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Short Communication

Troponin I elevation after elective percutaneous coronary interventions: Prevalence and risk factors

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ABSTRACT

Troponin elevation after coronary angioplasty is a prognostic marker associated with significant morbidity and mortality, although its prevalence varies according to clinical and procedural characteristics. We analyzed the frequency of post-procedural enzyme elevation among 112 elective interventions between 2013 and 2014 in a private hospital in Brazil. Troponin increase was observed in 62.5% of the procedures, and was related to age, female sex, low pre-procedural hemoglobin, prior angiotensin converting enzyme inhibitor or angiotensin receptor blocker use and multivessel angioplasty. PCI is not a risk free procedure and these results underscore the importance of a careful clinical assessment before its utilization.

Although the number of percutaneous coronary interventions (PCI) has declined in many countries, 955,000 procedures were still done in the United States in 2010.[1] In some countries, such as India and Brazil, the procedure count is still rising.[2,3] Also, in-hospital mortality and complications could occur in up to 1.31% and 11.5% of patients, respectively.[1,4] The prevalence of myocardial necrosis after PCI varies according to the criteria and biomarkers used for diagnosis. Troponin I (TnI) elevation has been found in 16–73% of patients, and is associated with an increase in mortality as high as 45%, according to multiple meta-analyses.[5–7] Additionally, 20% of these patients have a cardiovascular event during hospitalization, further illustrating the prognostic value of this endpoint.[6] Levels above 5 times the 99th percentile predict an even worse outcome, and similar findings involving high-sensitivity (HS) assays have also been described.[8]

Clinical, angiographic and procedure related conditions have been shown to be predictors of enzyme elevation after PCI. Older age, diabetes mellitus, heart failure, anemia, renal insufficiency, baseline elevated TnI, peripheral atherosclerosis, multivessel disease, multistenting, bifurcation lesions, calcified arteries and intraluminal thrombi are significant known risk factors.[9,10] The purpose of this study was to measure the prevalence of TnI elevation after elective PCI and to determine new potential risk factors associated with this outcome.

Consecutive patients submitted to PCI were screened between January 2013 and December 2014 in a private hospital in Rio de Janeiro, Brazil. Clinical, angiographic and procedural characteristics were collected retrospectively by chart review. Only elective procedures were included, and were defined by absence of myocardial infarction (MI) in the preceding 2 weeks to the intervention. Patients hospitalized for more than 7 days before the procedure and those with sepsis or active cancer were also excluded. Coronary obstructions ≥70% were considered relevant to determine the number of diseased vessels. Only those with at least 1 TnI (Abbot Laboratories, Architect STAT Troponin I or Architect High Sensitive STAT Troponin I) measured between 6 and 24 h post-PCI were included. Levels above the 99th percentile were considered elevated, and were defined differently for men (>0.033 ng/ml or >34.2 pg/ml for HS TnI) and women (>0.013 ng/ml or >15.6 pg/ml for HS TnI). In accordance with the Declaration of Helsinki, the study was approved by the hospital's human research committee and informed consent was not considered necessary.

Stata® 11.0 was used for statistical analysis. Collected data were correlated with any or ≥5 times the 99th percentile TnI elevations. Categorical variables were analyzed with Pearson's

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Table 1
Clinical, angiographic and procedural characteristics according to TnI elevation.

Patient characteristics	Total (%)	TnI > 99th percentile (%)	TnI ≤ 99th percentile (%)	*p* value
Total patient-procedures	112	70 (62.5)	42 (37.5)	–
Mean age, yrs (SD±)	70.7 (11.3)	72.9 (11.3)	67.0 (10.6)	**0.008**
Male	97 (86.6)	80	97.6	**0.009**
College education	70 (62.5)	58.6	69.0	0.268
Hypertension	103 (92)	92.9	90.5	0.726
Diabetes	40 (35.7)	32.9	40.5	0.415
Hyperlipidemia	98 (87.5)	87.1	88.1	1.0
Body mass index ≥30 kg/m^2	26 (23.2)	24.3	21.4	0.729
Heart failure or LVD	18 (16)	20	9.5	0.188
Mean hemoglobin, mg/dl (SD±)	13.1 (1.46)	12.8 (1.58)	13.5 (1.12)	**0.017**
Mean creatinine, mg/dl (SD±)	1.14 (0.5)	1.15 (0.47)	1.13 (0.56)	0.832
Current or prior tobacco use	37 (33)	32.9	33.3	0.959
Prior MI or symptomatic CAD	82 (73.2)	70	78.6	0.321
Prior PCI	56 (50)	45.7	57.1	0.242
Prior CABG	23 (20.5)	21.4	19.0	0.763
Pre-procedural medications[a]				
Aspirin	82 (73.2)	67.1	83.3	0.08
Clopidogrel	50 (44.6)	42.9	47.6	0.624
β-Blockers	50 (44.6)	45.7	42.9	0.768
ACEi or ARB	63 (56.3)	67.1	38.1	**0.003**
CCB	32 (28.6)	32.9	21.4	0.195
Statins	82 (73.2)	72.9	73.8	0.912
Angiographic and procedural aspects				
Multivessel disease[b]	45 (40.2)	44.3	33.3	0.252
2 Vessels	29 (25.9)	–	–	
3 Vessels	16 (14.3)	–	–	
Multivessel angioplasty[c]	25 (28)	31.4	14.3	**0.046**
Multistenting[d]	45 (40.2)	45.7	31	0.123
High-Sensitivity TnI Measurement	33 (29.5)	31.4	26.2	0.556
Mean TnI Levels, ng/ml (SD±)	0.84 (3.1)	1.31 (3.8)	0.05 (0.1)	**0.036**

