International Journal of Research in Medical Sciences
Baiju R et al. Int J Res Med Sci. 2017 May;5(5):1888-1892
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: http://dx.doi.org/10.18203/2320-6012.ijrms20171812

Original Research Article

Cardiac troponin T estimation post elective stent implantation and prediction of early and late outcomes

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Received: 05 April 2017
Accepted: 15 April 2017

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ABSTRACT

Background: Coronary artery disease (CAD) is a major cause of mortality and morbidity. Per Cutaneous Interventions (PCI) is emerging as the mainstay of treatment for CAD. Periprocedural myocardial necrosis, which can range from a low-level elevation of cardiac biomarkers to a large myocardial infarction, is an important complication of PCI. There are conflicting reports regarding peri-procedural biomarker elevation and adverse outcome. It is in this context we have undertaken this study to assess the prognostic significance of cardiac troponin T elevation after elective stent implantation.

Methods: The study population included 100 consecutive patients who underwent elective PCI with stent implantation in cardiology unit of Medical College, Trivandrum. Serial cardiac enzyme levels were measured in all patients undergoing the procedure. CPK was measured at 8 hrs, 16 hrs and 24 hrs and Troponin T was measured at 8hrs and 24 hrs. post PCI. In hospital events were documented and patients were on follow up for a period of 1 year. Primary endpoints of death, myocardial infarction, recurrent ischemia leading to revascularization were noted.

Results: In our study population of 100 patients there were 87 males and 13 females. Among them 50% had unstable angina, 18% had exertional angina and 32% were post myocardial infarction patients. In this group of hundred patients 79% had single vessel disease, 18% had two vessels and 3% had triple vessel disease. A total of 103 stents were deployed. Mean CPK levels were CPK-1 (80.11+36.19), mean CPK-2 (83.91± 34.8) and mean CPK-3 (86.32+57.80). Mean Troponin T-1 was 0.04+0.1 and mean Troponin-2 was 0.06+0.145. In this study, we compared late onset angina with Troponin and CPK positivity and found that both Troponin-1 & Troponin-2 had significant correlation with late onset angina.

Conclusions: Periprocedural Troponin T is more sensitive than CPK in predicting late events. Thrombus containing lesions and bifurcation lesions were significantly associated with elevation in Troponin T. No significant Troponin T elevations were noted in patients with diabetes mellitus and those containing calcified lesions. Drug eluting stents were associated with a relatively lesser Troponin T elevations but not statistically significant.

Keywords: CPK, PCI, Troponin T

INTRODUCTION

Coronary artery disease (CAD) is a major cause of mortality and morbidity all over the world including India. The prevalence and mortality due to CAD is declining in the developed nations.[1] In India, due to rapid urbanization and change in lifestyle there is an increase in the prevalence of CAD and cardiovascular mortality.[2] The mainstay of treatment in India is still secondary and tertiary prevention and Per Cutaneous Interventions (PCI)

being available only in selected centers. PCI is associated with a small incidence of serious procedural complications such as death, stroke, life-threatening bleeding or large myocardial infarction. It is well recognized that ST-segment elevation myocardial infarction complicating PCIs results in a less favorable long-term outcome. Periprocedural myocardial necrosis, which can range from a low-level elevation of cardiac biomarkers to a large MI, is the most common complication. Such myocardial injury can result from events such as transient target vessel closure, side branch closure, distal embolization, slow flow, or vessel dissection.

This can sometimes occur in the absence of any symptoms and an elevation in cardiac enzymes may be the only manifestation of the event. Periprocedural CK-MB elevation is associated with an adverse outcome including increased mortality in various studies. [3-5] Some reports fail to show a relationship between modest creatine phosphokinase level elevations and survival. The recent American College of Cardiology/European Society of Cardiology Consensus Statement on the Re-definition of myocardial Infarction, while recognizing that elevation of cardiac enzymes after PCI may indicate a worse long-term prognosis, did not clarify the possible impact of varying levels of cardiac enzyme elevation on long-term survival.

