RESEARCH PAPER

OPEN ACCESS

Changes in cardiac troponin level in Myocardial infracted patients and its relation with age

Faiz Ullah Khan[1], Rahool[2], Bolan Nangyal[3], Hasnain Nangyal[4],
Muhammad Saleem Khan*[5]

[1]*Department of Pharmacy, Quaid-i-Azam University, Islamabad, Pakistan*

[2]*Department of Endocrinology, Ichan School of Medicine, Queens Hospital Centre, New York, USA*

[3]*Faculty of Medicine, Paktia University, Afghanistan*

[5]*Department of Botany,Hazara University, Mansehra, Pakistan*

[5]*Department of Zoology, Government College University, Faisalabad, Pakistan*

Abstract

Myocardial infarction (MI) is one of the most common diseases in all over the world. It is commonly diagnosed by measurements of cardiac enzymes named as cardiac troponin I (cTnI) and cardiac troponin T (cTnT). Raised cardiac troponin levels are considered as the cornerstone in the susceptibility and sensitivity of myocardial infarction. A study was conducted for the evaluation of serum Troponin I (cTnI) levels in different age groups of both gender. There was significant ($p < 0.05$) difference between male and females cTnI, values indicating high mortality rate in males (60.09%) as compared to females (48.57%). However, there was no significant difference ($p > 0.05$) between age groups and cTnl values which shows that susceptibility of MI is not associated with age and some other factors may also responsible for high troponin levels included as high blood pressure, obesity and living style.

* **Corresponding Author:** Muhammad Saleem Khan ✉ samiikhan@yahoo.com

Introduction

Acute myocardial infarction (AMI) is one of the major and leading causes of death (Anderson *et al.*, 2007). Myocardial infarction (MI) is diagnosed by clinical evaluations of cardiac enzymes named as cardiac troponin I (cTnI) and cardiac troponin T (cTnT). Cardiac troponins (cTr), is the structural proteins distinctive to the heart, are subtle and particularly the biological markers of myocardial damage (Morrow *et al.*, 2001). In clinical practice, they are very supportive for identifying patients with acute coronary syndromes who are at high danger and for selecting patients who will advantage from an early invasive plan and glycoprotein IIb/IIIa obstruction (Kastrati *et al.*, 2006). Cardiac muscles are incorporated by complex regulatory proteins named as "Cardiac Troponins". These regulatory proteins play their role in contraction by the help of Ca^{+2} which bound actin to myosin resulting increase in ATP hydrolysis. Cardiac troponins are not identified generally in healthy subjects. Elevations are expressed in patients who suffered from chest pain and myocardial necrosis. According to ESC/ACC, the recommended value for cTnT is 0.01ng/ml with 10% coefficient of variance value at the 99th percentile of 0.03 ng/ml (Wu *et al.*, 1999). There are different assays used for the cTnI, therefore the 99th percentile value depend upon the assay being used (Antman *et al.*, 2000; Morrow *et al.*, 2007). Fluctuations in Troponin T (cTnT) of patients is directly associated with morbidity and mortality in the Intensive Care Unit.

Due to myocardial necrosis, the cardiac troponin levels raise in circulation. The initial assays help to serve as a biomarker for diagnosis of myocardial ischemia. However in severe condition troponin elevations detect the MI. Troponin molecules are detectible in blood when diffuse from cytosol of cardiac muscle into the surrounding lymphatic and blood vessels (Antman *et al.*, 2000; Luepker *et al.*, 2003). Troponin level rises in 3-4 hours after onset of MI. It increases up to 40 times more than detection limit. This sensitivity is increased in patients who are admitted in the emergency department with symptom suggestive to ischemia and myocardial necrosis (Mac Rae *et al.*, 2006).

Function and maximal heart rate is decreased with age due to increase in end diastolic volume. (Upton *et al.*, 1980). Hypertension is another main cause of heart diseases in adults. The risk factor of hypertension is high blood pressure which causes atherosclerosis and ischemic heart diseases increasing the incidence of MI up to 2 or 3 times (Grossman and Messerli, 1996).

