CLINICAL-SURGICAL PROFILE OF PATIENTS WITH POST-CARDIAC MEDIASTINITIS: RETROSPECTIVE CROSS-SECTIONAL STUDY

Perfil clínico-cirúrgico de pacientes com mediastinite pós-cirurgia cardíaca: estudo transversal retrospectivo

Perfil clínico-quirúrgico de pacientes con mediastinitis post-cirugía cardíaca: estudio transversal retrospectivo

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ABSTRACT: Objectives: Describe the profile of patients who developed mediastinitis in the postoperative period of cardiac surgery in a hospital of high complexity, analyzing the outcome, related to the time of hospitalization, the need for reinternation, instituted antibiotic therapy and death. **Method:** Cross-sectional study, with retrospective data collection, through consultation with 86 medical records of patients who developed mediastinitis in the year 2015. Data were collected from the preoperative period up to 90 days after hospital discharge, the diagnosis of Mediastinitis or death. **Results:** The diagnosis of mediastinitis occurred in 45.3% of the cases during hospitalization and 54.7% after hospital discharge, of which 14.9% were treated ambulatory and 85.1% required reinternation. The mean hospitalization time was 31.8 days. The mean time for the diagnosis of Mediastinitis was 21.2 days (Standard deviation — SD ± 11,48). Treatment was mainly based on Quinolones (43%) and Glycopeptides (39.5%). **Conclusion:** Considering the frequency of identification of cases after hospital discharge, postoperative surveillance of surgical site infections among patients submitted to cardiac surgeries should be an objective shared by the multiprofessional team.

Keywords: Surgical wound infection. Mediastinitis. Cardiovascular surgical procedures. Perioperative nursing.

RESUMO: Objetivo: Descrever o perfil dos pacientes que desenvolveram mediastinite no pós-operatório de cirurgia cardíaca em um hospital de alta complexidade, analisando o desfecho, relacionado ao tempo de internação, à necessidade de reinternação, à antibioticoterapia instituída e a óbito. **Método:** Estudo transversal, com coleta de dados retrospectiva, por meio de consulta a 86 prontuários de pacientes que desenvolveram mediastinite no ano de 2015. Os dados foram coletados desde o pré-operatório até 90 dias após a alta hospitalar, o diagnóstico de mediastinite ou o óbito. **Resultados:** O diagnóstico de mediastinite ocorreu em 45,3% dos casos durante a internação e 54,7% após a alta hospitalar, dos quais 14,9% foram tratados ambulatorialmente e 85,1% necessitaram de reinternação. O tempo médio de internação foi de 31,8 dias. O tempo médio para o diagnóstico de mediastinite foi de 21,2 dias (desvio padrão — DP±11,48). O tratamento foi baseado principalmente em quinolonas (43%) e glicopeptídeos (39,5%). **Conclusão:** Considerando a frequência de identificação de casos após a alta hospitalar, a vigilância pós-alta de infecções do sítio cirúrgico entre pacientes submetidos a cirurgias cardíacas deve ser um objetivo compartilhado pela equipe multiprofissional.

Palavras-chave: Infecção da ferida cirúrgica. Mediastinite. Procedimentos cirúrgicos cardiovasculares. Enfermagem perioperatória.

RESUMEN: Objetivos: Describir el perfil de los pacientes que desarrollaron mediastinitis en el postoperatorio de cirugía cardíaca en un hospital de alta complejidad, analizando el resultado, relacionado con el tiempo de internación, la necesidad de reinternación, antibioticoterapia instituida y la muerte. **Método:** Estudio transversal, con recolección de datos retrospectiva, por medio de consulta a 86 historiales de pacientes que desarrollaron mediastinitis en el año 2015. Los datos fueron recogidos desde el preoperatorio, hasta 90 días después del alta hospitalaria, el diagnóstico de mediastinitis o el óbito.

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Resultados: El diagnóstico de mediastinitis ocurrió en 45,3% de los casos durante la internación y 54,7% después de alta hospitalaria, de los cuales, 14,9% fueron tratados ambulatorialmente y 85,1% necesitaron reinternación. El tiempo medio de internación fue de 31,8 días. El tiempo medio para el diagnóstico de mediastinitis fue de 21,2 días (desviación estándar — DP 11,48). El tratamiento se basó principalmente en quinolonas (43%) y glicopéptidos (39,5%). **Conclusión:** Considerando la frecuencia de identificación de casos tras el alta hospitalaria, la vigilancia postalta de infecciones del sitio quirúrgico entre pacientes sometidos a cirugías cardíacas debe ser un objetivo compartido por el equipo multiprofesional.

