The importance of troponin I in the diagnosis of myocardial infarction in the postoperative of coronary artery bypass graft surgery

Importância da troponina I no diagnóstico do infarto do miocárdio no pós-operatório de cirurgia de revascularização

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Abstract

Objective: The aim of this study is to establish a cut-off value for troponin I by correlating it to occurrence of postoperative myocardial infarction.

Methods: 180 consecutive patients with coronary disease referred for surgery were included. The mean age of the patients were 60.6 ($\pm$9.3) years, with 119 (66.1%) males and 61 (33.9%) females. The patients were divided into two groups: group without myocardial infarction (A) - 170 patients - and with myocardial infarction (B) – 10 patients.The troponin I was collected from each patient at the beginning of anesthesia and on the second postoperative day by correlating it to presence or not of postoperative myocardial infarction. StatsDirect 1.6.0 for Windows was used for statistical analysis.

Results: Preoperative troponin I was 1.0 ($\pm$6) ng/ml as mean. Univariate logistic regression showed correlation of troponin I of the second postoperative day with myocardial infarction (*P*=0.0005). ROC curve was used to define the cut-off value, and 6.1 ng/ml (sensitivity=90.0%, specificity=82.1%, OR=49.8 with CI=95% 6.1- 410.4, *P*<0.0001) were found.

Conclusion: The chance of a patient with postoperative myocardial infarction to present troponin I equal to or higher than 6.1 ng/ml is 49.8-fold higher than the chance of a patient without infarction to present troponin I higher than this value.

Descriptors: Troponin I. Myocardial infarction. Cardiac surgical procedures.

Resumo

Objetivo: Estabelecer um valor de corte para a troponina I, correlacionando-a com a ocorrência de infarto do miocárdio pós-cirúrgico (IAMPC).

Métodos: Foram incluídos 180 pacientes consecutivos portadores de coronariopatia obstrutiva com indicação cirúrgica. A idade média dos pacientes foi de 60,6 ± 9,3 anos, sendo 119 (66,1%) do sexo masculino e 61 (33,9%), do feminino. Os pacientes foram divididos em dois grupos: grupo sem infarto (A) - 170 pacientes - e infartado (B) - 10 pacientes. Foram coletados de cada um troponina I, ao momento da indução anestésica e ao segundo dia do pós-operatório, e correlacionada com a presença ou não de IAMPC. A análise estatística foi feita com a ajuda do programa StatsDirect 1.6.0 para Windows.

Resultados: A troponina I pré-operatória apresentou uma

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This study was carried out at the São José do Rio Preto Medical School
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média de 1,0 ± 6 ng/ml. A regressão logística univariada mostrou correlação da troponina I do segundo dia de pós-operatório com IAMPC com *P*=0,0005. A curva ROC determinou um valor de corte de 6,1 ng/ml, sensibilidade = 90,0% e especificidade = 82,1%, OR = 49,8 (IC 95% 6,1-410,4) com *P*<0,0001.

Conclusão: A chance de um paciente com infarto pós-operatório apresentar troponina igual ou superior a 6,1 ng/ml é 49,8 vezes maior do que a de um paciente que não infartou apresentar troponina acima desse nível.

Descritores: Troponina I. Infarto do miocárdio. Procedimentos cirúrgicos cardíacos.

INTRODUCTION

Thrombotic complications in coronary artery bypass graft surgeries (CABG) are presented as their main causes of mortality. Among them, it emphasizes the myocardial infarction (AMI) due to its high incidence, which varies from 5% to 15%, according to the literature. [1-5] The consequences of peri-operative AMI can vary from minor enzyme elevations without clinical relevance to presentations of low cardiac output or malignant tachyarrhythmias, followed by death or reduced long-term survival, which explains the efforts made in trying to avoid such complication [1-5].

In recent years, the introduction of troponin became faster and more accurate the diagnosis of cardiac events. Although new Q waves on ECG or new akinetic or dyskinetic segments suggest transmural infarction, minor myocardial lesions are not recognized unless the troponin is measured due to its high sensitivity and specificity [6].

Studies have shown that after CABG surgery the troponin I is high and its peak occurs between 6 to 8 hours after aortic unclamping and correlates directly with the occurrence of perioperative myocardial infarction (PMI) [7].

The aim of this study is to establish a cut-off value for troponin I, correlating it with the occurrence of postoperative myocardial infarction and its odds ratio.

METHODS

This retrospective study, after approval by the Ethics Committee in Research of the institution (protocol number 6649/2007) was performed at Hospital de Base of São José do Rio Preto in the period of October 16, 2006 to August 30, 2007. We included 180 consecutive patients without restriction to gender and patients with obstructive coronary artery disease with surgical indication. The only exclusion criterion was the not collection of troponin on the second postoperative day.