MI patient more prone to ischemia regarding age groups ranging from 30-40, 40-50 and 50-60. The increase serum troponin level also an indicator of fatality of the disease therefore, care must be taken by MI patients and should check troponin levels as men are more vulnerable and increased troponin levels. In this study, the level of cTnI and cTnT was recorded in the MI patients with different age groups and concluded that susceptibility of MI is not associated with age and some other factors may also responsible for high troponin levels including high blood pressure, noncompliance of blood pressure medicines, depression and life style.

Materials and methods

Study Design and Populations

To evaluate the serum Troponin I (cTnI) among age groups ranging from 30-40, 40-50 and 50-60 in both genders, 30 samples were collected from the patients who diagnosed with MI and hospitalized for one week. Those patients diagnosed with diabetes, congestive and chronic heart failure were considered as non-significant. The age limit was strongly applied to selected individuals.

Sampling Clinical Assessment

Complete initial clinical assessment were held for all selected patients that including physical examinations like pulse examination, blood pressure, temperature, weight, BMI and complete past history.

The whole blood was collected through venipuncture using heparinized syringe. The blood samples were collected in EDTA tubes caped red (troponin T) and green (troponin I).

Immediately the blood sample was not frozen or refrigerated for troponin but stored at room temperature for up to 8 hours. In order to separate the serum from cellular components most specimens required centrifugation (5000 rpm for 5 min) prior to running the test. The turnaround time in the setting of chest pain for the measurements of troponin is 60 minutes (Keller *et al.*, 2011).

Cardiac Troponin Test Investigation and Diagnosis Accuracy

The tests were performed in standard laboratory conditions using the Troponin test kits. Troponin I Assay is standard biomarker as it helps to diagnose the early stratification of patients which have chest pain with ischemia (Apple *et al.*, 1995). Reference Values for cTnI are >0.25ng/ml Diagnostic Value, 0.1-0.25ng/ml Intermediate Value, <0.1 ng/ml. Lower limit of detection is 0.04ng/ml. In healthy objects the troponin I value is 0.006ng/ml. In patients of unstable angina, elevations of troponin T also occur. Reference values< 0.01ng/ml, 0.01ng/ml are recommended as prognostic value. In normal individuals, the upper limit is < 0.01ng/ml. In a patients with ACS troponin T value > or = 0.01ng/ml shown the evidence of cardiac injury. In patients with ischemic heart diseases and other situations the prognostic value for troponin T is 0.01ng/ml. The patients which are diagnosed by ACS have troponin value< 0.20ng/ml. The troponin T level also rises after about 3-4 hours, which indicate the acute or more chronic evaluations.

Survey study and Statistical Analysis

In survey study, questionnaires were used for physical and preliminary estimation regarding prognosis of pathological conditions. The questionnaires were consisting of 21 questions were filled from 30 patients (23 men, and 7 females) with yes and no options of total population. The data was collected analyzed statically through one way ANOVA.

Results

In the current study, 30 patients were examined for MI diagnosis. Out of total samples 23 men (76.66%) were found at the risk of MI, whereas 7 females (23.33%) were positive for MI risk.

The number of normal individuals were approximately 6 (19%) with 4 (11%) obese (Table 1). The values of cTnI were measured for prognosis of susceptibility in patients of MI among age groups which are < 40 and > 50, in both genders (Fig. 1.). There is Significant (p<0.05) difference between males and females cTnI values indicating high mortality rate in males (60.09%) as compare to females (48.57%). There was no significant difference (p>0.05) between age groups and cTnI values which shows that susceptibility of MI is not associated with age. The mortality in patients among age of 30-40 was 53.3%56.4% in 40-50 and 62.5% in 50-60 age groups.

Table 1. Total population with MI (myocardial infarction) Risk and Mortality Rate.

