Clinical features and outcomes in patients with *diabetes mellitus* undergoing coronary artery bypass graft in a reference center in southern Brazil

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Summary

Objective: To describe clinical/laboratory features of patients undergoing coronary artery bypass graft (CABG) in a cardiology reference center. **Methods:** Cohort study; data from patients undergoing CABG (January 2004 to February 2006, n = 717) were evaluated for clinical/laboratory features before, during and after surgery (infections, duration of hospital stay, deaths). **Results:** Patients were 61.9 ± 11 years old, 67.1% males, 29.6% diabetics. Intraoperatively, diabetics had a central venous catheter placed for a longer period ($p < 0.001$), but extracorporeal circulation, aortic clamping and total surgery times were similar to those for non-diabetics. Infection occurred in 19.1% of patients (40.1% diabetics vs. 10.3% non-diabetics, $p < 0.001$). The duration of hospital stay was longer for patients with diabetes vs. non-diabetic patients, but there was no difference in deaths between the two groups ($p = 0.797$). **Conclusion:** Patients with diabetes undergoing CABG develop more infectious diseases and stay longer in hospital than non-diabetics.

Keywords: *Diabetes mellitus*; myocardial revascularization; infection.

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Introduction

Diabetes mellitus (DM) is an independent risk factor for coronary artery disease, stroke and heart failure, the main death causes in these patients[1]. Coronary artery disease has a higher incidence and is more severe in patients with DM compared to non-diabetic patients, affecting females[2] predominantly and causing multiple artery damage, forming unstable/more prone to rupture atheromata, leading to a worse prognosis for these patients: a lower short-term survival, a higher disease recurrence risk and a worse response to proposed treatments[3,4]. Among treatments, coronary artery bypass graft (CABG) has improved the survival in patients with severe coronary artery disease, surpassing medication treatment in those cases, especially in patients with DM[4].

However, several studies have shown a higher postoperative complication rate in these patients after heart surgeries, with reoperation and reintubation requirement, superficial and deep infections, perioperative stroke, kidney failure and longer hospital stay being highlighted[5,6]. However, previous studies by other authors[6] in our country did not show an association between DM and perioperative mortality risk[7]. As early as preoperatively, patients with DM are already different from those without DM, with older age[8], lower ejection fraction[5], higher obesity frequency, systemic arterial hypertension and cardiovascular disease history being more commonly found[8].

The identification of the clinical and laboratory profile of patients with DM before CABG and its relationship with clinical outcomes is a key factor for a better care planning, with subsequent improvement of outcomes and reduced hospital cost. Therefore, this study objective was to evaluate the risk profile of patients with DM undergoing CABG in a reference service in Southern Brazil, by comparing the clinical end-point frequency with that in patients without DM, identifying the main outcome predictor factors in this group.

Methods

A cohort study was conducted, with data being collected from all patients undergoing CABG from January 2004 through February 2006 in a reference service in the state of Rio Grande do Sul, Brazil. The exclusion criteria were: urgent surgery, no admission plasma glucose recorded, evidence of any infection within 36 hours from the surgery, and evidence of any postoperative infection (positive cultures or antibiotic use). 717 patients were included, from whom 212 (29.6%) had DM (defined by a DM history, use of oral antidiabetics or a fasting blood glucose 126 mg/dL at the admission).

The data were retrospectively collected, by completing a form containing demographic and identification (name, gender, race, age), clinical (weight, height, blood pressure, heart rate, axillary temperature, medication used, capillary glucose over the first 48 h postoperatively), laboratory (fasting plasma glucose, hematocrit, white blood cell count, platelets, creatinine, sodium, potassium), intraoperative (operative time and time with extracorporeal circulation, aortic clamping, mechanical ventilation, central venous catheter and urinary catheters) variables and comorbidities (hypertension, diabetes mellitus, smoking, obesity, dyslipidemia, prior acute myocardial infarct, heart failure, chronic kidney failure, prior stroke, prior neoplasm). The glomerular filtration rate was calculated through the Cockcroft-Gault equation[9].

The evaluated end-points, depending on whether DM is present or not, were: infections, postoperative hospital stay and deaths. The patient was considered to have postoperative infection in the following situations: respiratory tract infection (defined as the presence of a positive sputum test or a recent chest XR infiltrate not characterized clinically as resulting from heart failure), urinary tract infection (defined as the presence of a positive urine culture or a high white blood cell count in urine), superficial wound operatory infection (clinical diagnosis registered in the patient record, being only the skin and the subcutaneous tissue affected) or deep wound operatory infection (clinical diagnosis registered in the patient record as affecting mediastinum, bone or cartilage tissue with necrotic tissue present or not). In individuals experiencing more than one infectious episode, only the first one was considered to have the incidence calculated.

This study was approved by the Institutional Ethics Committee. The authors provided an agreement in which they pledged themselves to use the information with an exclusively scientific purpose, fully preserving the patient anonymity.