Anesthesia

The routine induction for heart surgery of our service is performed using midazolam (0-5mg), dexmedetomidine at 50µg/min (total induction dose ranging from 0.5-1 mg / kg), propofol (2-4mg/kg) and atracurium (0.5 mg/kg). Some anesthesiologists prefer to add fentanyl to inducing drugs. Maintenance of anesthesia was performed using isoflurane, atracurium and dexmedetomidine in infusion pump only.

Methods

Initially, the patients were divided into two groups regarding the presence or absence of postoperative myocardial infarction: Group A - without postoperative myocardial infarction (without PMI) and group B with PMI. The diagnostic criteria for PMI were: change in electrocardiogram with elevation of 1mV of the ST segment in peripheral leads or 2mV in precordial leads in at least two contiguous leads, new heart failure with need for vasoactive drugs or worsening of segmental contractility in the echocardiogram. Table 1 shows the main characteristics of patients in each group regarding preoperative factors.

Table 1. Characteristics of admission of the patients by group

	Group A (n=170)	Group B (n=10)	P
Age (years)	60.6±9,5	59.6±7.9	0.70
Gender	111H59M	8H2M	0.40
Stable angina	130 (76.5%)	8 (80%)	0.90
Unstable angina	24 (14.1%)	1 (10%)	0.80
PMI	16 (9.4%)	1 (10%)	0.90
Time of admission-surgery (days)*	3 (2-6)	2 (1.3-8.3)	0.65
SAH	141 (82.9%)	7 (70%)	0.30
DM	65 (38.2%)	5 (50%)	0.50
Normal cardiac function	126 (74.1%)	6 (60%)	0.40
Severe dysfunction	17 (10%)	1 (10%)	0.90
Parsonnet	7.9±6.3	6.1±4,7	0.30
Additive Euroscore*	3 (1-4)	2.5 (0-3)	0.29
Logistic Euroscore*	1.9 (1.3-3)	1.8 (0.9-2.6)	0.32

*MI – myocardial infarction; SAH – systemic arterial hypertension; DM - diabetes. Data shown as Mean ± Standard Deviation. *Median (percentile 25-75%)*

In each, troponin I was collected in the anesthetic induction on the second postoperative day by using the chemiluminescence method, in equipment Access of Sanofi-Pasteur Inc., by accepting as normal values below 0.1 nanograms per milliliter (ng/ml).

Statistical analysis

The statistical t-student test (continuous variables with Gaussian distribution), Mann-Whitney (discrete or continuous variables with non-Gaussian distribution), Fisher's exact test (categorical variables) were used to

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establish the significance levels, ROC curve of the two groups of patients (A and B) to determine the cut-off value of troponin I in the second postoperative period and establishment of sensitivity, specificity, relative risk and level of statistical significance by the Fisher method - all by using the StatsDirect statistical software version 1.9.15. A *P* value equal to or less than 0.05 was considered significant.

RESULTS

We divided the patients into two groups, with Group A consisting of patients without postoperative myocardial infarction, defined as change on the postoperative electrocardiogram and/or evolving to pump failure, and/or with echocardiography with new areas of segmental dysfunction. The group B consisted of patients who presented postoperative myocardial infarction.

The group characteristics were tested in Table 1, that showed that patients in group A had the same risk factors of patients in group B. Associated with this, in Table 2 we can see clearly that in both groups the median of the bypass performed was the same, as well as the occurrence of surgery without using cardiopulmonary bypass and rate of readmission, but the mortality was significantly higher in patients with postoperative myocardial infarction (group B) than in group A. The length of stay in ICU was also significantly higher for group B compared to group A.

Table 2. Characteristics of patients's evolution by group

	Group A (n=170)	Group B (n=10)	P
Total number of bypasses*	3 (2-3)	2 (1-3.25)	0.40
With CPB	114 (67%)	6 (60%)	0.60
Time of stay in ICU (days)*	2 (2-3.8)	4.5 (3.3-8.5)	0.0001
Readmission to ICU	11 (6.4%)	1 (10%)	0.60
Death	9 (5.3%)	4 (40%)	0.0030

*CPB – cardiopulmonary bypass; ICU – Intensive Care Unit. Data shown as Mean ± Standard Deviation. * Median (percentile 25-75%)*

In Table 3 we note that even without difference found between the creatinine peak, the values of CRP and preoperative troponin, there was clear difference in troponin I on second day of the groups with *P*<0001.

The univariate logistic regression showed correlation of troponin I of the second postoperative day between PMI of *P*=0.0005. The ROC curve (Figure 1) determined a cut-off value of 6.1 ng/ml, sensitivity=90.0% and specificity=82.1%. The odds ratio can be obtained by the division of two ratios: the number of infarcted patients on non-infarcted with troponin I greater than 6.1 and the

number of infarcted patients on non-infarcted patients with troponin I less than 6.1 mg/dl. The value found for the odds ratio was 49.8 (95% CI 6.1-410.4) with *P*<0.0001.

