

Predictors of mediastinitis after cardiac surgery

Preditores de mediastinite em cirurgia cardíaca

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Abstract

Mediastinitis is a serious complication of open-heart surgery, with an incidence that varies from 0.4 to 5%, mortality from 10 to 47% and a high morbidity rate.

Objectives: to identify the preoperative and trans-operative risk factors of mediastinitis after open-heart surgery in our hospital.

Methods: This was a prospective study of 1298 patients submitted to the open-heart surgery in São Lucas hospital in the period from March 1997 to May 2000. Nine potential risk factors associated with mediastinitis were studied (obesity, diabetes mellitus, chronic obstructive pulmonary disease, the use of internal mammary artery grafts, cardiopulmonary

bypass time, smoking, gender, ejection fraction and previous heart surgery) using univariate analysis, where necessary followed by multivariate logistic regression.

Results: Of the 1298 patients studied, 62.6% were men and 18.3% suffered from diabetes. Thirty-eight patients (2.9%) presented with mediastinitis postoperatively, and 6 (15.8%) of these died. Four variables were identified as risk factors by univariate analysis ($p < 0.05$) and were after analysed by logistic regression. Three variables were identified as independent predictors of mediastinitis: obesity ($p = 0.008$), chronic obstructive pulmonary disease ($p = 0.007$) and diabetes mellitus ($p = 0.009$), even when gender and age were considered. The internal mammary artery graft was observed as a risk predictor only when associated to obesity.

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Conclusion: In our hospital, mediastinitis occurs most frequently in patients suffering from obesity, diabetes, and/or chronic obstructive pulmonary disease and in the patients where the internal mammary artery was used in obese patients.

Descriptors: Mediastinitis; Mediastinal Infection. Cardiac surgery, infection. Surgical infection.

Resumo

Introdução: A mediastinite é uma grave complicação da cirurgia cardíaca, com incidência de 0,4% a 5%, mortalidade de 10% a 47% e elevada morbidade.

Objetivo: Identificar os fatores de risco pré e transoperatórios para mediastinite após a cirurgia cardíaca em nosso hospital.

Método: Estudo prospectivo de 1298 pacientes submetidos à cirurgia cardíaca no Hospital São Lucas no período de março de 1997 a maio de 2000. Foram avaliados nove potenciais fatores de risco associados a mediastinite (obesidade, *diabetes mellitus*, doença pulmonar obstrutiva crônica, ponte mamária,

tempo de bypass cardiopulmonar, tabagismo, sexo, fração de ejeção e cirurgia cardíaca prévia), através de análise univariada, seguida de análise multivariada de regressão logística.

Resultados: Dos 1298 pacientes estudados, 62,6% eram homens e 18,3% eram diabéticos. Trinta e oito (2,9%) pacientes apresentaram mediastinite e seis (15,8%) destes morreram. Quatro variáveis foram selecionadas por análise univariada ($p < 0,05$) e incluídas na análise de regressão logística. Foram identificadas três variáveis como preditores independentes para mediastinite: obesidade ($p = 0,008$), doença pulmonar obstrutiva crônica ($p = 0,007$) e *diabetes mellitus* ($p = 0,009$), mesmo quando analisados sexo e idade. Ponte mamária foi observada como preditor de risco somente quando associada à obesidade.

Conclusão: Em nosso hospital, a mediastinite ocorreu com maior prevalência nos pacientes obesos, com *diabetes mellitus*, com DPOC e naqueles onde se utilizou ponte mamária associado com obesidade.

Descritores: Mediastinite. Infecção mediastinal. Cirurgia cardíaca, infecção. Infecção cirúrgica.

INTRODUCTION

Mediastinitis is one of the most serious complications of median sternotomies and is associated with significant morbidity and mortality [1,2].

The etiopathogenesis remains little understood but it is believed that contamination of the wound during surgery, most commonly by gram-positive bacteria, is the main cause [1-3]. Several researches have demonstrated the interaction of pre- and trans-operative risk factors in the genesis of mediastinitis, especially obesity, diabetes, previous heart surgery and the use of internal mammary arteries in the procedures of coronary artery bypass grafting [1,4,5].

Diagnosis is difficult and is generally delayed, thus, a high degree of suspicion is required [6]. Clinical and radiographic findings help in the investigation and the utilization of computed thoracic tomography detects diagnostically significant signs, such as to the presence of mediastinal fluid collection, dehiscence or sternal or pneumo-mediastinal erosion [3,7]. Nevertheless, the definitive diagnosis is achieved by sternal puncture, collecting material for analysis of the bacteria, or from the surgical wound itself.

