Association between Preoperative C-Reactive Protein Levels with Postoperative Complications of Cardiovascular Surgery

SILVINA V. WALDMAN, ROSANA POGGIO, LAURA R. CARRIZO, WALTER RODRÍGUEZ, MIGUEL SELLANES, HUGO GRANCELLI[MTSAC], CLAUDIO E. PENSA[MTSAC], MARIANA CARNEVALINI, HERNÁN COHEN ARAZI[MTSAC]

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Address for reprints:
Dr. Hernán Cohen Arazi
FLENI
Montañeses 2325
(1428) Buenos Aires, Argentina
Tel.: 54 (011) 5777-3200
Fax: 54 (011) 5777-3209
e-mail: carazi@fleni.org.ar

SUMMARY

Background
Systemic inflammatory response syndrome is a frequent complication in the postoperative of cardiac surgery, which can evolve with vasoplegic shock and the most severe cases can end in the failure of one or more organs. Predictors in the preoperative, perioperative associated with this complication have been described; however, a subclinical inflammation state in the preoperative, not detected by routine tests, could be related to the inflammatory response occurred in the postoperative. High levels of C-reactive protein (CRP), an inflammation parameter in different clinical scenes and which is associated with the prognosis of different cardiovascular pathologies, may predict the syndrome.

Objective
To evaluate the contribution of preoperative elevated levels of C-reactive protein to predict systemic inflammatory response syndrome and its postoperative complications in cardiac surgery.

Material and Methods
A total of 169 consecutive patients, (male 77.3%, age 61.1±15.9, EuroSCORE 9.46 [SD 12.7]) undergoing cardiac surgery between April 2007 and December 2008 were prospectively included. The level of CRP was determined in all the patients. The combined endpoint included systemic inflammatory response syndrome and its association with atrial fibrillation, renal failure, shock or death.

Results
Eighty-seven patients (54%) developed systemic inflammatory response syndrome and 50 patients (31%) showed combined endpoint. Hospital mortality was of 5.6% (9 patients).
Adjusted by preoperative and intraoperative variables, preoperative levels of CRP≥2 mg/dl were associated with the combined endpoint (OR 2.95, HF 95% 1.20-7.23; p<0.018), with the evolution of systemic inflammatory response syndrome (SIRS) (OR 5, 10, HF 95% 1.48-17.58; p<0.010), combined SIRIS with shock (OR 6.50, HF 95% 4.59-27.34; p<0.005), combined SIRIS with atrial fibrillation (OR 3.51, HF 95% 1.14-10.79; p<0.028), renal failure (OR 2.91, HF 95% 1.19-7.12; p <0.019) and shock (OR 4.13, HF 95% 1.25-13.6; p <0.020).

Conclusions
The criterion of adaptation of coronary revascularization (percutaneous or surgical) in a high complexity cardiovascular center was inappropriate in a minority of cases. Such criterion is a potentially applicable tool both in the decision-making in those patients with coronary disease and in the control of quality of cardiology departments.

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Key words > Thoracic surgery – C-reactive protein- Inflammation- Postoperative complications.

Abbreviations >

CVA	Cerebrovascular accident	**RF**	Renal failure
EC	Extracorporeal circulation	**CRP**	C-reactive protein
MRS	Myocardial revascularization surgery	**CVP**	Central venous pressure
LVDD	Left ventricle diastolic diameter	**SIRS**	Systemic inflammatory response syndrome
AF	Atrial fibrillation	**Systolic BP**	Systolic blood pressure
RR	Respiratory rate		

FLENI – Department of Cardiology
[MTSAC]Full Member of Sociedad Argentina de Cardiología

BACKGROUND

Systemic inflammatory response syndrome (SIRS) is a frequent complication in the postoperative of cardiac surgery (1-4) which can lead to a vasoplegic shock in 8-12% of the patients. (5) The most severe cases can lead to failure of one or more organs, which is associated with a high mortality. (3)

