"CORRELATIVE STUDY OF IN-HOSPITAL CLINICAL OUTCOMES WITH N TERMINAL – PRO B TYPE NATRIURETIC PEPTIDE, GLYCATED HEMOGLOBIN AND HEMOGLOBIN IN ACUTE MYOCARDIAL INFARCTION"

By

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DISSERTATION SUBMITTED TO SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH, KOLAR, KARNATAKA

In partial fulfillment of the requirements for the degree of

M.D. (GENERAL MEDICINE)

Under the Guidance of

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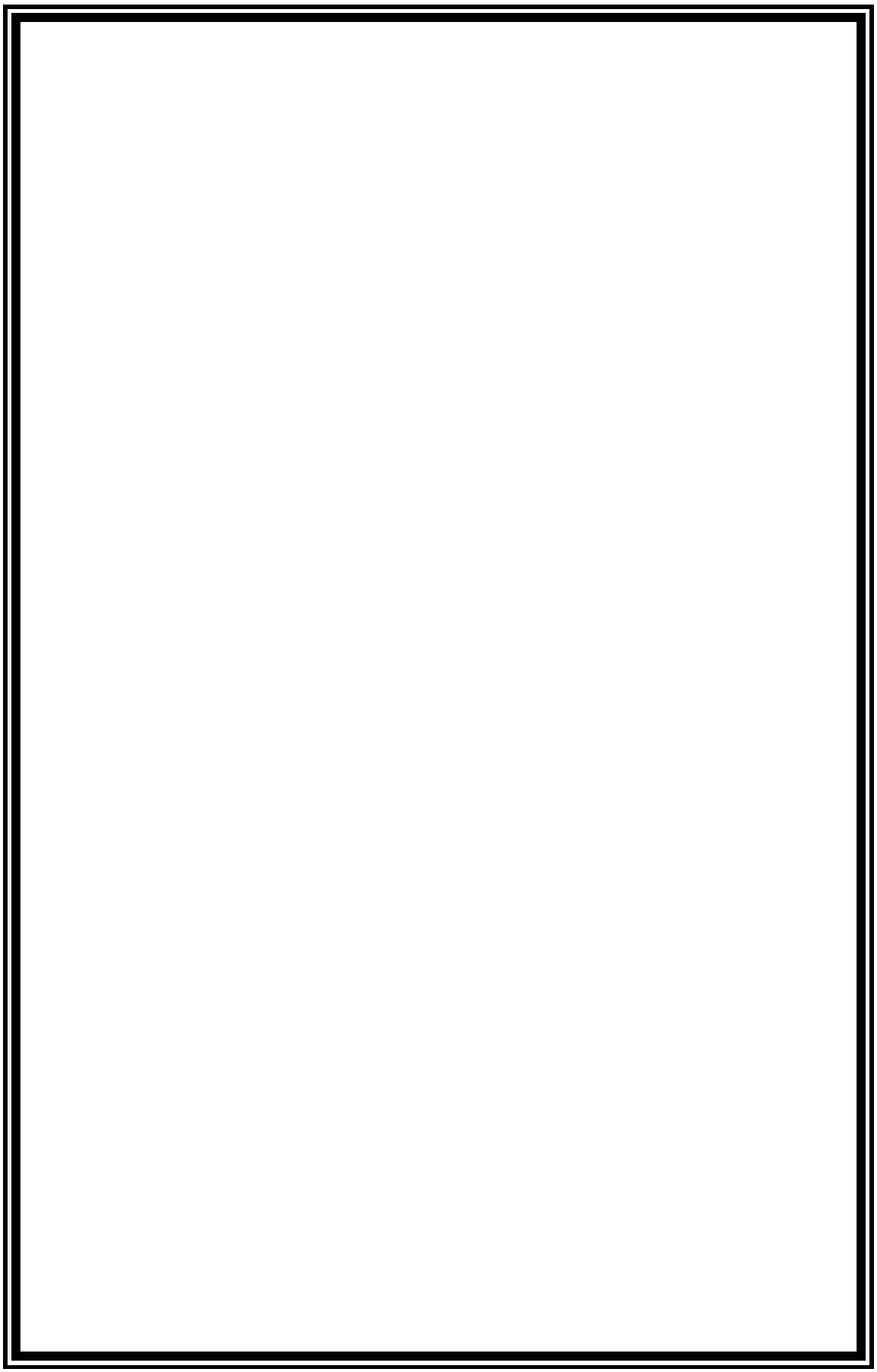

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ACKNOWLEDGEMENT

I sincerely thank my guide and teacher ***Dr B.N. Raghavendra Prasad****, M.D., Professor and Head of Department of Medicine for guidance and encouragement throughout the process of preparing this dissertation.*

I thank ***Dr Ashakiran S****, M.D., Professor of Biochemistry, for his valuable advice and supervision during the preparation of this dissertation.*

It is a privilege to extend my regards and gratitude to my teachers Professors ***Dr. V Lakshmaiah, Dr Prabhakar K, Dr. P N. Venkataratnamma,. Raveesha A, Dr Srinivasa Rao*** *for all that they have taught me during my stay at Sri Devraj Urs Medical College and also for their critical analysis and guidance during the making of this dissertation.*

I extend my deepest regards to ***Dr. Anand Kumar****, Cardiologist, RLH-NH Heart center, for his valuable advice and also for permitting me to use the services of CCU staff during the preparation.*

I extend my warm regards and thanks to my teachers and faculty of Department of Medicine ***Dr S Kumar, Dr Vidyasagar CR, Dr Jayaram, Dr.Srinivas SV, Dr Mukesh K, Dr Reetesh, Dr. Harish Kumar, Dr Naveen L, Dr.Santoshi, Dr Anto George, Dr Reddy Prasad*** *for their support and advice during the preparation.*

I thank my colleagues and friends ***Dr Sreekanth, Dr Anil, Dr Ujjawal, Dr.Kiran, Dr Srirama, Dr Gautham*** *and* ***Dr. Ashish*** *for their support and making my stay at Sri Devraj Urs Medical College a memorable one. I am thankful my seniors and juniors for their support. I thank* ***Dr Harish*** *my comrade in arms for his support and invaluable help in finishing my dissertation.*

*I thank **Dr Mahesh**, Assistant Professor, Community Medicine, for his valuable statistical analysis.*

*I express my deepest gratitude to all the **Non-teaching staff** in the department, **Technicians** in Clinical Laboratory Division, of Central laboratory, R.L.Jalappa Hospital and Research centre**, Staff** of RLJH-NH Heart center CCU, who lent me a helping hand in the completion of the dissertation and their valuable support during this study.*

*I thank my **father** who has been inspiring me all my life and continues to be the guiding star in my life. I thank my **mother** for her support and affection. I thank my **wife** and my **sister** for their encouragement and support. I am thankful to all my family members for their support.*

Last but not the least I thank all the patients, who have cooperated during the study and helped me complete my dissertation.