Palabras clave: Infección de la herida quirúrgica. Mediastinitis. Procedimientos quirúrgicos cardiovasculares. Enfermería perioperatoria.

INTRODUCTION

Despite the recent technical and scientific advances in cardiac surgeries, mediastinitis affects between 0.3 and 3.4% of patients undergoing this type of surgery, resulting in an increase in morbidity and mortality, which can impact up to 19% of cases[1].

Mediastinitis is classified as an organ/space surgical site infection (OS-SSI), since it involves any part of the anatomy open or manipulated during a surgery, and can be diagnosed by positive mediastinal tissue or fluid culture, evidence on anatomical or histopathological examination, fever (>38ºC), chest pain, sternal instability, purulent drainage from the mediastinal area, or mediastinal enlargement during imaging examination[2].

Mediastinitis has multiple causes, including pre-surgical, surgical, and post-surgical risk factors[3]. The main pre-operative risk factors are diabetes mellitus (DM), smoking, obesity, advanced age (over 60 years old), malnutrition, male gender, chronic renal failure and/or creatinine >1.5 mg/dL, and left ventricular ejection fraction <40%[3]. Surgical risk factors include: coronary artery bypass grafting (CABG) using both thoracic (mammary) arteries, emergency surgeries, surgical time, prolonged cardiopulmonary bypass (CPB), multiple blood transfusions, and excessive use of electrocautery[3,4]. Post-surgical risk factors comprise prolonged hospitalization in inpatient units and intensive care units (ICU); respiratory, renal, and gastrointestinal complications; reoperation for bleeding; dehiscence; and sternal instability[3,4].

In addition to the negative effects on patient recovery, mediastinitis results in social and economic impacts, with higher hospital costs, length of stay, and need for surgical reintervention, as well as important social repercussions in the life of patients who survive this complication[5].

OBJECTIVES

- To describe the profile of patients who developed mediastinitis in the postoperative period of a cardiac surgery in a high complexity hospital;
- To analyze the outcome related to the length of stay, readmission, antibiotic therapy, and death of patients who developed mediastinitis in the postoperative period of cardiac surgery.

METHOD

This is a cross-sectional study, with retrospective data collection, based on 86 medical records of patients who developed mediastinitis from January to December 2015. It was conducted in a high complexity public university hospital specialized in cardiac and thoracic surgeries, which has 535 beds available, distributed among seven inpatient units, and 157 ICU beds. The surgical center has 14 operating rooms and performs an average of 20 surgeries/day[6].

The Human Research Ethics Committee (REC) approved this investigation, under report number 1.664.466 (Certificate of Presentation for Ethical Consideration — CAAE 56229716.83001.0068), complying with the ethical principles established in Resolution No. 466, from 2012[7].

We used a convenience sample, selected from the data sheet of the local medical-hospital information unit. Patients undergoing cardiac surgeries who had developed mediastinitis from January to December 2015 were included. Those who were under 18 at the date of surgery, underwent prior surgical procedure within up to 90 days, had a diagnosis of osteomyelitis, and cases that did not meet the criteria of mediastinitis proposed by the Centers for Disease Control and Prevention (CDC) were excluded[2]. Thus, among the 142 potentially eligible records, 86 met the inclusion and exclusion criteria and composed the study sample.

Data were collected by analyzing the available records in the medical files of the hospital, from the preoperative period until 90 days after hospital discharge, the diagnosis of mediastinitis, or death. We used an instrument of data collection adapted from the study by Oliveira[8], which presented the following details:

- Patient-related factors: record number, birth date, biological gender, age, education level, date of hospitalization, date of surgery, date of discharge, date of death, medical history, status on the scale of the American Society of Anesthesiologists (ASA), smoking, use of steroids, and pre-existing infection;
- Factors related to the anesthetic-surgical procedure: time of onset and end of anesthesia, surgery performed, type of surgery, need for and duration of CPB, CABG (use of the internal mammary artery, saphenous vein, or radial artery), and need for blood transfusion;
- Factors associated with the postoperative period: date of admission in and discharge from the ICU, types of antibiotics used in the postoperative period, date of admission in and discharge from the inpatient unit;
- Regarding the SSI diagnosis: made during hospitalization or in the outpatient follow-up, with microbial culture of an isolated microorganism, evidence of mediastinitis in the anatomical or histopathological examination, purulent drainage from the mediastinal area, sternal pain, mediastinal enlargement during imaging examination, fever above 38°C and sternal instability, antibiotic use, type of antibiotic, and postoperative complications (cardiac and vascular, respiratory, and renal);
- Readmission: date of hospitalization, discharge and death, antibiotics administered, wound culture, type of bandage used to treat mediastinitis.

A pilot test with five patient records (not included in this study) of individuals who developed mediastinitis was carried out to verify the adequacy of the data collection instrument to the objectives proposed in research.

We analyzed the data with the software Statistical Package for the Social Sciences (SPSS), version 20.0, and presented the results in a descriptive and mathematical-statistical manner, using absolute frequency and percentage. We adopted the Kruskal-Wallis test, the Pearson correlation coefficient, and the Wilcoxon Mann-Whitney test to correlate the variables. We considered an $\alpha \leq 0.05$ significant.

RESULTS

The sample consisted of 86 patients, of whom 50 (58.1%) were women aged from 24 to 88 years old, mean of 57.66 years (standard deviation — SD±13.37). With respect to medical history, diabetes mellitus (34; 39.5%) was the most prominent condition. As to smoking, 13 (15.1%) patients reported being smokers and 26 (30.2%), former smokers.

The mean body mass index (BMI) was 28.33 kg/m² (SD±5.03), and most individuals were in the overweight range (34; 40%), followed by obesity (28; 32.5%), normal weight (21; 24.7%), and underweight (2; 2.4%).

Table 1 shows the other clinical and surgical data of the patients who composed the sample.

Among the patients who underwent CABG, the most used grafts were the internal mammary artery (48; 92.3%), followed by the saphenous vein (47; 90.4%), and the radial artery (2; 3.8%). The mean amount of internal mammary artery graft was 1.10 (SD±0.309).

Postoperative complications occurred, i.e., before the diagnosis of mediastinitis, in 48 patients (55.8%). One patient might have developed one or more complications, and the most prevalent ones were cardiac and vascular (29; 33.7%), respiratory (22; 25.6%), and renal (13; 15.1%) complications.

Nine patients died (10.5%), of whom seven (70%) presented various causes, such as unspecified sepsis and shock, acute myocardial infarction, and liver failure. Three deaths (30%) were associated with the development of mediastinitis.

Mediastinitis was identified during hospitalization in 39 cases (45.3%), and 47 (54.7%) patients were diagnosed after hospital discharge. Among the cases diagnosed after discharge, seven (14.9%) were treated on an outpatient basis, and 40 (85.1%) required readmission. The time of onset of mediastinitis, between the date of surgery and the onset of symptoms, varied from four to 64 days, with an average of 21.2 days (SD±11.48).

Surgical wound culture was performed in 78 patients (90.7%). In 68 (79.1%) of them, the culture was positive. Tables 2 and 3 describe the isolated microorganisms and the agents used in the treatment.

Adopting the criteria proposed by CDC[2], the signs and symptoms of mediastinitis found in the patients' charts at the time of diagnosis (during hospitalization, outpatient treatment, or readmission) were: positive culture of mediastinal fluid or tissue (68; 79.1%); purulent drainage from the mediastinal area (68; 79.1%); evidence of mediastinitis in the anatomical

or histopathological examination (39; 45.3%); sternal pain (37; 43%); mediastinal enlargement during imaging examination (25; 29.1%); fever above 38°C (24; 27.9%); and sternal instability (5; 5.8%). The mean of signs and symptoms characteristic of mediastinitis associated with each other was 3.09 (SD±1.11), with a minimum of one and a maximum of six symptoms.

DISCUSSION

In this study, the profile of patients who developed mediastinitis consisted of women with DM history, overweight, mean age of 57 years, prolonged length of stay, often diagnosed after hospital discharge – approximately 21.2 days after the procedure –, mediastinitis treatment based on quinolones and penicillins, and mortality of 30% associated with mediastinitis.