Preoperative and perioperative predictors related to this complication have been described, including genetic factors, (6) previous clinical condition, drugs administered in the preoperative stage (7) and technical details of the surgery. (8, 9) However, a subclinical inflammatory state in the preoperative stage, not detected by routine tests, could be related to the inflammatory response occurred in the postoperative and with the complications that are seen in the evolution. (10)

The elevated C-reactive protein (CRP) is an inflammatory parameter in different clinical scenes and is associated with the diagnosis of several cardiovascular pathologies. (11-17) In cardiac surgery there are controversial results regarding CRP as a predictor of risk. (14, 16, 18, 19)

This study evaluates if the preoperative levels of CRP are associated with the evolution to SIRS and complications in the postoperative of cardiac surgery regardless of other predictors already described.

MATERIAL AND METHODS

Those patients who underwent cardiac surgery between April 2007 and December 2008 in our center were selected prospectively.

All those patients over 18 years treated with elective cardiac surgery were included.

Pregnant patients, those with diagnosis of infected endocarditis, patients with clinical or laboratory markers of active infection, patients who needed an emergency surgery due to aortic dissection and those who underwent cardiac transplant were excluded.

All the patients underwent a laboratory test within 24 hours before the surgery which included routine tests with evaluation of renal function, coagulogram, hepatogram and CRP. CRP determination was performed by fluorescence polarization immunoassay of intermediate sensitivity (Abbot Diagnostics®, Chicago, Illinois).

A combined primary endpoint of SIRS associated with atrial fibrillation (AF), shock, renal failure (RF) or death was chosen. The association of SIRS with RF, SIRS with shock, SIRS with RF and SIRS with death, as well as each of these events individually were defined as secondary end-points.

SIRS was defined according to the presence of two or more of the following criteria (20): temperature above 38 ºC or below 36 ºC, tachycardia (HR > 90 bpm), tachypnea (RR > 20/min) with hypocapnia (PCO2 < 32 mm Hg) and alterations in white blood cell count (WBC > 12.000/mm3 or < 4.000/mm3 or 10% of immature forms), with the requirement of noradrenaline ≥ 0.5 μ/kg/min. (21)

Postoperative AF was considered as an endpoint when diagnosed by telemetry or electrocardiogram, with more than an hour of duration or electric or pharmacological cardioversion requirement, with no justified causes (anaemia, electrolytic disorders, adrenergic drug bolus), during hospitalization.

The criteria of the Acute Kidney Injury Network were used to define RF, (22) as an acute reduction of the renal function (within 48 hours), diagnosed by an absolute increase of serum creatinine ≥ 0.3 mg/dl, or higher than 50% (1.5 times) with regard to basal value, or reduction to < 0.5 ml/kg/h in the diuresis for more than 6 hours, despite an adequate moisturizing and central venous pressure (CVP).

Vasoplegic shock was defined according to: mean arterial pressure < 50mm or systolic blood pressure (systolic BP) < 80 mm Hg and CVP <5 mm Hg, despite an adequate moisturizing, added to intravenous infusion of noradrenaline in doses higher than 0.5 μg/kg/min, or the requirement of a second vasopresor drug in patients with adequate peripheral perfusion. In case of having a Swan-Ganz catheter, vasoplegic shock was considered when cardiac index was > 2.5 L/min-1m-2, with pulmonary capillary pressure < 10 mm Hg and systemic vascular resistance < 800 dinas.s-1 cm-5. (23).

Statistical analysis

Continuous variables with normal distribution are presented as mean ± standard deviation; T-test was used for the comparisons. Continuous variables with asymmetric distribution are expressed as median and interquartile range and for the comparisons the Wilcoxon signed-rank test, the Kruskall-Wallis and the Wilcoxom rank-sum test were used. Normality was analyzed by histogram, the relation between mean and median, skewness and kurtosis values and the Wilk-Shapiro test.

Regression analysis was started with a simple regression model in order to obtain raw coefficients. In the case of continuous variables the assumption of linearity was controlled.

Then, the variables to include in the multiple model were selected with a parsimonious model due to small n. In the final model, $p < 0.05$ was considered as a marker of statistical significance.

