



Mediate and late postoperative evolution of patients undergoing elective cardiac surgery

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ABSTRACT

Objective: to investigate the mediate and late postoperative evolution of patients undergoing cardiac surgery according to the type of surgery. **Methods:** this is an observational study carried out in a hospital in the countryside of São Paulo between March 2016 and October 2017. Data were collected through consultation of medical records. In the immediate postoperative period, complications and the outcome of hospitalization were investigated. In the late postoperative period, complications, new procedures and outcome over two years were investigated. **Results:** 118 patients participated. Hyperglycemia was the most frequent mediated complication in the myocardial revascularization group and in combined revascularization and valve repair surgeries. Non-therapeutic "international normalized ratio" was the most frequent complication in the valve repair group. As for the outcome, 90.9% were alive after two years of hospital discharge. **Conclusion:** the frequency of complications in the middle and late postoperative period was low.

Descriptors: Cardiovascular Surgical Procedures; Postoperative Complications; Perioperative Nursing; Nursing Care.

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INTRODUCTION

The progress of science and technology in health has enabled important advances in the treatment of cardiovascular diseases (CVD), such as the improvement of minimally invasive procedures, better surgical techniques, in addition to better preparation of the multidisciplinary team for the performance of postoperative care. However, cardiac surgery has a high potential for the incidence of complications that can increase both postoperative morbidity and mortality of patients(1).

In Brazil, according to data available at the Informatics Department of the Unified Health System (DATASUS - Departamento de Informática do Sistema Único de Saúde), from January 2016 to November 2017, 22,240 myocardial revascularization surgeries (MRS) and 10,124 valve surgeries (valve replacement, valve reconstruction or both)(2).

With the change in the demographic profile in recent years, there has been an increase in the number of elderly people and in life expectancy, reflecting the higher incidence of heart disease, among other CVDs. There is a change in the sociodemographic and clinical profile of

patients with indication for cardiac surgery(2).

The severity of patients undergoing MRS has increased in recent decades, expanding the possibility of postoperative complications(3). The indication of surgical intervention for individuals with valve heart disease occurs when there is a failure in the adaptation mechanisms that compensate for the valve anatomical dysfunction, leading to the clinical manifestations of this dysfunction(4).

The main complications and mortality in the postoperative period of cardiac surgery, in general, may be related to the following factors: advanced age; females; pre-existing diseases; smoking; malnutrition; obesity; type of medication used preoperatively; physiological condition of the cardiovascular system preoperatively; type and time of surgery; use and time of cardiopulmonary bypass (CPB); time of postoperative intubation, among others(5).

In general, researchers seek to investigate the postoperative complications of patients undergoing cardiac surgery with a focus on the immediate postoperative period during their stay in the Intensive Care Unit (ICU). These complications are related, in

most cases, to the increased time of orotracheal intubation, hemodynamic instability, greater possibility of bleeding, neurological complications and acute kidney injury(1,6). However, complications can also occur in the immediate postoperative period(7), as well as in the late postoperative period(8), such as surgical site infection (SSI), altered blood glucose, anemia, among others(7-8).

The present investigation was developed aiming to contribute to the knowledge of this theme, favoring the identification and early treatment of complications, improving the recovery and rehabilitation of these patients during the middle and late postoperative periods.

Thus, this study aimed to investigate the mediate and late postoperative evolution of patients undergoing cardiac surgery, according to the type of surgery.

METHOD

This is an observational study with additional follow-up of patients who participated in a previous study, which was carried out from August 2013 to February

2015. The previous study was of a descriptive, cross-sectional type, developed in a university hospital in the countryside of São Paulo, Brazil, belonging to the Regional Health Department of Ribeirão Preto (RHD XIII)(9).

In the present study, all data presented here were collected from patients' medical records, related to the mediate and late postoperative period. The data regarding preoperative (sociodemographic characterization) and intraoperative (type of surgery performed) periods were obtained from the database of the main researcher.

Regarding the identification of postoperative times, it is considered immediate postoperative from the beginning of patients' admission to post-anesthesia recovery, immediately after the end of surgery until the first 24 hours after surgery. The mediate postoperative period begins after 24 hours, and lasts until hospital discharge. The late postoperative period, on the other hand, succeeds the previous stage and extends, for up to 90 days, in the case of prosthesis placement(10).