Such result differs from other studies, because male patients are more susceptible to the development of mediastinitis, as they have more hair follicles in the sternotomy region, favoring microbial growth and infections[3,4]. However, we highlight that the sample of this study comprised a small number of patients.

The main diagnostic signs and symptoms identified were the positive culture of secretion and purulent drainage from deep tissues (79.1%). *Staphylococcus aureus* was the most prevalent microorganism found (30.9%) in the culture of mediastinal secretion. Such data are consistent with a study in which *Staphylococcus aureus* was the most prevalent microorganism (30.7%) among gram-positive bacteria[3]. In Brazil, this microorganism is the main etiological agent in mediastinitis[3].

The aspects observed in the present analysis agree with those of a multicenter study evaluating 41 individuals who developed mediastinitis in a sample of 5,158 patients. Infection occurred

Table 1. Description of surgical and hospitalization data of patients undergoing cardiac surgeries who developed mediastinitis.

Variables	N (%)	Mean±SD	Minimum– Maximum
CABG	48 (55.8)	-	-
Heart valve surgeries	21 (24.4)	-	-
Other	6 (7)	-	-
Aortic aneurysm repair	4 (4.6)	-	-
Heart valve surgery + CABG	4 (4.6)	-	-
ASD/VSD closure	3 (3.5)	-	-
Cardiac surgery			
With CPB	79 (91.9)	-	-
Without CPB	7 (8.1)	-	-
Blood components in the intraoperative period			
Yes	23 (26.7)	-	-
No	63 (73.3)	-	-
ASA			
II	1 (1.2)	-	-
III	50 (58.1)	-	-
IV	35 (40.7)	-	-
Length of stay (days)	-	31.8±24.1	7-127
Preoperative hospitalization (days)	-	5.42±6.13	0-34
ICU hospitalization (days)	-	11.1±14.5	3-87
Postoperative hospitalization (days)	-	25.37±21.65	5-102
Time until diagnosis of mediastinitis (days)	-	21.2±11.48	4-64
Duration of anesthesia (min)	-	436.9±95.9	305-860
Duration of CPB (min)	-	91.4±51.9	0-336

CABG: coronary artery bypass grafting; SD: standard deviation; ASD: atrial septal defect; VSD: ventricular septal defect; CPB: cardiopulmonary bypass; ASA: American Society of Anesthesiologists; ICU: intensive care unit.

approximately 20 days after the surgical procedure and manifested after hospital discharge, being associated, among other aspects, with high BMI, leading to an increase in the length of stay over 11 days and risk of readmission five times higher when compared to patients who did not develop the complication[9].

We emphasize that several aspects increase the risk of developing mediastinitis and relate to the patient's comorbidities, such as DM, obesity, smoking, and kidney failure, as well as surgical and technical factors[1,10]. As to diabetes, elevated glucose levels may be associated with an increase in the inflammatory process, thus predisposing the patient to a significantly higher risk of infection[3]. Obesity hinders preoperative skin preparation[11], leading to a difficult wound healing process because of the risk of sternal dehiscence by rupture of the surgical suture, facilitating the entry of pathogens[3]. In addition, obesity makes it difficult to adjust doses of antibiotic to the body mass, resulting in low antibiotic tissue concentration, decreasing its effectiveness[3,12]. Tobacco users, especially those with chronic obstructive pulmonary disease (COPD), are more susceptible to SSI, since they are less able to maintain satisfactory levels of oxygenation in their tissues[4]. Smoking deteriorates lung cells, leading to delayed healing, necrosis, and SSI[13].

Moreover, prolonged cardiac surgeries – 4 to 5 hours – increase the risk of developing mediastinitis[4]. The type of surgical procedure performed can also be related to a greater risk of SSI. In CABG, using the mammary artery compromises sternal irrigation, causing local hypoxia and facilitating the proliferation of infectious microorganisms[4]. The use of two mammary arteries increases the risk of infection because it decreases the blood supply to sternal muscles [4].

Other important aspects concerning the surgical procedures analyzed are the use and duration of CPB. Prolonged CPB increases the risk of infection[4]. Also, it causes physiological changes in the immune system due to the use of hypothermia and hemodilution[3]. Regarding surgeries, blood transfusion results in an immunosuppressive effect, favoring the occurrence of infection and increasing the probability of developing mediastinitis[4].