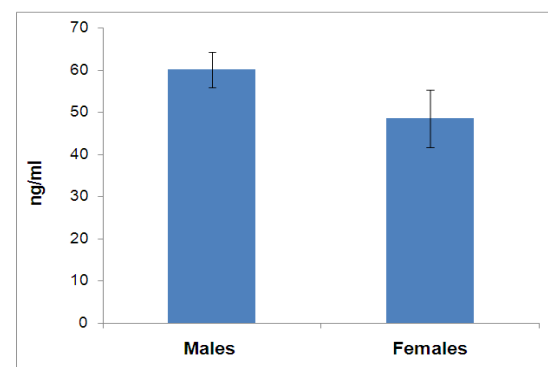| Gender	Frequency	MI Risk	Mortality Rate (%)
Male	23.00	76.66%	60.09%
Female	7.00	23.33%	48.57%
Total	30.00		

Fig. 1. The ratios of cTnI (ng/ml) values in males and females.

In the second part of the study, data was collected by survey from patients diagnosed with MI to find out the relationship of disease with other factors. After analysis on the base of yes and no of the questionnaires results analyzed with p values as existence of high b. p (P=0.384*) which is the main cause of MI and the values reveal that high blood pressure has correlation with prescribed medicines is (P=0.722**) and noncompliance of antihypertensive medicines the incidence MI increased to (P=0.522**).

Other co factors related with high blood pressure are obesity and weight male patients are more associated with this conditions as in females as shown in Fig. 2.
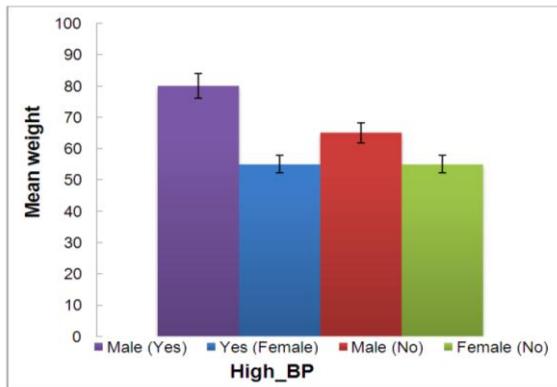

Fig. 2. Relationship between high-BP and means weight in male and female.

Table 2 shows that chest pain is a significant factor (P=0.659**) which is associated with angina (P=0.791**), low use of medicine (P=0.861**) and high blood pressure (P=0.583**). Its mortality may increases in patients with MI (P=0.659**). The Fig. 3. represents that 80% male patients diagnosed with MI have chest pain female patients have higher ratio (90%) of chest pain.
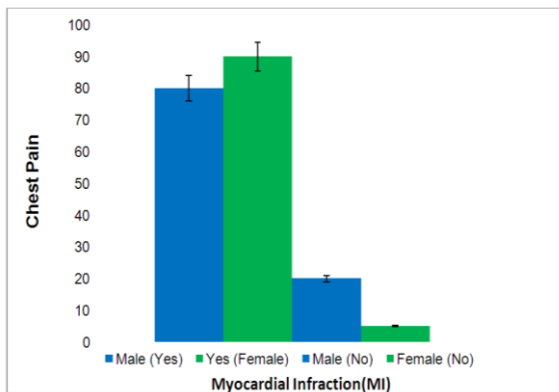

Fig. 3. The relationship between chest pain and Myocardial Infraction (MI) in males and females.

Table 2. Different factors associated with MI and its *p values* M/F (males/females).

Condition	*P-value* (M/F)
Chest pain	0.659**
Angina	0.791**
Med use	0.861**
High BP	0.583**

(** indicates $p \leq 0.01$).

