ORIGINAL ARTICLES

# COMPARISON OF TROPONIN I WITH CK-MB AND ECG FOR PREDICTING CLINICALLY SIGNIFICANT MYOCARDIAL INJURY AFTER CORONARY ARTERY BYPASS GRAFTING

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## ABSTRACT

***Objective:*** To compare quantitative values of cTnI with CKMB and ECG according to Task Force's definition in detecting/predicting perioperative myocardial infarction (PMI) after coronary artery bypass grafting.
***Study Design:*** Comparative cross sectional study.
***Place and Duration of Study:*** Armed Forces Institute of Cardiology and National Institute of Heart Diseases from February, 2018 to August, 2018.
***Materials and Methods:*** A comparative cross sectional study was conducted on 122 patients, who underwent elective coronary artery bypass grafting (CABG) during specified period. Ejection fraction above 20% and cardiopulmonary bypass with single aortic cross-clamp technique were inclusive factors too while redo CABG, low HCT, recent MI and concomitant valve procedures were excluded from the study. Sampled with consecutive non probability technique and patients assessed on AHA task force perioperative MI criteria. cTnI compared with CK-MB and ECG in predicting clinically significant PMI, morbidity/mortality and length of hospital stay (HLOS).
***Results:*** Among 122 patients, 64% were males and 36% females. Mean age among participants was 50.75 years with standard deviation of 7.49. A therapeutic elevation of cTnI was observed in 11 (9%) as compared to CKMB elevations in 24 (19.7%). A total mortality was 13 (10.6%) wherein 6 (4.9%) patients had elevated cTnI as compared to elevated CKMB in 12 (9.8%) patients. HLOS averaged at 6 days (>60%) with 8 (6.4%) patients had >6 days stay in significant CKMB group as compared to 6 (4.8%) patients for elevated cTnI. Perioperatively 10 (8%) patients had atrial fibrillation in elevated CKMB group as compared to 4 (3.3%) in elevated cTnI group. Frequency of IABP and CRRT was 11 (8.8%) and 2 (1.6%) in elevated cTnI group as compared to 24 (19.2%) and 6 (4.8%) in elevated CKMB group respectively.
***Conclusion:*** For Pakistani perspective cTnI and CKMB along ECG carry equivocal statistical significance in predicting PMI. However CKMB carries added advantage of detecting postoperative renal dysfunction. Further studies are essential to clarify this important association.

**Keywords:** Troponin I, CK-MB, CABG, Perioperative MI.



## INTRODUCTION

The incidence of perioperative myocardial infarction (PMI) ranges from 7-15% after cardiac surgery affecting length of hospital stay (HLOS), incurred cost and more importantly reduced short term survival[1-3]. WHO included chest pain, cardiac specific biomarkers and new ECG changes as diagnosis of acute myocardial infarction (AMI) whereas 2007 Task Force of ESC/ ACCF/AHA/WHF redefined PMI as elevated cardiac enzymes at five times upper limit of laboratory normal (ULN) within 72 hrs after surgery associated with new Q waves or ST changes or LBBB on ECG[4]. Various studies searched for "ideal" cardiac marker that would demonstrate absolute cardiac specificity, would not be present in blood without cardiac muscle damage and its concentration would rise rapidly after a heart attack and it would be inexpensive to test for and could be performed on automated instruments[5]. Those markers ranged from non-specific AST, LDH and CK to more specific LD1, CK-MB, Myoglobin, Trop T and Trop I.

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The dimer CK-MB level increases within 3-12 hrs of onset of chest pain, peaks within 24 hrs and returns to baseline after 48-72 hrs whereas Trop I has same initial rise but peaks at 24-48 hrs and returns to baseline over 5-14 days. Some trials have shown that cTnI and CK-MB to beat 96% and 52% respectively in identifying PMI[6]. In addition, it was also noted that patients who had elevated cTnI without AMI could have 10-fold increase in the odds of developing later cardiac complications including death and would benefit from invasive therapies[7,8].

In Intensive Care of our institution, we carry out quantitative CK-MB on POD 0-3 for CABG patients and direct our therapies accordingly. In this study, the positive predictive values of quantitative CK-MB and cTnI are compared in detecting PMI, risk of short term mortality and increased HLOS thereby directing early interventional therapies, reducing costs and subsequent validating Task Force's recommendations on Pakistani cardiac surgical population.

## MATERIAL AND METHODS

This was a descriptive comparative study conducted on 122 patients, who underwent elective coronary artery bypass grafting (CABG) at operating theatres and subsequently followed in intensive care and high dependency units. With Institutional Review Board approval, written consent was obtained from each patient. During preoperative assessment, patient`s demographics, EURO score noted, baseline ECG interpreted and blood samples taken for baseline quantitative nTnI and CK-MB if not taken already. Age over 20 years, ejection fraction above 20% and cardiopulmonary bypass with single aortic cross-clamp technique were considered inclusive factors while redo CABG, HCT less than 25%, recent MI and concomitant valve procedures were excluded from the study. Sampled with consecutive non probability technique and selected by Armed forces nursing staff that were trained and informed about the inclusion and exclusion criteria. Patients were assessed on 2007 Task Force of ESC/ACCF/ AHA/WHF perioperative MI criteria. cTnI compared with CK-MB and ECG in predicting clinically significant PMI, short term morbidity/ mortality and length of hospital stay (HLOS).