These definitions, especially considering the definition of immediate postoperative, were developed for patients

who await, in post-anesthetic recovery, discharge from anesthesia, i.e., patients who await reversal of anesthesia and stabilization of vital signs. This definition does not fit for patients undergoing cardiac surgery, as they are referred to an ICU immediately after surgery, and not for post-anesthetic recovery, and remain there until the vital signs stabilize, and not just until the reversal. anesthesia. These patients spend an average of 48 hours in the ICU after surgery(11).

There is no exclusive postoperative classification in the literature for patients who generally depend on ICU stay after surgery. What is in common is that, as in the post-anesthetic recovery, patients in the postoperative period of cardiac surgery will be discharged from the ICU due to the stabilization of vital signs.

Given the above, we assume that the mediate postoperative period started from patients' admission to the ward, after discharge from the ICU, until the time of hospital discharge, and the late postoperative period started after discharge from hospital until the two first years after hospital discharge.

The sample consisted of subjects of both sexes, aged over 18 years, who underwent the first coronary artery bypass surgery, surgeries to repair valve diseases or combined surgeries, and with elective scheduling of their surgeries. Patients who did not have cognitive conditions to answer the questionnaire, as assessed by the Mini Mental State Examination (MMSE), in the version adapted for Brazilian Portuguese; who presented clinical decompensation of heart disease, on the day before surgery (presence of dyspnea, precordialgia and orotracheal intubation); who had elective scheduling of surgeries less than 12 hours in advance; who were discharged from the ICU, in a university hospital in the countryside of São Paulo between August 2013 and February 2015 were excluded. Data collection on mediate and late postoperative evolution occurred from March 2016 to October 2017 by consulting the hospital's electronic medical record system.

Data regarding the sociodemographic and clinical characterization in the preoperative period are the same as in the previous study, thus, the main researcher's database was obtained: birth and hospitalization dates; sex (male or female);

presence of a partner (yes or no); education (in complete years); professional situation (active or inactive); family monthly income (in reais, Brazilian currency); surgery performed (myocardial revascularization, heart valve disease repair or combined surgeries). Age was calculated by subtracting the interview date from the date of birth. The sociodemographic and clinical characterization instrument of the previous study was validated with respect to face and content by a committee of four judges with extensive experience in cardiology and cardiovascular surgery. For each of the judges, they were asked to assess all the instrument items regarding pertinence (if the items expressed a true relationship with the study proposal) and clarity (if the items were described in an understandable way). If the judge assessed an item as unclear or not relevant, there was room for suggestions as well as room for adding new items.

To investigate the evolution in patients' mediate postoperative period, the following data were collected: pulmonary complications: presence of acute respiratory failure, atelectasis, pleural effusion, bronchoaspiration, pneumothorax, hypoxia,

hemothorax; cardiac complications: cardiorespiratory arrest, acute myocardial infarction, arrhythmias, cardiac tamponade, cardiogenic shock; hematological complications: bleeding, non-therapeutic international normalized ratio (INR); neurological complications: sensorineural deficit, agitation, stroke, mental confusion; endocrine complications: hyperglycemia or hypoglycemia(12); infectious complications: SSI; kidney complications: acute kidney injury; digestive complications: mesenteric ischemia, digestive hemorrhage. The median postoperative length of stay was calculated by subtracting the date of hospital discharge from the date of discharge from the ICU.

To investigate the evolution of patients' late postoperative period, locations of outpatient follow-up, procedures after hospital discharge (pacemaker implantation, chemical thrombolysis, percutaneous coronary intervention, new cardiac surgery), presence of SSI and outcome two years after (alive, death or censored) were collected hospital discharge. Patients who abandoned follow-up at the study hospital were considered "censored". To collect the "outcome" variable, three attempts were made by telephone contact with "censored"

patients, in order to investigate whether they were alive two years after discharge. Patients who did not answer the three phone calls were classified as “censored” in the “outcome” variable.

The data related to a medical diagnosis of SSI, both in the middle and late postoperative periods, were obtained from the Hospital Infection Control Commission (HICC) of the referred hospital, which classifies them according to the Brazilian National Health Regulatory Agency(13).