Fig. 4 shows the depression and its relation with mean age the complex way of existence heavy breathing reported in MI patients due to stress and high cholesterol level, heavy sweating and onset of plaque formation in the coronary arteries of MI patients.
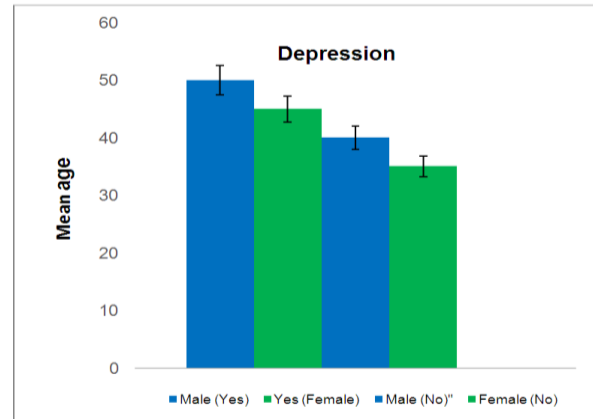

Fig. 4. The relationship between depression and mean age in both males and females.

Discussion

Every year, 1 billion peoples are dying due to myocardial infraction around the globe. It is caused by damage in myocardiocytes. Chest pain or angina is the leading symptom of MI in which leads to ischemia and stoppage of blood to the particular area of coronary arteries. The person experience heavy or crushing sensation. High blood pressure is the main cause of chest pain in both genders (Kearney *et al.*, 2005). It damages in two ways, high B.P cause damage to coronary arteries, leading to blockage in arteries and abnormal blood flow to heart which causes angina and chest pain (Deb *et al.*, 2010).

The previous year studies revealed that risk factor of stroke in asthmatic and heart patients are more common in men and women. In women with adult asthma, the rate of heart diseases increase up to 2-10folds and rate of stroke increases up to 2.36 fold (Toren and Lindholm, 1996; Iribarren *et al.*, 2004). Asthma has direct effect on nocturnal sleep quality and patient complains sleepiness of day time. In patients of MI with age of 30-39 the sleepiness is (6.71%), 40-49 is (17.47%) and in age of 50-59 is (24.94%). In a male the sleepiness ratio is 68.18% and in a female is 31.82 % (Iribarren *et al.*, 2004; Schanen *et al.*, 2005).

Reichlin *et al.* (2009) determined the level of cardiac troponin in blood samples using some new assays. They found that the cardiac troponin level was significantly higher in patients with acute myocardial infarction. Mahajan and Jarolim (2011) interpreted the elevated cardiac troponin levels and sensitivity of cardiac troponin to MI. In Another study conducted by Reiter *et al.* (2011) concluded that cTnI sensitive assays in the eldery patients have high accuracy. The Patients are more susceptible to heart diseases due to depression.

The myocardial infarction is also relying upon BMI (body mass index) values. In several populations the mortality and morbidity of myocardial infarction is associated with increased BMI values. According to NCEP (Adult Treatment Panel), family history, hypertension, smoking, LDL cholesterol levels > 4.14mmol/liter and HDL cholesterol levels < 0.91mmol/liter are major independent risk factors for CHD (congenital heart diseases).

In addition several epidemiological studies revealed that individuals who are associated with increase body mass index are at high mortality and morbidity of CHD and myocardial infarction. If the BMI (body mass index) value is above 21, statistics shows that ischemic heart diseases mortality is increases up to 21% (Must *et al.*, 1992; Manson *et al.*, 1995). In this study, the patients with high mean body weight had more blood pressure the leading cause of MI.

Age also contribute their role in the cause of myocardial infarction. The common risk factor of MI after the age of 45 in men and 55 in women is heart diseases. In adolescence the cause of MI is associated with congenital heart diseases. However this study showed that, the age did not have significant effect on the levels of cTnI and cTnT but as the age cross the 50 the cardiac cells reduce the secretion of cTnI and cTnT as shown in the Fig. 1.

Conclusion

From this study it has been concluded that prognosis and susceptibility of myocardial infarction is rely significantly upon measurements of cTnI, which lowers the false positive risk factors of MI. The elevations of cTnI are associated with cardiac and non-cardiac conditions.

The association of age, diet, BMI, smoking, hypertension, depression and pan, gutka and naswar with MI in regards of diagnosis of elevations of troponin I is not negligible. All these factors contribute directly and indirectly to elevate troponin I levels. There is no major difference between troponin I levels among young individuals and adults, but there is a difference of gender as troponin I levels according to this recent study are found to be increases in male (60.09%) as compare to females (48.57%) but is has been verified that the mortality of myocardial infarction would be equal in males and females.

