

Postoperative mediastinitis in cardiovascular surgery. Analysis of 1038 consecutive surgeries

Mediastinite no pós-operatório de cirurgia cardiovascular. Análise de 1038 cirurgias consecutivas

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Abstract

Objective: To report the incidence of postoperative mediastinitis in cardiovascular surgery.

Methods: The medical records of all 1038 patients who underwent cardiovascular surgical procedures between May/2007 and June/2009 were reviewed. All operations were performed at the Division of Cardiovascular Surgery of Cardiac Emergency Hospital of Pernambuco – PROCAPE.

Results: On average, complication occurred within 13 days after operation; in a total of 25 lethal cases (2.4%), deaths occurred in eight (32%). Several risk factors for mediastinitis were identified as follows: 56% diabetes, 56% smoking, 20% obesity, 16% chronic obstructive pulmonary disease, and 8% end-stage renal disease. Mediastinitis was reported in 21 (84%) patients submitted to coronary artery bypass grafting and it was related to a major risk for

development of infection (IC 3.44-8.30, $P=0.0001$). High rates of complications were observed: respiratory failure (44%), stroke (16%), cardiogenic shock (12%), acute renal failure (28%), pulmonary infection (36%), multiple organs failure (16%), and sternal dehiscence (48%). Bacterial cultures of exudates were positive in 84% of patients; *Staphylococcus aureus* was the most frequently pathogen (28.8%) detected.

Conclusion: Mediastinitis remains as a severe surgical complication and difficult to manage in postoperative cardiovascular surgery. The disease has low incidence rate but high lethality. Coronary bypass was associated to a major risk for development of infection.

Descriptors: Infection. Mediastinitis. Cardiac surgical procedures.

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Resumo

Objetivo: Relatar a incidência de mediastinite no pós-operatório de cirurgia cardiovascular.

Métodos: Foram analisados os prontuários de 1038 pacientes submetidos à cirurgia cardiovascular entre maio/2007 e junho/2009. Todas as operações foram realizadas na Divisão de Cirurgia Cardiovascular do Pronto Socorro Cardiológico de Pernambuco – PROCAPE.

Resultados: A mediastinite ocorreu, em média, 13 dias após a cirurgia, num total de 25 (2,4%) casos, com taxa de letalidade 32,0% (n=8). Vários fatores de risco foram identificados: 56% diabéticos, 56% tabagistas, 20% obesos, 16% portadores de doença pulmonar obstrutiva crônica e 8% com insuficiência renal crônica. A maioria (n=21; 84,0%) dos casos foi observada em pacientes submetidos à revascularização do miocárdio, sendo esta associada a maior risco de desenvolvimento da infecção (IC 3.44-8.30,

$P=0,0001$). Observou-se alto índice de complicações: insuficiência respiratória (44%), acidente vascular cerebral (16%), choque cardiogênico (12%), insuficiência renal aguda (28%), infecção pulmonar (36%), falência de múltiplos órgãos (16%) e deiscência de esterno (48%). A cultura do exsudato foi positiva em 84% dos casos, sendo o *Staphylococcus aureus* o patógeno mais observado (28,8%).

Conclusões: A mediastinite continua como complicação cirúrgica bastante grave e de difícil manuseio no pós-operatório de cirurgia cardiovascular. A doença permanece como de baixa incidência, entretanto, ainda com alta letalidade. A cirurgia de revascularização está associada a maior risco de desenvolvimento da infecção.

Descritores: Infecção. Mediastinite. Procedimentos cirúrgicos cardíacos.

INTRODUCTION

Mediastinitis is an operative deep-wound infection with clinical and/or microbiological evidence of retrosternal space involvement. It might be associated to osteomyelitis of the sternum with or without sternal instability; its incidence ranges from 0.2% to 5.0%. It is considered one of the most severe complicated median sternotomies, and it is associated to significantly morbidity and mortality [1].