Thus, SSI are infections related to surgical procedures, whether or not prostheses have been placed, and are classified according to the involvement of the planes: superficial incisional, deep incisional, and organ/cavity(13).

Incisional SSI occurs in the first 30 days after the surgical procedure (the first day being the procedure date), involving only skin and subcutaneous tissue and presents at least one of the following criteria: positive culture of secretion or tissue from the superficial incision, obtained aseptically; purulent drainage from the superficial incision. The superficial incision is deliberately opened by a surgeon in the presence of at least one of the following

signs or symptoms: pain; increased sensitivity; local edema; hyperemia or heat, unless the culture is negative and diagnosis of superficial infection by the surgeon or another attending physician(13).

Deep SSI occurs within the first 30 days, and, if implants have been placed, it can occur up to 90 days after surgery, involving soft tissues deep in the incision, such as fascia and/or muscles, and has at least one of the following criteria: deep spontaneous dehiscence or incision opened by a surgeon and positive or not performed culture when patients present at least one of the following signs and symptoms: fever (temperature $\geq 38^{\circ}\text{C}$); pain or localized swelling; purulent drainage from the deep incision, but not from an organ/cavity; abscess or other evidence of infection involving deep tissues, detected during clinical, anatomopathological or imaging examination or diagnosis of deep incisional infection made by a surgeon or other attending physician(13).

Finally, organ or cavity SSI occurs in the first 30 days after surgery or up to 90 days, if implant placement, involves any organ or cavity that was opened or manipulated during surgery and meets at

least one of the following criteria: positive culture of secretion or tissue of the organ/cavity obtained aseptically; presence of abscess or other evidence that the infection involves the deep planes of the wound identified in reoperation, clinical, anatomopathological or imaging examination or diagnosis of organ/cavity infection by an attending physician(13).

The study was developed in accordance with Resolution National Health Council (CNS – Conselho Nacional de Saúde) 466/12. As this is a new project and addresses different objectives from the first study, it was submitted and approved separately by a Research Ethics Committee, under Opinion 1.201.379. The waiver of signing an Informed Consent Form was requested and approved.

The data were entered in the Office Excel 2010 program with double entry and subsequent validation. Validation was performed in Excel itself, with the technique: “formulas”, “insert function”, “if”, “comparison of each cell in the worksheet of the first entry with its corresponding one in the worksheet of the second entry”.

Then they were transported to the IBM SPSS program, version 22.0 for

Windows (SPSS, Inc., Chicago, IL, USA) for descriptive analysis of the study variables. Descriptive analyzes of simple frequency were performed for nominal or categorical variables and analysis of central tendency and dispersion for numerical variables.

RESULTS

The study sample consisted of 118 patients, 59 (50%) of whom underwent MRS, 48 (40.6%) of heart valve disease repair surgeries and 11 (9.4%) of combined MRS surgery and heart valve disease repair. Of the 48 patients who underwent surgery for heart valve disease repair, 25 (52.1%) underwent implantation of a metallic valve prosthesis. Participants’ sociodemographic characterization is shown in Table 1.

Table 2 shows participants’ characteristics according to the complications identified in the mediate postoperative period.

In the group of patients who underwent MRS, the most frequent complication was hyperglycemia (n=38; 64.4%), followed by mental confusion (n=8;

Table 1 - Sociodemographic characterization of participants according to the type of surgery, sex, marital status, employment relationship, age, education and monthly income (n=118). Ribeirão Preto, Sao Paulo, Brazil.

Variable	MRS *			Heart valve disease repair			Heart valve disease repair + MRS *		
	n (%)	Mean (SD)**	Min and Max	n (%)	Mean (SD)**	Min and Max	n (%)	Mean (SD)**	Min and Max
Sex									
Male	40 (67.8)			28 (58.3)			9 (81.8)		
Partner presence									
Yes	44 (74.6)			36 (75.0)			8 (72.7)		
Paid activity									
No	37 (62.7)			30 (62.5)			8 (72.7)		
Age in years		61 (10.3)	41 – 84		55 (13.2)	26 – 88		63 (10.2)	46 – 82
Education in years		5.3 (4.7)	0 - 20		5.1 (3.9)	0 - 15		4.0 (2.1)	2 - 8
Family monthly income in reais***		2924.5 (3254.0)	70.0 - 20000		1982.3 (1250.8)	250 - 5000		1319.8 (712.7)	500 - 2300

