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ORIGINAL ARTICLE

Prevalence of Surgical Myocardial Revascularization in Diabetics and Non-diabetics After Acute Myocardial Infarction

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Abstract

Background: Diabetes mellitus (DM) is a metabolic disorder characterized by persistent hyperglycemia. The main cause of death among diabetics is cardiovascular disease (CVD), which is a precursor to acute myocardial infarction (AMI). Approximately 30% of diabetic patients with AMI require myocardial revascularization surgery (MRS).

Objective: To evaluate the prevalence of MRS in diabetic and non-diabetic patients after AMI in a hospital in the city Criciúma, Brazil, during the period from 2016 to 2019.

Methods: A cross-sectional study was carried out with secondary data collection, with analysis of 215 medical records of diabetic and non-diabetic patients with AMI, submitted or not to MRS during the study period. For statistical analysis, the Shapiro-Wilk test, Pearson's chi-square test and Fisher's exact test were used, with a significance level of $\alpha = 0.05$.

Results: The frequency of diabetic AMI patients with hypertension (88.1%) was significantly higher ($p<0.01$) than of diabetic AMI patients without hypertension. Although no statistically significant differences were found in the other variables between the groups, smoking, hypertension and dyslipidemia were more prevalent in diabetic than in non-diabetic patients with AMI undergoing MRS.

Conclusion: The prevalence of MRS after AMI in diabetic patients was higher than in non-diabetic patients.

Keywords: Diabetes Mellitus; Hyperglycemia; Myocardial Revascularization.

Introduction

Diabetes mellitus (DM) is a metabolic disorder characterized by persistent hyperglycemia, resulting from inadequate insulin production and/or action.[1] Persistent hyperglycemia is associated with chronic microvascular and macrovascular complications, reduced quality of life, and increased morbidity and mortality;[2] and these complications lead to retinopathy, nephropathy, neuropathy, coronary artery disease (CAD), cerebrovascular disease and peripheral arterial disease.[3]

DM and its complications are the main causes of early death, and cardiovascular disease (CVD) is the main cause of death among diabetic patients.[4] These patients have more atherogenic risk factors such as hypertension, obesity and dyslipidemia than non-diabetic individuals.[5]

Among the CVDs, CAD, precursor of myocardial ischemia, is the main cause of morbidity and mortality in DM patients.[5] One of the complications of CAD is acute myocardial infarction (AMI), which consists of a clinical or pathological event in the scenario of myocardial ischemia, with evidence of myocardial injury.[6] In this regard, AMI and DM are closely related, since the risk of infarction in diabetics without previous infarction is similar to non-diabetics with previous infarction.[7]

Thus, as compared with non-diabetics, diabetic subjects not only have a higher prevalence of CAD but also a greater extension of coronary ischemia, due to the involvement of multiple arteries, and greater risk for AMI. For this reason, diabetic patients correspond to 30% of individuals who undergo myocardial

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revascularization surgery (MRS), a surgical procedure that restores cardiac blood flow via venous or arterial grafting.[7-9]

Although the International Study of Comparative Health Effectiveness With Medical and Invasive Approaches (ISCHEMIA) reported that there is no evidence that an invasive strategy, compared with a conservative one, reduces the risk of ischemic cardiovascular events,[10] MRS should be the procedure of choice for diabetic patients with AMI, duet to the high complexity of CAD and greater extension of infarction in this population. Also, MRS has been shown to increase survival of DM patients as it provides protection against subsequent infarction.[11]

Based on the fact that DM leads to multiple cardiovascular complications, we compared the prevalence of MRS between diabetic patients with AMI and non-diabetic patients with AMI.

Methods

This was a cross-sectional study with analysis of census data. Data were collected from electronic medical records of patients in a hospital in the city of Criciuma, Brazil, from March 2016 to March 2019.