Of these two methods, diagnosis by puncture of the sternum can demonstrate the existence of mediastinitis at an earlier stage in patients in which there is clinic suspicion,

because it is a less invasive procedure and has less risks than to reopening the thoracic cavity [8,9]. Treatment demands surgical re-exploration and immediate empirical antibiotic therapy [6,10-12].

In this research we tried to identify pre- and trans-operative predictors of risk related to mediastinitis after heart surgery performed in our department.

METHOD

A descriptive, analytical (cohort) observational study was performed from variables obtained from the database of the sector of heart surgery. All patients submitted to heart surgery in the São Lucas Hospital, PUCRS, from March 1997 to May 2000 were included in the study, giving a total of 1298 patients.

The data were obtained by the same researcher, according to a specific protocol of the heart surgery recovery unit, during the period in which the patients were hospitalized. The occurrence of events was recorded until hospital discharge. The data were stored using the ACCESS program and, afterwards the association between mediastinitis and pre- and trans-operative risk factors was analyzed using the SPSS 9.0 program.

Nine variables were analyzed: (1) Gender: (2) Diabetes

mellitus (DM); (3) Chronic obstructive pulmonary disease (COPD); (4) obesity (defined as body mass index greater than 30); (5) smoking; (6) previous heart surgery; (7) pre-operative ejection fraction less than 40%; (8) use of mammary artery grafts and (9) cardiopulmonary bypass time greater than 90 minutes.

The qui-squared test was utilized for univariant analysis. Subsequently, variables which presented with statistical significance ($p < 0.05$) were submitted to logistic regression analysis, using the Forward Wald program.

Mediastinitis was defined based on clinical, laboratorial and tomographic criteria.

A review of the literature was performed in the areas of heart and thoracic surgery, using Medline and textbooks.

RESULTS

Thirty-eight (2.9%) of the 1298 patients studied evolved with mediastinitis in the postoperative period. The characteristics of this group and the prevalence of the analyzed variables are summarized in Table 1. Among the patients who developed mediastinitis, six (15.8%) died.

From the nine analyzed variables, a significant association in the development of mediastinitis was only observed for obesity, diabetes, COPD and mammary artery grafts.

Logistic regression analysis identified obesity, diabetes and COPD as independent predictors of higher risk of mediastinitis, as is illustrated in Table 2.

Table 1. Unvaried analyze

Variable	Patients with Mediastinitis N (%)	p-value
Gender, male	27 (71.1)	0.35
MD	14 (36.8)	0.005
COPD	13 (34.2)	0.005
Obesity	7 (34.2)	0.002
Smoking	20 (52.6)	0.29
Previous heart surgery	2 (5.3)	1.0
EF <40%	4 (12.1)	1.0
Mammary artery grafts	24 (63.2)	0.041
Bypass time > 90 min	14 (36.8)	0.045

DM = diabetes mellitus; COPD = chronic obstructive pulmonary disease PCS = previous cardiac surgery; EF = ejection fraction

Table 2. Multivariate analysis

Variable	p-value	OR	CI 95%
Obesity	0.008	3.30	1.36-7.99
MD	0.009	2.5	1.25-4.90
COPD	0.007	2.61	1.29-5.26

These variables remained independent predictors of risk even after taking into consideration gender and age. The use of mammary artery grafts was seen as a predictor of risk only when associated with obesity.

DISCUSSION

Mediastinitis is defined as an infection of the deeper tissues of the operative wound associated with osteomyelitis of the sternum, which can also involve the mediastinal space. The incidence of mediastinitis varies according to the institution, but it is calculated as being between 0.4 to 4.0% according to the Guidelines of the ACC/AHA [13]. Researches present a wide range of from 10 to 47% for mortality of involved patients [14]. In our service, the incidence of mediastinitis was 2.9% and the mortality rate was 15.8% of these patients.

Many factors have been associated to the development of mediastinitis after heart surgery. However, there is no consensus in the literature about which factors are more important and if each one is an independent predictor of higher risk for postoperative mediastinitis [6]. Published studies give conflicting results about associated risk factors, probably due to differences in the methodologies used. Additionally, there can be variations according to the institution where the surgical procedure was performed, as well as its geographic location [4].