Note: MRS *=Myocardial Revascularization Surgery; Mean (SD) **=Mean (Standard Deviation); Min=Minimum; Max=Maximum; ***reais is the Brazilian currency, one real corresponds to about 5 US dollars)

13.6%). In the group of patients who underwent surgery for heart valve disease repair, the most frequent complication was non-therapeutic INR (n=10; 20.8%), followed by hyperglycemia (n=8; 16.7%). In the group of patients who underwent combined surgery of MRS and heart valve disease repair, the most frequent complication was hyperglycemia (n=5; 45.5%).

The average length of stay of patients in the MRS group was 7.2 days (SD=6.1; median=5.0), ranging from two to 40 days. In the heart valve disease repair group, the mean time was 9.6 days (SD=5.5; median=8.0), ranging from two to 26 days. In the group of combined surgeries, the average hospital stay was 12.3 days (SD=10.6; median=9), ranging from five to 42 days. As for The outcome of

Table 2 - Characterization of participants according to the type of surgery and the presence of complications in the mediate postoperative period (n=118). Ribeirão Preto, Brazil, 2017

Variable	MRS ⁺	Heart valve disease repair	Heart valve disease repair + MRS ⁺
	n=59 n (%)	n=48 n (%)	n=11 n (%)
Pulmonary complications			
Pleural effusion	3 (5.1)	2 (4.2)	1 (9.1)
Hypoxia	1 (1.7)	3 (6.3)	0
Hemothorax	1 (1.7)	0	0
Acute respiratory distress	1 (1.7)	2 (4.2)	0
Bronchoaspiration	1 (1.7)	0	0
Atelectasis	0	0	0
Pneumothorax	0	0	0
Cardiac complications			
Arrhythmias	2 (3.4)	7 (14.6)	1 (9.1)
Acute Myocardial Infarction	2 (3.4)	0	0
Cardiopulmonary arrest	2 (3.4)	0	0
Cardiac tamponade	0	1 (2.1)	1 (9.1)
Cardiogenic shock	0	0	0
Hematological complications			
Non-therapeutic INR**	3 (5.1)	10 (20.8)	1 (9.1)
Bleeding	1 (1.7)	2 (4.2)	0
Neurological complications			
Mental confusion	8 (13.6)	4 (8.3)	1 (9.1)
Sensorineural deficit	4 (6.8)	3 (6.3)	0
Agitation	3 (5.1)	1 (2.1)	1 (9.1)
Stroke	3 (5.1)	0	0
Endocrine complications			
Hyperglycemia	38 (64.4)	8 (16.7)	5 (45.5)
Hypoglycemia	3 (5.1)	0	0
Kidney complications			
Acute kidney injury	2 (3.4)	0	0
Digestive complications			
Gastrointestinal bleeding	1 (1.7)	2 (4.2)	0
Mesenteric ischemia	0	0	0
Infectious complications			
Surgical site infection	2 (3.4)	1 (2.1)	1 (9.1)
SSI*** superficial incisional	1 (1.7)	1 (2.1)	0
SSI*** deep incisional	1 (1.7)	0	1 (9.1)

Note: MRS*=Myocardial Revascularization Surgery; INR **=international normalized ratio; SSI***=Surgical Site Infection.

hospitalization, all patients in the sample were discharged.

As for follow-up, at the beginning of the late postoperative period of patients, after hospital discharge, it was observed that all patients, regardless of the surgery performed, returned to the outpatient clinic of the study for routine follow-up consultation.

Regarding the performance of new procedures related to the circulatory

system, two patients in the MRS group underwent percutaneous coronary intervention (3.4%), one patient (2.1%) in the heart valve disease repair group underwent two mitral valve replacement surgeries and a patient in the heart valve disease repair group implanted a permanent pacemaker (2.1%).

Table 3 shows the occurrence of patients' SSI, according to the surgery performed.

Table 3 - Characterization of participants regarding the presence of surgical site infection, according to the type of surgery and the classification of the infection (n=118). Ribeirão Preto, Sao Paulo, Brazil.

