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Determination of Cardiac Markers & HbA1c level in Premature Coronary Artery Disease

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Abstract: ***Background*:** Coronary artery diseases are condition arises due to the clogging of atherosclerotic plaque coronary artery of heart; results decrease in the blood flow to the heart muscles. Formation of atherosclerotic plaques is the major cause of coronary artery disease (CAD). Among the several cardiovascular diseases, coronary artery disease (CAD) is the most prominent and prevalent. Cardiac biomarkers have become frontline diagnostic tools for myocardial infarction (MI); clinicians can make faster diagnostic decisions and design a more effective treatment plan, which reduces mortality. Detection of cardiac biomarkers plays an increasingly important role in evaluating and diagnosing patients with chest pain. Micro-vascular complications are increasingly linked to chronic hyperglycemia. Meta analysis of ten likewise studies on type-II diabetes have shown a potential association among cardiovascular disease and glycated hemoglobin and that have highly significant association (18%) of cardiovascular diseases risk by every 1% of elevated glycated hemoglobin concentration. ***Materials and Methods:*** The total study group consists of 400 subjects, of which 200 premature coronary artery disease patients (cases) & 200 were healthy individuals (controls). Venous blood was used for analysis. Cardiac markers (Tropnin-I & Myoglobin) were done by Immunofluorescence & HbA1c was done by Ion exchange HPLC method Bio-Rad D-10 Analyzer. The data analysis was done by using mean, standard deviation & student t-test. ***Results:*** Trop-I (0.58 ± 0.48 vs. 0.02 ± 0.006), Ck-MB (39.1 ± 11.02 vs. 14.79 ± 4.0) & Myoglobin (84.01 ± 8.22 vs. 38.99 ± 7.06) were higher in CAD patients than control subjects. The HbA1c (6.51 ± 0.36 vs. 4.66 ± 0.41) was higher in CAD patients than control subjects. The level of serum cardiac markers & HbA1c were significantly increased in CAD patients as compared to healthy individuals. ***Conclusion:*** The present study concluded that increased level of cardiac markers & HbA1c in Premature CAD patients as compared to healthy individuals.

Keywords: Coronary artery disease; Glycosylated Hb (HbA1c); Myocardial infarction.

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INTRODUCTION

Coronary artery diseases (also called as ischemic heart disease) are condition arises due to the clogging of atherosclerotic plaque coronary artery of heart; results decrease in the blood flow to the heart muscles. Among the several cardiovascular diseases, coronary artery disease (CAD) is the most prominent and prevalent. [1] It is estimated that the increment of

cardiovascular illness death will be 25 million by 2030. [2] The major cause for death in India, accounting for 10% of whole deaths is cardiovascular disease. The NCDs reported that more than 2.5 million death due to CVD in India in 2008, two -thirds due to CAD & one third due to stroke.[3] As per WHO statistics, 17.1 million deaths were caused by CVDs in 2004 and by 2030, 23.6 million deaths will be caused by CVDs, mainly coronary artery disease (CAD) and stroke.[4]The resource-limiting Asian countries like India have seen frightening sets for the increasing Coronary heart disease prevalence and cardiovascular diseases mortality over the past two decades. India is undergoing an epidemiological transition where the burden of communicable diseases declined slowly, whereas, the burden of non-communicable diseases is increasing rapidly. In India, the prevalence of CHD has increased fourfold over the previous forty years. [5]

There are several risk factors identified by the American Heart Association. Certain risk factors can be modified, but other factors are unmodifiable. There are modifiable risk factors such as tobacco smoke, high blood cholesterol, high blood pressure, inactivity; obesity, diabetes mellitus, and stress have inversely linked with diseases. However, non-modifiable risk factors such as age, sex, and heredity have also increased the risk of diseases within a stipulated time frame. [6]