The Guidelines of the American College of Cardiology and the American Heart Association utilize an estimation of the risk created by a study group on cardiovascular diseases from England, as is shown in Table 3.

In our study, the factors considered independent predictors of potential risk of mediastinitis were obesity, COPD and diabetes Mellitus. According to the reviewed data, among all the risk factors, obesity seems to be the most important independent risk factor for mediastinitis, as has already been demonstrated in several studies [2,5,15-20]. In the Parisian Mediastinitis Study Group Risk Factors for Deep Sternal Wound Infective [21] obesity was the only independent preoperative risk factor for mediastinitis.

Table 3. Preoperative estimate of risk of mediastinitis

Variable	Score	Perioperative risk	
		Score Total	%
EF < 40%	2	0	0.4
Urgent surgery	1.5	1	0.5
Emergency surgery	3.5	2	0.6
Diabetes mellitus	1.5	3	0.7
Dialysis or creatinine = 2	2.5	4	1.1
DPOC	3.5	5	1.5
Obesity (BMI 31-36)	2.5	6	1.9
Severe obesity (BMI > 37)	3.5	7	3.0
		8	3.5
		9	5.8
		10	>=6.5

Northern New England Cardiovascular Disease Study Group: Preoperative Estimation of Risk of Mortality, Cerebrovascular Accident (CVA), and Mediastinitis (for use only in isolated CAGB Surgery)

The exact mechanism by which obese patients are susceptible is not well known. It is probable, that in these patients, the levels of antibiotics in the tissues utilized during prophylaxis in the perioperative period are inadequate, as these patients present with a greater volume. Additionally, the preparation of the skin of obese patients may be more difficult or even inadequate. An additional factor is that the great quantity of adipose tissue can serve as a substrate for infections of the surgical wound.

Diabetes mellitus has been associated with postoperative mediastinitis in some published series [5,15,17,22,23], mainly for those patients who utilize insulin.

Some researches, however, show contradictory results [2,5,15]. FURNARY et al. [24] and ZERR et al. [25] showed that the maintenance of glycemia at values of less than 200 mg/dL, by a continuous intravenous insulin infusion, significantly reduces the incidence of mediastinitis in diabetic patients. From these results, the ACC/AHA Guidelines for coronary artery bypass graft surgery [13] recommend glycemia levels of less than 200 mg/dL. Currently we routinely utilize in our service continuous intravenous insulin infusion when the glycemia levels are higher than 160 mg/dL and try to maintain the glycemia around 100 mg/dL. This control is achieved in the immediate postoperative period until 36 to 48 hours after the operation.

COPD has already been demonstrated as a risk factor for mediastinitis in previous studies, although not in isolation

[11,26,27]. Patients with COPD are more susceptible to infection of the operative wound due to tissue hypoxemia. Many of these patients need corticoid therapy in the pre- and or post-operative periods, which could facilitate the appearance of infections.

STÄHLE et al. [28] showed that the use of the internal mammary arteries for coronary artery bypass grafting is a risk factor which is increased by postoperative complications, especially in diabetic patients. This fact has already been reported in other studies [5,19,21,23,29], and some studies have even suggested that the mammary artery grafts should not be used in some obese and diabetic patients [22] and those suffering from COPD or peripheral vascular disease [26,30]. Nevertheless, more recent publications suggest that in selected cases, the careful use of mammary artery grafts may not behave as an independent risk factor for mediastinitis [2,8]. Our study did not show that the use of mammary artery grafts was an independent risk factor, but obese patients submitted to the procedure presented with a higher incidence of mediastinitis.

Previous heart surgery and Cardiopulmonary Bypass times are variables linked to the duration of the surgical procedure and have been shown to be possible risk factors in some studies [2,5,9,17,21,22,27,31], even when individually analyzed. The time of bypass did not presented any correlation to mediastinitis in the studies of MILANO et al. [2] and LOOP et al [5]. Both the variables were not significantly associated with mediastinitis in the current research.

Pre operative ejection fraction, gender and smoking were not risk factors in our study.

CONCLUSION

The mediastinitis occurred with a higher prevalence in our hospital in obese and diabetic patients and those suffering from COPD and where mammary artery grafts were utilized only when associated with obesity. It is essential that each institution periodically identifies its risk factors for mediastinitis, not only to establish preventive conducts but also to inform the patient and her/his doctor the rate of occurrence of this serious post-operative complication.

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