Variable	MRS*	Heart valve disease repair	Heart valve disease repair + MRS*
	n=59	n=48	n=11
	n (%)	n (%)	n (%)
SSI** deep incisional			
Saphenectomy	5 (8.5)	0	0
Sternal	0	0	1 (9.1)
Organ or cavity SSI **			
Endocarditis	1 (1.7)	1 (2.1)	0
Mediastinitis	1 (1.7)	0	1 (9.1)

Note: MRS*=Myocardial Revascularization Surgery; SSI**=Surgical Site Infection.

Regarding the outcome after two years of hospital discharge, eight censored patients were found in the MRS group. After telephone contact, it was identified that

seven were alive and one patient died.

As for patients undergoing heart valve disease repair surgeries, 11 patients were considered censored. After telephone

contact, it was identified that six were alive and five remained censored. With regard to patients undergoing combined surgery, all outcomes were found in patients' medical records.

The final description of the outcome

of patients after two years of hospital discharge is shown in Table 4. It was observed that most patients, regardless of the surgery performed, were alive after two years of hospital discharge.

Table 4 - Characterization of the 118 participants regarding the outcome after two years of hospital discharge according to the type of surgery (n=118). Ribeirão Preto, SP, Brazil, 2017

Outcome	MRS*	Heart valve disease repair	Heart valve disease repair + MRS*
	n=59 n (%)	n=48 n (%)	n=11 n (%)
Alive	57 (96.6)	40 (83.3)	10 (90.9)
Follow-up at the study hospital	52 (88.1)	35 (72.9)	10 (90.9)
Follow-up at another hospital	5 (8.5)	5 (10.4)	0
Death	2 (3.4)	3 (6.3)	1 (9.1)
Censored **	0	5 (10.4)	0

Note: MRS*=Myocardial Revascularization Surgery; **Censored: the patient who did not return for routine outpatient follow-up and did not answer the three phone calls was considered censored.

DISCUSSION

A low frequency of complications was found in the mediate postoperative period of patients undergoing cardiac surgery. All patients in the sample were discharged after surgery. There is a scarcity of works investigating the theme, which made it difficult to compare the results of

this with others already published.

Returning to the main complications evidenced in this study, it was identified that hyperglycemia was the most frequent mediate postoperative complication both for the group of patients undergoing MRS and for the group of combined surgeries, and the second most frequent in the group of patients undergoing heart valve disease repair

surgeries.

Hyperglycemia is a frequent complication in the postoperative period of cardiac surgery. The factors that contribute to its occurrence are related to: insulin resistance; increased levels of cortisol and growth hormone in response to surgical stress; the release of endogenous catecholamines in response to the use of CPB; administration of epinephrine after CPB for hemodynamic support(14).

The persistence of postoperative hyperglycemia can increase the risk of developing SSI, predisposing patients to impaired wound healing, increasing the risk of developing cardiac, respiratory, renal, neurological complications, in addition to favoring the onset of other types of infection, leading to worsening of postoperative morbidity and mortality rates. Currently, rigorous care for hyperglycemia in the immediate postoperative period of cardiac surgery is quite common, using protocols, in which blood glucose is checked every two hours, with the aim of keeping blood glucose below 180 mg/dl, preferably in the range of 110 and 140 mg/Dl(14). It is necessary to control blood glucose, also strictly, in the immediate postoperative period in order to

prevent complications related to this metabolic disorder.

In the group of patients undergoing MRS, the second most frequent complication in the mediate postoperative period was mental confusion, a complication that also affected four patients (8.3%) who underwent surgery to repair valvular heart disease and one (9.1%) patient undergoing combined surgery. The so-called "delirium" is an acute confusional state, characterized by a disturbance of consciousness, alteration in cognition and variable course throughout the day. It is a very common occurrence in surgical patients(15). In hospitalized patients, the incidence can vary from 11 to 42%(16).

In a study conducted in 2015, Brazilian researchers(7) retrospectively assessed the medical records of 2,648 patients who underwent MRS and heart valve disease repair surgeries, with the aim of identifying the main postoperative complications that occurred in the first 30 days after surgery. Neurological injury was present in 4.3% of patients. The authors did not specify the type of neurological injury; however, in the present study, mental confusion affected 13.6% of patients

undergoing MRS.