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LIST OF ABBREVIATIONS

CAD	Coronary Artery Disease
MI	Myocardial Infarction
ECG	Electrocardiography
BNP	Brain Natriuretic Peptide
NT-pro BNP	N Terminal pro Brain Natriuretic Peptide
HbA1c	Glycated Hemoglobin
AMI	Acute Myocardial Infarction
STEMI	ST segment Elevation Myocardial Infarction
LVEF	Left Ventricular Ejection Fraction
ACS	Acute Coronary Syndrome
NSTEMI	Non ST segment Elevation Myocardial Infarction
LVEF	Left Ventricular Ejection Fraction
TIMI	Thrombolysis in Myocardial Infarction
GRACE	Global Registry of Acute Coronary events
GISSI	Gruppo Italiano per lo Studio della Streptochinasi nell'Infarto Miocardico
cTn	Cardiac Troponin
cTnT	Cardiac Troponin T
TnT	Troponin T
LBBB	Left Bundle Branch Block

ABSTRACT

Background and Objectives: Risk stratification in cases of acute myocardial infarction is done using clinical data, electrocardiographic changes, biochemical values and echocardiography. Early risk stratification is essential to treat high risk patients aggressively, to reduce the morbidity and mortality. In this study we assess the short term prognostic value of N terminal pro B type natriuretic peptide (NT pro BNP), Glycated Hemoglobin (HbA1c), Hemoglobin (Hb), measured at admission, in studying the outcomes with 7 days of admission in cases of acute myocardial infarction (AMI).

Methods: A total of 100 patients, presenting to R L Jalappa Narayana Hrudayalaya Heart Center, will be included into the study. Patients were evaluated with history, physical, electrocardiogram, cardiac markers, NT pro BNP, HbA1c, Hb, and Echocardiogram. These patients were observed over a period of 7 days, during their stay in hospital. Patients were monitored for adverse outcomes like heart failure, arrhythmias, reinfarction, mitral regurgitation and any other complications. NT pro BNP values ranged widely from <20 pg/ml to 2000 pg/ml, a value of 125pg/ml in age < 75y and >450 pg/ml in age >75 y was considered abnormal. HbA1c level of >6.5% was considered abnormal. Hb of <13mg/dl in males and <12mg/dl in females was considered abnormal.

Results: There was a significant negative correlation observed between NT pro BNP and Left ventricular ejection fraction at p – 0.0001. Total of 27 cases developed complications like heart failure, reinfarction, mitral regurgitation which

was significantly associated with abnormal NT pro BNP values at p – 0.002. Total 6 patients had died although the NT pro BNP values were elevated in all the cases there was no statistically significant association between NT pro BNP values and mortality. HbA1c was not found to be significantly associated with LVEF, adverse out comes and mortality in short term. Low Hb levels correlated significantly with LVEF at p – 0.04. Anemia was also associated with significant increased risk of arrhythmias at p – 0.03.

Conclusion: NT pro BNP and Hb levels are strong predictors of in hospital adverse cardiac events. NT- pro BNP and Hb are good tools for the risk stratification of acute MI patients so that appropriate treatment strategies could be planned. NT pro BNP levels correlate with the degree of left ventricular systolic dysfunction and hence an indirect evidence of infarct size, which are amongst the major determinants of long term outcomes in such patients.

Key words: N terminal pro B type natriuretic peptide (NTproBNP), Glycated Hemoglobin (HbA1c), Hemoglobin (Hb), acute myocardial infarction (AMI), Prognosis.

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INTRODUCTION

Cardio Vascular Diseases (CVD) are currently the leading cause of death globally, accounting to 21.9 % of total deaths. This number is projected to increase to 26.3% by 2030.[1] With the changing socio-economic landscape in India; there is a rapid and significant transition in the profile of the diseases affecting its people. Chronic non communicable diseases contributed to 53% of deaths and 43% of the disease-adjusted life years (DALYs) lost in 2005.[2] Cardiovascular Diseases (CVD) account for the majority of the chronic non communicable diseases in India. The incidence of CVD has risen from about 7% in 1970 to 32% in 2011. [3] Coronary Artery Disease (CAD) is prevalent among 8-10% of urban and 3-4% of rural population, which represents a six fold rise in urban and two fold rise in rural setting from 1960 to 2000. CAD accounts for close to 1.5million deaths per year; [4] as the prevalence of Diabetes, Hypertension and Metabolic Syndrome is increasing, the incidence of CVD is projected to increase further in the future. This has significant impact on the socio-economics.

The INTERHEART Study[5] demonstrated that compared to Western population deaths due to Acute Myocardial Infarction (AMI) occurred at least five to ten years earlier in south Asians when compared to western population. The higher risk for AMI in South Asians in their younger age is largely determined by the higher levels of conventional risk factors. The nine conventional risk factors (abnormal lipids, smoking, hypertension, diabetes, abdominal obesity, psychosocial factors, consumption of fruits & vegetables, alcohol and regular physical activity) collectively explain 86 per cent of the AMI risk in south Asians. The other important findings of this study were that south Asian men got AMI five to six years earlier than women;

higher level of prevalence of risk factors in cases and controls under the age of sixty and regular alcohol consumption is not protective in south Asians.[5, 6]

Interestingly the incidence of coronary artery disease in South Asian migrants in Western countries is more than that of the general population; [7, 8] this racial and geographical predilection points to a genetic susceptibility of people of South Asian descent, including Indian Subcontinent. This opens up an enormous field of genetics and epigenetics, in trying to explain the scientific reason behind higher prevalence of risk factors in South Asians at a younger age. Further studies are needed in this regard.

Epidemiological data indicate that the higher prevalence of conventional risk factors in India were largely related to urbanization as there were significant differences in incidence of these risk factors in urban-rural settings. [9] Further more there is an economical and social perspective to this problem in India. Due to several factors like illiteracy, poor access, poor primary and evidence based care, lack of support services and follow up; leads to 49.1% higher mortality among the poor in India when compared to the rich. [10] This also means a huge economic loss to India, as estimates of World Health Organization show that our country lost close to 9 billion US dollars (USD) due to premature deaths directly attributed to heart disease, stroke and diabetes in the year 2005.[6]

Acute Coronary Syndrome (ACS) is a blanket term for various presentation that result from one common pathology, that of acute myocardial ischemia. A block in coronary arteries due to atherosclerotic plaque rupture or erosion, superimposed with thrombosis is usually the main cause of myocardial ischemia. If this blockage persists for a sufficient period of time then, this can lead to myocardial necrosis and cell death.[11]Myocardial ischemia and cell necrosis underlies the clinical spectrum of ACS

including ST segment elevation, non ST segment elevation myocardial infarctions and also unstable angina. Myocardial necrosis is detected by the presence in the blood of biochemical markers like Troponin (cTn) or the MB fraction of Creatinine Kinase. Cardiac Troponins I and T are components of the contractile apparatus of myocardial cells and expressed almost exclusively in heart muscle.