Once selected the variables, which were included manually and verified, were reintroduced when finishing the model to assure they were correct, especially in the case of important biological variables. Each of them was evaluated by Wald, LR test and the coefficient variation with regard to the estimated for that variable in the simple model.

In the case of continuous variables linearity was evaluated with graphical models.

All the analyses were analyzed with the STATA 9.0 (STATA Corporation, College Station, TX ®) software.

In addition to CRP analysis as a continuous variable, the cohort was divided into low or elevated levels of CRP. CRP cutoff was determined in 2 mg/dl, which was the value that better described the risk of the primary event by ROC curve, with a sensitivity of 65% and a specificity of 74%.

Likewise, preoperative CRP value was divided into quartiles to evaluate its association with the combined endpoint.

RESULTS

Of the total of 176 patients admitted for cardiovascular surgery, 7 were excluded (2 with diagnosis of infected endocarditis, 3 with diagnosis of aortic dissection, 2 in emergency of cardiac transplant). A total of 169 patients were included. The clinical characteristics of the studied population are presented in Table 1 (global). In 39.1% (66 patients) myocardial revascularization surgery (MRS) was performed, in 32% (54 patients) valvular procedures, in 18.3% (31 patients) combined valvular and revascularization procedures and in 10.8% (18 patients) congenital heart disease surgery or ascending aorta surgery. Parsonnet and EuroSCORE risk scores with a mean of 16 and 9.46 respectively were used.

Hospital mortality was of 5.6% (9 patients). A total of 54% of the patients showed SIRS (87 patients), 28.4% evolved with AF (48 patients), 32.5% with RF (55 patients) and 10.6% had shock diagnosis (18 patients).

The best cutoff which identified the group with a higher rate of events in our population was a preoperative level of CRP of 2 mg/dl. Those patients with CRP ≥ 2 mg had more cerebrovascular accidents (CVA) antecedents (5% vs. 15%; p=0.036). There were no significant differences in the preoperative clinical variables, risk stratification by scores or the medication used (Table 1). In Tables 2 and 3 the appearance of the primary final event and secondary events according to CRP preoperative levels are detailed. In those patients with preoperative levels of CRP ≥2 mg/dl, the combined endpoint occurred in 45% (37 patients), unlike 15% (13 patients) with CRP < 2 mg/dl (OR 3.58, HF 95% 1.66-7.72; p< 0.000). The relation between CRP and the primary event was evaluated dividing the sample into quartiles (Q1-Q4) of CRP. The obtained samples showed for Q1 (CRP < 0.9 mg/dl) an OR of 0.48 (0.22-1.05; p= 0.068), for Q2 (1-1.19 mg/dl) an OR of 0.38 (0.06-0.92; p= 0.028), for Q3 (2-5.4 mg/dl) an OR of 1.99 (0.73-5.42; p=0.177) and for Q4 (> 5.4 mg/dl) an OR of 4.87 (1.57-15.11; p= 0.0006).

In turn, those patients with basal levels of CRP ≥ 2 mg/dl had more SIRS (OR 3.26, HF 95% 1.74-6.15; p= 0.000) and the combined secondary endpoints of SIRS+AF were more frequent (48.6% vs. 18.6%, OR 4.15, HF 95% 1.54-11.21; p< 0.005), SIRS+ renal failure (62.5% vs. 20.8%, OR 6.06, HF 95% 2.47-14.91; p < 0.000), SIRS+ shock (32.4% vs. 6%, OR 7.11, HF 95% 1.84-27.4; p=0.004) and SIRS associated with death (17.2% vs. 4%, OR 1.04-29.4; p < 0.045). An association between preoperative levels of CRP with the development of renal failure (44.4% vs. 21.3%, OR 2.76-HF 95% 1.4-5.45; P < 0.003) and shock (17.3% vs. 5%, OR 3.85, HF 95% 1.22 -12, 10; p < 0.021) was also observed. There was a non significant tendency to higher mortality in the group of preoperative levels of CRP ≥ 2 mg/dl (8.6% vs. 2.5%; p < 0.07).

