Sepsis in the Postoperative Period of Cardiac Surgery: Problem Description

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Abstract

Background: In spite of the advances in sepsis diagnosis and treatment in the last years, the morbidity and mortality are still high.

Objective: To assess the prevalence, in-hospital evolution and prognosis of patients that presented sepsis in the postoperative period of cardiac surgery.

Methods: This is a prospective study that included patients (n = 7,332) submitted to cardiac surgery (valvular or coronary) between January 1995 and December 2007. The classic criteria of sepsis diagnosis were used to identify the patients that developed such condition and the preoperative comorbidities, in-hospital evolution and prognosis were evaluated.

Results: Sepsis occurred in 29 patients (prevalence = 0.39%). There was a predominance of the male when compared to the female sex (79% *vs*. 21%). Mean age was 69 ± 6.5 years. The main preoperative comorbidities were: systemic arterial hypertension (79%), dyslipidemia (48%) and family history of coronary artery disease (38%). The mean Apache score was 18 ± 7, whereas the Sofa score was 14.2 ± 3.8. The primary infectious focus was pulmonary in 19 patients (55%). There were 19 positive cultures and the mean IV hydration during the first 24 hours was 1,016 ± 803 ml. The main complications were acute renal failure (65%), low cardiac output syndrome (55%) and malignant ventricular arrhythmia (55%). Mortality was 79% (23 patients).

Conclusion: The occurrence of sepsis after cardiac surgery was a rare event; however, its occurrence showed catastrophic clinical outcomes. The high morbidity and mortality showed the need to improve treatment, aiming at patients' better clinical evolution. (Arq Bras Cardiol 2010; 94(3):332-336)

Key words: Sepsis; postoperative care; heart / surgery; thoracic surgery.

Introduction

The advent of cardiac surgery represents a milestone in Medicine, as this procedure can prolong the patient's life and decrease the morbidity of the coronary atherosclerotic disease[1].

In the last years, the advances in this surgery have been striking, which has determined an improvement in the results and the progressive increase in the number of patients submitted to this procedure[2].

In the United States, in 2006, 700,000 Americans had a heart attack and around 500,000 had a recurrent attack. The direct and indirect expenses with coronary artery disease (CAD) were US$ 142.5 billion dollars. More than a million cardiac catheterisms and more than 400,000 myocardial revascularization surgeries were performed[3].

The cardiac surgery, in most cases, is a clean surgery with a low rate of infectious complications; however, when these do happen, they contribute to patients' unfavorable evolution[4].

Patients that develop sepsis, regardless of the infectious focus and the subjacent disease, present high morbidity and mortality, which vary from 17% to 65%[5].

Recently, recommendations that standardize the diagnosis and treatment of this disease have been published, aiming at improving the clinical evolution of patients[6].

In spite of the increasing information on sepsis, there is not a relevant number of recent publications that standardize the diagnosis and treatment in the context of the in-hospital postoperative period of patients submitted to cardiac surgery.

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The main objective of the present study was to evaluate the morbidity and mortality of patients submitted to cardiac surgery (clean) that developed sepsis during the in-hospital postoperative period, whereas the secondary objective was to assess the prevalence of this type of sepsis.

Methods

This study was approved by Ethics Committee in Research of our Institution and carried out based on a dynamic real-world registry that started in January 1995, which includes all adult patients submitted to elective cardiac surgery.

From January 1995 to December 2007, we studied 7,332 patients from this registry submitted to surgery for the correction of acquired valvulopathy (n = 1,366 patients) or to myocardial revascularization surgery (n = 5,966 patients), classified as clean surgeries.

Prophylactic antibiotic therapy was prescribed according to the institution protocol, from the anesthetic induction to the second postoperative day.

Sepsis in the postoperative period was defined as evidence of infection associated with two or more criteria of systemic inflammatory response syndrome (SIRS): body temperature >38ºC or <36ºC, heart rate >90 bpm, respiratory rate >20 bpm or $PaCO_2$ <32 mmHg, leukocytes >12,000 cells/mm^3, <4,000 cells/mm^3 or > 10 young forms[7].

We assessed the hospital evolution of patients in order to identify those that developed sepsis at the in-hospital postoperative phase (post-op).

The assessed pre, intra and postoperative characteristics of the patients with sepsis were: age, sex, body mass index (BMI), previous myocardial revascularization surgery (MRS), previous percutaneous coronary intervention (PCI), previous acute myocardial infarction (AMI), diabetes mellitus, systemic arterial hypertension (SAH), dyslipidemia, smoking status, previous cerebrovascular accident (CVA), chronic renal disease (creatinine ≥1.5 mg/dl), dyslipidemia, chronic obstructive pulmonary disease, family history of CAD, deaths, post-op CVA, post-op acute renal failure (ARF), low cardiac output syndrome, bleeding episode that needed blood derivative transfusion in the post-op period, prolonged respiratory support (>48 hrs), post-op heart failure, malignant ventricular arrhythmia (ventricular tachycardia and/or fibrillation), acute respiratory failure, positive cultures, identified microorganisms, primary focus of infection, variation in glycemia and mean arterial pressure (MAP), heart rate (HR), partial oxygen pressure (PO_2), partial pressure of carbon dioxide (PCO_2) (6, 24, 48 hours after the sepsis diagnosis) antibiotic therapy, Intensive Care Unit stay duration and hospital stay duration. We assessed the APACHE and SOFA scores when the sepsis was diagnosed.