**Table-I: Demographics of study population.**

| Variable | Mean ± SD | Median |
|---|---|---|
| Age (years) | 50.75 ± 7.49 | 52 (years) |
| Height (cms) | 173.88 ± 9.65 | 176 cm |
| Weight (kgs) | 78.84 ± 11.25 | 81 kg |
| Stay (days) | 7.61 ± 4.08 | 6 (days) |

**Table-II: Statistical Comparison of clinically significant variables ($p$<0.05).**

| Variables | PMI | ECG | Mortality | Inotropic Support | Prolong Ventilation | HLOS | IABP | CRRT |
|---|---|---|---|---|---|---|---|---|
| Elevated cTnI | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.79 |
| Elevated CKMB | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

For statistical analysis of demographic data, descriptive statistics (percentage, mean, median and mode) were taken. For comparison of groups, ANOVA was applied for continuous variables and chi square test was performed for categorical variables. A $p$-value <0.05 was taken as statistically significant.

## RESULTS

The incidence of peri-operative myocardial infarction (PMI) in our organization came out to be 19.2%. Among 122 patients, 64% were males and 36% were females' subjects. Mean age among participants was 50.75 years with standard deviation of 7.49. Frequency chart is shown in table-I. A significant elevation of cTnI was observed in 11 (9%) patients ($p$ 0.001) as compared to CKMB elevations in 24 (19.7%, $p$ 0.001). A total mortality

was 13 (10.6%) wherein 6 (4.9%, *p* 0.002) patients had elevated cTnI as compared to elevated CKMB in 12 (9.8%, *p* 0.001) patients. HLOS averaged at 6days (>60%) with 8 (6.4%, *p* 0.001) patients had >6 days stay in significant CKMB group as compared to 6 (4.8%, *p* 0.001) patients for elevated cTnI. Perioperatively 10 (8%) patients had atrial fibrillation in elevated CKMB group as compared to 4 (3.3%) in elevated cTnI group. Frequency of IABP and CRRT was 11 (8.8%, *p* 0.002) and 2 (1.6%) in elevated cTnI group as compared to 24 (19.2%, *p* 0.001) and 6 (4.8%, *p* 0.001) in elevated CKMB group respectively.

In this study we also observed that sustained rise of either cTnI or CKMB for initial two days of surgery carried added morbidity/mortality. After two days, further per day enzymes measurements was of no significance and added cost burden to patients specially in decelerating trends. It was also observed that CKMB elevation was significantly predicted postoperative renal compromise with subsequent CRRT use. The statistical significances of this study is shown in table-II.

## DISCUSSION

According to the findings of the present study, the incidence of PMI was 19.2% which is higher than internationally quoted values ranging from 7-15%[1,2,3]. This variation may be attributed to so called "Asiatic coronaries" (small caliber), differences in surgical techniques, perfusion strategies, myocardial protection and surgical selection criteria. In similar studies evaluating both enzymes in European population[9,10] showed a low profile superiority of cTnI over CKMB but our study has shown an equivocal statistically significant relationship between elevated cTnI and CKMB in predicting PMI and consequently do-able supportive measures to steer morbidity/mortality pathway. It has been shown by various studies[11-14] that cTnI and CKMB if combined with ECG, can effectively diagnose myocardial ischemia which is also shown in our study. However, isolated ECG changes carry little to no significance[15].

Our study was unique in many ways. Firstly, it evaluated task force`s recommendations on Pakistani population which has not been validated in any asian country. Secondly, it included many other factors such as prolong ventilation, inotropic support and use of CRRTwhich not only showed the added benefit in predicting required supportive measures but also assist in early start of therapies to prevent irremediable damage of vital organs[16-18]. Finally, one more surprising strength of our study was a statistical significant relationship between elevated CKMB levels with possibility of renal stunning and use of CRRT. The literature review has few non RCTs[19,20] showing that the surges of CKMB and cTnI has positive correlation with renal dysfunction but none predicted the institution of renal therapies.

With numerous merits, our study has demerits too which can be rectified in future studies. Firstly, such study can be devised to make it a randomized controlled trial. Secondly, sample size can be increased to make it more representative of Pakistani population. Thirdly, inclusion of surgical techniques, perfusion strategies and surgical selection criteria can help lessen errors if any.

## CONCLUSION

In conclusion, we are confident that cTnI or CKMB with ECG carry equal predictive power to detect clinically significant myocardial injury following CABG according to recommendations that CKMB carries additional association with renal dysfunction which needs to be evaluated further. It is also important to consider only one enzyme at a time according to ease and cost of laboratory procedures. However it is also being emphasized that isolated ECG changes for detection of PMI carry little significance if not supported by cardiac enzymes elevation and hemodynamic compensations.

## ACKNOWLEDGEMENT

I would like to take this opportunity to express my gratitude to my supervisor Prof Col Rashad Siddiqi for incorporating various learning

ways not only in academics but also personal. His versatility will always highlight a sense of sharp perfection for my future. He was the only source of containment for me in cardiothoracic anesthesia.

## CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any of its authors.

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