As for non-therapeutic INR, the most frequent complication in the group of patients undergoing surgery for heart valve disease repair, it is believed that it must be related to the initiation of oral anticoagulation therapy, considering that 25 (52.1%) patients underwent replacement valve by metallic prosthesis implant. We did not find in the literature studies that investigated INR values in the immediate postoperative period of cardiac surgery, which makes it impossible to compare our results.

It is generally agreed that metallic prostheses expose patients to high risks of thromboembolism (TE), regardless of heart rate. It is estimated at 12% per year for prostheses in the aortic position and 22% in the mitral position, in the absence of oral anticoagulants. Patients with metallic prostheses, regardless of whether their implantation is mitral or aortic and heart rate, need antithrombotic prevention(17).

Regarding the outcome of patients at the time of hospital discharge after cardiac surgery, a study was found, conducted in northeastern Brazil, in which the authors stated that 19 (10.4%) of the

183 patients assessed evolved to death(18), unlike the results found in this study.

In a retrospective investigation carried out by Brazilian researchers, the authors identified that the average event-free survival time after valve replacement surgery with biological prostheses was 10.7 years and for mechanical prostheses it was 14.6 years. The need for reoperation was significantly greater in patients with biological prostheses in both mitral and aortic positions and the average time of reoperation-free survival after valve replacement surgery with a biological prosthesis was 11 years and for mechanical prostheses, 16 years(19).

In a North American study, the authors investigated the postoperative evolution of patients who underwent surgery for mitral valve replacement/repair in terms of hospital mortality and long-term survival. A total of 100,873 patients who underwent surgery from 2000 to 2006 were assessed, and of this total, 1,627 (1.6%) underwent cardiac reoperation in the first three years after primary surgery. The authors concluded that the incidence of reoperation was low over three years, but accompanied by a high surgical risk, significantly increased in patients who underwent urgent reoperation,

in the presence of endocarditis and with a previous diagnosis of heart failure(20).

It was observed in the present study that a patient who underwent mitral valve replacement underwent definitive pacemaker implantation surgery, due to a total atrioventricular block. This type of conduction disorder is a common complication after cardiac surgery, especially in repair of aortic valve dysfunction, and is usually temporary in nature(21).

Regarding infections, it was found that SSI frequency in patients was low over two years. Although few patients evolved with endocarditis and mediastinitis in the present study, these infections are considered very serious and have a high mortality rate. Endocarditis is a serious complication that, in most cases, makes patients need a reoperation. In proportional risk models, researchers identified older age and longer CPB time associated with an increased risk of overall mortality in patients with endocarditis(22).

Finally, as explained throughout the discussion, there is a scarcity of papers investigating the theme. Even those studies that have already been developed with a focus on the mediate postoperative evolution

of patients undergoing cardiac surgery, they had very distinctive objectives, and sometimes focusing on just one type of complication or just one type of surgery. The longitudinal studies developed with these patients focused on postoperative mortality and survival, which made it difficult to compare the results found in this study with those available in literature.

CONCLUSION

The frequency of complications of patients in the immediate postoperative period of cardiac surgery was low. Hyperglycemia was the most frequent complication in the group of patients who underwent MRS and combined surgery. In the group of patients who underwent surgery to repair valve disease, the most frequent complication was coagulation disorder, followed also by hyperglycemia. All patients were discharged from the hospital.

Regarding the evolution of the late postoperative period, it was found that most patients remained in outpatient follow-up at the study hospital, after two years of hospital discharge. As for SSI frequency, few patients

developed this complication in the late postoperative period, with most of patients with this complication belonging to the MRS group. Most patients, regardless of the surgery performed, were alive after two years of hospital discharge.

The use of secondary data was considered as a study limitation. Considering the results found, it was observed that some complications are amenable to nursing interventions in the search for their prevention, control and early detection, such as hyperglycemia, mental confusion, and infectious complications.

As it is a subject little investigated, it is believed that it is important to carry out new prospective longitudinal studies, in order to strengthen the evidence for the prevention and treatment of complications in the middle and late postoperative period of these patients.

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