Cardiac biomarkers have become frontline diagnostic tools for myocardial infarction (MI); clinicians can make faster diagnostic decisions and design a more effective treatment plan, which reduces mortality.[7] Detection of cardiac biomarkers plays an increasingly important role in evaluating and diagnosing patients with chest pain. A clinical definition of MI has been updated recently to include cardiac marker estimation as part of the guidelines for MI diagnosis. Acute MI can be defined as an increase and decrease in serum biochemical markers (such as Troponin and CK-MB) as well as symptoms of ischemic injury, new pathologic Q waves on the electrocardiogram, ischemic changes in the electrocardiogram (ST-segment elevation or depression), coronary artery intervention, and histologic findings. Microvascular complications are increasingly linked to chronic hyperglycemia.[8] Meta analysis of ten likewise studies on thype-II diabetes have shown a potential association among cardiovascular disease and glycated hemoglobin and that have highly significant association (18%) of cardiovascular diseases risk by every 1% of elevated glaycated hemoglobin concentration. [9] The study of Cardiac markers & HbA1C levels will be helpful in the diagnosis & management of CAD.

MATERIALS AND METHODS

The present study was hospital based cross sectional observational study, which had carried out in the Department of Biochemistry, SGT Medical College, Gurugram. The subjects for the study included from Medicine OPD SGT Medical College, Gurugram & Cardiology department of SGPGI, Lucknow. The written consents were taken from the patients prior to the study & the objectives of the study were fully explained. The written informed consent was taken from the subjects to be included in the study. The clearance was taken from institutional ethics committee of FMHS, SGT University.

The study included a total 400 subjects; which was divided in to two groups. The first group has 200 cases & second group has 200 controls. Selection of cases was done on the basis of ECG graph & cardiac markers.
Group I (Cases): This group had 200 Patients of either gender suffering from premature CAD (Males <55 years & female<65years in females)

Group II (Controls): This group had 200 Age & gender matched healthy individuals
Premature coronary artery disease according to American Heart Association (AHA) defined as atherosclerotic narrowing of coronary arteries. (Males <55 years & in females <65years)

Exclusion criteria for cases

1. Any other Acute /Chronic inflammatory disorder
2. Smoking & Alcoholism
3. Recent use of lipid lowering drugs & corticosteroids
4. Pregnant or lactating women.

Exclusion criteria for Controls

1. Any other Acute /Chronic inflammatory disorder
2. Smoking & Alcoholism
3. Pregnant or lactating women.

Objectives:

- Estimation of cardiac markers in premature coronary artery disease patients & controls
- Compare the result of Cardiac markers in coronary artery disease patients & controls
- Estimation of HbA1c level in coronary artery disease patients & controls
- Compare the result of HbA1c in coronary artery disease patients & controls

Sample collection:

Five ml blood will be collected from the patients as well as controls after taking appropriate aseptic precaution. The sample was collected in EDTA & plain vacutainer for the estimation of various parameters.

Methods:

- Estimation of Serum Tropnin-I & Myoglobin by Immunofluorescence on MISPA REVO Quantitative analyzer [10]
- Estimation of Serum CK-MB activity by Immuno-inhibition Method, commercially available kit from ERBA Diagnostics Mannheim, Germany [11]
- Estimation of HbA1c by Ion exchange HPLC method by commercially available kit on Bio-Rad D-10 analyzer [12]