GISSI trial showed the importance of thrombolysis or reperfusion strategy as a treatment for AMI**.**[12]Since the use of thrombolysis and advent of Coronary Care Units (CCU), significant progress has been made to decrease the mortality and morbidity of the patients of Acute Coronary Syndromes (ACS) has fallen drastically. GRACE score is a tool to stratify the patients of AMI into high, medium and low risk groups so that more focused and appropriate care can be given.[13]

B-type Natriuretic Peptide belongs to a group of three natriuretic peptides including Atrial Natriuretic Peptide (ANP) and C-type Natriuretic Peptide (CNP). ANP and BNP are released by cardiac myocytes and CNP is released predominantly from endothelium. BNP is released mainly due to stretch of the cardiac myocytes, in addition to this hypoxia/ischemia and neurohormonal mechanisms also activate the release of BNP. [14] So the amount of BNP released in AMI, measured at admission, in patients who present within 12 hours of onset of chest pain, can be a useful marker to risk stratify the patients and to predict the in-hospital and long term outcomes.

Glycated Hemoglobin (HbA1C) levels have shown to influence the mortality and morbidity in AMI cases in both non diabetics and diabetics.[15] Hemoglobin (Hb) levels affect the oxygen carrying capacity and a low Hb levels can have adverse outcomes in AMI cases. There was a study done where attempts to increase the Hb by giving Erythropoietin (EPO) in AMI cases, to see whether it improves the outcome, resulted in poor outcomes and it had to be discontinued. [16] Hb levels at

admission in patients of AMI can be used to assess the in-hospital mortality and morbidity.[17]

In this study we tried to study the clinical outcome and in-hospital mortality, morbidity using N terminal B type natriuretic peptide (NT pro BNP), HbA1c and Hb, measured at the time of admission, in patient of AMI presenting within 12 hours.

OBJECTIVES

1. To stratify risk and study the clinical outcome during the first 7 days in Acute Myocardial Infarction patients using NT pro BNP, HbA1c, Hb.

2. To study the association between NT pro BNP, HbA1c, Hb levels and adverse cardiovascular events during the first 7 days in cases of Acute Myocardial Infarction.

REVIEW OF LITERATURE

HISTORICAL REVIEW

The history of the heart and its diseases is a fascinating story, initially shrouded in deep mystery and romanticism leading to erroneous teaching for almost thousands of years, until William Harvey's experimental research paved the way for proper understanding of circulatory system. Cardiology has advanced remarkably since the early civilizations, who believed the heart to be source of heat and impervious to disease, to the current day approach to heart diseases using biochemistry, vascular biology, molecular genetics, interventions and surgery.

"The heart….is the beginning of life; the sun of the microcosm….for it is the heart by whose virtue and pulse the blood is moved, perfected, made apt to nourish, and is preserved from corruption and coagulation; it is the household divinity which, discharging its function, nourishes, cherishes, quickens the whole body, and is indeed the foundation of life, the source of all action." William Harvey, 1628. [18]

Early civilizations thought that the blood vessels were carrying *pneuma* the life sustaining spirit of the vital organs. This was eloquently elaborated by Galen (A.D. 130 – 200) and this flawed beliefs persisted until Andreas Vesalius corrected the anatomy (1543), then William Harvey proposed that blood circulates due to the force of the heart (1616).[19, 20] Many believe that this discovery of William Harvey marked the beginning of Cardiology as well as introduction of experimental observation in the field of medicine.

Over a century later on July 21, 1768, William Heberden presented "Some Account of a Disorder of the Breast" to the Royal College of Physicians, London. He stated "But there is a disorder of the breast marked with strong and peculiar

symptoms, considerable for the kind of danger belonging to it, and not extremely rare. The seat of it, and sense of strangling and anxiety with which it is attended, may make it not improperly called angina pectoris."[21] The term angina was derived from a Latin word meaning "strangling". This characteristic description is considered to mark the beginning of appreciation of coronary artery disease.

A coronary etiology was first suspected by Edward Jenner and Caleb Parry. They further were supported by their autopsy findings of ossified coronaries in their friend, temperamental surgeon John Hunter, who was suffering from angina, saying that his "life was in hands of any rascal who should choose to annoy and tease me." This coronary implication was published by Parry in 1799 in Syncope Anginosa.

Nevertheless a coronary cause of angina pectoris was not readily accepted until the late nineteenth century. The main reasons for this was that there were many misconceptions like: the heart was thought to be immune to disease; the coronaries were not carefully dissected; Skoda, Hope, Stokes and several others believing in stethoscope and physical diagnosis found little or nothing to corroborate a coronary cause.

It was in the middle of nineteenth century with Rudolf Virchow's observations; the importance of thrombosis in arteries was understood. By the end of nineteenth century William Osler and others started linking angina pectoris with coronay artery disease. In 1901 William Osler classified angina and called the anterior branch as the "artery of sudden death" William Einthoven's three lead electrocardiogram (ECG) was used in 1920 to diagnose MI clinically. Precordial leads introduced by Frank Wilson in 1930s supplemented the diagnosis.

The development of biochemical tests like transaminases, creatinine kinase, troponins in the later part of twentieth century helped to diagnose MI. Initially it was thought to be invariably fatal. Strict bed rest for 6 to 8 weeks was rigidly advised for heart attacks until 1952 when Levine and Lown suggested an "armchair" approach was better. Anticoagulation, strongly recommended by Wood and others for myocardial infarction in the 1950s, became controversial in the 1960s. Before the defibrillator and coronary care units, the mortality of infarction was 30 percent. With the development of the defibrillator by William Kouwenhoven, Claude Beck and Paul Zoll were able to prove that rescue of cardiac arrest victims was possible. Beck dramatically stated that "The death factor in coronary artery disease is often small and reversible . . . The heart wants to beat and often it needs only a second chance." His concept that "the heart is too good to die," instilled optimism into the care of coronary patients. Since then various advances like thrombolysis, coronary arteriography and arterioplasty have further reduced the mortality.

The coronary care has gone through recognizable phases: first, cardiac resuscitation and the essential role of the nurse; second, prevention of arrhythmias; third, hemodynamic catheter monitoring and treatment of pump failure; fourth, reduction of infarct size—first with beta blockers and glucose-insulin-potassium and then thrombolytic therapy (1987); and fifth, primary angioplasty (1987). Clinical and electrocardiographic distinctions have been drawn between unstable angina, an acute coronary event, nontransmural/non–Q wave/non-ST elevation infarction, and transmural/ST elevation infarction. Risk stratification using various biochemical, hematological and echocardiographic data has been used to provide appropriate care for high risk patients.