There are several possibilities of ports of entry for pathogenic agents in patients undergoing thoracic surgery, especially those undergoing cardiac surgeries, through the involvement of irrigation to the sternum using internal thoracic arteries to perform coronary artery bypass grafting (CABG); prostheses in close contact with bloodstream; patients organic debility, or postoperative poor hemodynamic condition of some of these patients jeopardizing their defense as occurs with the diabetic patients, the elderly, and with important dysfunction of the myocardium [1].

The classical signs of acute infection may not be present in mediastinitis. In about 20% of the cases, local pain is confounded with postoperative pain and concomitant infection. Fever and leukocytosis may be the only signs of infection but not in many cases. The most frequent presentation is an operative wound dehiscence with externalizations of local secretion (70% to 90% of the cases) and local signs of pain, inflammation, and sternal instability [1]. Gram-negative bacteria, especially the *Staphylococcus*

aureus, or the *Staphylococcus epidermidis*, are responsible for 70% to 80% of mediastinitis cases [1].

The diagnosis of mediastinitis is characterized by the association of sternal instability and the presence of retrosternal purulent fluid collection [2]. The diagnosis should be premature due to the high mortality presented, around 20 to 40% [3], reaching up to 70% of the cases [4].

Mediastinitis treatment may range from antibiotics therapy to washing out systems to sternectomies with complex techniques of esthetic surgery restoration [5].

The Cardiac Emergency Hospital of Pernambuco – PROCAPE, at the State University of Pernambuco campus, is a well-respected teaching hospital in cardiology and comprehensively assists the metropolitan region of Recife and the inland municipality of the State of Pernambuco. The hospital was opened in 2006 and the surgical procedures in cardiovascular surgery were initiated on May 2007. From then until July 2009, 1038 patients underwent cardiovascular surgery. This hospital has a great search for heart surgery monthly. The incidence profile of complications due to mediastinitis in the postoperative period is yet unknown, as well as the potential factors and/or etiological factors involved in the range of hospital.

The aim of this study was to report the incidence of mediastinitis in the post-operative period of patients who underwent surgery at the Division of Cardiovascular Surgery at PROCAPE; to study the prevalence of clinical features in the post-operative period most likely involved in the development of mediastinitis; to compare the

frequency of mediastinitis among the several types of cardiovascular surgeries; to observe the complications associated to the development of mediastinitis; to relate the etiologic agents involved in the uprising of clinical presentation, and to study patients' progression and outcome.

METHODS

By a retrospective, descriptive, cross-sectional study, we studied patients who underwent surgery at the PROCAPE Cardiovascular Surgery Service and developed mediastinitis post-operatively, from May 2007 to June 2009. The search for the patients' clinical records was carried out by their register in the logs of surgery service description. Data was obtained from these logs as well as the hospital medical health database.

Cases with diagnosis of mediastinitis were reviewed: patients who presented fever, pain, and exudates located into surgical wound; sternal mobility; outflow of purulent matter from surgical wound; leukocytosis, and clinical instability.

The following variables were assessed: preoperative clinical characteristics (systemic arterial hypertension, diabetes mellitus, smoking, obesity, chronic obstructive pulmonary disease, and end-stage renal disease), type of surgery (coronary artery bypass grafting, specifying whether to use the internal thoracic artery or not, unilateral or bilateral), use of cardiopulmonary bypass support (if it should be used, compute the CPB time in minutes), incidence of mediastinitis, time lag to appearance of clinical presentation, hospital length of stay, complications and

associated states to the appearance of mediastinitis, and etiologic agents involved through culture of material harvested during reoperation to solve the clinical presentation and the lethality rate.

Analysis was performed with EPIINFO version 6.04. Pearson's chi-square test with analysis and interpretation was used to statistically analyze data. For these analyses, a *P* value < 0.05 was considered as statistically significant.

The study was approved by the Research and Ethics Committee of the HUOC/PROCAPE Hospital Complex, committee report nº 093/2009.