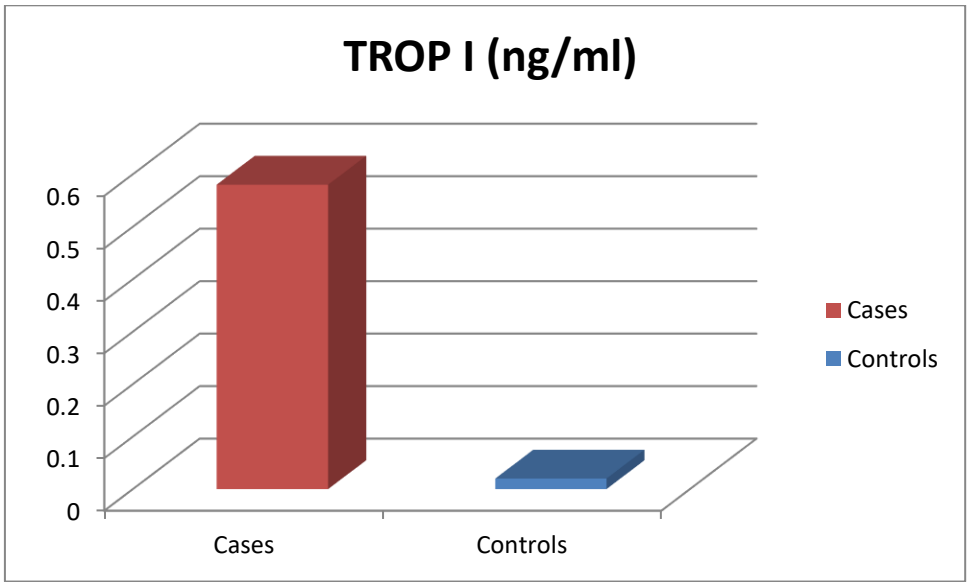
Statistical Analysis

Data and various parameters will be analysed on SPSS software (USA inc.) version 23. Mean and standard deviation of all parameters will be calculated. Chi square test will be applied to non-parametric variables. Student t-test will used to compare averages in two groups

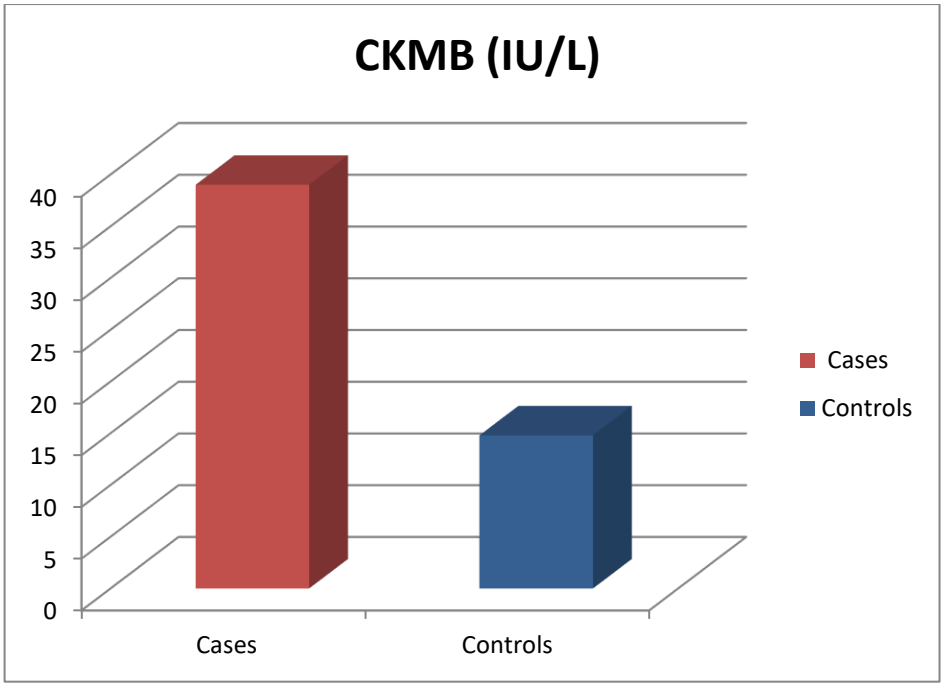
RESULTS:

Table 1: Comparison of Cardiac Markers in Cases (Gr-I) &Controls (Gr-II)