All medical records including the ICD-10 I21 (AMI) between 2016 and 2019 were initially included. From these, only those patients who had the diagnosis of AMI recorded by the assistant physician were included in the study. Records of 269 diabetic and non-diabetic patients with AMI, submitted or not to MRS, were analyzed. Fifty-four medical records of patients who did not have the diagnosis of AMI reported by the assistant physician (only acute coronary syndrome instead), patients younger than 18 years old, and patients who died from cardiac arrest and whose cause of death was erroneously recorded as AMI were excluded, yielding 215 records for analysis.

Statistical analysis

Data were statistically analyzed using the statistical package for the social sciences (SPSS) software, version 22.0. Quantitative variables showed normal distribution by the Shapiro-Wilk test and were expressed as mean and standard deviation. Qualitative variables were expressed as frequency and percentage.

The statistical tests were conducted with a significance level of $\alpha = 0.05$ and 95% confidence interval. The Pearson's chi-square test and the Fisher's exact test were conducted, followed by a post-hoc test when statistical significance was detected.

This study was approved by the ethics committee of the *Universidade do Extremo Sul Catarinense* (UNESC) (approval number 3.481.493) and by the ethics committee of the hospital (approval number 3.910.851).

Results

Characteristics of AMI patients (n=215) are described in Table 1. Mean age of patients was 61.8 years, 73% of patients were men. Most patients had systemic arterial hypertension (SAH) (68.8%), 21.9% had a history of AMI, and only 18.1% had a family history of CAD.

The variables sex, smoking, dyslipidemia, personal history of AMI, MRS and family history of CAD did not show significant association with diabetes. On the other hand, 88.1% of DM patients with AMI had SAH, while 11.9% did not ($p<0.001$), and among non-diabetic patients with AMI, 61.5% had SAH and 38.5% did not (Table 2).

Only 17.9% (n=28) of non-diabetic patients with AMI (n=156) and 23.7% (n=14) of diabetic patients (n=59) with AMI underwent MRS. Thus, the frequency of AMI patients who underwent MRS was higher among diabetics than in non-diabetics. In addition, the frequency of diabetic men who underwent MRS was higher than diabetic women who underwent MRS (64.3% *vs*. 35.7%). Regarding smoking, 50% of diabetic patients who underwent MRS were smokers and 50% were non-smokers.

The frequency of hypertensive and dyslipidemic patients who underwent MRS was higher among diabetic than non-diabetic patients (92.9% vs. 71.4% and 21.4% vs. 14.3%, respectively). Among patients with personal history of AMI, 21.4% of diabetic and 21.4% of non-diabetic patients underwent MRS.

Discussion

This was a single-center study with 215 patients that showed that the frequency of AMI was significantly higher among diabetic hypertensive patients that among diabetic patients without hypertension, highlighting the relevance of hypertension in the context of diabetes and AMI. These data are in accordance with the literature, that shows a prevalence of 60% of hypertension in DM.[7] Besides, in the coexistence diabetes and hypertension, the risk of CVDs doubles,[12] increasing mortality from these diseases by 70%.[13]

Table 1 – Characteristics of diabetic and non-diabetic patients with AMI (n=215)

	Mean ± standard deviation, n (%)
	n=215
Age (years)	61.78 ± 11.71
Sex	
Male	157 (73.0)
Female	58 (27.0)
DM	
No	156 (72.6)
Yes	59 (27.4)
Smoking	
No	99 (46.0)
Yes	116 (54.0)
SAH	
No	67 (31.2)
Yes	148 (68.8)
Dyslipidemia	
No	176 (81.9)
Yes	39 (18.1)
Personal history of AMI	
No	168 (78.1)
Yes	47 (21.9)
MRS	
No	173 (80.5)
Yes	42 (19.5)
Family history of CAD	
No	195 (90.7)
Yes	20 (9.3)

SAH: systemic arterial hypertension; AMI: acute myocardial infarction; CAD: coronary artery disease; DM: diabetes mellitus; MRS: myocardial revascularization surgery. Year of data collection: 2020.