ACUTE MYOCARDIAL INFARCTION

Mortality in cardiovascular (CV) disease has decreased considerably over the past few decades.[22] Despite this decline, acute coronary syndromes (ACS), and especially acute myocardial infarction (MI), which imposes a great burden on society and the individual patients, is still one of the major causes of death in India. ACS represents a spectrum of clinical conditions ranging from unstable angina (UAP) without myocardial necrosis to ST-segment-elevation MI (STEMI) with clear evidence of myocardial damage.[23] The underlying cause of ACS is atherosclerosis, an inflammatory disease that starts early in life as fatty streaks in the coronary arteries and may progress to atherosclerotic plaques, which, if ruptured, may lead to thrombus formation and the impairment of coronary flow.[24]

Definitions [25]

The term acute myocardial infarction (MI) should be used when there is evidence of myocardial necrosis in a clinical setting consistent with acute myocardial ischaemia. Under these conditions any one of the following criteria meets the diagnosis for MI:

- Detection of a rise and/or fall of cardiac biomarker values [preferably cardiac troponin (cTn)] with at least one value above the 99th percentile upper reference limit (URL) and with at least one of the following:

1. Symptoms of ischaemia.
2. New or presumed new significant ST-segment–T wave (ST–T) changes or new left bundle branch block (LBBB).
3. Development of pathological Q waves in the ECG.
4. Imaging evidence of new loss of viable myocardium or new regional wall motion abnormality.
5. Identification of an intracoronary thrombus by angiography or autopsy.

- Cardiac death with symptoms suggestive of myocardial ischaemia and presumed new ischaemic ECG changes or new LBBB, but death occurred before cardiac biomarkers were obtained, or before cardiac biomarker values would be increased.
- Percutaneous coronary intervention (PCI) related MI is arbitrarily defined by elevation of cTn values (>5 x 99th percentile URL) in patients with normal baseline values (≤99th percentile URL) or a rise of cTn values >20% if the baseline values are elevated and are stable or falling. In addition, either (i) symptoms suggestive of myocardial ischaemia or (ii) new ischaemic ECG changes or (iii) angiographic findings consistent with a procedural complication or (iv) imaging, demonstration of new loss of viable myocardium or new regional wall motion abnormality are required.
- Stent thrombosis associated with MI when detected by coronary angiography or autopsy in the setting of myocardial ischaemia and with a rise and/or fall of cardiac biomarker values with at least one value above the 99th percentile URL.
- Coronary artery bypass grafting (CABG) related MI is arbitrarily defined by elevation of cardiac biomarker values (>10 x 99th percentile URL) in patients with normal baseline cTn values (≤99th percentile URL). In addition, either (i) new pathological Q waves or new LBBB, or (ii) angiographic documented new graft or new native coronary artery occlusion, or (iii) imaging evidence of new loss of viable myocardium or new regional wall motion abnormality.

Criteria for prior myocardial infarction

Any one of the following criteria meets the diagnosis for prior MI:

- Pathological Q waves with or without symptoms in the absence of non-ischaemic causes.

- Imaging evidence of a region of loss of viable myocardium that is thinned and fails to contract, in the absence of a non-ischaemic cause.
- Pathological findings of a prior MI.

Despite sharing a common pathophysiological mechanism, the clinical presentation differs between patients with ACS, and based on established management strategies the syndrome has been divided into two distinct categories: [23, 25]

1) STEMI, with typical ECG changes, indicating the total occlusion of a coronary artery without collateral flow protecting the jeopardized zone, and

2) Unstable coronary artery disease or non-ST-elevation acute coronary syndrome, including both UAP and non-STEMI (NSTEMI), with a subtotal or intermittent coronary occlusion, embolization, or a total occlusion with transmural ischemia prevented by collateral circulation.

CLINICAL FEATURES

Onset of myocardial ischaemia is the initial step in the development of MI and results from an imbalance between oxygen supply and demand. Myocardial ischaemia in a clinical setting can usually be identified from the patient's history and from the ECG. Possible ischaemic symptoms include various combinations of chest, upper extremity, mandibular or epigastric discomfort (with exertion or at rest) or an ischaemic equivalent such as dyspnoea or fatigue. The discomfort associated with acute MI usually lasts 20 min. Often, the discomfort is diffuse-not localized, nor positional, nor affected by movement of the region-and it may be accompanied by diaphoresis, nausea or syncope. However, these symptoms are not specific for myocardial ischaemia. Accordingly, they may be misdiagnosed and attributed to

gastrointestinal, neurological, pulmonary or musculoskeletal disorders. MI may occur with atypical symptoms—such as palpitations or cardiac arrest—or even without symptoms; for example in women, the elderly, diabetics, or post-operative and critically ill patients. Careful evaluation of these patients is advised, especially when there is a rising and/or falling pattern of cardiac biomarkers.[25]

CLINICAL CLASSIFICATION OF MYOCARDIAL INFARCTION

In addition to the classification of MI into ST elevation and Non ST elevation MI, which helps in treatment strategy, MI can be classified in to various groups based on clinical, pathological, and prognostic differences.

Type 1: Spontaneous myocardial infarction

This is an event related to atherosclerotic plaque rupture, ulceration, fissuring, erosion, or dissection with resulting intraluminal thrombus in one or more of the coronary arteries, leading to decreased myocardial blood flow or distal platelet emboli with ensuing myocyte necrosis. The patient may have underlying severe CAD but, on occasion (5 to 20%), non-obstructive or no CAD may be found at angiography, particularly in women. [26-28]

Type 2: Myocardial infarction secondary to ischaemic imbalance

In instances of myocardial injury with necrosis, where a condition other than CAD contributes to an imbalance between myocardial oxygen supply and/or demand, the term ‘MI type 2’ is employed. In critically ill patients, or in patients undergoing major (non-cardiac) surgery, elevated values of cardiac biomarkers may appear, due to the direct toxic effects of endogenous or exogenous high circulating catecholamine levels.

Also coronary vasospasm and/or endothelial dysfunction have the potential to cause MI. [29-31]

Type 3: Cardiac death due to myocardial infarction

Patients who suffer cardiac death, with symptoms suggestive of myocardial ischaemia accompanied by presumed new ischaemic ECG changes or new LBBB—but without available biomarker values— represent a challenging diagnostic group. These individuals may die before blood samples for biomarkers can be obtained, or before elevated cardiac biomarkers can be identified. If patients present with clinical features of myocardial ischaemia, or with presumed new ischaemic ECG changes, they should be classified as having had a fatal MI, even if cardiac biomarker evidence of MI is lacking.