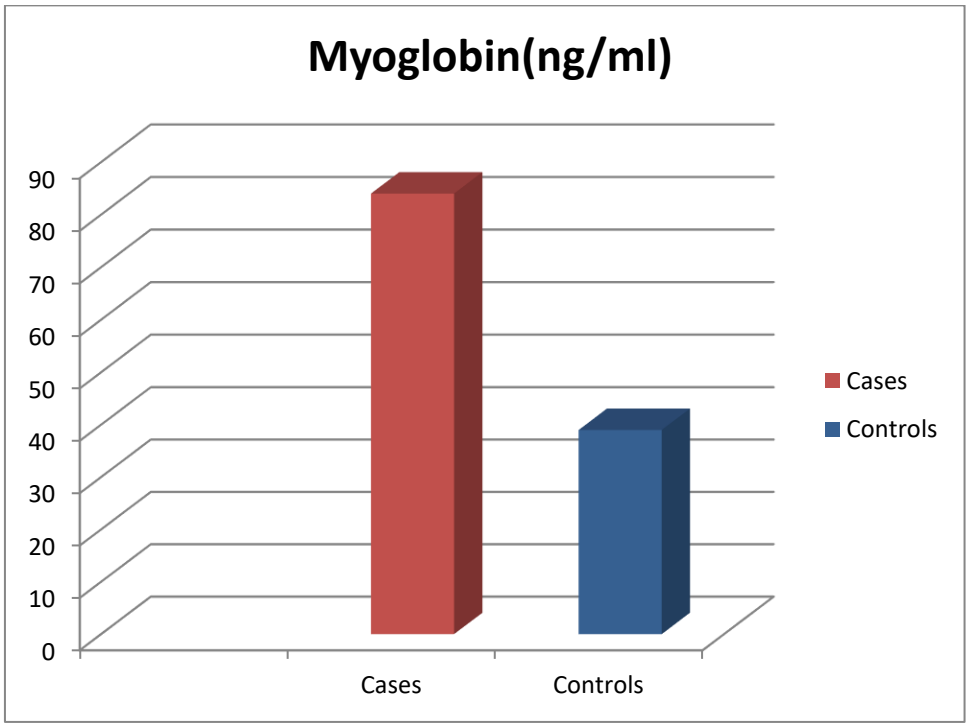
Parameters	Group-I (Cases) Mean± SD	Group-II (Controls) Mean± SD	P value
Trop-I(ng/ml)	0.58±0.48	0.02±0.006	<0.001
CKMB (IU/L)	39.01±11.02	14.79±4.0	<0.001
Myoglobin (ng/ml)	84.01±8.22	38.99±7.06	<0.001



Graph 1: Shows Mean Trop-I level in Cases &Controls



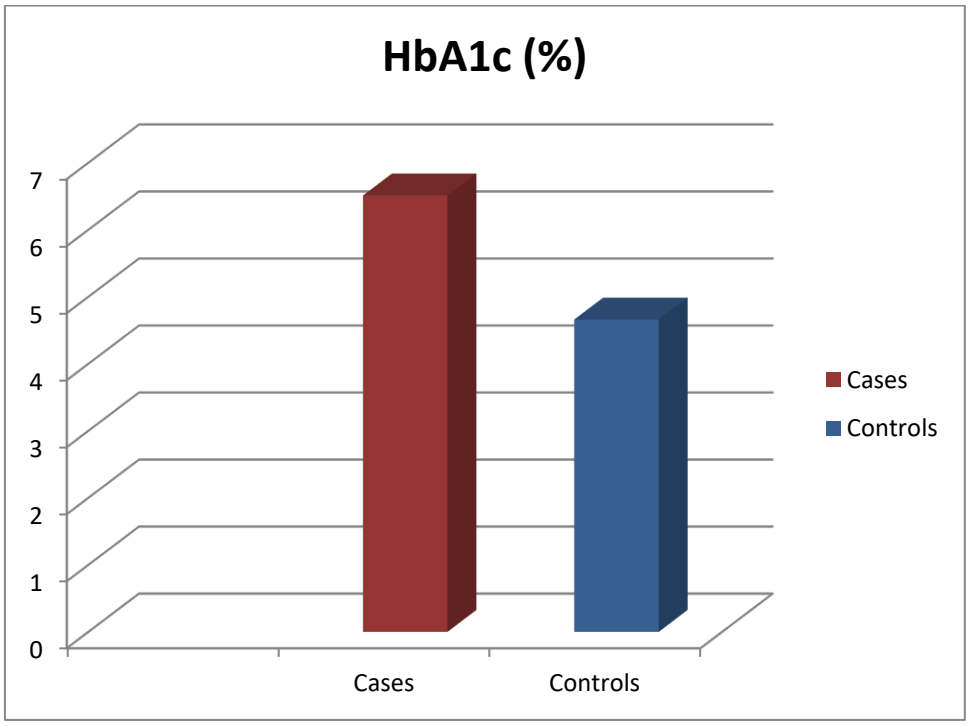
Graph 2: Shows Mean Ck-MB level in Cases &Controls