TnI – troponin I; MI – myocardial infarction; LVD – left ventricular dysfunction; CAD – coronary artery disease; PCI – percutaneous coronary intervention; CABG – coronary artery bypass grafting; ACEi – angiotensin converting enzyme inhibitors; ARB – angiotesin receptor blockers; CCB – calcium channel blockers.
Bold values are <0.05.
[a] Medication usage at hospital admission.
[b] ≥70% obstruction in ≥2 vessels.
[c] Intervention in ≥2 vessels.
[d] Implantation of ≥2 stents.

χ^2 and Fisher's exact tests. Continuous variables were assessed by 2-sample *t* tests and the Wilcoxon-Mann–Whitney test. Variables with a *p* value <0.1 in the univariate analysis were included in the multivariate model. A *p* value <0.05 was considered significant.

A total of 158 patient-procedures were screened for inclusion, of which 46 were excluded because of recent MI (30), absence of post-procedural TnI levels (7), prolonged hospitalization (4), sepsis (3) or active cancer (2), leaving 112 procedures that were included in the analysis. Eighteen patients had 2 procedures and one patient had 3 during the study period, so the interventions were performed in 92 individual patients. Besides aspirin, a clopidogrel loading dose between 300 and 600 mg was routinely administered during or immediately after the intervention, even to those previously using the medication.

Troponin elevation occurred in 62.5% of the procedures and 68.5% of patients. Clinical, angiographic and procedural characteristics and their relationship to TnI elevation are listed in Table 1. Among the 19 patients with multiple procedures, 16 (84.2%) had at least one intervention with enzyme elevation, although the prevalence within the 39 procedures performed in this group was 58.9%. Greater than 5 times TnI increase occurred in 32.1% of the interventions.

Age, female sex, low pre-procedural hemoglobin, prior angiotensin converting enzyme inhibitor (ACEi) or angiotensin receptor blocker (ARB) use and multivessel angioplasty were related to any TnI elevation. When considering elevations ≥5 times, only age did not remain statistically significant, while previous aspirin use had a protective effect (Table 2). In the multivariate analysis, age ≥70 years, ACEi or ARB use, multivessel angioplasty, and

Table 2
Multivariate predictors of troponin elevation ≥5 times above the 99th percentile.

Predictor	Univariate OR (95% CI)	*p* value	Multivariate OR (95% CI)	*p* value
Female sex	3.89 (1.26–12.0)	0.018	4.17 (1.08–16.16)	**0.039**
Hemoglobin <13 mg/dl	2.89 (1.24–6.77)	0.014	3.1 (1.17–8.2)	**0.022**
Prior aspirin use[a]	0.42 (0.18–0.99)	0.049	0.39 (0.14–1.1)	0.074
ACEi or ARB use	2.27 (0.98–5.26)	0.055	2.67 (0.98–7.28)	0.055
Multivessel angioplasty[b]	2.82 (1.16–6.84)	0.022	3.22 (1.16–8.93)	**0.025**

OR – odds ratio; CI – confidence interval; ACEi – angiotensin converting enzyme inhibitors; ARB – angiotesin receptor blockers.
Bold values are <0.05.
[a] Usage at hospital admission.
[b] Intervention in ≥2 vessels.

absence of previous aspirin use appeared as significant risk factors for any TnI increase, whereas only female sex, pre-procedural hemoglobin <13 mg/dl and multivessel PCI predicted ≥5 times elevations. Also, patients with a college education had a significantly lower mean post-PCI TnI level (0.36 ng/ml SD± 0.72 vs 1.64 ng/ml SD± 4.9, $p = 0.03$). The use of HS TnI did not predict enzyme elevation.

Our study demonstrated a high prevalence of TnI elevation, although still comparable to other publications. The findings that older age, female sex, pre-procedural hemoglobin and multivessel intervention are predictors of enzyme increase are also compatible with other studies.[9,10] Aspirin and college education had a protective effect, which is in accordance to Khawaja et al's findings of a worse prognosis after PCI in patients without at least a high school education.[11] The association of prior ACEi use with TnI elevation has been previously described in a rat model by Mustafa et al., and could be explained by a greater enzyme washout after the artery is opened due to local vasodilation.[12] Other hypotheses include an interference in the TnI assay or its metabolization, or even a greater medication usage among those with heart failure (72.2% × 53.2%), which could act as a confounder.

Troponin increase after elective PCI is a useful surrogate for future adverse clinical events, as numerous publications have shown. These harmful outcomes may result not only from myocardial injury, but also from coronary wall damage and subsequent endothelial dysfunction. Determining the main factors associated with this endpoint is an essential step in improving patient care and prognosis. Our data hypothesize on new possible associations, such as previous ACEi or ARB use and educational status, as well as the potentially protective effect of aspirin, although potential confounders could still have influenced these findings. In conclusion, PCI is not a risk free procedure and these results underscore the importance of a careful clinical assessment before its utilization.

Conflicts of interest

The authors have none to declare.

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