Type 4 and 5: Myocardial infarction associated with revascularization procedures

Periprocedural myocardial injury or infarction may occur at some stages in the instrumentation of the heart that is required during mechanical revascularization procedures, either by PCI or by coronary artery bypass grafting (CABG). Elevated cTn values may be detected following these procedures, since various insults may occur that can lead to myocardial injury with necrosis. [32-34] It is likely that limitation of such injury is beneficial to the patient: however, a threshold for a worsening prognosis, related to an asymptomatic increase of cardiac biomarker values in the absence of procedural complications, is not well defined. Subcategories of PCI-related MI are connected to stent thrombosis and restenosis that may happen after the primary procedure. [35, 36]

Pathophysiology of MI

Atherosclerotic Coronary Artery disease accounts for more than 80% of cases of Myocardial Infarction, with non-atherosclerotic disease being a rare cause. Atherosclerosis is an inflammatory disorder of the vascular tree, characterized by focal lipid rich deposits of atheroma.

There is enough evidence to suggest that atherosclerosis is a chronic inflammatory response to vascular injury caused by a variety of agents that activate or injure endothelium and promote lipoprotein infiltration, retention, and modification, combined with inflammatory cell entry, retention and activation. [37, 38] It remains to a large extent clinically silent until atheroma becomes large enough to block the circulation or there is plaque disruption causing thrombosis and occlusion of the vessel.

"Fatty Streak" is the initial lesion in the progression of Atherosclerosis. It tends to occur in areas where there is disruption of laminar flow, such as bifurcations.[39] It often arises from areas of increased lipoprotein within the regions of intima. Inflammatory monocytes move into these early lesions, take up the lipids forming 'foam cells'. These cells then release cytokines and growth factors which then stimulate the smooth muscle cells, which then move to the site and proliferate in an attempt to stabilize the lesion. If they are successful the atheroma will be silent till it grows to such an extent to obstruct the flow. In such situations patients usually present with stable angina.

Alternatively when the inflammation predominates due to release of cytokines, like interleukin-1, tumor necrosis factor-alpha, interferon-gamma, platelet-derived growth factors and matrix metalloproteinases; the intimal smooth muscles cells

become senescent and collagen cross-struts form within the fibrous cap and these changes make the fibrous cap unstable and vulnerable for mechanical stress that can lead to rupture or fissuring of plaque surface. Any breach in the fibrous cap will expose the highly thrombogenic lipid core and this leads to platelet aggregation and thrombosis that extends into the arterial lumen, which can cause partial or total occlusion. This causes an imbalance between oxygen supply and demand, leading to Acute Coronary Syndrome. If this mismatch is prolonged then, this leads to Myocardial Infarction.

At an early stage, the atherosclerotic plaque constitutes an asymmetrical thickening of the arterial intima but does not cause any impairment of the coronary artery. As the plaque gradually grows, it leads to the successive narrowing of the coronary artery. Whether a plaque can be responsible for the initiation of an acute coronary event has little to do with the degree of obstruction that it causes.[40] In victims of sudden coronary death, non-critical stenosis was present in around 40%.[41] Coronary plaque rupture, and subsequent thrombus formation when the thrombogenic lipid core is exposed to blood in the arterial lumen, precipitates the majority of events. [42] Underlying plaque rupture was the etiology of sudden death in 55-60%, while plaque erosion, i.e. endothelial denudation with the exposure of subendothelial connective tissue, was the mechanism in around 30% and thrombi attributed to a calcified nodulus in 2% to 7%. [43] The vulnerable, rupture-prone plaque typically has a lipid core, which is an extracellular mass of lipid containing cholesterol and its ester that is covered by a thin cap of fibrotic issue. [43, 44] Nonsymptomatic plaque ruptures contribute to the non-linear progression of coronary obstructions, as can be observed in repeated angiographic studies in patients. [45]

The etiology of atherosclerosis is still not fully understood, but there are several factors that contribute to its progression. The four major risk factors for atherosclerotic disease and death are probably hypertension, smoking, dyslipidemia, and diabetes, but obesity, stress, genetics and a host of other factors are also involved, perhaps via a primary action on the endothelium, making it susceptible to lipid retention. [46] In the recent INTERHEART study, nine factors were identified that accounted for > 90% of the risk of MI: smoking, history of hypertension or diabetes, waist/hip ratio, dietary patterns, physical activity, consumption of alcohol, blood apolipoproteins (Apo) and psychosocial factors.[5]

Men develop atherosclerosis and suffer their first MI at an earlier age, than women.[47]As to the underlying mechanisms in the development of an acute event; women have been reported to have erosions more frequently than men. [43] After the menopause, women have almost the same frequency of plaque rupture as men and, compared with younger women with plaque, they have more calcifications and a larger necrotic core.

Pathology

Earliest changes in the cardiac muscle, viewed through electron microscope, are seen within 20 min; these are decrease in the size and number of glycogen granules, intracellular edema, swelling and distortion of tubular system, sarcoplasmic reticulum and mitochondria. After 60 minutes myocyte swelling and internal disruption of mitochondria starts to appear. Usually by 20 min to 2 hours ischemic changes in some cells will become irreversible. Coagulation necrosis is usually found in the central of the infarct.

Although biochemical and functional abnormalities begin almost immediately at onset of ischemia, severe loss of myocardial contractility occurs within 60 seconds, while other changes take a more protracted course; for example, the loss of viability (irreversible injury) takes at least 20 to 40 minutes following total occlusion of blood flow.

Two zones of myocardial damage occur: a central zone with no flow or very low flow, and a zone of collateral vessels in a surrounding marginal zone. The survival of the marginal zone is dependent on the level of ischemia and the duration of ischemia. In autopsy hearts, the size of the ischemic zone surrounding an acute myocardial infarction is associated with increased apoptosis and degree of occlusion of the infarct-related artery.[48] The extent of coronary collateral flow is one of the principal determinants of infarct size. Indeed, at autopsy it is not uncommon to see chronic total coronary occlusion and an absence of myocardial infarction in the distribution of that artery. Absence of myocardial ischemia (revealed by electrocardiographic changes or angina during transient coronary balloon occlusion) is associated with presence of well-developed collateral vessels, suggesting that the patients with well-developed collateral vessels have a low risk of developing acute myocardial infarction upon abrupt closure of the culprit coronary artery.[49] Collaterals are better developed in patients with angina and in younger individuals as compared to older patients with acute infarcts.[50] Because infarct size is an important determinant of survival as well as development of congestive heart failure, efforts have been directed to limit infarct size by early reperfusion, reduction of myocardial oxygen demand, and prevention of reperfusion injury. In 1971, Page et al. showed that infarcts involving 40 percent of left ventricle are predictors of cardiogenic shock and death.[51]

Brain Natriuretic Peptide and Myocardial Infarction

In 1981, de Bold and coworkers observed that the heart has an endocrine function, which resulted in the detection of the atrial natriuretic peptide (ANP). [52] It has since become apparent that there is a family of natriuretic peptides that play an important role in the control of CV homeostasis and also myocardial and vascular structure and function. [53,54] Three natriuretic peptides have so far been identified and well characterized in humans; in addition to ANP, they also include the B-type natriuretic peptide (BNP) and the C-type natriuretic peptide (CNP). [55]