Graph 3: Shows Mean Myoglobin level in Cases &Controls

Table2: Comparison of HbA1c in Cases (Gr-I) &Controls (Gr-II)

Parameters	Group-I (Cases) Mean ± SD	Group-II (Controls) Mean ± SD	P value
HbA1c (%)	6.51±0.36	4.66±0.41	<0.001



Graph 4: Shows Mean HbA1c level in Cases &Controls

DISCUSSION:

Cardiovascular diseases represent an economic and health burden all over the world. [13]The underlying pathophysiological mechanisms for these syndromes begin with the process of atherosclerosis, which develops and progresses for decades before the acute event. Atherosclerosis can be described as a low-grade inflammatory state of the intima (inner lining) of medium-sized arteries that is accelerated by well-known risk factors such as high blood pressure, high cholesterol, smoking, diabetes, and genetics.[14]

The National Health Policy 2017 of India seeks to minimize premature deaths from cardiovascular illnesses in addition to screening and treating hypertension people by 2025.Cardiovascular diseases comprise a huge portion of non-communicable diseases.[15] Inadequate access to treatments for high systolic blood pressure and high total cholesterol, as well as underdiagnosis of these conditions, are prevalent in India and contribute to their rising prevalence. [16]

Table 1 shows mean level of serum troponin I level in the group I (cases) & group II (Controls group). There is significant elevation of troponin I in case group as compared to the control group (P<0.001).

The troponin I and troponin T subtypes are sensitive biomarkers of myocardial damage (damage to the heart muscle). Blood troponin levels are measured in acute coronary syndrome (ACS) patients.

A victim of a heart attack will have high blood troponin levels. Troponin can remain elevated for up to 2 weeks following a myocardial infarction. Heart troponin is the only clinically validated biomarker that can affect a patient's acute coronary syndrome treatment. [17]

Table 1 shows mean level of serum CKMB level in the group I (cases); group II (Controls) group. There is significant increased level of CKMB in cases group as compared to the control group (P<0.001). CK converts Creatinine into

phosphocreatine and ADP using ATP.CKMB present in cardiac muscle. Creatine MB isoforms (CK-MB) levels can also be used to detect MI because an elevated CK-MB level is linked to myocarditis and electrical cardio version. [18]

Similarly the mean levels of Myoglobin significantly increased in cases group (i.e. group I) as compared to controls group (P<0.001). A protein called myoglobin is involved in the binding of iron and oxygen. It is found in the heart and skeletal muscle tissues. Determining the level of myoglobin in combination with other biochemical markers can be very useful in the identification of early MI patients. Acute Myocardial Infarction (AMI) is diagnosed with less specificity when the myoglobin level is high. Other criteria such as CK-MB, Cardiac Troponin, ECG, and clinical history should be considered. [19]

Cardiac profile studies are supported by Reiter et al & Wilson Tang et al & shows systemic inflammation of the cardiac muscle in the case group.

Table 2 shows mean values of HbA1c, which was significantly higher in the case group (Group I) as compared to the control group (p< 0.001); suggesting poor glycemic control. Selvin et al. 2012 ; analyzing ten prospective trials, it was determined that there was an 18% increase in the risk of CVD, a 13% increase in CHD, a 16% increase in fatal CHD, and a 17% increase in stroke risk for every 1% increase in HbA1c. Additionally, they conducted a meta-analysis of five randomized controlled trials (RCTs) and found that, in type 2 diabetic patients receiving a 5-year treatment, a 0.9% decrease in HbA1c led to a significant reduction of 17% in non-fatal MI events and 15% in CHD events, but not a significant reduction in stroke events. Advanced glycation end products are created when glucose combines with different proteins. These products have the potential to cause long-term issues with atherosclerosis and plaque formation. These consequences happen gradually over decades of exposure to persistently high blood glucose levels; as explained by Selvin et al. [20]The finding of our study supports Selvin et al. if a 1% increase in HbA1c can cause complications of CVD.