The variables included in the univariate analysis

Table 1. Population and procedural characteristics

	Global	Global	Global	p
N	169	87	82	
Age, years	61.1 (15.9)	59.8 (18)	61.8 (14,1)	0.32
MAle, % (n)	77.3 (128)	73.1 (65)	79.0 (63)	0.22
Parsonnet (DE)	16.0 (15.1)	14.6 (14,8)	17.8 (15,9)	0.26
EuroSCORE (DE)	9.46 (12.7)	7.7 (9,8)	11.7 (15,3)	0.09
Hypertension, % (n)	68 (116)	66.3 (58)	70.3 (58)	0.64
Diabetes, % (n)	17.2 (29)	20 (17)	13.6 (12)	0.35
Dyslipidemia, % (n)	59.2 (100)	58.8 (52)	58 (48)	0.92
Nicotinism (Smoking), % (n)				
- Present	13.6 (24)	8.8 (8)	19.8 (16)	0.08
- Previous	33.1 (56)	31.3 (27)	34.6 (29)	0.08
Obesity, % (n)	47.9 (82)	45 (38)	54.3 (44)	0.47
Previous AMI, % (n)	18 (30)	15.2 (13)	22 (17)	0.42
Previous revascularization				
- TCA % (n)	10.7 (18)	10 (9)	10 (9)	0.76
- MRS, % (n)	8.9 (15)	11.3 (9)	7.5 (6)	0.78
CVA, % (n)	10.1 (17)	5 (4)	15 (13)	0.036
Peripheral vascular disease, % (n)	15.5 (26)	12.5 (11)	20 (15)	0.31
Chronic renal failure, %(n)	14.9 (25)	10 (9)	20 (16)	0.09
COPD, % (n)	9.5 (16)	5 (4)	15 (12)	0.06
Medication				
- Aspirin, % (n)	33 (56)	30 (26)	33.8 (30)	0.38
- Beta-blockers, % (n)	54.2 (92)	50 (44)	55 (48)	0.30
Statins, % (n)	41.9 (71)	37.5 (34)	45.6 (37)	0.27
LVDD, mm (n)	52.6 (7,9)	52.6 (8)	52.1 (8,1)	0.61
CRP, mg/dl (interquartile range)	1.8 (1,2-5,2)	1.2 (0.9-1.4)	5.2 (2,9-11)	
Type of surgery				
- MRS, % (n)	39.1 (66)	33.8 (29)	40.7 (37)	0.46
- Valvular, % (n)	32 (54)	37.5 (33)	29.6 (21)	0.40
- Combined, % (n)	18.3 (31)	17.5 (15)	18.5 (16)	0.78
- Other, % (n)	10.7 (18)	11.3 (10)	11.1 (8)	0.82
CT, min (SD)	115.7 (58.3)	106.5 (44.1)	125.3 (69,6)	0.55

SD: Standard deviation. AMI: Acute myocardial infarct. TCA: Transluminal coronary angioplasty. MRS: Myocardial revascularization surgery. CVA: Cerebrovascular accident. COPD: Chronic obstructive pulmonary disease. LVDD: Left ventricle diastolic diameter. CRP: C-reactive protein. Combined: Valvular surgery associated with revascularization. Other: Congenital heart disease surgeries or ascending aorta surgery. CT: Clamp time.

are detailed in Tables 1 and 2.

Those variables that obtained p values considered as significant with their corresponding OR for the combined endpoint in the univariate analysis are shown in Table 4. Those variables associated independently with the combined endpoint in the multivariate analysis (Table 5) were the preoperative CRP levels (OR 3.31, HF 95% 1.41-7.74; p < 0.006), the left ventricle diastolic diameter (LVDD) (OR 1.08, HF 95% 1.02-1.15; p< 0.025) and the clamp time (CT) expressed in minutes (OR 1.01, HF 95% 1.00-1.02; p < 0.030).

