mortality, even in successfully treated patients, who survive at least 6 months postoperatively [2].

There is large amount of etiologies for congestive heart failure in postoperative patients with coronary bypass graft. They can be divided into two main categories, viz, complications of cardiac surgery per se and complications of the underlying disease that led to coronary bypass. Among complications of operation, the graft occlusion, which may be related to an elevation in platelet activation secondary to epinephrine, in conjunction with fibrinolysis and decreased systolic ventricular function, vasospasm, or air bubbles within the graft in the immediate postoperative period, which peak up within the 2-hour post-reperfusion period. [2] Early graft failure due to thromboembolism has been reported up to a maximum of thirty days after surgery.

Some of the most devastating complications are the cardiac tamponade and the postoperative excessive bleeding. The risk of pericardial effusion after cardiac surgery is approximately 1.5% in the immediate postoperative period. Of these patients, almost half have evidence of excessive bleeding and significant cardiac tamponade and require immediate intervention, as well as data that suggest delayed tamponade (> 48 hours postoperatively). Cardiac surgery is inherently arrhythmogenic, producing a variety of electrophysiological disturbances, most commonly atrial fibrillation [11]. Heart failure can also occur secondary to the patient's underlying disease that led to cardiac surgery, including complications of acute myocardial infarction, such as cardiogenic shock, myocardial rupture, or post-infarct pericarditis [12].

MATERIAL

This was an observational transverse analytical and retrospective study. 232 patients with significant left main coronary stenosis submitted to CABG in our institution between

January and December 2018 were included. Demographic and clinical variables, postsurgical complications (strokes, arrhythmias, renal failure, perioperative heart attacks and death) were documented. The results were evaluated by descriptive and inferential statistics using the statistical package SPSS® v.25.

RESULTS

Of the 232 analyzed patients, 19.8% were female and 80.2% male. The average age of the patients was 64.43 ± 8.87 . The average age of the complicated patients was 63.24 ± 8.96 years-old compared to the uncomplicated 66 ± 8.53 years-old, with a statistical significance of $p = 0.002$. Of note,

Table 1. Clinical Characteristics and their relation with complications

VARIABLE	Total population, n=232 n (%)	COMPLICATION			p value	OR CI 95%
		Absent, n=123 n (%)	Present, n=100 n (%)			
Gender						
Female	46 (19.8)	17 (12.87)	29 (29)			
Male	186 (80.2)	115 (87.12)	71 (71)	0.002	2.89 (1.48-5.64)	
Body mass index , mean \pm SD	27.54 \pm 4.37	28.2 \pm 4.44	26.6 \pm 4.13	0.008		
Obesity	164 (70.6)	100 (75.7)	64 (64)	0.051		
Age	64.43 \pm 8.87	63.24 \pm 8.96	66 \pm 8.53	0.019		
Diabetes mellitus II	122 (52.6)	65 (49.24)	57 (57)	0.241		
Insulin-dependent	47 (20.3)	21 (15.9)	26 (26)	0.058		
Smoking	117 (50.4)	69 (52.27)	48 (48)	0.519		
Systemic arterial hypertension	192 (82.8)	107 (81.06)	85 (85)	0.431		
HIV	3 (1.3)	1 (0.75)	2 (2)	0.407		
Hypothyroidism	8 (3.4)	3 (2.27)	5 (5)	0.260		
Chronic kidney disease	11 (4.7)	1 (0.75)	10 (10)	0.010	15 (1.9-120)	
Dyslipidemia	173 (74.6)	90 (68.18)	83 (83)	0.016	2.17 (1.15-4.11)	
Chronic hepatic disease	1 (0.4)	1 (0.75)	0	0.383		
Stroke	14 (6)	4 (3.03)	10 (10)	0.027		

we found 50.4% were smokers, 52.6% had diabetes mellitus, out of them 20.3% were on insulin treatment (Table 1). Of the patients reported, 82.8% had a history of hypertension, 74.6% dyslipidemia and 71.6% history of ischemic heart disease. The EuroSCORE of the patients were mostly found to be low risk with an average of 1.99. (Table 2) The operations performed were mostly elective as 95.7% (Table 3).

The left main coronary artery stenosis was on average 68.73% with a LVEF of 49.32%. The number of grafts were between 2 to more than 4; three grafts were performed in 37.1%. Endarterectomy was performed in 5.6% of patients. From 0 to 8 blood units were transfused in these patients, the mean was 2 packages in 32.9%.

The average aortic cross-clamping time was 59.16 ± 1.12 minutes, with an extracorporeal circulation time of 98.20 ± 1.87 minutes. Postoperative mechanical ventilation length was 12.11 ± 2.58 hours, inotropic duration of 25.46 ± 1.89 hours, with a length of stay in intensive care unit of 57.88 ± 2.35 hours, and duration of post-surgical complications of 2.97 days (Table 4) (Table 5).