The statistical analysis was conducted by using the software Statistical Package for Social Sciences (SPSS version 17.0). The sample characteristics were described by mean, standard deviation, median, interquartile ranges, ratios and occasional differences between patients with and without DM via Chi-square and Student's *t* test. The significance level considered was of 0.05.

Results

The preoperative demographic, clinical, laboratory and comorbidity characteristics of the 717 patients in the study, depending on whether DM is present or not, are shown in Table 1. The age was similar for both groups; however, among the patients with DM, a lower ratio of males (60.8% vs. 70.1%), a higher number of patients reporting dyslipidemia (46.2% vs. 14.1%) and a higher number of hypertension cases (89.2% vs. 56.6%) were observed. These patients also had higher preoperative fasting plasma glucose as expected (114.2 ± 36.3 mg/dL vs. 102.8 ± 27.1 mg/dL, $p < 0.001$), a lower glomerular filtration rate ($p < 0.001$) and a higher total count of blood white cells ($p < 0.001$).

Table1 – Preoperative clinical and demographic characteristics in 717 patients undergoing coronary artery bypass graft, depending on whether diabetes is present or not

Characteristics	With diabetes n = 212	Without diabetes n = 505	p value
Age (years)	61.0 ± 10.7	62.3 ± 10.8	0.913
Elderly (> 65 years)	132 (62.3)	281 (55.6)	0.120
Males	129 (60.8)	354 (70.1)	0.020
Race			0.222
White	168 (90.8)	417 (93.8)	
Non-white	17 (9.2)	27 (6.1)	
Prior neoplasm	1 (0.5)	2 (0.4)	1.000
Coronary angiography during hospitalization	156 (73.6)	372 (73.8)	1.000
Percutaneous coronary intervention during hospitalization	13 (6.1)	29 (5.7)	0.977
Prior AMI	37 (17.5)	89 (17.6)	1.000
Prior stroke	22 (10.4)	48 (9.5)	0.825
COPD	24 (11.3)	58 (11.5)	1.000
Dyslipidemia	98 (46.2)	71 (14.1)	< 0.001
BMI (kg/m²)			0.715
< 25	95 (47.5)	223 (44.2)	
25-30	72 (36.0)	191 (37.8)	
> 30	33 (16.5)	91 (18.0)	
Hypertension	189 (89.2)	286 (56.6)	< 0.001
Blood pressure (mmHg)			
Systolic	132.8 ± 15.6	129.3 ± 16.1	0.006
Diastolic	82.5 ± 10.9	74.5 ± 8.9	< 0.001
Heart rate (bpm)	83.3 ± 10.4	77.5 ± 8.8	< 0.001
Respiratory rate (RR)	18.0 ± 2.6	16.6 ± 2.0	< 0.001
Preoperative fasting plasma glucose (mg/dL)	114.2 ± 36.3	102.8 ± 27.1	< 0.001
GFR (mL/min)	74.8 ± 28.3	89.0 ± 42.4	< 0.001
Preoperative white blood cell count	7658.7 ± 2106.3	6557 ± 1021	< 0.001

Data is expressed by means ± standard deviation (Student's t Test) or n and percentage in brackets (Chi-square test). AMI, acute myocardial infarction; COPD, chronic obstructive pulmonary disease; BMI, body mass index; GFR, glomerular filtration rate, as calculated by the Cockcroft-Gault equation.

As for intraoperative characteristics, the extracorporeal circulation, aortic clamping and total surgery times were similar between individual with and without DM. Postoperatively, the patients with DM had a central venous catheter placed for a longer time ($p < 0.001$). The mean capillary glucose was higher postoperatively (123.7 ± 31.3 mg/dL) than the preoperative plasma glucose (114.2 ± 36.3 mg/dL, $p = 0.007$), considering only patients with DM. The intraoperative characteristics and postoperative comorbidities for the 717 patients in the study, depending on the presence or not of DM, are shown in Table 2.

One hundred and thirty-seven patients (19.1%) had some kind of infection, of which 85 were respiratory tract infections (62%), 13 were urinary tract infections (9.5%), 35 were superficial wound operatory infections (25%), and 5 were deep wound operatory infections (3.6%). Considering the patients that had any infection, 85 (40.1%) had DM and 52 (10.3%) did not have DM, $p < 0.001$. Figure 1 shows the categories and respective infection prevalence, comparing patients with and without DM. The most common infection in patients with DM was superficial skin infection (16.5%). In individuals without DM, only one patient showed respiratory tract infection (10.3%). There was no difference between the prevalence of respiratory tract infection between patients with and without DM ($p = 0.062$).

