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Research Brief

Prognostic significance of Troponin I in patients undergoing primary percutaneous coronary intervention

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ABSTRACT

This observational study investigates the prognostic significance of troponin I in patients undergoing primary percutaneous intervention (pPCI). Sequential cardiac biomarker sampling of the enrolled patients (n = 167) was performed on admission and at 6,12,24 and 48 h. Clinical characteristics, major adverse cardiac and cerebrovascular events (MACCE) (death, reinfarction, stroke and new or worsening heart failure) and left ventricular ejection fraction (LVEF) were noted on admission and 30 day follow-up. A 24-h troponin I level >60 ng/ml predicted MACCE (OR 4.06, p = 0.023; adjusted OR 5.09, p = 0.034) and less than 10% improvement in LVEF on follow-up (OR 2.49, p = 0.007).

Thus, in patients undergoing pPCI, 24-h cardiac Troponin I is a good non-invasive surrogate to predict MACCE and improvement in LVEF.

1. Introduction

ST Elevation Myocardial infarction (STEMI) is one of the major causes of mortality and morbidity worldwide. Early diagnosis and reperfusion with fibrinolytic or primary percutaneous coronary intervention (pPCI) helps to salvage the myocardium and improve outcomes. Risk stratification in STEMI thus becomes imperative. It achieves the goal of early reperfusion, and also predicts adverse outcomes. The scope of our study is to evaluate the prognostic significance of troponin I in the current era of catheter based revascularisation for STEMI. We also tried to investigate whether there is an absolute value of troponin I which predicts adverse events.

2. Methods

In this single centre, non-randomised, prospective observational study, patients more than 18 years of age undergoing primary percutaneous coronary intervention were enrolled. Those diagnosed with chronic kidney disease were excluded. Troponin I sampling was done on admission and at 6, 12, 24 and 48 h thereafter and was analysed by Ortho VITROS® 5600, XT7600 integrated systems (normal range upto 0.034 ng/ml, AMI cut-off: 0.12 ng/ml). Primary outcome measures were in-hospital and one month major adverse cardiac and cerebrovascular events (MACCE) and one month left ventricular ejection fraction (LVEF). MACCE included death, reinfarction, stroke and new or worsening heart failure. Assessment of LVEF was done using modified Simpson's biplane method. PCI was performed by using FDA approved second/third generation drug eluting stents. All patients on discharge received dual antiplatelet therapy (P2Y12 inhibitor + Aspirin) with statin. The choice of P2Y12 inhibitor was the sole discretion of treating physician. Patients were treated with guideline directed maximum tolerated dose of medications. The statistical analyses were performed using Chi square test or Fisher exact test for categorical data and Student '*t*' test and ANOVA for continuous data. Strength of association was measured using Odds ratio.

3. Results

In a period of 12 months, out of 172 consecutive patients with STEMI, 167 patients were enrolled in the study. 5 patients, whose 24-h troponin I could not be collected, for reasons of mortality or

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sampling errors, were excluded from the study. The clinical profile of the study subjects was as shown in Table 1.

The mean age of presentation was 55.6 ± 11 years, with majority being males (83.8%).

Diabetes mellitus (52.1%) and hypertension (46.1%) were the major risk factors in our study. In patients with multivessel disease (n = 63), non-culprit artery was addressed medically in 41% of cases, with rest undergoing revascularisation during the index hospitalisation (36.5%, n = 23) or after discharge (22%, n = 14).

Overall MACCE occurred in 11 patients. Two reinfarctions occurred prior to discharge. Nine additional events occurred during follow up. There were two strokes, one subacute thrombosis, five heart failures and one mortality.

Major predictors of MACCE were as summarized in Table 2. Admission, peak and 24-h troponin levels significantly correlated with MACCE. Several 24-h Troponin I values were arbitrarily considered, and one which achieved the highest statistical significance for prediction of outcomes was chosen. A 24-h troponin I value > 60 ng/ml differentiated patients with or without MACCE. 2/3rd of MACCE (n = 7) occurred when 24-h troponin valve >60 ng/ml and remaining 1/3rd in those with value less than 60 ng/ml (p 0.023, OR 4.06 [1.13–14.52]; p = 0.034, adjusted OR 5.09 [1.13–22.99]). The sensitivity, specificity, positive predictive value and negative predictive value of 24-h troponin I to predict MACCE was 63.6%, 69.9%,13% and 96.5% respectively. In patients presenting 6 h after symptom onset, a 24- hour Troponin I level >70 ng/ml was 10 times more likely to predict MACCE (p = 0.036, OR 10 [1.22–81.81]).

A significant correlation was also observed, between 24-h troponin I and improvement in LVEF. 57.7% (n = 65) of patients with 24-h value less than 60 ng/ml showed improvement in LVEF (p = 0.007, OR 2.49 [1.27–4.88]). Similarly, a lower peak troponin I level predicted ≥10% LVEF improvement on follow-up (p = 0.007).

Table 1
Clinical profile of study population (n = 167).

