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Mortality in Patients Undergoing Open Aortoiliac Surgery: Prognostic Value of Troponin T in the Immediate Postoperative Period

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Background: Patients undergoing open aortoiliac surgery constitute a high-risk subgroup. The aim of this study was to evaluate the relationship between postoperative troponin T (TnT) elevation with the associated postoperative mortality, and mean hospital stay.

Methods: This was a prospective observational study of consecutive patients who underwent open aortoiliac surgery during 2006. TnT levels in the first 72 hours after the operation, immediate mortality, postoperative care unit stay, and total postoperative hospital stay were recorded. Statistical analyses were performed with the program SPSS 14.0; the chi-square test (or the Fisher's exact test) was used for qualitative variables and the Mann−Whitney test for quantitative variables.

Results: Of the 65 patients included in the study, postoperative TnT was elevated in 14 (21.5%) patients. No significant differences were found in age, sex, hypertension, dyslipidemia, smoking, diabetes mellitus, ischemic heart disease, heart failure, bronchopathy, or renal failure between groups. Mortality in patients with elevated TnT levels was significantly higher (42% compared with 3.92%; relative risk 10.93 ± 0.76; $p = 0.001$). Likewise, their mean postoperative intensive care unit stay was significantly greater (23.21 ± 6.96 days compared to 2.86 ± 1.96; $p < 0.001$). This finding resulted in a significantly longer postoperative hospital stay (32.57 ± 25.38 days compared with 12.47 ± 2.21).

Conclusion: TnT level in the immediate postoperative period is a highly relevant indicator of prognosis in patients undergoing major vascular surgery.

INTRODUCTION

Open aortoiliac surgery is a surgical procedure that involves laparotomy to act directly on the abdominal aorta artery, the iliac arteries, or their main branches. Despite the development in endovascular techniques in the past years, and the existence of extra-anatomic revascularization techniques, it still represents almost 50% of the procedures performed to treat the pathology in this sector in our environment.[1]

These techniques constitute aggressive procedures because patients undergo significant surgical stress from dehydration and heat loss caused by peritoneal cavity exposition. It also involves the need for aortic clamping, which leads to hemodynamic stress and cardiac overload. The blood loss is far from negligible, and the postoperative period is frequently prolonged because of an associated postoperative paralytic ileus. Nevertheless, the good long-term results it has in both occlusive and aneurysmatic disease often compensates for all these drawbacks.[2,3] However, it still should not be

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forgotten that these procedures are being used on high-risk patients. Vascular patients generally have coronary disease, which is often asymptomatic and therefore unknown.[4] High rates of coronary events and cardiovascular death have been reported in the immediate and late postoperative period for these patients.[5]

The troponins are a group of proteins present in the contractile unit of the heart muscle tissue. They are released into the blood when there is myocardial damage, which makes them a sensitive, specific indicator of heart damage.[6] Their main use lies in the area of acute coronary syndromes; however, troponin levels also rise when there is heart damage from other causes (e.g., arrhythmias, decompensated heart failure), as well as in the presence of chronic renal failure. They also have a demonstrated prognostic value for mortality in acute coronary syndromes.[7]

Bearing all of this in mind, the aim of this study was to evaluate the relationship between elevated troponin T (TnT) levels, immediate postoperative mortality, care unit stay, and total postoperative hospital stay for patients undergoing major aortoiliac surgery.

MATERIALS AND METHODS

A prospective observational study of patients who underwent open aortoiliac vascular surgery in our center was designed. We included all patients scheduled for elective surgery during the year 2006.

Preoperative Evaluation

All the patients received a preoperative assessment consisting of medical history, physical examination, hemogram, biochemical and hemostasis blood analysis, electrocardiogram (ECG), spirometry, and chest x-ray. Patients having a history of cardiac pathology or an altered ECG were also evaluated by a cardiologist, selectively undergoing a test for detection of myocardial ischemia and/or cardiac catheterization at the specialist's discretion. Finally, all the patients were given an evaluation by an anesthesiologist on the basis of their physical status using the American Society of Anesthesiologists (ASA) classification.

TnT Level Determination

The patients were divided into two groups depending on whether their TnT levels were elevated in the immediate postoperative period. The determination was performed after they were admitted to the intensive care unit (ICU), once a day for three days. The maximum value from the three samples obtained for each patient was used for determining the patient group. TnT levels were established by immunochemiluminescence in the central laboratory at our hospital. This method has a minimum sensitivity of 0.01 ng/mL, a level above 0.1 ng/mL being considered a significant elevation.

Electrocardiograph Monitoring

A 12-lead ECG was performed on all patients once a day for the first 72 hours. Additional studies were also performed throughout patient stay if they showed cardiac signs or symptoms, elevated myocardial damage indicators, or ECG alterations on continuous monitoring.