RESULTS

During the study period, 25 (2.4%) cases of mediastinitis occurred after heart surgery with sternotomy. The majority of the patients were male (68%). The mean age of the patients was 57.8 ± 19.3 years. Some comorbidity factors were predominant, such as: hypertension 80% (n=20), diabetes 56% (n=14), smoking 56% (n=14), obesity 20% (n=5), chronic obstructive pulmonary disease (COPD) 16% (n=4), and end-stage renal disease 8% (n=2).

The profile of surgeries at the cardiovascular surgery service and the distribution of mediastinitis cases separated by type of surgery are depicted in Figures 1 and 2, respectively. Coronary artery bypass grafting surgery had been related to the occurrence of the most cases of mediastinitis (84%; n=21), while the remaining occurrences took place after surgery of mitral valve replacement (two cases) and correction of a congenital heart defect (two cases, tetralogy of Fallot (1); correction of interatrial

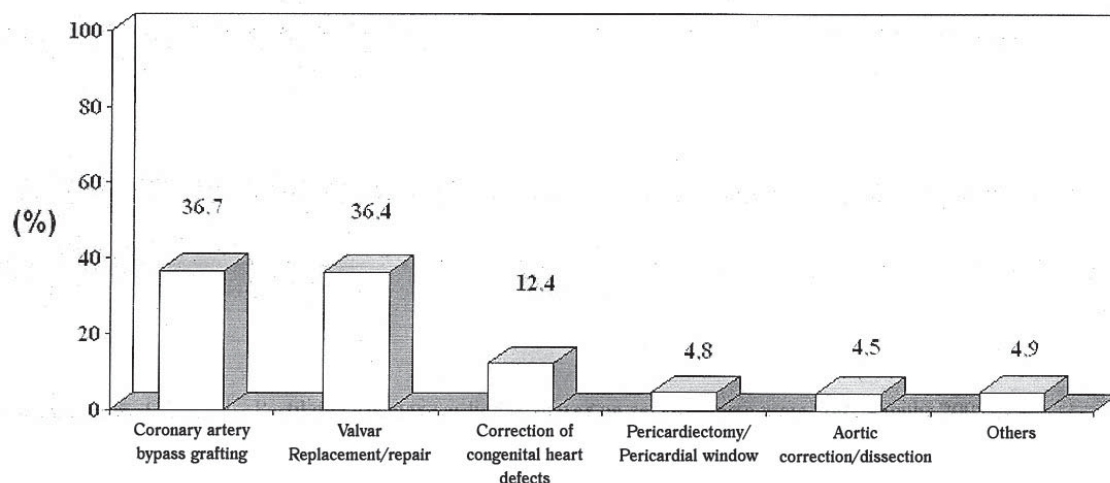


Fig. 1 – Profile of surgeries at the Cardiovascular Surgery Service from May 2007 to June 2009

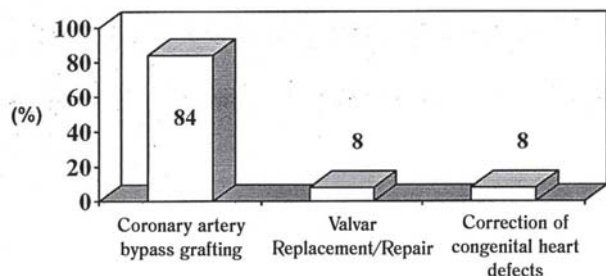


Fig. 2 – Distribution of mediastinitis cases by type of surgery

communication (1) associated to interventricular communication). It is worth highlighting that in 85.7% (n=18) of the coronary artery bypass grafting surgeries, which evolved with mediastinitis, the left internal thoracic artery (LITA) was used, and both surgeries of mitral valve replacement were re-operations. In the analysis of mediastinitis cases regarding the type of surgery it was observed a statistically significant difference ($P=0.0001$) among groups, demonstrating the coronary artery bypass

grafting surgery as the procedure associated to a higher risk of mediastinitis development (Table 1).