Table 2 – Characteristics of patients with AMI by the presence or not of DM

	Diabetes, n (%)		p-value*
	No	Yes	
	n=156	n=59	
Sex			
Male	119 (76,3)	38 (64,4)	0,080
Female	37 (23,7)	21 (35,6)	
Smoking			
No	69 (44,2)	30 (50,8)	0,385
Yes	87 (55,8)	29 (49,2)	
SAH			
No	60 (38,5)†	7 (11,9)	<0,001
Yes	96 (61,5)	52 (88,1)†	
Dyslipidemia			
No	130 (83,3)	46 (78,0)	0,362
Yes	26 (16,7)	13 (22,0)	
Personal history of AMI			
No	125 (80,1)	43 (72,9)	0,251
Yes	31 (19,9)	16 (27,1)	
MRS			
No	128 (82,1)	45 (76,3)	0,340
Yes	28 (17,9)	14 (23,7)	
Family history of CAD			
No	141 (90,4)	54 (91,5)	0,797
Yes	15 (9,6)	5 (8,5)	

*SAH: systemic arterial hypertension; AMI: acute myocardial infarction; CAD: coronary artery disease; DM: diabetes mellitus; MRS: myocardial revascularization surgery. Year of data collection: 2020; *Pearson's chi-square test; †statistically significant after the post-hoc test.*

In the studied population, mean age of the AMI patients was 61.9 years old, which is in accordance with the literature that shows that the mean age of patients with AMI is 60 years old.[14] In addition, it is known that CVDs cause considerable morbidity and mortality in the elderly population,[15] and that the prevalence of diabetes increases with age, especially after the age of 40,[16] corroborating the fact that most common profile of an AMI patient is an elderly diabetic patient.

In our study, 73% of the myocardial infarction patients were male, which is comparable to the frequency described in the literature (81.2%).[14] Also, although the rates of AMI was higher among diabetic than non-diabetic women (35.6% vs. 23.6%), the rates of AMI was lower among diabetic than non-diabetic men (64.4% vs. 76.3%). These data agree with those reported in the literature that

Table 3 – Characteristics of diabetic and non-diabetic patients with AMI who underwent or did not undergo MRS

	MRS in non-diabetic patients, n (%)			MRS in diabetic patients, n (%)		
	No	Yes	p-value	No	Yes	p-value
	n=128	n=28		n=45	n=14	
Sex						
Male	98 (76.6)	21 (75.0)	0.860*	29 (64.4)	9 (64.3)	0.999‡
Female	30 (23.4)	7 (25.0)		16 (35.6)	5 (35.7)	
Smoking						
No	57 (44.5)	12 (42.9)	0.872*	23 (51.1)	7 (50.0)	0.942*
Yes	71 (55.5)	16 (57.1)		22 (48.9)	7 (50.0)	
SAH						
No	52 (40.6)	8 (28.6)	0.235*	6 (13.3)	1 (7.1)	0.999‡
Yes	76 (59.4)	20 (71.4)		39 (86.7)	13 (92.9)	
Dyslipidemia						
No	106 (82.8)	24 (85.7)	0.999‡	35 (77.8)	11 (78.6)	0.999‡
Yes	22 (17.2)	4 (14.3)		10 (22.2)	3 (21.4)	
Personal history of AMI						
No	103 (80.5)	22 (78.6)	0.820*	32 (71.1)	11 (78.6)	0.738‡
Yes	25 (19.5)	6 (21.4)		13 (28.9)	3 (21.4)	
MRS						
No	117 (91.4)	24 (85.7)	0.476‡	41 (91.1)	13 (92.9)	0.999‡
Yes	11 (8.6)	4 (14.3)		4 (8.9)	1 (7.1)	

*SAH: systemic arterial hypertension; AMI: acute myocardial infarction; CAD: coronary artery disease; MRS: myocardial revascularization surgery; year of data collection: 2020; *Pearson's chi-square test; ‡ Fisher's exact test.*

the incidence of CVD in diabetic individuals is twice the incidence in non-diabetic men, and the three times the incidence in non-diabetic women.[17]