When performed univariate and multivariate secondary endpoints analysis (see Table 3), the variables that showed a statistically significant association with SIRS were CRP preoperative levels (OR 2.75, HF 95% 1.36-5.55; p < 0.005), LVDD (OR 1.04, HF 95% 1.00 -1.10; p < 0.046) and CT (OR 1.01, HF 95% 1.00-1.02; p < 0.027).

CRP preoperative levels (OR 9.95, HF 95% 2.44-40.5; p < 0.01), Parsonnet score (OR 1.10, HF 95% 1.04-1.16; p < 0.001), preoperative RF antecedent (OR 21.2, HF 95% 2.18-207.58; p < 0.008) and CT (OR 1.02, HF 955 1.01-1.04, p < 0.005) were associated with complicated SIRS with RF.

Elevated preoperative CRP level was predictor of SIRS with AF (OR 4.44 HF 95% 1.53-12.85; p < 0.006), together with CT (OR 1.01, HF 95% 1.01-1.03; p < 0.004) and the preoperative level of CRP was associated in a statistical significant way (OR 5.96, HF 95% 1.17-30.47; p < 0.032) with the development of SIRS + shock together with Parsonnet score (OR 1.06, HF 955 1.02-1.11; p < 0.001) and with the appearance of RF in the postoperative (OR 3.28 HF 95% 1.22-8.79; p < 0.018), together with Parsonnet score (OR 1.09, HF 95% 1.04-1.13; p < 0.000) and the antecedent of preoperative RF (OR 74.54, HF 95% 8.64-643.37; p < 0.000).

The development of shock in the postoperative was independently associated with the preoperative elevated CRP levels (OR 4.11, HF 95% 1.08-15.63; p < 0.038) and CT (OR 1.07, HF 95% 1.04-1.11; p < 0.000).

Table 2. Primary final event and secondary events according to preoperative levels of CRP.

	CRP < 2	CRP ≥ 2	p
Combined (SIRS + AF + RF + shock + death), % (n)	15 (13)	45 (37)	0.000
SIRS, % (n)	38 (33)	65,8 (54)	0.000
SIRS + AF, % (n)	18.6 (16)	48.6 (40)	0.004
SIRS + RF, % (n)	20.8 (18)	62.5 (51)	0.000
SIRS + shock, % (n)	6 (5)	32.4 (27)	0.002
SIRS + death, % (n)	4 (3)	17.2 (14)	0.028
AF, % (n)	26.3 (23)	30.9 (25)	0.55
RF, % (n)	21.3 (19)	44.4 (36)	0.003
Shock, % (n)	5 (4)	17.3 (14)	0.015
Death, % (n)	2.5 (2)	8.6 (7)	0.074

SIRS: Systemic inflammatory response syndrome. AF: Atrial fibrillation. RF: Renal failure.

Table 3. Association between preoperative C-reactive protein ≥ 2 mg/dl and the secondary endpoints.

	OR	HF 95%	p
SIRS	3.26	3.26	< 0.000
SIRS + AF	4.15	4.15	< 0.005
SIRS + RF	6.06	6.06	< 0.000
SIRS + shock	7.11	7.11	< 0.004
SIRS + death	5.54	5.54	< 0.045
Death	3.85	3.85	< 0.094
RF	2.76	2.76	< 0.003
Shock	3.85	3.85	< 0.021

SIRS: Systemic inflammatory response syndrome. AF: Atrial fibrillation. RF: Renal failure.

DISCUSSION

In this study, preoperative levels of CRP ≥ 2 mg/dl were independently associated with higher risk of SIRS associated with AF, RF, shock or death, as well as with SIRS, SIRS with AF, SIRS with RF and SIRS with shock.