The most frequent complaint was retrosternal pain (92%; n=23). The mean time of mediastinitis appearance was 13.1 ± 7.2 days (range from 5 to 35 days). Three patients presented clinical signs and symptoms of late mediastinitis (after 30 days). The mean hospital length of stay was 56.4 ± 24.5 days.

The major complications and associated states observed in mediastinitis cases are presented in Table 2.

The culture of the material harvested during re-operations for mediastinitis approach turned to be positive in 21 patients (84%); *Staphylococcus aureus* was the most observed pathogen (28%) followed by *Acinetobacter spp* (20%) (Table 3).

The majority of the patients (72%; n=18) undergoing heart surgery with cardiopulmonary bypass (CPB); mean time was 79.3 ± 15.2 minutes. Of these, 10 surgeries (40%) had CPB time > 90 minutes.

Mediastinitis lethality rate was 32% (n=8) (Figure 3). Of the patients who died, four had multiple organ failure and one end-stage renal disease.

Table 1. Comparison of prevalences among groups with mediastinitis cases

Groups	Individuals	Cases os mediastinitis	Incidence – CI 95%
CABG	381	21	5.51% (3.44 – 8.30)*
Mitral valve Replacement/Repair	379	02	0.53% (0.06 – 1.89)
Correction of congenital heart defect	128	02	1.56% (0.19 – 5.06)

*P-value = 0.0001

Table 2. Associated complications and states in mediastinitis cases

Complications	N	%
Respiratory insufficiency	11	44
Stroke	4	16
Cardiogenic shock	3	12
End-stage renal disease	7	28
Pulmonary infection	9	36
Multiple Organ Failure	4	16
Sternal Dehiscence	12	48

Table 3. Analysis of etiologic agents of mediastinitis cases in the post-operative period through culture of exudate

Bacterium isolated	N	%
Staphylococcus aureus	7	28.8
Acinetobacter spp	5	20.0
Staphylococcus epidermidis	3	12.0
Enterobacter spp	3	12.0
Klebsiella pneumoniae	2	8.0
Fungi	1	4.0
Negative Culture	3	12.0
Result not found in the clinical records	1	4.0
Total	25	100.0

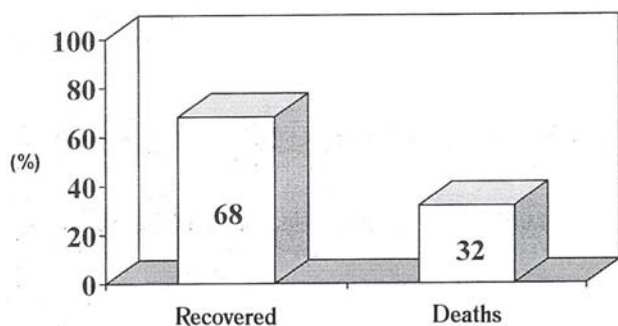


Fig. 3 – Lethality rate among cases of mediastinitis

DISCUSSION

This study has demonstrated a mediastinitis incidence rate of 2.4% (n=25) in the post-operative period following cardiovascular surgery matching the spectrum reported in the literature, which ranges from 0.2% to 5% [6].

The risk factors reported by the literature [4,7] were observed in 23 (92%) patients, among which the most frequent ones were diabetes and smoking. The latter has already been demonstrated as a risk factor for an adverse outcome in prior studies, although not independently [8]. Smokers (especially those with chronic pulmonary obstructive disease) would be the most susceptible to surgical wound infection due to their reduced pulmonary capacity to maintain optimal levels of tissue normal oxygenation [8].

The increased prevalence of females as a risk factor for the development of mediastinitis [9] was not observed in this study. The fact that the majority of the patients undergoing coronary artery bypass grafting surgery at PROCAPE were men (60.1%) was highlighted. This is the reason we are working with a biased population.