Variables Recorded

The patient variables recorded were age, sex, main vascular diagnosis, intervention type (Table I), vascular risk factors (hypertension, diabetes mellitus, dyslipidemia, and smoking), comorbidity risk factors (chronic ischemic heart disease, congestive heart failure, chronic obstructive pulmonary disease, and chronic renal failure), and ASA classification.

The variables analyzed were survival at discharge, ICU stay, total postoperative hospital stay, cause of death, and development of acute coronary syndrome (as defined by the Joint European Society of Cardiology/American College of Cardiology Committee in 2000).[8]

Statistical Analyses

Statistical analysis was performed with SPSS 14.0 software. The tests used were the chi-square (or Fisher's exact test, if applicable) for the qualitative variables and the Mann−Whitney test for the quantitative. The significance level accepted was 5%. Homogeneity testing was performed for the two groups, and statistical association tests were carried out on elevation or not of TnT levels, survival to discharge, ICU stay, and total postoperative hospital stay. (Values were indicated as mean ± standard deviation).

RESULTS

Sixty-five patients were included in this study. No intraoperative deaths were registered in the first 72 hours. There were 61 male patients (93.85%) with a mean age of 65.57 ± 9.34 years. As to vascular risk factors, 41.54% of the patients were hypertensive, 20% were diabetic, 39.92% were dyslipidemic,

Table I. Surgical procedures

Procedures	Total 65 procedures
Aortobifemoral bypass	30 patients
Abdominal aortic aneurysm open surgery	21 patients
Iliofemoral bypass	8 patients
Aortoiliac thromboendarterectomy	2 patients
Other procedures:	4 patients
Infected abdominal vascular graft excision	2 patients
Thoracoabdominal aortic aneurysm (endoprosthesis and visceral retrograde revascularization)	1 patient
Synchronous thoracic endograft and abdominal aortic aneurysm open surgery	1 patient

Table II. Cohorts comparison

	Normal Tn T	Risen Tn T	*p*
Age (years)	64.37	69.93	0.056
Sex (masculine)	96.10%	84.70%	0.2
Arterial hypertension	47.10%	64.30%	0.367
Diabetes mellitus	21.60%	14.30%	0.717
Dyslipidemia	41.20%	21.40%	0.175
Tobacco use	74.50%	78.60%	0.529
Ischemic heart disease	13.70%	35.70%	0.113
Chronic heart failure	3.90%	0%	0.613
Chronic obstructive pulmonary disease	3.90%	0%	0.613
Chronic renal failure	7.80%	14.30%	0.602
Mean ASA	2.43	3.08	0.005

Table III. Results

	Risen Tn T	Normal Tn T	*p*
Mortality (%)	42%	3.92%	0.0001
ICU stay (mean/median, in days)	23.21/3	2.86/2	< 0.0001
Total hospital stay (mean/median, in days)	32.57/14.5	12.47/10	NS

NS, nonsignificant.

and 75.38% were smokers. Associated comorbidity was chronic ischemic heart disease in 18.46% of the cases, congestive heart failure in 3.08%, chronic obstructive pulmonary disease in 3.08%, and chronic renal failure in 9.23 %.

Regarding the preoperative anesthesiologist risk (ASA classification), 4 (6.2%) patients were ASA 1, 26 were ASA 2 (40%), 30 were ASA 3 (46.2%), and 5 were ASA 4 (7.6%). Of the 12 patients with chronic ischemic heart disease, two had been revascularized (one by surgery and the other by coronary angioplasty and stent). Fifteen patients (23%) were evaluated by a cardiologist in the preoperative period. Ischemia detection tests (stress ECG with dipyridamole) were performed on four patients, one resulting positive; however, revascularization was not carried out because this patient had been considered not revascularizable in a prior cardiac catheterization. A diagnostic cardiac catheterization, which did not show any significant lesions, was also carried out on one patient before surgery.

TnT levels rose in 14 patients (21.54%), of whom six died, whereas only two deaths occurred among the 51 patients with normal levels. No statistical differences were found in age, gender, vascular risk factors, or comorbidity between the two groups. There were significant differences in mean ASA (Table II). Of the 14 patients with elevated TnT, 11 presented a noncomplicated clinical status (corresponding to a normal postoperative condition) when enzymatic levels were determined.

Global mortality was 12.31%, with statistically significant differences between both groups (3.92% in patients with normal TnT levels compared with 42% in patients with elevated TnT; $p = 0.0001$). The relative risk was 10.93 (95% confidence interval, 2.47-48.35). ICU stay was also longer in the patients with elevated TnT (23.21 ± 6.96 days compared with 2.86 ± 1.96; $p < 0.001$). However, there was no statistical significance in the mean postoperative hospital stay, although it was longer in the group with elevated TnT levels (32.57 ± 25.38 days compared with 12.47 ± 2.21) (Table III).