Table 3. Laboratorial characteristics of the patients's evolution by group

	Group A (n=170)	Group B (n=10)	P
Peak of creatinine (mg/dL)*	1.2 (1-1.5)	1.2 (1-2)	0.81
Admission CRP (mg/dL)*	0.7 (0.4-1.3)	0.8 (0.3-1.2)	0.81
CRP 1st PO (mg/dL)	6.8 ± 3.2	5.7 ± 2.3	0.81
CRP 2nd PO (mg/dL)	6.8 ± 3.2	14.1 ± 6.1	0.66
Preoperative TnI (ng/mL)*	0.1 (0.1-0.1)	0.1 (0.1-0.1)	0.24
TnI 2nd PO (ng/mL)*	1.4 (0.7-3.5)	13.8 (9.4-44.1)	0.0001

*CRP – C-reative protein; TnI – Troponin; PO – postoperative. Data shown as Mean ± Standard Deviation. * Median (percentile 25-75%)*

Sensitivity=90%
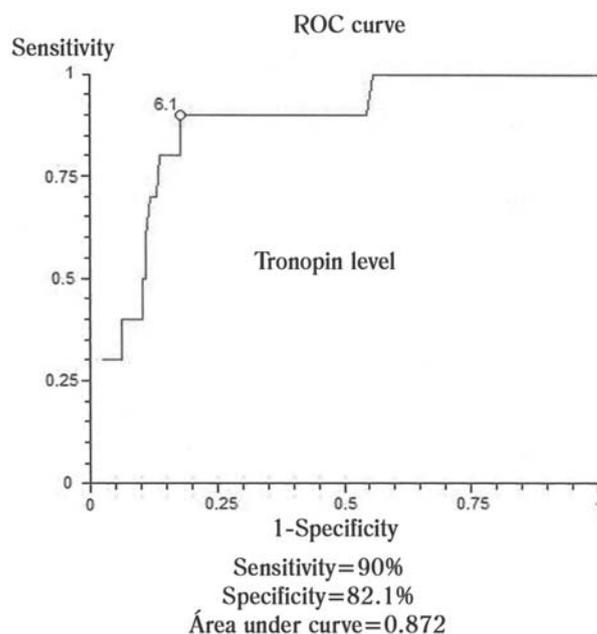Specificity=82.1%
Área under curve=0.872

Fig. 1 – ROC curve showing the cut-off value of sensitivity and specificity by correlating Troponin I collected on the second postoperative day and occurrence of postoperative myocardial infarction

DISCUSSION

The troponin I showed to be effective for predicting the risk of mortality and cardiac events in patients with unstable angina, to estimate the size of infarction after reperfusion and to be a specific marker of cardiac lesion during coronary

artery bypass grafting [6]. Its value in diagnosis of myocardial infarction is well known in clinical patients, but it is still under study in patients already grafted, [1,3-9].

As already reported in the literature, levels of troponin, either I or T, raise at the first postoperative day of coronary artery bypass grafting, even without ischemic event associated [8]. The identification of a cut-off value for troponin I is important because it becomes another tool for diagnosis of postoperative myocardial infarction, which has a major negative impact for recovering of postoperative patients [6].

There is no risk of cross-reactivity of isoforms derived from the degradation of skeletal muscle, and such risk is not increased in healthy people without heart disease, even those who had undergone high muscle stress or non-cardiac surgeries [3,7].

Although the infarcted group presents a much smaller number of patients than the group without infarction (10 against 170 infarcted), there was no difference in preoperative characteristics, as shown in Table 1. Therefore, we can say that the groups are uniform. Nevertheless, with a so low number of infarcted patients we can not guarantee that our sample is realy representative of the general profile of patients with acute myocardial infarction in the postoperative of myocardial revascularization surgery in other regions. A multicenter study would be ideal to obtain a definitive answer on the subject.

The occurrence of acute postoperative myocardial infarction - that could change the values of troponin I and causing bias in this study - was a characteristic that occurred in both groups equitably. In group A the previous infarction occurred in 16 patients (9.4%) while in Group B was only one patient (10%), with p not significant. In both groups, the median of initial troponins did not differ (P=0.24). Thus, this feature does not interfere in the group analysis.

Eigel et al. and Thiemann et al. are in agreement that the troponin - when high preoperatively in coronary artery disease patients - is associated with cardiac events prior to surgery, and it is used as an index of severity and correlates directly with increased morbidity/mortality [7.9]. In our patients there was no statistically significant difference between groups A and B regarding preoperative troponin I (P=0.14) probably because patients with myocardial infarction prior to surgery were not excluded, as well as found in the aforementioned studies.

CONCLUSION

The possibility of a patient with postoperative infarction presenting troponin equal or greater than 6.1 ng/ml is 50-fold higher than the possibility of a non-infarcted patient presenting troponin with a level greater than 6.1 ng/ml.

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