References

Anderson JL, Adams CD, Antman EM, Bridges CR, Califf RM, Casey DE, Chavey WE, Fesmire FM, Hochman JS, Levin TN. 2007. ACC/AHA 2007 guidelines for the management of patients with unstable angina/non–ST-elevation myocardial infarction: a report of the American College of Cardiology/ American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 2002 Guidelines for the Management of Patients With Unstable Angina/Non–ST-Elevation Myocardial Infarction) developed in collaboration with the American College of Emergency Physicians, the Society for Cardiovascular Angiography and Interventions, and the Society of Thoracic Surgeons endorsed by the American Association of Cardiovascular and Pulmonary Rehabilitation and the Society for Academic Emergency Medicine. Journal of the American College of Cardiology **50(7)**, e1-e157.

Antman E, Bassand J-P, Klein W, Ohman M, Sendon JLL, Rydén L, Simoons M, Tendera M. 2000. Myocardial infarction redefined-a consensus document of the Joint European Society of Cardiology/American College of Cardiology committee for the redefinition of myocardial infarction: the Joint European Society of Cardiology/American College of Cardiology Committee. Journal of the American College of Cardiology **36(3)**, 959-969. DOI: 10.1016/s0735-1097(00)00804-4.

Apple FS, Voss E, Lund L, Preese L, Berger CR, Henry TD. 1995. Cardiac troponin, CK-MB and myoglobin for the early detection of acute myocardial infarction and monitoring of reperfusion following thrombolytic therapy. Clinica chimica acta **237**(**1**), 59-66.
DOI: 10.1016/0009-8981(95) 06064-k.

Deb P, Sharma S, Hassan K. 2010. Pathophysiologic mechanisms of acute ischemic stroke: an overview with emphasis on therapeutic significance beyond thrombolysis. Pathophysiology **17**(**3**), 197-218.
DOI: 10.1016/j.pathophys.2009.12.001.

Grossman E, Messerli FH. 1996. Diabetic and hypertensive heart disease. Annals of internal medicine **125**(**4**), 304-310.
DOI: 10.7326/0003-4819-125-4-199608150-00009.

Iribarren C, Tolstykh IV, Eisner MD. 2004. Are patients with asthma at increased risk of coronary heart disease? International journal of epidemiology **33**(**4**), 743-748.
DOI: 10.1093/ije/dyh081.

Kastrati A, Mehilli J, Neumann F-J, Dotzer F, ten Berg J, Bollwein H, Graf I, Ibrahim M, Pache J, Seyfarth M. 2006. Abciximab in patients with acute coronary syndromes undergoing percutaneous coronary intervention after clopidogrel pretreatment: the ISAR-REACT 2 randomized trial. Jama **295**(**13**), 1531-1538.

Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, He J. 2005. Global burden of hypertension: analysis of worldwide data. The lancet **365**(**9455**), 217-223.
DOI: 10.1016/s0140-6736(05)70151-3.

Keller T, Zeller T, Ojeda F, Tzikas S, Lillpopp L, Sinning C, Wild P, Genth-Zotz S, Warnholtz A, Giannitsis E. 2011. Serial changes in highly sensitive troponin I assay and early diagnosis of myocardial infarction. Jama **306**(**24**), 2684-2693.
DOI: 10.1001/jama.2011.1896.

Luepker RV, Apple FS, Christenson RH, Crow RS, Fortmann SP, Goff D, Goldberg RJ, Hand MM, Jaffe AS, Julian DG. 2003. Case definitions for acute coronary heart disease in epidemiology and clinical research studies a statement from the AHA council on epidemiology and prevention; AHA statistics committee; World heart federation council on epidemiology and prevention; the European Society of Cardiology Working Group on Epidemiology and Prevention; Centers for Disease Control and Prevention; and the National Heart, Lung, and Blood Institute. Circulation **108**(**20**), 2543-2549.
DOI: 10.1161/01.cir. 0000100560.46946.ea.