Characteristics	Percentage (n)	
Gender:		
Male	83.8% (140)	
Female	16.2% (27)	
Age (years):	55.6 ± 11.1	
Age distribution:		
<41 years	8.4% (14)	
41–60 years	57.4% (96)	
>60 years	34.1% (57)	
Risk Factors:		
Diabetes	52.1% (87)	
Hypertension	46.1% (77)	
Dyslipidemia	15.6% (26)	
Smoking	17.4% (29)	
Alcoholism	13.2% (22)	
Family History[a]	12.6 (21)	
Type of STEMI:		
Anterior or with combination	56.3% (94)	
Inferior or with combination	40.1% (67)	
True Posterior wall	1.2%(2)	
Lateral wall	2.4%(4)	
Window period (hours):	4.18 ± 3.19	
<6 h	85.8% (143)	
6–12 h	10.8% (18)	
>12 h	3.6% (8)	
Killips class at presentation:		
I	68.3% (114)	
II	17.4% (29)	
III	4.8% (8)	
IV	9.6% (16)	
Angiographic profile:		
Single vessel disease	62% (104)	
Double vessel disease	25% (41)	
Triple vessel disease	13% (22)	
TIMI Thrombus grade:		
0	1%(2)	
1	1.8%(3)	
2	3% (5)	
3	9% (15)	
4	12% (20)	
5	73.1% (122)	
TIMI flow:		
1	3.6% (6)	
2	17.4% (29)	
3	79% (132)	
Left ventricular EF assessment		
At presentation (%)	40 ± 6	
Post revascularisation (%)	42.15 ± 5.37	
At follow up (after 30 days)	45 ± 7	
Troponin I (ng/ml)	Mean	SD
On Admission	16.19	55.18
6 h	113.57	101.47
12 h	91.44	78
24 h	52.72	45.47

[a] Family history of Coronary Artery disease in first degree relative.

4. Discussion

In our study of primary PCI patients, we observed significant correlation between troponin I levels, MACCE and one-month LVEF.

Cardiac biomarkers like troponins help in early and well as late risk stratification in STEMI.[1] Analyses from several large clinical trials and registries have established that peak troponin levels are a good estimate of infarct size, an independent predictor for left ventricular function at 3 months, and major adverse cardiac events at 1 year.[1,2] Admission troponin values are also associated with an increase in cardiovascular mortality.[3] We made similar observations in our study and also demonstrated that a lower peak troponin I level was associated with improved LVEF on follow-up.

Yariv et al advocated that, 24-h troponin I levels predict adverse clinical outcomes including death, recurrent ischemic events and heart failure.[4] This was a community based study and included acute myocardial infarctions (STEMI, NSTEMI) irrespective of the treatment received. We too drew similar conclusion with a more specific subset of post primary PCI patients.

However, **we also deduced a novel value of troponin I** which not only predicts MACCE, but also the LVEF at one month of follow-up. The risk of MACCE increased 5 times, if 24 h Troponin I levels were more than 60 ng/ml. Thus, **a 24 h Troponin I value > 60 ng/ml was an independent predictor of MACCE with a high negative predictive valve**.

Similarly, if the levels of troponin I were less than 60 ng/ml at 24 hours, the odds that LVEF improved by ≥ 10% on follow-up increased 2.5 times. A lower peak troponin I level also predicted EF improvement on follow-up.

5. Conclusion

We thus conclude that in patients undergoing primary PCI, pre-discharge 24 h cardiac Troponin I is a good non-invasive surrogate to predict MACCE and improvement in ejection-fraction.

6. Limitations

- Our study is a single centre, non-randomised study and hence there is a probability of selection bias.
- The follow up period for the study was only one month. Hence certain complications like late sent thrombosis, very late stent thrombosis and in-stent restenosis could not be evaluated. A longer follow up would have added weight to the low frequency

Table 2
Predictors of MACCE and LVEF: Predictors of MACCE.

Variable	Odd Ratio (95%CI)	p value	Adjusted OR (95% CI)	p Value	Sn (%)	Sp (%)	PPV (%)	NPV (%)
Diabetes Mellitus	**4.5** (0.94–21.5)	0.041	–	–	81.8	50	10.3	**97.5**
Window Period > 6 h	**9.2** (2.54–33.23)	0.001	**7.61** (1.71–33.83)	0.008	54.5	88.4	25	**96.5**
Cardiogenic Shock	**4.12** (0.97–17.4)	0.014	–	–	27.2	91.7	18.7	**94.7**
Post-procedure TIMI I flow	**8.5** (1.37–53.10)	0.036	–	–	–			
24-hr Trop I level > 70 ng/ml	**6.05** (1.67–21.86)	0.0051	–	–	63.6	77.6	16.7	**96.8**
24-hr Trop I level > 60 ng/ml	**4.06** (1.13–14.52)	0.023	**5.09** (1.13–22.99)	0.034	63.6	69.9	13	**96.5**
24-hr Trop I level > 70 ng/ml in window period > 6 h subgroup	**10** (1.22–81.81)	0.036	**-**	–	–	–	–	**-**
Higher Peak Trop I levels	**-**	0.029	–	–	–			
Higher Trop I levels on admission	**-**	0.01	–	–	–			
Predictors of EF improvement at 30 days in our study								
Lower peak Trop I levels	–	0.018	–	–	–			
24 h Trop I level < 60 ng/ml	**2.49** (1.27–4.88)	0.007	–	–	77.4	42.2	57.5	64.8

*Sn: Sensitivity, Sp: Specificity, PPV: positive predictive value, NPV: negative predictive value.

events like stroke and non-fatal reinfarction and could have gained statistical significance.

- Sicker subsets of patients in whom mortality occurred within 24 h of presentation were excluded from the study as troponin I could not be sampled at 24 h

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Nil.

Declaration of competing interest

Nil.

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