SIRS is a frequent complication in the postoperative of cardiac surgery if the classification of the AHA/ACC is taken into account. (20) In most of the cases its evolution is favourable; however 1 in10 patients may present vasoplegic shock; which has a high mortality when it produces splanchnic failure. Some of the identified predisposing factors are: treatment with vancomycin, opiates, midazolam, angiotensin converting enzyme inhibitors, calcium blockers, heparin, milrinone, isoflurane, ethylene oxide and protamine, blood contact with the plastic material of cardiopulmonary circuit bypass and blood, normothermic and enriched cardioplegia. (24)

However, the responses may vary among individuals, which suggest genetic differences. (6)

On the other hand, a state of underlying inflammation, not identified by clinical parameters and routine laboratory, may influence in the postoperative evolution. (12, 18) Among the inflammation biomarkers, CRP is the most widely used. (25)

Specificity in the preoperative levels of CRP to predict complications in MRS with extracorporeal circulation (EC) is controversial. (11, 12, 14, 16, 18, 19, 26, 27)

There is evidence that AF is associated with systemic inflammation occurred in the perioperative of cardiac surgery. (25) Elevated basal levels of CRP may identify high risk patients. (28, 29) Its elevation is associated with a high incidence of AF in the postoperative of cardiovascular surgery (20-50%) and AF involves higher CVA risk, renal failure, longer stay in hospital and mortality. (28, 29, 30)

Likewise, according to the criteria used, between 3% and 30% of the patients present postoperative

Table 4. Univariate analysis of the primary endpoint

	OR	p
Age, years	1.01/year	0.01
Male	1.9	0.000
Parsonnet	1.03/endpoint	0.042
EuroSCORE	1.04/endpoint	0.064
Hypertension	1.71	0.141
Diabetes	0.91	0.834
Dyslipidemia	1.00	0.990
Nicotinism (Smoking)		
- Present	1.79	0.315
- Previous	1.08	0.829
Obesity	1.01	0.975
Previous AMI	2.61	0.092
Previous revascularization		
- TCA	0.67	0.468
- MRS	0.27	0.017
CVA	0.62	0.371
Peripheral vascular disease	1.59	0.383
Chronic renal failure	1.64	0.000
COPD	1.07	0.909
Medication, %		
- Aspirin	0.73	0.386
- Beta-blockers	0.76	0.446
- Statins	0.93	0.843
LVDD, mm	1.08	0.004
CRP, mg/dl	1.04	0.001
CT, min	1.01	0.016

AMI: Acute myocardial infarct. TCA: Transluminal coronary angioplasty. MRS: Myocardial revascularization surgery. CVA: Cerebrovascular accident. COPD: Chronic obstructive pulmonary disease. LVDD: Left ventricle diastolic diameter. CRP: C-reactive protein. CT: Clamp time.

Table 5. Multivariate analysis for the combined endpoint

	OR	HF 95%	p
Preoperative CRP, ≥ 2 mg/dl	3.31	1.41-7.74	< 0.006
LVDD, mm	1.08	1.02-1.15	< 0.025
CT, min	1.01	1.00-1.02	< 0.030

Preoperative CRP: Preoperative C-reactive protein. LVDD: Left ventricle diastolic diameter. CT: Clamp time.

renal dysfunction; this complication has an influence on postoperative morbidity and mortality. Despite a multifactorial origin, the inflammatory response is one of the associated factors with this complication. (16) In turn, renal filtration helps in the purification of cytokines, so postoperative renal dysfunction may has an influence on the evolution and importance of the inflammatory response and in this way favour other greater complications, including perpetuation of renal dysfunction. (16, 31) A recent study made by Kim et al. showed an association between the preoperative levels of CRP and renal dysfunction in the postoperative. (16)

Previous studies done in patients undergoing thoracic surgery demonstrated that preoperative levels of CRP were related to the postoperative complications. (32)

Similar results were observed in cardiovascular surgery with evidence of early bypass occlusion, (29) increased incidence of RF, (14) infections, and hospital mortality. (12) Most of the information comes from patients undergoing MRS, to whom CRP predicted mortality at 9 months, but with curves that are early separated. (19)

In our study, CRP ≥ 2 mg/dl was associated independently of preoperative and intraoperative variables with the appearance of complications in the postoperative in a cohort of patients undergoing different procedures of cardiovascular surgery with cardiopulmonary bypass. The upper quartile was the one associated with higher risk of events (OR 4.87).