The correlation between coronary artery bypass grafting surgeries when using both internal thoracic arteries and the development of mediastinitis is well-documented in the literature, which emphasizes more than 80% of infection cases, such as complications associated to surgery [1, 10]. In the present study, coronary artery bypass grafting surgery has been related to the occurrence of 84% (n=21) of mediastinitis cases, and it has been demonstrated in our casuistics that this procedure was associated to a major risk of infection development in comparison to other procedures (statistically significant difference). However, two aspects must be highlighted: 1) both internal thoracic arteries were not used in all patients; 2) among the patients undergoing this type of surgery 14.3% (n=3) did not receive either right or left internal thoracic arteries. This makes us

think that not only the bilateral use of internal thoracic arteries but also the use of unilateral internal thoracic arteries is capable of raising the risk for mediastinitis. Nevertheless, the present study cannot categorically express this statement, taking into account that a comparison between both groups (unilateral internal thoracic artery vs none of the internal thoracic arteries) was not carried out in order to estimate whether the risk of developing mediastinitis is higher in the group using internal thoracic arteries or not.

In our casuistics, the mediastinitis mean time of appearance (13.1 days) occurred at the same time as reported in the literature, normally at the first 15 days post-operatively [11]. It has been highlighted that nearly half of the patients presented dehiscence and/or sternal instability. Considering the great variability in the time of the appearance of symptoms (5 to 35 days), we must consider that some of the patients were already at home. We must consider the possibility of other patients may have developed this complication after their hospital discharges and may have not been referred to the cardiovascular surgery service of origin.

Mediastinitis continues to be one of the main complications of cardiovascular surgery, and it is associated to high morbidity and cost [12]. The economic impact of this entity has been evaluated in several studies, most of which were conducted in the United States [12]. Diez et al. [13] have found that the mean length of stay was 45 days, demonstrating the morbidity degree that the disease impinges to the patient. Our data have also shown a significantly prolonged mean length of stay (56.4 days)

In the present study, the majority of the patients (72%; n=18) was operated on cardiopulmonary bypass support; of these, 40% (n=10) had CPB time longer than 90 minutes. The cardiopulmonary bypass time is a variable related to the duration of surgical procedure, and it was demonstrated as a possible risk predictor in some of the studies [14]. However, the present study, in fact, does not establish such an observation as being the truth, once there were no control group CPB analyses (non-mediastinitis group) to compare with.

Several studies [15-17] have pointed *Staphylococcus aureus* as the main germ responsible for the development of mediastinitis and with our casuistics it was not otherwise. It is curious to observe that all the positive cultures were monobacterial, considering that it is expected about 40% of mixed infections [1,5]. Another important aspect was the presence of the *Acinetobacter spp* in 20% (n=5) of cases. Diez et al. [13] and Souza et al. [17] analyzing the etiologic agents involved in the appearance of mediastinitis in the post-operative of cardiovascular surgery through culture media from the surgical wound did not obtain any incidence of *Acinetobacter spp* among their cases. On the other hand, they have found agents not observed in our cases such as

Escherichia coli and *Pseudomonas aeruginosa*. The cultures which presented negative results were probably due to the institution of an early antibiotic therapy when clinical manifestations have occurred, prior to the collect of culture material.

In our cardiovascular service, mediastinitis presented a lethality rate of 32% (n=8), within the scope highlighted in the literature which ranges from 14 to 47%. However, this datum should not lead us to assume that this rate is acceptable only for the fact of paralleling to that of other cardiovascular services. We should point out here that half of the patients who died developed multiple organ failure.

CONCLUSION

It has been found that the incidence of mediastinitis is compatible with that reported in the literature. Coronary artery bypass grafting surgery is associated to a higher risk of developing infection in comparison to other surgical procedures. Even when not using the internal thoracic artery, coronary artery bypass grafting was the procedure most related to the development of mediastinitis in the post-operative of cardiovascular surgery at the hospital where this study was carried out. *Staphylococcus aureus* remains as the main etiologic agent. The lethality of mediastinitis was within the expected limits, yet a high lethality rate.