While ANP and BNP both have the heart as their major source of origin, the CNP is predominantly released from the endothelium. CNP lacks the strong natriuretic and diuretic effects that are characteristic of ANP and BNP. Although ANP and BNP have similar physiological effects, BNP has emerged as the biomarker of choice in CV diseases. BNP is released as a preproBNP peptide of 134 amino acids from the cardiomyocytes, in response to the excessive stretching of the left ventricular (LV) wall, and cleaved into proBNP (108 amino acids) and a signal peptide with 26 amino acids. ProBNP is subsequently cleaved into BNP (32 amino acids) and the inactive N-terminal proBNP .[55]

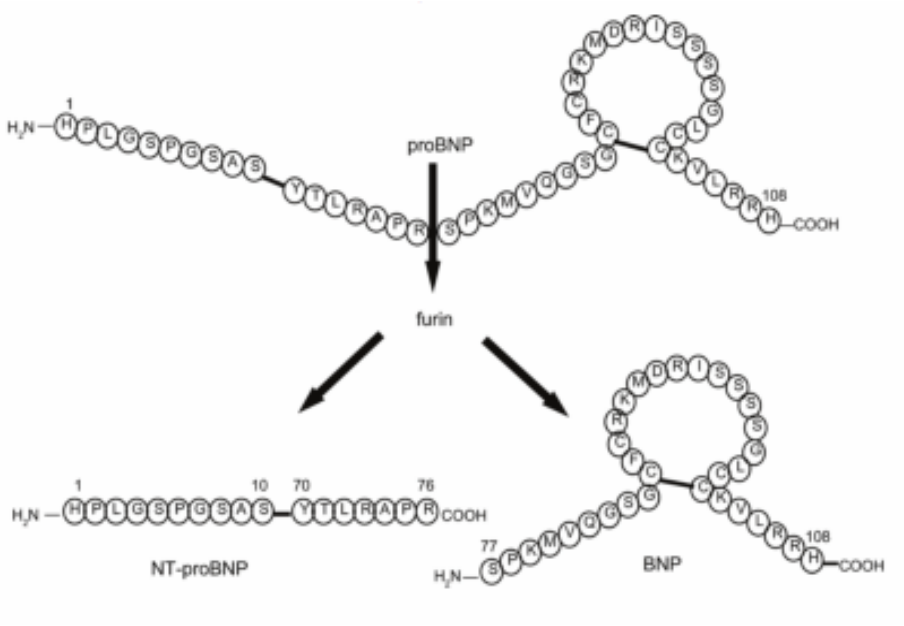

Figure 1: Schematic diagram showing cleavage of proBNP to BNP and NT -proBNP

In addition to increased wall stress, neurohormonal activation and hypoxia/ischemia stimulate BNP secretion.[56] There are probably also as yet unknown factors that contribute to its release. The prevailing view has been that BNP and NT-proBNP are released in a 1:1 proportion, but this assumption has lately been refuted. [57] The elimination of BNP is dependent on receptors and enzymatic degradation, while the mechanisms for NT-pro BNP clearance are less well understood. It has been suggested that NT-pro BNP is more dependent on renal function for its clearance than BNP, but this concept has been challenged. [58] NT pro BNP is a larger molecule than BNP and its half-life is longer (120 vs. 20 minutes), which explains the higher circulating levels of NT-pro BNP compared with BNP. NT-pro BNP has been proven to be more stable than BNP during sampling and management, as well as during freezing and long-term storage. [59] Various measures have been tested in order to offset the degradation of BNP that occurs after sampling. They have involved the use of plastic tubes, the addition of EDTA and also the addition of protease inhibitors. [59]

Although BNP was first recognized as a diuretic and vasodilator hormone, a number of additional important physiological paracrine and autocrine effects have been identified since its discovery.

The most important are as follows:

- The suppression of the sympathetic nervous system, peripherally and centrally
- The suppression of the renin-angiotensin-aldosterone system
- The inhibition of the growth of vascular smooth muscle and possibly an antifibrotic effect on the heart muscle
- The reduction of peripheral vascular resistance
- An increase in endothelial permeability

Over the years, both BNP and NT-proBNP have emerged as promising biomarkers in CV disease and there are data to support the use of B-natriuretic peptides in a number of clinical situations, such as the diagnosis and ruling out of CHF, the detection of asymptomatic LV systolic or diastolic dysfunction, monitoring the response to therapy in CHF, as a marker of prognosis not only in CHF but also in the general population, in MI patients and in patients with ACS.[60-64] Studies have indicated that B-natriuretic peptides might predict the risk of mortality and CHF, in both the short and long term, even in ACS patients without evidence of myocardial necrosis or CHF.[60] In several recent reports, BNP/NT-proBNP has been included in multimarker approaches in order to improve the prediction of outcome in ACS patients, and also other populations, and it has been shown to provide independent information, in addition to variables such as LVEF, C-reactive protein and measures of renal function, on both the short- and long-term prognosis.[65]

In addition to various situations with a left heart condition, increased levels of BNP and NT- proBNP have been registered in patients with hypoxia and right ventricular disorders, such as acute or chronic pulmonary disease and pulmonary embolism.[66, 67] There are also a number of non-cardiac conditions in connection with which elevated levels have been observed, e.g. renal dysfunction, diabetes mellitus, anemia, thyrotoxicosis and liver cirrhosis.[68]

Although an enormous amount of experience has been acquired in recent years, there are still a number of unanswered questions related to the role of B-natriuretic peptides in clinical medicine. As to the relative merit of one type of peptide in favor of another, current data appear to agree that the performance of BNP and NT-proBNP is similar in most populations.[69] Measurements of Bnatriuretic peptides are included in the international guidelines for the treatment of CHF, including the establishment of diastolic LV dysfunction, [70] but so far there are no universally accepted recommendations for the routine assessment of B-natriuretic peptides in ACS. In this patient population, one important question is still the optimal time point for assessment and whether serial analyses provide more information than a single measurement. At present, the prevailing opinion appears to be that B-natriuretic peptides should not be routinely analyzed in all patients with ACS, as, in most patients, this would not lead to any change in therapy, or any other action that would influence mortality or morbidity to any significant extent.