Only one case of perioperative myocardial infarction was found, diagnosed by elevated TnT levels together with ECG criteria in the absence of chest pain; the patient was among the survivors.

Multiorgan failure and hospital-acquired pneumonia were the dominant causes of patient death, no death being attributable to myocardial ischemia (Table IV).

DISCUSSION

It has been clearly established that high mortality rates, particularly from cardiac causes, and major cardiovascular events in the immediate postoperative period exist among vascular patients.[9-16]

Table IV. Death summary

Patient age (yr)	Procedure	Death cause	Tn T level	Death postoperative day
74	Abdominal aortic aneurysm open surgery	Acute mesenteric ischemia	0.233 ng/mL	4
75	Thoracoabdominal aortic endograft, aortoceliac and aortomesenteric bypass	Multiorganic failure	0.089 ng/mL	133
67	Infected aortobifemoral graft excision and new axilobifemoral bypass	Multiorganic failure	< 0.01 ng/mL	22
75	Aortobifemoral bypass	Ischemic stroke	0.104 ng/mL	6
83	Abdominal aortic aneurysm open surgery	Multiorganic failure	0.195 ng/mL	13
62	Aortobifemoral bypass	Hospital acquired pneumonia	0.166 ng/mL	14
71	Symptomatic abdominal aortic aneurysm open surgery	Ventilator associated pneumonia	1.08 ng/mL	130
77	Aortobifemoral bypass	Multiorganic failure	< 0.01 ng/mL	47

Nevertheless, the rate of perioperative myocardial infarcts in our series was low, only a single case being found. Likewise, on analyzing the cause of death, we confirmed that none were of exclusively cardiac origin; multiorgan failure and intrahospital pneumonia, which are more characteristic of prolonged stays in ICUs, predominated.

The diagnosis of postoperative myocardial ischemia is difficult to establish, as much because of patient characteristics (absence of chest pain, stemming from analgesia and sedation) as to the different physiopathology of myocardial ischemia in surgical patients. It is known that minimal elevations in TnT levels reflect subclinical myocardial damage, not necessarily because of an acute coronary syndrome, as Abraham et al. indicated.[17] Surgical stress produces a systemic inflammatory response with catecholamine increase that affects cardiac function indirectly and can lead to progressive worsening of other processes that are the final cause of death. However, we cannot infer a direct causal relationship from our study results, although we feel that this is a working hypothesis that should be investigated in more in-depth pathological studies.

In this respect, elevated TnT levels in absence of acute coronary syndrome behaved as an early indicator for prognosis of mortality, given that there were no deaths in the first 72 hours and, in fact, most of the deaths occurred various days or weeks after this parameter increased.

The longer mean ICU stay found for the patients with elevated TnT is an indirect estimator of severe postoperative complications. It must still be determined whether the complications involved in a longer stay were the direct cause of cardiac alterations (manifested by elevation of TnT levels) or whether these patients' complications contributed to the development of subclinical myocardial damage.

When reviewing the published data, increase in mortality from all causes and long-term reports of major cardiovascular events (not only in the immediate postoperative period) for vascular patients are also worthy of note.[18-21] Likewise, several studies have pointed out how important an elevation in preoperative TnT is as a risk indicator in specific populations, even in the absence of clinically symptomatic acute coronary pathology at the time TnT levels are determined.[22-24]

Clinical practice guidelines on preoperative cardiologic risk evaluation include vascular interventions among those that involve the greatest risk of perioperative cardiac complications. The guidelines insist on multidisciplinary management in evaluating preoperative risk by a selective application of diagnostic tests, depending on procedure urgency, intervention type, and specific patient factors, because really few patients benefit from a prior prophylactic coronary revascularization.[25]

In evaluating the comparability of our two groups, it should be noted that there was a greater incidence of chronic ischemic heart disease in the patients in whom TnT levels rose, although this did not reach statistical significance. It would be advisable to carry out a multivariate analysis to detect possible factors of confusion that might have influenced our results, but the limited number of cases makes it impossible to determine this reliably.

Finally, it should be pointed out that our series is composed of a heterogeneous patient sample, including cases that ranged from low-risk interventions, such as iliofemoral bypasses, to high-risk procedures, such as prosthetic infections and thoraco-abdominal aneurysms. The mortality rate encountered undoubtedly reflects this.

CONCLUSION

Elevation of TnT levels in the immediate postoperative period in patients undergoing open aortoiliac surgery in our center is significantly related to greater intrahospital mortality rate from all causes and to a longer ICU stay. Routine establishment of this parameter could be useful as a short-term prognostic indicator of survival in major vascular surgery.

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