Complications were reported in 43.1% of patients, of which kidney failure was the most frequent one in 18.9%. Other more prominent complications were atrial fibrillation in 11.3%, excessive bleeding more than expected in 4.2% reporting a mortality of 2.9% (Table 6).

DISCUSSION

Operative mortality for coronary bypass graft surgery is low, between 2-3% [4], although some complication rate of 20-30% can be observed. In our study we found a mortality of 2.9% [7], which is within the previously mentioned range; we also found an average of complications of 43.1% in patients with significant left main artery stenosis on whom an arterial bypass graft surgery was performed.

It has been described that ischemic heart disease mainly affects the male sex, which coincides with our study in which we found 19.8% female and 80.2% male patients [5,7].

Patients with diabetes were also found to have a higher prevalence of need for coronary bypass graft surgery, which

Table 2. EuroSCORE II in patients with significant left main coronary artery stenosis

VARIABLE	COMPLICATION			p value
	Total population, n=232 n (%)	Absent, n=123 n (%)	Present, n=100 n (%)	
Low risk (0-2.9)	205 (88.4)	126 (95.45)	79 (79)	0.001
Moderate risk (3-5)	17 (7.3)	5 (3.78)	12 (12)	0.010
High risk (>5)	10 (4.3)	1 (0.75)	9 (9)	0.016
Average EuroSCORE	1.99	1.62	2.48	0.04

coincides with our study since 52.6% had a history of diabetes, of which 20.3% were on insulin treatment. Metabolic syndrome is associated with higher morbidity and mortality after coronary bypass surgery and consequently, with an index of major adverse cardiovascular events [1].

Many of the complications associated with coronary bypass graft surgery can be anticipated considering the bases of the preoperative medical history, characteristics and demographics of the patient. Risk factors for perioperative morbidity and mortality after coronary bypass can be divided into 3 categories: patient characteristics, characteristics of the health

care provider, and postoperative factors [2].

Among the characteristics of the patients such as older age, female sex, African-American ethnicity, greater body surface area and myocardial infarction a week prior to the procedure, all of them are consistent with our study, since our statistical analysis found a relevant prevalence for complications in the female sex and an odds ratio of 2.89 (95% CI 1.4-56, p = 0.002).

Other factors for postoperative complications are factors with an impact on how well the tolerance to coronary bypass graft surgery's invasiveness is tolerated (eg, age, COPD, kid-

Table 3. Coronary artery bypass graft surgery characteristics in patients with left main coronary artery stenosis

VARIABLE	COMPLICATION			p value
	Total population, n=232 n (%)	Absent, n=123 n (%)	Present, n=100 n (%)	
Number of grafts				
1	35 (15.1)	17 (12.8)	18 (18)	0.61
2	110 (47.4)	57 (43.18)	53 (53)	
3	86 (37.1)	58 (43.93)	28(28)	
4	1 (0.4)	0 (0)	1(1)	
Endarterectomy				
Yes	13 (5.6)	8 (6)	5 (5)	0.72
No	94.4 (219)	124 (93.93)	95 (95)	
Type of Surgery				
Elective	223 (96.1)	129 (97.72)	94 (94)	0.145
Urgent	9 (3.9)	3 (2.27)	6 (6)	
Blood Units transfused in OR				
0	24 (10.3)	16 (12.1)	8 (8)	0.001
1	71 (30.6)	49 (37.12)	22 (22)	
2	76 (32.8)	47 (35.6)	29 (29)	
3	38 (16.4)	16 (12.12)	22 (22)	
4	21 (9.1)	3 (2.27)	18 (18)	
8	1 (0.4)	0 (0)	1(1)	

OR= Operating room.

Table 4. Intraoperative variables in patients with significant left main coronary artery stenosis

VARIABLE	Total population, n=232	COMPLICATION		p value
		Absent, n=123	Present, n=100	
LMCS stenosis, %	68.73	67.8	69.9	0.323
LVEF, %	49.32	50.6	47.6	0.033
Aortic cross-clamping time, (min)	59.16	59.04	59.32	0.901
CPB time (min)	98.2	9.14	102.29	0.058

CPB= Cardiopulmonary bypass; LMCS= Left main coronary stenosis; LVEF= Left ventricle ejection fraction

ney function), factors that identify disease progression (eg. acute coronary syndrome, left ventricular function, NYHA and CCS classification), factors that impact on the complexity of the procedure (eg, previous surgery, emergency surgery, the presence of acute ischemic mitral regurgitation) and factors that influence the postoperative period (eg, diabetes, neurological disability, reduced mobility) which are very similar with those in our study where the main complication was found in patients with a history of chronic kidney disease 15 times more than a patient without ($p = 0.01$) [5,9].