The preoperative length of stay is also fundamental. A study showed that each week of preoperative hospitalization increased by 15% the risk of mediastinitis, associated with prolonged preoperative fasting, which compromises the adequate nutrition and postoperative recovery of patients[14].

Table 3. Distribution of antibiotics and antifungal agents used in the postoperative of cardiac surgeries.

Agents	N	%
Quinolones	37	43.0
Glycopeptides	34	39.5
Penicillins	20	23.2
Cephalosporins	15	17.5
Antifungal agents	11	12.8
Polymyxins	9	10.5
Aminoglycosides	6	7.0
Oxazolidinone	5	5.8
Cyclic lipopeptides	4	4.3
Nitroimidazole	3	3.5
Carbapenems	3	3.5
Other	5	5.8

Table 2. Distribution of microorganisms isolated from patients with mediastinitis, according to the length of stay in the postoperative period.

Microorganism	N	%	Mean length of stay±SD (days)	Minimum– Maximum	Median
Staphylococcus aureus	21	30.9	16.05±12.26	8-60	11
Klebsiella pneumoniae	14	20.6	48.14±32.43	10-127	51
Coagulase-negative *staphylococcus*	09	13.2	41±21.24	14-87	39
Candida sp.	05	7.3	68.2±28.2	19-87	74
Enterobacter sp.	05	7.3	25.8±22.1	9-60	15
Escherichia coli	04	5.9	31.75±18.9	20-60	23.5
Enterococcus sp.	04	5.9	38±18.88	11-54	43.5
Proteus mirabilis	03	4.4	21.67±7.50	14-29	22º
Corynebacterium sp.	01	1.5	76±0	76-76	76
Serratia marcescens	01	1.5	36±0	36-36	36
Acinetobacter johnsonii	01	1.5	09±0	9-9	09

SD: standard deviation.

Additionally, it raises the risk of developing infectious complications, including SSI, ICU admission, and the use of invasive devices (central venous catheter, indwelling urinary catheter, and mechanical ventilation), which make the patient susceptible to health care-related infections[15].

Therefore, postoperative infections in patients who underwent cardiac surgeries, such as mediastinitis, drastically affect patients' survival and increase the need for readmissions[16].

In this sense, research analyzing readmissions among 5,509 patients submitted to cardiac surgeries identified a readmission rate of 18.7%, with infections between the two main causes. The authors pointed out that, on average, these patients are readmitted up to 22 postoperative days and generate new hospitalizations, with a median of five days, and the more complex the procedure, the greater the chances of readmission[17].

Considering these aspects, mediastinitis strongly impacts patients both physically and emotionally, requiring differentiated care from the health team to prevent it, or to recognize early signs, speeding up treatment and avoiding major harm in the long-term.

To that end, the multidisciplinary team needs to implement measures that affect the entire perioperative period, seeking to minimize the contamination by potentially pathogenic microorganisms present in the patient's airways and skin, i.e., screening for carriers of multiresistant *Staphylococcus aureus*, antibiotic prophylaxis, glycemic control, adequate skin preparation, and an efficient surgical technique[10].

As most cases of mediastinitis are developed in the period after discharge, post-discharge surveillance measures must be adopted, preferably ensuring the involvement of the entire multidisciplinary team, as well as extensive patient guidance[18].

Thus, this study underlines the importance of an adequate preparation of the multidisciplinary team, with physicians and nurses attentive to the main signs and symptoms of this complication. The team must also be prepared to properly guide patients and follow their cases, since most of the diagnosed cases occur after hospital discharge and lead to new admissions to treat this complication.

CONCLUSION

We concluded that the profile of patients who developed mediastinitis after cardiac surgeries consisted, mainly, of women with diabetes history, overweight, mean age of 57 years, who underwent CABG, with CPB, and prolonged length of stay. Diagnosis and treatment of mediastinitis were performed after hospital discharge.

The most common symptoms during the diagnosis of mediastinitis were positive culture and purulent drainage from surgical wounds. The most frequently identified microorganisms were *Staphylococcus aureus*, *Klebsiella pneumoniae*, and coagulase-negative *staphylococcus*, and the postoperative antibiotic therapy administered was based on quinolones, glycopeptides, and penicillins.

These results point to the strict need to control risk factors prior to the surgical procedure, through measures to prevent and control health care-related infections. Thus, training the multidisciplinary team and reinforcing preventive measures are essential to reduce this complication.

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