Mac Rae AR, Kavsak PA, Lustig V, Bhargava R, Vandersluis R, Palomaki GE, Yerna M-J, Jaffe AS. 2006. Assessing the requirement for the 6-hour interval between specimens in the American Heart Association Classification of Myocardial Infarction in Epidemiology and Clinical Research Studies. Clinical chemistry **52**(**5**), 812-818.
DOI: 10.1373/clinchem.2005.059550.

Mahajan VS, Jarolim P. 2011. How to interpret elevated cardiac troponin levels. Circulation **124**(**21**), 2350-2354.

Manson JE, Willett WC, Stampfer MJ, Colditz GA, Hunter DJ, Hankinson SE, Hennekens CH, Speizer FE. 1995. Body weight and mortality among women. New England journal of medicine **333**(**11**), 677-685.
DOI: 10.1097/ 00006205-199511000-00011.

Morrow DA, Cannon CP, Jesse RL, Newby LK, Ravkilde J, Storrow AB, Wu AH, Christenson RH, Apple FS, Francis G. 2007. National Academy of Clinical Biochemistry Laboratory Medicine Practice Guidelines: clinical characteristics and utilization of biochemical markers in acute coronary syndromes. Clinical chemistry **53**(**4**), 552-574.
DOI: 10.1161/circulationaha.107.182882.

Morrow DA, Cannon CP, Rifai N, Frey MJ, Vicari R, Lakkis N, Robertson DH, Hille DA, DeLucca PT, DiBattiste PM. 2001. Ability of minor elevations of troponins I and T to predict benefit from an early invasive strategy in patients with unstable angina and non-ST elevation myocardial infarction: results from a randomized trial. Jama **286**(**19**), 2405-2412.

Must A, Jacques PF, Dallal GE, Bajema CJ, Dietz WH. 1992. Long-term morbidity and mortality of overweight adolescents: a follow-up of the Harvard Growth Study of 1922 to 1935. New England journal of medicine **327**(**19**), 1350-1355.
DOI: 10.1056/nejm199211053271904.

Reichlin T, Hochholzer W, Bassetti S, Steuer S, Stelzig C, Hartwiger S, Biedert S, Schaub N, Buerge C, Potocki M. 2009. Early diagnosis of myocardial infarction with sensitive cardiac troponin assays. New England Journal of Medicine **361**(**9**), 858-867.

Reiter M, Twerenbold R, Reichlin T, Haaf P, Peter F, Meissner J, Hochholzer W, Stelzig C, Freese M, Heinisch C. 2011. Early diagnosis of acute myocardial infarction in the elderly using more sensitive cardiac troponin assays. European heart journal **32**(**11**), 1379-1389.

Schanen J, Iribarren C, Shahar E, Punjabi N, Rich S, Sorlie P, Folsom A. 2005. Asthma and incident cardiovascular disease: the Atherosclerosis Risk in Communities Study. Thorax **60**(**8**), 633-638.
DOI: 10.1136/thx.2004.026484.

Toren K, Lindholm NB. 1996. Do patients with severe asthma run an increased risk from ischaemic heart disease? International journal of epidemiology **25**(**3**), 617-620.
DOI: 10.1093/ije/ 25.3.617.

Upton MT, Rerych SK, Roeback JR, Newman GE, Douglas JM, Wallace AG, Jones RH. 1980. Effect of brief and prolonged exercise on left ventricular function. The American journal of cardiology **45**(**6**), 1154-1160.
DOI: 10.1016/0002-9149(80)90473-7.

Wu AH, Apple FS, Gibler WB, Jesse RL, Warshaw MM, Valdes R. 1999. National Academy of Clinical Biochemistry Standards of Laboratory Practice: recommendations for the use of cardiac markers in coronary artery diseases. Clinical chemistry **45**(**7**), 1104-1121.