In contrast, the recently updated American Heart Association/American College of Cardiology guidelines for PCI states that although there is no consensus as to what constitutes a clinically significant myocardial infarction after a PCI only elevations in cardiac enzymes of more than 3-times normal should be considered to be significant. Thus, a debate remains about whether mild elevations in cardiac enzymes have the adverse impact on survival as more marked elevations. It is in this context we have undertaken this study to assess the prognostic significance of cardiac troponin T elevation after elective stent implantation. The objective of the present study is:

- To study the utility of cardiac troponin T estimation in predicting in hospital events and one year outcomes.
- To compare the efficacy of serum CPK and cardiac troponin T in predicting the above outcomes.

METHODS

The study population included 100 consecutive patients who underwent elective PCI with stent implantation in cardiology unit of Medical College Trivandrum since January 2003. Patients who had unstable angina or acute myocardial infarction were excluded. Also, patients with contraindications to antithrombotic or anti platelet therapy including low platelet count, high risk of bleeding, coronary artery bypass graft in the previous 3 months and myocardial infarction within 3 weeks were excluded.

All angioplasty procedures were performed with standard techniques. Previous day of stent implantation patients were loaded with 300mg of aspirin and clopidogrel. All interventional procedures were performed through femoral route. It was left to the operator's discretion to choose between conventional stenting and direct stenting based on the vessel anatomy and personal preference. If angiography suggested incomplete stent expansion or residual stenosis more than 30%, further high pressure balloon inflations were performed.

Procedural success was defined as reduction in stenosis diameter less than 30% without fatal complications or emergency CABG. After the procedure clopidogrel 75 mg and aspirin 300mg were continued. Clopidogrel was continued for at least 6weeks in addition to lifelong aspirin 150mg per day. Serial cardiac enzyme levels were measured in all patients undergoing coronary intervention after the procedure. CPK was measured at 8 hrs., 16 hrs. and 24 hrs. post PCI. Troponin T was measured at 8hrs and 24 hrs. post PCI. In hospital events were documented and patients were on follow up for a period of 1 year. Primary endpoints of death, myocardial infarction, recurrent ischemia leading to revascularization were noted.

RESULTS

In present study population of 100 patients there were 87 males and 13 females. Mean age of patients were 54.8±6.9 years. with males having a mean age of 54±7.03years and females 58.03±6.25 years. Among them 50% had unstable angina, 18% had exertional angina and 32% were post myocardial infarction patients. In this group of patients 36% of patients had diabetes of which 29 were males and 7 were females and 45% had hypertension with 37 males and 8 females.

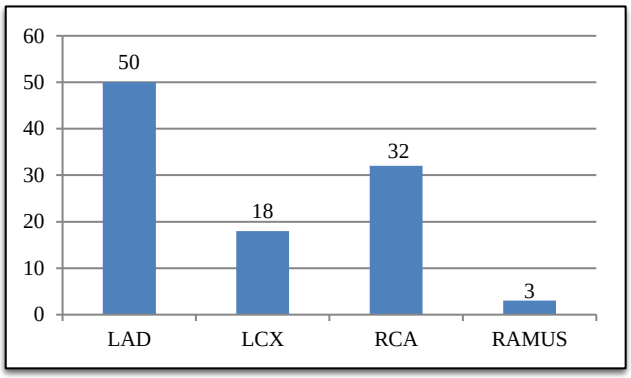

Figure 1: Vessels stented.

Among them 27% were smokers and 25% had family history of coronary artery disease. Mean total cholesterol of this group was 199.45 ±40.68mg % and mean LDL was 130.19±37.89 mg% and mean HDL was 38.78±7.78 mg%. Mean LV ejection fraction was 67.06±8.44% and mean serum creatinine was 0.81±0.18mg%. In this group

of hundred patients 79% had single vessel disease, 18% had two vessels and 3% had triple vessel disease. A total of 103 stents were deployed. The distribution of stents used were LAD stented in 50 patients, LCX stented in 18, RCA stented in 32 and ramus stented in 3 patients (Figure 1). Mean percentage of stenosis before stenting was 86.21±7.9 %. Among them 8% had calcified lesions, 14% had thrombus containing lesions and 10% had bifurcation lesions. Mean vessel diameter was 3.03±0.31mm and mean lesion length was 14.98±4.50 mm (Table 1). Mean stent deployment pressure was 9.64±1.96 mmHg and in 10% drug eluting stents were used. Mean Troponin T-1 was 0.04+0.1 and mean Troponin-2 was 06+0.145 (Figure 2).