REFERENCES

1. El Oakley RM, Wright JE. Postoperative mediastinitis: classification and management. *Ann Thorac Surg*. 1996;61(3):1030-6.
2. Levi N, Olsen PS. Primary closure of deep sternal wound infection following open heart surgery: a safe operation? *J Cardiovasc Surg (Torino)*. 2000;41(2):241-5.
3. Vaska PL. Sternal wound infections. *AACN Clin Issues Crit Care Nurs*. 1993;4(3):475-83.
4. Tarelli G, Maugeri R, Pedretti R, Grossi C, Ornaghi D, Sala A. The use of bilateral mammary artery in myocardial revascularization. The risk factors emergent from a multivariate analysis conducted on 474 patients. *G Ital Cardiol*. 1998;28(11):1230-7.
5. Adams DH, Antman EM. Medical management of the patient undergoing cardiac surgery. In: Braunwald E, editor. *Heart disease: a textbook of cardiovascular medicine*. 6th ed. Philadelphia:W.B. Saunders;2001. p.2059-83.
6. Berg HF, Brands WG, van Geldorp TR, Kluytmans-VandenBergh FQ, Kluytmans JA. Comparison between closed drainage techniques for the treatment of postoperative mediastinitis. *Ann Thorac Surg*. 2000;70(3):924-9.
7. Sampaio DT, Alves JCR, Silva AF, Lobo Jr NC, Simões D, Faria W, et al. Mediastinite em cirurgia cardíaca: tratamento com epíloon. *Rev Bras Cir Cardiovasc*. 2000;15(1):23-31.
8. Benlolo S, Matéo J, Raskine L, Tibourtine O, Bel A, Payen D, Mebazaa A. Sternal puncture allows an early diagnosis of poststernotomy mediastinitis. *J Thorac Cardiovasc Surg*. 2003;125(3):611-7.
9. Prevosti LG, Subramainian VA, Rothaus KO, Dineen P. A comparison of the open and closed methods in the initial treatment of sternal wound infections. *J Cardiovasc Surg (Torino)*. 1989;30(5):757-63.
10. Risk factor for deep sternal wound infection after sternotomy: a prospective, multicenter study. *J Thorac Cardiovasc Surg*. 1996;111(6):1200-7.
11. Santos FCP, Carvalho EL, Maiello PCA, Santos DFP, Neto ATC, Paulista PP. Mediastinite: uma revisão. *Rev Fac Ciênc Méd Sorocaba*. 2007;9(2):6-9.
12. Hollenbeak CS, Murphy DM, Koenig S, Woodward RS, Dunagan WC, Fraser VJ. The clinical and economic impact of deep chest surgical site infections following coronary artery bypass graft surgery. *Chest*. 2000;118(2):397-402.
13. Diez C, Koch D, Kuss O, Silber RE, Friedrich I, Boergemann J. Risk factors for mediastinitis after cardiac surgery: a retrospective analysis of 1700 patients. *J Cardiothorac Surg*. 2007;2:23.
14. Noyez L, van Druuten JA, Mulder J, Schröen AM, Skotnicki SH, Brouwer RM. Sternal wound complications after primary isolated myocardial revascularization: the importance of the post-operative variables. *Eur J Cardiothorac Surg*. 2001;19(4):471-6.
15. Macedo CA, Baena MES, Uezumi KK, Castro CC, Lucarelli CL, Cerri GG. Mediastinite aguda: aspectos de imagem pós-cirurgias cardíacas na tomografia computadorizada de multidetectores. *Radiol Bras*. 2008;41(4):269-73.
16. Schimin LC, Batista RL, Mendonça FCC. Mediastinite no Hospital de Base do Distrito Federal: incidência em seis anos. *Rev Bras Cir Cardiovasc*. 2002;17(2):36-9.
17. Souza VC, Freire ANM, Tavares-Neto J. Mediastinite pós-esternotomia longitudinal para cirurgia cardíaca: 10 anos de análise. *Rev Bras Cir Cardiovasc*. 2002;17(3):266-70.