A study by Mega et al in Massachusetts, USA, in 2004 showed that increased concentrations of BNP at initial presentation, in patients with STEMI are associated with higher short term risk of mortality. [71]

A multicentric study by Galvani et al in Italy inferred that NT-pro-BNP levels, measured at admission early after the onset of the ischaemic episode, improve the

early risk stratification of patients with acute coronary syndrome and are strongly predictive of short term mortality.[72]

A study by Puri et al in Lucknow, India in 2003 -2004 concluded that NT-pro-BNP has the strongest predictive value to assess the risk of adverse events including death in patients with ACS. Information provided by this biomarker is incremental to that offered by conventional risk markers in patients with ACS. [73]

In a multimarker study by Blankenberg et al comparing NT-pro-BNP with nine inflammatory markers and microalbuminuria, NT-pro-BNP was the only marker shown to improve risk stratification of recurrent cardiovascular events. [74]

The main findings of a study by Mayr and others in Austria were significant correlation of NT-pro BNP measured on day 3 after admission with acute and chronic infarct size, ejection fraction and segmental wall thickening after AMI assessed by cardiac magnetic resonance imaging as well as with biomarkers of myocardial necrosis. Furthermore, it highlighted the potential of NT-pro BNP concentration (>1115 pg/ml on third day after AMI) to identify patients with no significant recovery of global and regional myocardial function over a period of up to 12 months. Moreover, when considering age, delay in time - to reperfusion, baseline infarct size and EF, creatinine, NT-pro BNP as well as maximum creatine kinase and cardiac troponin T in a multiple linear regression analysis, baseline EF and NT-pro BNP were significantly related to the mid – term recovery of global myocardial function. [75]

A study in UK by McCann et al demonstrated that, on multivariate analysis, Heart - fatty acid binding protein (H- FABP), NT- pro- BNP, and peak cardiac troponin T were independent predictors of 1- year death/MI, when measured in

patients presenting with chest pain < 4 hours duration. Measuring H-FABP and pro-BNP may help improve long- term risk stratification.[76]

A study in New Zealand by Richards et al concluded that the plasma NT-pro-BNP and BNP levels measured within a few days of AMI independently predict death and heart failure in the presence or absence of preserved ejection fraction and are related to the risk of new ischemic events. [77]

A 2005 study in USA by Ezekowit z et al revealed NT- pro- BNP to be an independent and potent prognostic risk factor – more powerful than traditional markers of risk – at three early time points in patients presenting with STEMI and treated with primary PCI. It demonstrated three novel findings: the basal level of NT-proBNP is proportionate to the elapsed time from symptom onset in patients presenting with STEMI; NT-proBNP is correlated with infarct size as determined by biochemical and Electrocardiographic measures; and NT proBNP is closely related to measures of successful reperfusion. So, higher NT- proBNP is correlated with longer time from symptom onset to presentation, worse tissue level perfusion and larger infarct size in patients with acute STEMI. NT -proBNP has a potential role in early risk stratification of patients during STEMI, mainly for sizing the infarct. [78]

A study in South Africa by Ranjith et al demonstrated that elevation in admission NT- proBNP levels is an important determinant of acute and intermediate cardiac risk in patients with ACS. NT- pro BNP concentrations were superior to those of troponin T as prognostic markers in both STEMI and NSTEMI. [79]

A 2009 study in France by Lorgis et al showed that NT- proBNP concentration has incremental prognostic value even in older patients above and beyond GRACE risk score and traditional biomarkers after AMI. [80]

A study by Pasupathi and others in Tamil Nadu, India showed a significant increase in lipid peroxidation and cardiac biomarkers (including BNP) in the circulation of patients with myocardial infarction. [81.]

An Indian study by Puri A et al in 2005 hypothesized that in acute MI patients with apparently normal ejection fraction and without left ventricular dysfunction, a higher NT-proBNP level would suggest poorer short - term clinical outcomes and would require a more aggressive treatment strategy. [82]

Glycated Hemoglobin and Myocardial Infarction

Cardiovascular diseases are the cause of death in up to 65-75% patients with type 2 diabetes mellitus (DM).[83] Absolute risk of death related to the coronary heart disease (CHD) is more than three times higher among diabetic patients than among non diabetic ones.[84] Age and Sex adjusted mortality of Diabetic patients without coronary artery disease is equal to that of patients who have a history of Myocardial Infarction but without diabetes. [85] Autonomic neuropathy in DM related to the electrical complications of AMI may contribute to the increased tendency for development of supra and ventricular arrhythmias. [86] Post-AMI mechanical complications are related mostly to developing of heart failure, and may be presented as left ventricular remodeling with higher left ventricular filling pressure, left ventricular diastolic dysfunction, or decreased left ventricular ejection fraction.

Hyperglycemia during acute myocardial infarction (AMI) is associated with a poor prognosis, and blood glucose level is an independent predictor of mortality in patients with or without known diabetes. [87] The future glycometabolic profile of patients suffering AMI without diabetes can be predicted in the hospital phase. [88]

There is also a correlation between blood glucose on hospital admission for AMI and long-term mortality in patients with or without known diabetes. [89]Moreover, hyperglycemia in patients with ST elevation MI was found to be an important predictor of impaired epicardial flow. [90] In acute coronary syndromes, glucose metabolism is modified, and stress hyperglycemia commonly occurs secondary to increased catecholamine levels. Due to stress hyperglycemia, a method looking only at plasma glucose levels at the time of an AMI cannot be used to predict the prognosis. Thus, glycosylated hemoglobin (HbA1c) values may reveal diabetes in cases of AMI.

Elevated HbA1c is an important determinant of atherosclerosis beyond the risk associated with established diabetes.[91] The subdiabetic or prediabetic state, also known as impaired glucose tolerance (IGT), is associated with a higher incidence of cardiovascular events. [92, 93] Undiagnosed diabetes was found in 4.3% of patients in one study, contributing to approximately 10% of mortality. [94]

Furthermore in the ARIC (Atherosclerosis Risk in Communities) study, which is a community based prospective cohort study which included 15,792 middle aged adults from four US communities, showed that people with HbA1c of more that 6% are at high risk for developing diabetes and also have increased cardiovascular risk even after adjusting for other risk factors. [95]

Glycated Hemoglobin (HbA1c)

Glycated hemoglobin (HbA1c) is formed by a post-translational, non-enzymatic, substrate concentration dependent, irreversible process of combination, of aldehyde group of glucose and other hexose with the amino terminal valine of the β

chain of hemoglobin. Human adult hemoglobin (Hb) usually consists of HbA (97% of the total), HbA2 (2.5%) and HbF (0.5%). Adult hemoglobin is made up of four polypeptide chains, two α and two β chains.

Formation of glycated hemoglobin is essentially irreversible and its concentration in blood depends on both the life span of the red blood cell (average120 days) and blood glucose concentration. Since the rate of formation of HbA1c is directly proportional to the concentration of glucose in the blood, the HbA1c concentration represents the integrated values for glucose over the preceding 6 to 8weeks. This provides an additional criterion for assessing glucose control because HbA1c values are free of day-to-day glucose fluctuation and are unaffected by recent exercise or food ingestion. The contribution of the plasma glucose concentration to HbA1c depends on the time interval, with more recent values providing larger contribution than earlier values. The plasma glucose in the preceding 1 month determines 50% of the HbA1c, whereas days 60 to 120 determine only 25%. The half-life of HbA1c is 35 days.