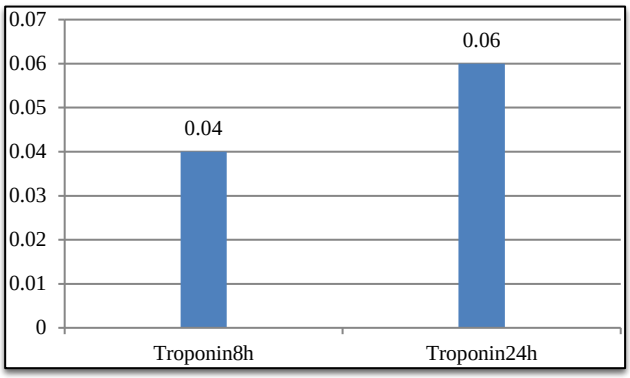

Figure 2: Post procedure Troponin-T.

Mean CPK levels were CPK-1 (80.11+36.19), mean CPK-2 (83.91±34.8) and mean CPK-3 (86.32+57.80) Figure 3.

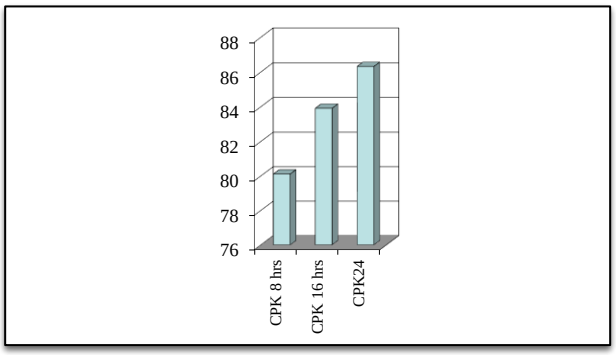

Figure 3: Post procedure CPK.

Only 2 patients had in hospital events. One patient had anterior MI on the same day and repeat CAG showed acute thrombus and patient subsequently underwent cutting balloon angioplasty which later got occluded and he had CABG with graft to LAD. He had Troponin T positive with normal CPK values.

Other patient had unstable angina and showed fresh thrombus in a branch. He also had Troponin T positive with normal CPK values. All the patients were followed up for one year except 7% who lost to follow up. Total of 11 patients had late onset angina within one year of sent implantation of these had exertional angina class 11 and four had unstable angina.[7]

In this study, we compared late onset angina with Troponin and CPK positivity and found that both Troponin-1 and Troponin-2 had significant correlation with late onset angina. Troponin T elevation were compared in diabetic patients and no statistically significant elevation was observed.

Table 1: Characteristics of lesions.

Mean % target vessel diameter	3.03±0.31 mm
Mean % stenosis pre-PCI	86.21±7.9%
Mean % stenosis post PCI	2.1±5.5 %
Mean lesion length	14.98±4.5mm
Bifurcation lesions	10 %
Calcified lesions	8%
Thrombus containing lesions	14%

Table 2: Peri-procedural tropt and Cpk vs late onset angina.

Late onset angina	Yes	No	P value
TropT1	0.17±0.19	0.03±0.09	<.025
TropT2	0.23±0.27	0.04±0.10	<.025
CPKI	81.54±27.8	79.93±37.21	NS
CPK2	91.0±25.94	83.03±35.78	NS
CPK3	126.8±131.46	81.31±28.72	<0.1

We studied lesion characteristics with Troponin T elevation and found that there was no significant correlation with calcified lesions. Thrombus containing lesions and bifurcation lesions were found to have a statistically significant elevation in the Troponin 2 values. We compared drug eluting stents with Troponin positivity and found that it was not statically significant but there was a trend towards lesser Troponin T elevations with drug eluting stents. We compared direct stenting with Troponin positivity but there were no statistical significance.

Table 3: Troponin rise and lesion characters.