Limitations

The number of patients is not enough to define the differences in mortality, for which an expected mortality of 5.6% and a difference of risk of 30% among the patients with CRP ≥ 2 and < 2 and a power of 0.8, n= 1370 patients would be required.

The used CRP is of intermediate sensitivity; however, previous studies have demonstrated adequate sensitivity and specificity of this marker to predict cardiovascular events. (33) Likewise, it would allow a massive use of this measurement due to its lower cost.

CONCLUSIONS

Preoperative levels of CRP ≥ 2.0 mg/dl were associated with a higher risk of SIRS, RF, AF, shock and death in the postoperative. A higher risk of renal failure and shock in patients with and with no SIRS was observed.

RESUMEN

Asociación de valores de proteína C reactiva preoperatoria con complicaciones en el posoperatorio de cirugía cardiovascular

Introducción

El síndrome de respuesta inflamatoria sistémica es una complicación frecuente en el posoperatorio de cirugía cardíaca, que puede evolucionar con shock vasopléjico y los casos más graves pueden derivar en falla de uno o más órganos. Se describieron predictores en el preoperatorio y el perioperatorio asociados con esta complicación; sin embargo, un estado de inflamación subclínico en la etapa preoperatoria, no detectado por estudios de rutina, podría relacionarse con la respuesta inflamatoria desencadenada en el posoperatorio. Niveles elevados de proteína C reactiva (PCR), un parámetro de inflamación en diferentes escenarios clínicos y que se asocia con el pronóstico de diversas patologías cardiovasculares, podrían predecir el síndrome.

Objetivo

Evaluar la contribución de la elevación de los niveles

preoperatorios de proteína C reactiva para predecir el síndrome de respuesta inflamatoria sistémica y sus complicaciones posoperatorias en cirugía cardíaca.

Material y métodos

Se incluyeron 169 pacientes consecutivos, prospectivos (77,3% hombres, edad 61,1 ± 15,9, Euroscore 9,46 [DE 12,7]) sometidos a cirugía cardíaca entre abril de 2007 y diciembre de 2008. Se determinó el nivel de PCR en todos los pacientes. El punto final combinado incluyó síndrome de respuesta inflamatoria sistémica y su asociación con fibrilación auricular, insuficiencia renal, shock o muerte.

Resultados

Ochenta y siete pacientes (54%) desarrollaron el síndrome de respuesta inflamatoria sistémica y 50 pacientes (31%) presentaron el punto final combinado. La mortalidad intrahospitalaria fue del 5,6% (9 pacientes).

Ajustados por variables preoperatorias e intraoperatorias, los niveles preoperatorios de PCR ≥ 2 mg/dl se asociaron independientemente con el punto final combinado (OR 2,95; IC 95% 1,20-7,23; p < 0,018), con la evolución con síndrome de respuesta inflamatoria sistémica (SRIS) (OR 2,46; IC 95% 1,17-5,15; p < 0,000), SRIS combinado con insuficiencia renal (OR 5,10; IC 95% 1,48-17,58; p < 0,010), SRIS combinado con shock (OR 6,50; IC 95% 1,59-27,34; p < 0,005), SRIS combinado con fibrilación auricular (OR 3,51; IC 95% 1,14-10,79; p < 0,028), insuficiencia renal (OR 2,91; IC 95% 1,19-7,12; p < 0,019) y shock (OR 4,13; IC 95% 1,25-13,60; p < 0,020).

Conclusiones

Los niveles preoperatorios de PCR ≥ 2,0 mg/dl pueden predecir el síndrome de respuesta inflamatoria sistémica y el síndrome de respuesta inflamatoria sistémica con insuficiencia renal, fibrilación auricular, shock y muerte en el posoperatorio de cirugía cardíaca.

Palabras clave > Cirugía torácica - Proteína C reactiva - Inflamación - Complicaciones posoperatorias

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Conflict of interest statement

Authors declare no conflict of interests.