CONCLUSION:

Our study shows significant increased level of Trop-I, CK-MB & Myoglobin in cases as compared to the controls group. The level of myoglobin in combination with other biochemical markers can be very useful in the identification of early MI. The elevated activity of HbA1c suggesting a greater risk of atherosclerosis, plaque formation and cardiovascular disease.

REFERENCES:

1. "Ischemic Heart Disease'' National Heart, Lung and Blood Institute (NHLBI) Available from :(https://www.nhlbi.nih.gov/health-topics/ischemic-heart-disease) Retrieved 2 Feb 2019
2. Kumar L, Das AL. Assessment of serum lipid profile in patients of coronary artery disease: A case-control study. International Journal of Contemporary Medical Research. 2018; 5: 59-62
3. Moorthy N et al. Role of Angiotensin-Converting Enzyme (ACE) gene polymorphism and ACE activity in predicting outcome after acute myocardial infarction. IJC Heart & Vasculature. 2021; 32: 1-7.
4. WHO. Cardiovascular diseases (CVDs). WHO fact sheet. 2011.
5. Krishnan MN. Coronary heart disease and risk factors in India On the brink of an epidemic. Indian heart journal.2012; 64:364-67.
6. Gurung N, Anbarasi K. Knowledge on risk factors for coronary artery disease among OPD patients at selected hospital, Bangalore. International Journal of Health Sciences & Research. 2016; 10(6): 156-61.
7. Mythili S, Malathi N. Diagnostic markers of acute myocardial infarction. Biomed Rep . 2015; 3(6):743-48.
8. Klein R, Klein BE, Moss SE. Relation of glycemic control to diabetic microvascular complications in diabetes mellitus. Ann Intern Med . 1996; 124: 90–96.
9. Selvin E, Marinopoulos S, Berkenblit G, Rami T, Brancati FL. Meta-analysis: glycosylated hemoglobin and cardiovascular disease in diabetes mellitus. Ann Intern Med. 2004; 141: 421-31.
10. . Mair J et al. Equivalent Early Sensitivities of Myoglobin, Creatine Kinase MB Mass, Creatine Kinase isoform Ratios, & Cardiac Troponins I and T for Acute Myocardial Infarction. Clin Chem. 1995; 41:1266–72.
11. Stein W. CK-MB methods & clinical significance; Proceedings of the CK-MB symposium, Philadelphia, 1981;61-74.
12. American diabetes Association. Standards of medical care for patients with Diabetes mellitus. Diabetes care. 2000; 23(1):32-42.

13. Benjamin et al. Heart disease and stroke statistics-2017 update: a report from the American Heart Association. Circulation. 2017; 135 (10): e146-e603
14. Srikanth S, Ambrose JA. Pathophysiology of coronary thrombus formation and adverse consequences of thrombus during PCI. Current Card Rev. 2012; 8:168-76.
15. Ministry of Health and Family Welfare, Government of India. National health policy 2017. https://mohfw.gov.in/sites/default/ files/9147562941489753121.pdf (accessed May 18, 2018).
16. Roth GA, Fihn SD, Mokdad AH, Aekplakorn W, Hasegawa T, Lim SS. High total serum cholesterol, medication coverage and therapeutic control: an analysis of national health examination survey data from eight countries. Bull World Health Organ 2011; 89: 92–101
17. Reiter M et al. Heart-type fatty acid-binding protein in the early diagnosis of acute myocardial infarction. Heart.2013; 99:708-14.
18. Wilson Tang W et al. National academy of clinical biochemistry laboratory medicine practice guidelines: clinical utilization of cardiac biomarker testing in heart failure. Circulation.2007; 116:99-109.
19. Wu Y et al. Diagnostic and prognostic biomarkers for myocardial infarction. Front Cardiovascular Medicine: 2021. (https:// doi. org/ 10. 3389/fcvm. 2020. 617277).
20. Zhang Y et al. Glycosylated Hemoglobin in Relationship to Cardiovascular Outcomes and Death in Patients with Type 2 Diabetes. www.plosone.org; 2012: 7.