With respect to smoking status, the frequency of smokers was higher than non-smokers among AMI patients. This is also in line with the literature, since smoking is significantly associated with increased risk for CAD.[14] However, among smoker patients with AMI, there was a lower (but not significant) percentage of diabetic and non-diabetic individuals, although the literature has highlighted that the combination of smoking and DM increases the risk of AMI. [18]

Findings related to dyslipidemia did not show statistically significant differences, and we found a frequency of 18.1% of dyslipidemia among AMI patients. This is comparable to the prevalence (23%) reported in another Brazilian study[14] investigating the prevalence of risk factors in AMI patients. Although this was a relatively low frequency (18.1%), it is believed that it could be even lower, since dyslipidemia is the main modifiable risk factor for AMI.[19] In the present study, among AMI patients who underwent MRS, the rate of dyslipidemia was higher in diabetic than in non-diabetic patients. One possible explanation for this finding is the fact that the episodes of infarction are usually more severe in these patients. Consequently, diabetic dyslipidemic patients have significantly increased mortality.[20]

There is consensus in the literature that the risk for CVD in diabetic patients is comparable to that in non-diabetic patients with history of AMI, indicating that the incidence of AMI in diabetic patients without a history of CAD is similar to that in non-diabetic patients with a history of CAD.[21] Findings of the present study differ from the literature data, since the prevalence of AMI in patients with DM without a history of AMI was 72.9%, and the percentage of AMI among non-diabetic patients with a previous history of AMI was 19.9%.

In addition, in our study, only 8.5% of diabetic patients had a family history of CAD. This result disagrees with those of Gama et al.[22] reporting that first-degree relatives of CAD patients have a history of CAD.[22] In our study, considering that patients are not usually asked about the family history of AMI and the personal history of CAD, and these data are not registered in the medical records, they were considered absent.

Among patients undergoing MRS, 33% had DM; this is in accordance with the study by Gama et al.[22] that reported that 25% of patients undergoing multiple arterial revascularization, MRS or percutaneous coronary intervention had DM.[22] These data are important since the procedure of choice for diabetic patients with AMI is revacularization,[23] due to its benefits including lower risk and rates of mortality from coronary heart diseases, myocardial infarction and repeated revascularization.[22]

Besides, DM alone is not an additional risk for cardiac mortality in vascular procedures, reinforcing the indication of MRS for diabetic patients considering the high rates of restenosis following coronary angioplasty.[24]

A limitation of this study was the presence of missing data due to inadequate completion of medical records by the healthcare professionals. For this reason, the following assumptions were made:

- Patients who did not have recorded comorbidities were considered without comorbidities;
- When a patient characteristic was recorded in only one part of the medical record (but not in others), this characteristic was considered to be present;
- Patients taking anti-hypertensive drugs were considered hypertensive; however, patients using statins who did not have recorded dyslipidemia in the medical records were not considered dyslipidemic;
- Former smokers were considered smokers;
- Pre-diabetic patients were considered non-diabetic;
- The types of AMI (AMI with ST-segment elevation and AMI without ST-segment elevation), its complexity and need of percutaneous therapy were not considered;
- In many medical records, MRS was recorded after the study period although AMI had occurred during this period; in this case, MRS was considered absent.

Therefore, these epidemiological data reinforce the need for further research on risk factors in diabetic patients with AMI for the development of preventive and therapeutic strategies for this population, and performance of MRS as the procedure of choice.

Conclusions

The prevalence of MRS was higher in diabetic than in non-diabetic patients following an AMI. The cross-sectional nature of the study precluded inferences of causality between the variables; however, this study adds to the body of literature, fostering the development of studies on clinical outcomes.

Author contributions

Conception and design of the research, analysis and interpretation of the data, statistical analysis, critical revision of the manuscript for intellectual content and writing of the manuscript: Schwanck AMC, Menezes ISB, Canto MC; acquisition of data: Schwanck AMC, Menezes ISB.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

This study is not associated with any thesis or dissertation work.

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee on Animal Experiments of the Comitê de Ética e Pesquisa da UNESC under the protocol number 3852071.

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