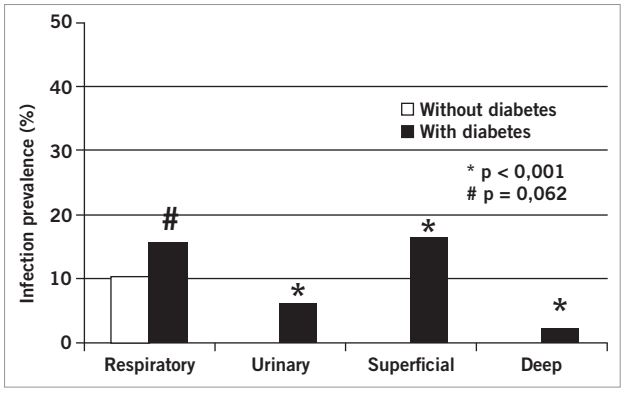
Considering only patients with DM, there was no difference between the mean capillary glucose evaluated within 48 h after the surgery and the presence of infection in these patients (126.3 ± 31.6 vs. 121.9 ± 31.0 mg/dL in patients with DM and infection vs. patients with DM without infection, $p = 0.702$).

Table 2 – Intra- and postoperative characteristics in 717 patients undergoing coronary artery bypass graft, depending on whether diabetes is present or not

Characteristics	With diabetes n = 212	Without diabetes n = 505	p value
Extracorporeal circulation time (min)	80.5 ± 29.4	78.3 ± 22.8	0.347
Aortic clamping time (min)	51.6 ± 18.9	51.9 ± 20.1	0.875
Total surgery time (hours)	4.4 ± 0.7	4.3 ± 0.7	0.193
Indwelling central venous catheter (hours)	75.3 ± 35.6	58.7 ± 16.2	< 0.001

Data is expressed by means ± standard deviation (Student's t Test) or n and percentage in brackets (Chi-square test). DM: *diabetes mellitus*

Figure 1 – Infection type and prevalence in patients with and without diabetes undergoing coronary artery bypass graft



* *vs.* patients without diabetes # *vs.* patients without diabetes

The stay in hospital was longer in patients with DM (8.8 ± 3.9 days) vs. patients without DM (6.4 ± 1.4 days, p < 0.001).

No difference in number of deaths was found between patients with (10; 4.7%) and without DM (20; 4.0%), p = 0.797.

Discussion

The data presented here reports the differences before and after coronary artery bypass graft in patients with DM in Brazil. The higher occurrence of infections postoperatively and the longer time of a central venous catheter placed in patients with DM are featured. These facts likely contributed to the longer stay in hospital, although they were not reflected in higher in-hospital mortality for these patients.

A higher percentage of postoperative infections in CABG was also observed by other authors[4,10-14], with a few exceptions[15-18]. Considering patients with DM, their disadvantage over patients without DM for any CABG postoperative infection, especially deep wound infection, was maintained, as other authors show[11]. The experience other centers have in implementing a hyperglycemia intensive management protocol with a continuous insulin infusion[13,16] and/or subcutaneous insulin[8] in this setting may reduce those rates, in addition to lowering mortality and cost[16], thus reinforcing the implementation we have already provided in our Institute. It is important to remember that patients with a more severe and more complicated atherosclerotic disease, including those with DM, are expected to have a surgery indicated more often than a percutaneous intervention, what certainly contributes to higher postoperative complication odds.

In addition to the higher postoperative infection risk in coronary artery bypass graft, patients with diabetes were more frequently females and dyslipidemia, obesity and hypertension were more commonly identified among them, what is expected, since there is an association between these conditons[19]. Lower glomerular filtration rates and higher heart rates in patients with diabetes are likely due to the occurrence of a kidney disease[6] and an autonomic neuropathy[20] in this group, respectively. A higher white blood cell count before the surgery would be caused by a chronic inflammation state previously described in these individuals, where the common soil theory contributes both to atherosclerosis and diabetes development as a part of the same phenomenon associated with a mild chronic systemic infection[21].

These are suggested mechanisms to explain why DM would make CABG prognosis worse: poorer neutrophil phagocytic activity in patients with DM[22], a greater number of prior comorbidities[8], a higher renal dysfunction prevalence, that is a known marker of both postoperative poorer prognosis[23] and greater odds of vascular damage existing previously to the surgery[24], what could determine a higher risk of postoperative cardiovascular events. More preoperative comorbidities and poorer kidney function were shown in our study patients with DM.

The finding of longer stay in hospital resulting from diabetes presence needs to be highlighted because it brings about an increased cost. Once the association between diabetes and diabetes/infection with longer hospital stay is identified, the health providers should seek to implement measures to reduce those outcomes[8,13,16,25], resulting in a likely cost reduction, which has already been shown in other institutions[16].

It is important to highlight some of this study limitations, such as the data collect retrospective nature. Despite the record quality, other end-points of interest could not be assessed, including stroke occurrence, transfusion need, reintubation and postoperative dialysis, since these end-points had no systematic assessment conducted by

the attending physicians. Finally, this study low power to assert postoperative mortality has been similar between patients with and without DM should be considered, as the study was designed to evaluate composite end-points.

Conclusion

We concluded patients with DM undergoing CABG have more preoperative comorbidities when clinically assessed and have intraoperative characteristics similar to those in patients without DM. However, they develop more infections and stay longer in hospital than those without DM; but this is not reflected in higher in-hospital mortality.

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