Original Article

Chest Pain Management

Chest Pain Management Using Prehospital Point-of-Care Troponin and Paramedic Risk Assessment

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ABSTRACT

Objective: To evaluate the prehospital point-of-care troponin testing and paramedic risk stratification within existing chest pain care pathways reveals promising reliability and validity, suggesting their potential as valuable tools in enhancing early cardiac assessment and improving patient outcomes.

Study Design: Prospective study

Place and Duration of Study: This study was conducted at the Department of Medicine, Nishtar Medical University, Multan, from February 2021 to January 2022.

Methods: Study included 400 consecutive patients experiencing acute chest pain categorized as emergencies. All patients were transported to the hospital via ambulance for subsequent medical care. Positive TnT test prehospital and at the time of hospital admission were compared. Main variables of study were values of troponin test in myocardial infarction associated chest pain patients at hospital and during emergency travelling and previous history coronary artery disease, myocardial infarction and risk factors like diabetes, smoking and hypertension.

Results: Myocardial infarction was positive in 32.0% in chest pain patients. Prehospital troponin was positive in 33 (8.3%) patients. Troponin test was positive in 53.8% patients at admission. The sensitivity for prehospital troponin to myocardial infarction was 18.0% and the sensitivity to myocardial infarction for in-hospital troponin was 74.2% with specificity 96.3% and 55.9%, respectively. ($p<0.001$).

Conclusion: In regions where patient transport times are brief, the point-of-care rapid Troponin T (TnT) test reveals only a minority of individuals experiencing chest associated, prehospital TnT test positive outcome emerges as an objective indicator for a more adverse prognosis in those with suspected heart attacks.

Key Words: Point of care, Chest Pain, Myocardial infarction, Troponin test, Prehospital

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INTRODUCTION

Acute chest pain represents 10% of ambulance attendances and is linked to significant healthcare costs and resource utilization[1]. Existing guidelines advise transporting most patients to emergency departments for further assessment due to the presence of chest pain in many serious diagnoses; however, approximately 50% of these patients are ultimately discharged without a specific diagnosis[2]. Recent studies indicate that risk stratification in coronary artery disease can be made safely by paramedic staff by testing point-of-care troponin level, leading to a reduction in emergency department length of stay[3,4].

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While health outcome studies evaluating this strategy are still emerging, prehospital risk stratification and point-of-care troponin testing may be non inferior to existing care processes in terms of early major adverse cardiac events[5]. Studies conducted to date have primarily utilized conventional troponin assays, but the emergence of point-of-care, high-sensitivity troponin (hsTn) assays may become more prevalent in the near future[6].

However, the potential widespread availability of hsTn assays poses challenges due to significant infrastructure costs linked to outfitting ambulances with point-of-care testing devices and TnT cartridges[7,8]. Additionally, uncertainties persist regarding whether implementing a prehospital risk stratification and point-of-care troponin model would ultimately lead to net cost savings, considering the associated paramedic training expenses[9,10].

The present study aimed to investigate paramedic risk assessment, in conjunction with point-of-care troponin testing that may help optimize resource allocation by directing patients to the most appropriate level of care.

METHODS

The Prospective study was conducted at department of Medicine, Nishtar Medical University, Multan, from

February 2021 to January 2022. Total 400 consecutive patients experiencing acute chest pain categorized as emergencies were included. All patients were transported to the hospital via ambulance for subsequent medical care. The protocol approved by the hospital Board. Study protocol involved the collection of 5 mL of blood for the rapid Troponin T (TnT) test after obtaining verbal informed consent from the patient. The blood collection took place either in the patient's home or in the ambulance. Subsequently, a second TnT test was conducted upon the patient's arrival at the hospital. All patients in the study were administered 500 mg of intravenous aspirin and received nitroglycerin sublingually during ambulance transport. Upon hospital admission, a 12-lead electrocardiogram was promptly conducted, and concurrent assessments of creatine kinase were carried out. Subsequent serial measurements were left to the discretion of the attending physician, who was informed of the troponin T (TnT) test results.