	Yes	No	P
Calcified lesion			
Troponin T1	0.05±0.08	0.04±0.15	NS
Troponin T2	0.06±0.08	0.06±0.15	NS
Thrombus containing lesion			
Troponin T1	0.011±0.18	0.03±0.10	<0.1NS
Troponin T2	0.15±0.17	0.04±0.13	<0.05 (Significant)
CPK2	93.14±48.6	82.4±32.1	NS
Bifurcation lesion			
Troponin T1	0.05±0.105	0.04±0.11	NS
Troponin T2	0.10±0.25	0.06±0.13	<0.025 (Significant)

Table 4: Stent technique and troponin rise.

	Yes	No	P
Drug eluting stent			
Troponin T1	0.01±0	0.05±0.12	NS
Troponin T2	0.01±0	0.07±0.15	NS
Direct stenting			
Troponin T1	0.04±0.07	0.04±0.11	NS
Troponin T2	0.08±0.016	0.06±0.14	NS

DISCUSSION

In our study population of 100 patients majority (87%) were male with a mean age of 54.86±6.9years. Thirty six patients had diabetes the major risk factor for CAD and forty five had systemic hypertension. Among them 27% were smokers and 25% had family history of coronary artery disease. Mean total cholesterol in this group was 199.45±40.68mg% and mean LDL was 130.19±37.89 mg%. These risk factors were the common risk factors for developing CAD as noted in similar other studies from our country.

Troponin elevation after coronary angioplasty is a prognostic marker associated with significant morbidity and mortality. Although the number of PCI has declined in many countries, 955,000 procedures were still done in the United States in 20106. In India and many developing countries, the procedure count is still rising.[7] The prevalence of myocardial necrosis after PCI varies according to criteria and biomarkers used for diagnosis. Troponin I 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.[8-9]. Levels above 5 times the 99th percentile predict an even worse outcome, and similar findings involving high-sensitivity assays have also been described10. 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 Troponin I, peripheral atherosclerosis, multi vessel disease, multi stenting, bifurcation lesions, calcified arteries and intra luminal thrombi are significant known risk factors. In this study, we compared late onset angina with Troponin and CPK positivity and found that both Troponin 1 and 2 had significant correlation with late onset angina.

Troponin T elevation were compared in diabetic patients and no statistically significant elevation was observed. We studied lesion characteristics with Troponin T elevation and found that there was no significant correlation with calcified lesions. Thrombus containing lesions and bifurcation lesions were found to have a statistically significant elevation in the Troponin 2 values. We compared drug eluting stents with Troponin positivity and found that it was not statically significant but there was a trend towards lesser Troponin T elevations with drug eluting stents. We compared direct stenting with Troponin positivity but there were no statistical significance.

In a prospective sub study of the SYMPHONY trials confirms that cTnI is often elevated after PCI and that this is an important predictor of later cardiac events. Nearly half of all sub study patients had elevated cTnI after intervention. Cardiac troponin often is elevated after PCI, with positive results in 25% to 50% of patients. Elevated cTnI after PCI is strongly associated with increased 90-day risks of MI and the composite of death or MI, even after adjustment for baseline characteristics, procedural variables and pre-procedural marker status[11].

Even though many studies support that the peri procedural biomarker rise is associated with adverse outcome few studies did not support this view. In a study conducted by Bertinchant JP et al, elevation in troponin I after elective successful angioplasty, although more frequent than elevation in troponin T or CK-MB, was not an important correlate of cardiac events during 1-year follow up.[12] 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.

CONCLUSION

Periprocedural Troponin T is more sensitive than CPK in predicting late events. Thrombus containing lesions and bifurcation lesions were significantly associated with elevation in Troponin T. No significant Troponin T elevations were noted in patients with diabetes mellitus and those containing calcified lesions. Drug eluting stents were associated with a relatively lesser Troponin T elevations but not statistically significant. In conclusion, PCI is not a risk-free procedure and determining the main factors associated with adverse outcome is an essential step in improving patient care and prognosis.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Baiju R, Viswanathan S, Kumar SK.K. Cardiac troponin T estimation post elective stent implantation and prediction of early and late outcomes. Int J Res Med Sci 2017;5:1888-92.