The morbidity was evaluated through the measurement of the occurrence of previously described post-op complications and mortality was measured by the number of deaths. The categorical variables were described as percentages and the continuous variables as means and standard deviations. The ANOVA test was used for the statistical analysis of some of the numerical variables and statistical significance was set at $p \leq 0.05$.

Results

Of the 7,332 patients submitted to cardiac surgery during the analyzed period, 29 developed sepsis during the in-hospital post-op period (prevalence = 0.39%).

There was a predominance of male patients with sepsis during the post-op period when compared to female patients (79% *vs*. 21%); the patients' mean age was 66 ± 6.5 years and the mean BMI was 22.6 ± 6.2 kg/m^2. The main preoperative comorbidities were SAH in 79% of the patients, dyslipidemia in 48%, family history of CAD in 38% and smoking habit in 34% of the patients (Table 1). The mean APACHE score was 18 ± 7, and the mean SOFA score was 14.2 ± 3.8.

The primary infectious foci identified in the patients were: pulmonary in 19 patients (55%), cardiac valve in 3 (10%), abdominal in 2 (6.8%) and bone in 2 (6.8%).

The frequency of distribution of positive cultures was as follows: blood cultures = 11, pulmonary secretion = 6, uroculture = 1 and surgical wound = 1.

The main isolated microorganisms were: *Pseudomonas MR* in 4 patients, *Candida glabrata* in 3, *Staphylococcus epidermidis* in 3, *Stenotrophomonas maltophilia* in 3, *Candida albicans* in 3, *Streptococcus viridans* in 3, *Staphylococcus coagulase* negative in 3, *Flavobacterium* in 1, *Acinetobacter calcoaceticus* in 1, *Streptococcus faecalis* in 1, *Neisseria* sp in 1 and yeast in 1.

The antibiotic agents that were most frequently used for the treatment were: vancomycin in 11 patients, ceftazidime in 11, ceftriaxone in 9, meropenem in 7, cefepime in 5, gentamycin in 4 and teicoplanin in 3.

The mean hydration in the first 24 hours after the sepsis diagnosis was 1,016 ± 803 milliliters. Table 2 shows the comparative analysis of glycemia, BP, HR, PCO_2 and PO_2 in the first 6, 24 and 48 hours of sepsis evolution.

The main post-op complications were: post-op ARF in 65% of the patients (all of them needed dialysis), low-cardiac output syndrome (55), malignant ventricular arrhythmia (55) and CVA (20%) (Table 3).

The in-hospital mortality was 79% (23 patients). The mean time of ICU stay was 45 ± 55 days, whereas the mean hospital stay duration was 54 ± 55 days.

Discussion

The infectious complications after clean cardiac surgeries occur in up to 3.5% of the patients, and the main ones are: mediastinitis, infection at the site of the removal of the saphenous vein graft, endocarditis, sternal infection, chest surgical wound infection, sepsis, pulmonary infections, vascular access site infections, urinary tract infections, gastrointestinal tract infections, etc[8-13].

The cardiac surgery postoperative infections contribute to the increase of the morbidity and mortality, the hospital and ICU stay duration and costs[14].

The main predictors of infections in the postoperative period are: body mass index ≥ 40 kg/m², hemodialysis in the preoperative period (pre-op.), pre-op cardiogenic shock, age ≥ 85 yrs, pre-op treatment with immunosuppressive agents, diabetes mellitus, ECC time ≥ 200 minutes, use of intra-aortic balloon 3 or more revascularized vessels[15-20].

The sepsis after cardiac surgery has been described as a low-prevalence infectious complication, albeit with tragic consequences[21-24].

Toumpoulis et al[25] studied 3,720 patients submitted to cardiac surgery, with the objective of identifying risk factors for sepsis and endocarditis. The prevalence of sepsis in the post-op was 1.2%; however, the in-hospital mortality was > 70% and there was an increase in costs and time of hospitalization associated with the occurrence of sepsis.

Michalopoulos et al[22] evaluated 2,615 patients submitted to cardiac surgery and verified a low prevalence of sepsis (2%). During sepsis, the patients presented the following picture: hypoxemia (41%), fever (39%), metabolic acidosis (36%), acute renal failure (36%), tachycardia (33%), arterial hypotension (28%) and mental confusion (22%).

In the present study, which assessed more than 7,000 patients submitted to cardiac surgery, sepsis also presented a low prevalence. However, the rates of complications, which were high, and mainly the mortality rate of 79%, suggest that patients that presented such infectious complication represent a group of very-high risk.

The BP and PCO_2 goals in the present study were reached at the sixth hour (and maintained up to the end of the second day), whereas the PO_2 goal was reached only at the 48th hour. Glycemic control was not reached until 48 hours of sepsis evolution. It is possible that the lack of early goal-reaching has contributed to the high mortality rate.