Positive TnT test prehospital and at the time of hospital admission were compared. In patients of chest pain MI incidence was noted and mentioned with positive and negative TnT prehospital test were recorded.

MI diagnosis was based on a significant rise in creatine kinase activity (more than twice the upper limit of normal), along with a creatine kinase MB increase of over 6%, concurrent ST elevations on electrocardiogram or as per World Health Organization criteria for typical clinical findings. For diagnosis of Coronary artery disease coronary angiography was performed. Presence of ST elevation above 1mm and 2 mm on limb lead and precordial lead was labeled as myocardial ischemia.

A device for whole blood rapid assay, utilizing Boehringer Mannheim's TnT (troponin T) test was applied for measurement of TnT levels. After heparinization of 150 ml whole blood, plasma and cellular fraction was separated. Plasma containing TnT, is diffused to the detection zone. Cardio specific gold-labeled antibodies and biotinylated antibodies are involved. These antibodies are specific to different epitopes (distinct regions) of Troponin T. A red line appears in the reading zone within 20 minutes. This red line serves as an indicator of the presence of serum TnT in the sample.

The data were presented as median or mean (SD) as appropriate. Statistical analyses employed Student's t-test and Fisher test with a significance threshold of $P < 0.05$. Sensitivity and specificity were calculated as percentages of true positives and true negatives, respectively, relative to total relevant cases.

RESULTS

Overall, 400 patients were included in this study with mean age 62.71±6.01 years. There were 209 (52.3%) males and 191 (47.7%) females. The distribution of hypertension, CAD, smoking, previous MI, dyslipidemia, diabetes mellitus and family history were shown in table 1.

Myocardial infarction was positive in 128 (32.0%) chest pain patients. Prehospital troponin was positive in 33 (8.3%) patients. Troponin test was positive in 215 (53.8%) patients at admission. The sensitivity for prehospital troponin to myocardial infarction was (18.0%) and the sensitivity to myocardial infarction for in-hospital troponin was (74.2%) with specificity (96.3%) and (55.9%), respectively. (p<0.001). (Table. 2).

Table No.1: Demographic and baseline characteristics of the study patients

Variable	Presence
Age (years)	62.71±6.01
Sex	
Male	209 (52.3)
Female	191 (47.7)
Previous myocardial infarction	146 (36.5)
Coronary artery disease	243 (60.8)
Hypertension	273 (68.3)
Diabetes mellitus	153 (38.3)
Smokers	70 (17.5)
Dyslipidemia	117 (29.3)
Family history	103 (25.8)
N (%), Mean ± S.D	

Table No.2: Association of myocardial infarction with troponin test at prehospital and in-hospital

Troponin result	Myocardial infarction		p-value
	Positive 128 (32.0%)	Negative 272 (68.0%)	
Prehospital test			
Positive, 33 (8.3%)	23 (18.0%)	10 (3.7%)	<0.001
Negative, 367 (91.7%)	105 (82.0%)	262 (96.3%)	
Sensitivity= TP/(TP+FN)=23/(23+105)*100=18.0% Specificity= TN/(TN+FP)=262/(262+10)*100=96.3%			
At hospital test			
Positive, 215 (53.8%)	95 (74.2%)	120 (44.1%)	<0.001
Negative, 185 (46.2%)	33 (25.8%)	152 (55.9%)	
Sensitivity= TP/(TP+FN)=95/(95+33)*100=74.2% Specificity= TN/(TN+FP)=152/(152+120)*100=55.9%			

DISCUSSION

The investigation examined whether pre-hospital TnT detection matches the established sensitivity and specificity for identifying acute myocardial infarction associated chest pain, as seen in emergency departments. The study revealed the practical form of conducting rapid TnT tests in ambulances, identification of point of care on positive TnT only a small fraction of acute myocardial infarction cases, displaying significantly lower sensitivity compared to TnT tests upon hospital admission.