In our study, the EuroSCORE II was used, which was

found to be significant ($p = 0.001$) to predict post-surgical complications. The EuroSCORE II is a tool used to estimate surgical risk based on these factors. Several risk models have been developed. These models can be useful tools during the decision-making process. In some scenarios, it may be more appropriate to refer patients to the interventional cardiologist for percutaneous coronary intervention or to continue medical therapy only. The EuroSCORE logistics scale has been used most frequently in Europe, recently updated to EuroSCORE II [6].

Status of the operation if elective or emergency must al-

Table 5. Postoperative variables in patients with left main coronary artery stenosis

VARIABLE	Total population, n=232	COMPLICATION		p value
		Absent, n=123	Present, n=100	
Mechanical ventilation (hours)	12.11	6.5	19.4	0.013
Inotropics (hours)	25.45	15.6	38.34	0.001
LOS in ICU (hours)	57.87	45.15	74.66	0.001

ICU= Intensive care unit; LOS= length of stay

ways be considered, since it is associated with a greater number of complications after surgery. Therefore, it is important to consider the basic diagnosis, as well as the time in which the surgery is performed to think about the prognosis [10]. In our study, 95.7% of surgeries were performed electively.

One of the most devastating complications is postoperative stroke, whose etiology is predominantly ischemic [6]. It is important to consider when evaluating patients, the wide variety of causes of complications, which can lead the patient to the emergency department [11]. In our study, only in 1.9% of cases presented some stroke.

There are a variety of surgical complications secondary to coronary artery bypass graft, among which the most frequent in the emergency services are postoperative infection, congestive heart failure and chest discomfort. The term

postoperative infection encompasses surgical site infections, pneumonia, urinary tract infections, and deep sternal wound infections, including the latter in turn, mediastinitis, pericarditis, and myocarditis. Sternal wound infections are relatively rare, only occurring in 1-2% of all patients who undergo cardiac surgery; however, if presented, they confer a high risk to the postoperative patient of coronary bypass surgery, presenting a mortality of 6-30%, a much higher mortality than the estimated mortality of a patient undergoing cardiac surgery in general. Sternal wound infections confer approximately a 2.5-fold increase in late mortality, even in successfully treated patients, who survive at least 6 months postoperatively [2]. In our study, 1.3% of infections were registered, which is within the range documented in the literature.

Another of the most devastating complications is the cardiac tamponade, which is almost always secondary to ex-

Table 6. Complications in patients with significant left main coronary artery stenosis

VARIABLE	Total population, n=232 n (%)
Total complications	100 (43.1)
Stroke	2 (0.8)
Renal Failure	18.9 (45)
Perioperative MI	4 (1.7)
Atrial fibrillation	27 (11.3)
Infection	3 (1.3)
Excessive bleeding	10 (4.2)
Death	7 (2.9)
Other	10 (4.2)

MI= Myocardial infarction

cessive postoperative bleeding. The risk of excessive bleeding after cardiac surgery is approximately 1.5% in the immediate postoperative period. Of these patients, almost half require immediate intervention, as well as may have delayed tamponade data (> 48 hours postoperatively). In our study, 4.2% of excessive bleeding was recorded, which is higher than previously reported.

Finally, cardiac surgery is inherently arrhythmogenic, producing a variety of electrophysiological alterations, most commonly atrial fibrillation. We registered 11.3% of atrial fibrillation, which is lower than reported in the literature up

to 30%.

In our casuistry, it was found that of the 232 patients operated on with significant left main coronary artery significant stenosis, 100 patients had some complication. It means a complication rate of 43.1%. A significant statistical relationship of complications was found with the female sex ($p = 0.001$), with a history of dyslipidemia ($p = 0.016$) and chronic kidney disease ($p = 0.01$).

Of the 43.1% of complications found in our patients, the most frequent was kidney failure in 18.9%. Considering the exacerbation of renal failure as a complication since the history of existing renal failure was prevalent in 4.7%. The second complication in frequency was atrial fibrillation with 11.3%, which is below the 30% reported in the literature. Of the most clinically relevant complications are perioperative infarction 1.7%, mediastinal infection 1.3% and stroke 0.8%

It was found that the patients who presented complications comparatively with the uncomplicated ones had a longer stay in intensive care with a longer duration of inotropic drugs and statistically significant prolonged need for mechanical ventilation, which entails a greater expense in hospital care.

In general, the mortality rate in the literature for coronary bypass surgery is low, between 2-3%. In our study we found a mortality of 2.9%, which is within the ranges reported in the literature.

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