Fowler et al[26] analyzed 331,429 patients submitted to myocardial revascularization surgery between January 2002 and December 2003, with the objective of developing an infection risk score. The prevalence of major infections was 3.5%: septicemia in 1.2% of the patients, infection at the site of the removal of the saphenous vein graft in 1.1%, mediastinitis in 0.9% and multiple-site infection in 0.2%. The mortality of patients with infection was higher when compared to those without infection (17% *vs*. 3%, p < 0.001).

In the present study, the temporal onset of complications, that is, the occurrence of adverse events after the onset of sepsis, suggests that the patients with this disease are more vulnerable and thus, present such high rates of complications. We believe, for instance, that the patient with sepsis has a higher chance of presenting acute renal failure, heart failure, etc.

The current treatment of severe sepsis must be based on the following procedures: aggressive and early (first six hours) volemic resuscitation (colloid or crystalloid), early antibiotic therapy (preferably at the first hour of septic shock), maintenance of hemoglobin > 8 g, administration of blood derivatives, adequate mechanical ventilation (when necessary), sedation, analgesia, no muscular blockers (whenever possible),

Table 1 – Clinical profile of patients

Variable	Prevalence
Systemic Arterial Hypertension, n	23 (79%)
Dyslipidemia, n	14 (48%)
FH of coronary artery disease, n	11 (38%)
Smoking, n	10 (34%)
Cerebrovascular accident, n	8 (27%)
Previous Acute myocardial infarction, n	7 (24%)
Previous PCI, n	6 (20%)
Previous MRS, n	5 (17%)
Diabetes mellitus, n	5 (17%)
Chronic obstructive pulmonary disease, n	3 (10%)
Chronic renal disease, n	2 (7%)

MRS - myocardial revascularization surgery, PCI - percutaneous coronary intervention, FH - family history, n - number of patients.

Table 2 – Temporal variation of hemodynamic, respiratory and glycemia parameters

Variable	6 h	24 h	48 h	p Value
HR, bpm	116 ± 21	115 ± 21	118 ± 23	0,8
BP, mmHg	60 ± 10	61 ± 10	62 ± 12	0,8
PCO_2, mmHg	48 ± 53	38 ± 6	40 ± 10	0,4
PO_2, mmHg	82 ± 26	88 ± 18	99 ± 6	0,3
Glycemia, mg/dl	183 ± 124	158 ± 47	195 ± 75	0,3

HR - heart rate, BP - blood pressure, PCO_2 - partial pressure of carbon dioxide in blood, PO_2 partial pressure of oxygen in blood.

Table 3 – Complications in the postoperative period

Variable	Prevalence
Bleeding with need for blood derivative transfusion, n	23 (79%)
Prolonged ventilatory support, n	21 (72%)
Acute renal failure, n	19 (65%)
Low cardiac-output syndrome, n	16 (55%)
Malignant ventricular arrhythmia, n	16 (55%)
Acute respiratory failure, n	16 (55%)
Cerebrovascular accident, n	6 (20%)
Congestive heart failure, n	5 (17%)

strict glycemia control (blood glucose < 150), dialysis therapy (there is an equivalence between the classic and the new modalities), corticoid administration when there is inadequate response of BP to fluid therapy and/or vasopressors, recombinant activated protein C if APACHE score is ≥ 25 or when there is multiple-organ failure, administration of sodium bicarbonate to patients with hypoperfusion induced by lactic acidosis with pH ≥ 7.15 and prophylaxis for deep venous thrombosis and stress ulcer [6].

The objectives in the first 6 hours of volemic resuscitation are: central venous pressure between 8 and 12 mmHg, mean BP ≥ 65 mmHg, urinary output ≥ 0.5 ml/kg/hour and central venous oxygen saturation (ScvO2) ≥ 70%. In cases where the administration of fluids does not reach the target ScvO2, a red blood cell transfusion must be considered (if the hematocrit is < 30%) as well as the intravenous infusion of dobutamine[6].

The implementation of this treatment contributes to decrease morbidity and mortality of severe sepsis in several clinical situations[6]. These measures must be adopted for patients submitted to cardiac surgery that develop severe sepsis, as they are capable of reducing morbidity and mortality.

In spite of its low prevalence, the sepsis that occurs in the post-op of cardiac surgery significantly contributes to patients' high morbidity and mortality. Therefore, the current recommendations for the treatment of severe sepsis represent a treatment strategy that is potentially capable of improving the hospital evolution of patients and need to be evaluated concerning the sepsis that occurs after cardiac surgery.

The present study presents some limitations: the study was carried out in a single center and modifications in sepsis diagnosis and treatment were verified during the assessed period.

Conclusions

Sepsis has always been a rare complication in the postoperative period of cardiac surgery. However, when observed, the result is catastrophic: 79% of the patients who presented such complication died during the hospitalization phase.

The therapeutic measures recommended by the international guidelines[6] for the treatment of sepsis must be applied to patients that present sepsis after cardiac surgery, as they are potentially capable of reducing morbidity and mortality.

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 post-graduation program.

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