The prehospital Troponin T (TnT) test's diminished sensitivity may be attributed to the brief time interval between the commencement of chest pain and the initial TnT test in the majority of the examined patients. TnT levels can elevate within 1 hour after the onset of chest pain. The sensitivity for MI remains about 50% until 3-4 hours after onset of pain.

The sensitivity for prehospital troponin to myocardial infarction was 18.0% and the sensitivity to myocardial infarction for in-hospital troponin was 74.2%. In another study, sensitivity of the rapid TnT test for acute MI was 33% in patients experiencing chest pain for less than 2 hours, and it notably increased to 86% for those with chest pain persisting for more than 8 hours.

Another study reported 18% sensitivity of prehospital TnT test and 98% in hospital for chest pain patients who were diagnosed with acute myocardial infarction later on. It was also concluded that positive prehospital Troponin T (TnT) test result serves as an objective indicator, suggesting a more unfavorable prognosis for individuals presenting with suspected acute chest pain.

Studies conducted by van Dongen et al[11] and Jungbauer et al[15] reported that utilization of a point-of-care (POC) troponin T measurement, specifically the Roche Cobas h232 assay with a detection range of 40–2,000 ng/L (values below 40 ng/L reported as <40 ng/L), allows ambulance paramedics to swiftly calculate an on-site HEART score, potentially leading to a reassessment of the need for immediate transportation to the Emergency Department. The within-series coefficient of variation for this assay is 9.3% in the low concentration range (40–200 ng/L), demonstrating excellent sensitivity correlation between final results and rapid TnT.[12]

Rasmussen et al[13] reported that performing pre-hospital point-of-care troponin measurements offers multiple potential advantages, as it enables the early detection of acute coronary syndrome (ACS) and facilitates the identification of high-risk patients prior to their arrival at the hospital. In another study Stopyra et al[14] reported that the prehospital point-of-care (POC) i-STAT cardiac troponin (cTn) measurement in patients transported with acute chest pain has shown a high specificity for myocardial infarction (MI), indicating its potential usefulness in confirming MI.

In two previous studies conducted by Kemper et al[15] and Sörensen et al[16] concluded that point-of-care testing has become a practical reality in prehospital care, with cardiac troponin T (cTnT) offering crucial information that aids EMS personnel in decision-making, preventing the underestimation of serious pathologies. It serves as an alert trigger for various potentially severe conditions, guiding emergency medical professionals in determining the most effective strategies to be pursued.

Elevated levels of cardiac troponin T (cTnT) have been linked to higher hospital mortality rates, while troponinemia is associated with increased morbidity and the occurrence of serious adverse events in both cardiovascular and non cardiovascular diseases; however, limited research has investigated the impact of prehospital troponin levels in identifying early mortality in patients without acute coronary syndrome[17,18].

CONCLUSION

In regions where patient transport times are brief, the point-of-care rapid Troponin T (TnT) test reveals only a minority of individuals experiencing chest associated, prehospital TnT test positive outcome emerges as an objective indicator for a more adverse prognosis in those with suspected heart attacks.

Limitations: The study may not account for all possible confounding variables that could influence the relationship between prehospital troponin testing, paramedic risk assessment, and chest pain management. Factors such as comorbidities, medications, and socio-economic status could impact the outcomes.

Practical Implications: Paramedics can use prehospital point-of-care troponin testing and risk assessment tools to identify patients at a higher risk of adverse cardiac events early in the care process. This early identification allows for quicker and more focused intervention for those at higher risk, potentially reducing the time to definitive treatment.

Author's Contribution:

Concept & Design of Study:	Feras Almarshad, Ghulam Mustafa
Drafting:	Feras Almarshad, Ghulam Mustafa
Data Analysis:	Feras Almarshad, Ghulam Mustafa
Revisiting Critically:	Feras Almarshad, Ghulam Mustafa
Final Approval of version:	Feras Almarshad, Ghulam Mustafa

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