A study in Turkey done by Cakmak et al demonstrated that elevated HbA1c levels at admission show higher ischemic scores and higher mortality when compared with patients with normal levels. [15]

A study in Netherlands by Timmer et al demonstrated that measurements of acute and chronic glycemic control are associated with long term mortality. They went on to suggest that measuring HbA1c will allow for better risk stratification in cases of acute MI, especially in cases of non diabetics.[96]

In an interesting study done by Eliana et al in Jakarta among non diabetic women showed that levels of HbA1c correlated with ADMA (Asymmetric dimethyl

arginine) levels. High ADMA levels block NOS (Nitric Oxide Synthase) pathway and are associated with endothelial dysfunction, which is the precursor for atherosclerosis. HbA1c level also correlated strongly with decreased FMD (Flow mediated dilatation), which is considered a hallmark of endothelial dysfunction and atherosclerosis.[97]

A study done in Montenegro by Vujosevic et al compared both admission glucose profile and HbA1c with outcomes in cases of Acute MI. The findings indicate that both the parameters correlate with poor electrical and mechanical complication in short term. [98]

Anemia in Myocardial Infarction

Anemia is seen in almost 15% of cases of AMI. [99] Anemia can worsen the outcomes in AMI by decreasing the oxygen content of the blood being delivered to the jeopardized myocardium and also increasing the myocardial oxygen demand as the heart tries to increase the cardiac output to maintain the adequate systemic oxygen delivery. [100,101] Anemia has been found to be an independent risk factor for poor cardiovascular outcomes in patients with heart failure[102, 103] and also those undergoing percutaneous coronary interventions. [104] The need for blood transfusion in cases of anemia in setting of ACS is associated with higher mortality. [105] Efforts to increase the hemoglobin content by giving erythropoietin in patients undergoing percutaneous coronary interventions resulted in worse out comes and had to be discontinued. [16]

A study was done in Boston by Sabatine et al in 41637 patients with ACS from 16 Thrombolysis in myocardial infarction (TIMI) trials. Hemoglobin levels were used and patients were divided into subgroups and outcomes were observed. The

study showed that hemoglobin levels were powerful and independent risk predictors of adverse out comes in patients across the spectrum of acute coronary syndrome. [106]

A Middle Eastern study involving six countries by Sulaiman et al, included 7922 patients of acute coronary syndrome and these patients where followed up to one year. Patients with anemia at admission had higher incidence of adverse events during in-hospital, at one month and also at one year time period. [107]

A study done in New York by Nikolsky et al showed that anemia at baseline in patients with acute myocardial infarction undergoing percutaneous coronary intervention is common and is also associated with adverse clinical outcomes and increased mortality. [108]

A study by Ennezat et al in France showed that anemia provides independent additional prognostic information to the GRACE risk score. They further opined that anemia, when combined with GRACE risk score refines its predictive value. The study was done on 1064 ACS patients. Anaemia was defined as haemoglobin less than 13 mg/dL in men or less than 12 mg/dL in women. The primary endpoint was 6-month death or rehospitalization for MI. [109]

Similar conclusions were reached by a study done in Brazil by Correia et al, who also compared anemia with GRACE risk score. A total of 227 patients of acute coronary syndrome were admitted and observed after risk stratification. Anemia correlated independently with in-hospital adverse out comes and also increased the predictive value of GRACE risk scoring system. [110]

MATERIALS AND METHODS

SOURCE OF DATA

A total of 100 consecutive patients who presented to R L Jalappa Hospital – Narayana Hrudayalaya Heart Center were included in this study.

The study period is August 2011 to May 2013.

METHOD OF COLLECTION

This study is an observational follow up study carried out in R.L. Jalappa Hospital – Narayana Hrudayalaya Heart Center, Tamaka, Kolar.

Informed consent from the patient or the relatives was taken prior to the inclusion in the study.

The patients were evaluated as per history, physical exam, Electrocardiogram, Complete Blood Count, Blood Urea, Serum Creatinine. NT pro BNP, HbA1c were be measured at admission and thorough Echocardiogram was done within 7 days of admission. The patients who were included were followed for 7 days during their stay in the hospital for various short term complications of acute myocardial infarction. Patients were observed for arrhythmias, heart failure, reinfarction, valvular dysfunction like mitral regurgitation and any other complications.

Sampling for NT pro BNP

Sample volumes of 150 µL of venous blood were collected in heparinised vials and assayed using the VIDAS NT pro BNP quantitiative test manufactured by Biomerieux, France. This test is an Enzyme-Linked Fluorescent assay (ELFA). The assay combines one-

step immunoassay sandwich method with a final fluorescent detection. A value of > 125 pg/ml for patients <75y of age and >450 pg/ml for those >75y was considered abnormal.

Estimation of HbA1C

Venous blood EDTA samples were collected and estimation of HbA1c was done by using whole blood mixed with lysing reagent to prepare a hemolysate and was analysed using weakly binding cation exchange resin and by using colorimeter at wavelength (λ)=415nm. A value of >6.5% was considered abnormal.

Echocardiography

All patients were subjected to a detailed echocardiography (Echo) and Doppler evaluation. Qualitative and quantitative assessment of segmental and global LV function was done in all patients with Vivid S5 High Performance Echocardiography machine by GE Medical systems. Modified Simpson's technique was used to determine the end - diastolic volume (EDV), end- systolic volume (ESV) and ejection fraction (EF). EF of <40% was taken as abnormal.

Inclusion Criteria

Those admitted in R L Jalappa Hospital – Narayana Hrudayalaya Heart Center having

1. Typical ischemic symptoms and new onset ST - segment T – wave changes
2. Admitted within 12 hours after onset of symptoms.
3. Patients within the age group of 30- 80 years.

Exclusion Criteria

1. Acute MI patients with previous chronic heart failure.
2. Acute MI patients with previous chronic kidney disease, Valvular Heart Disease, Chronic Obstructive Pulmonary Disease, Atrial Fibrillation
3. Acute MI patients with cardiogenic shock at presentation.

4. Acute MI patients who present 12 hours after the onset of symptoms.
5. Acute MI patients who are taken up for angioplasty within 7 days of study period.
6. Acute MI patient s of age < 30 years or > 80 years.

Statistical Analysis

Data was entered into Microsoft excel after coding and SPSS 11 version software was used to analyze the data. Descriptive statistics like Mean and Standard deviation was computed for Continuous data and Frequencies and proportions for categorical data. Mean difference between two groups was analyzed by student t test. Chi-square test was the test of significance for categorical data. Fisher extract test was used when expected count was less than five in any of the 2x2 cell. Odds ratio was computed to measure the strength of association.

$p < 0.05$ was considered as statistically significant.

RESULTS AND OBSERVATION

A total of 100 cases of Myocardial infarctions were included in the study and the mean age of the cases was 56.75 ± 11.14.

Table 1: Showing Sex Distribution of the MI cases

	Frequency	Percent
Male	85	85
Female	15	15
Total	100	100.0

In the study it was observed that majority of the cases were males i.e. 85% and 15% were females.

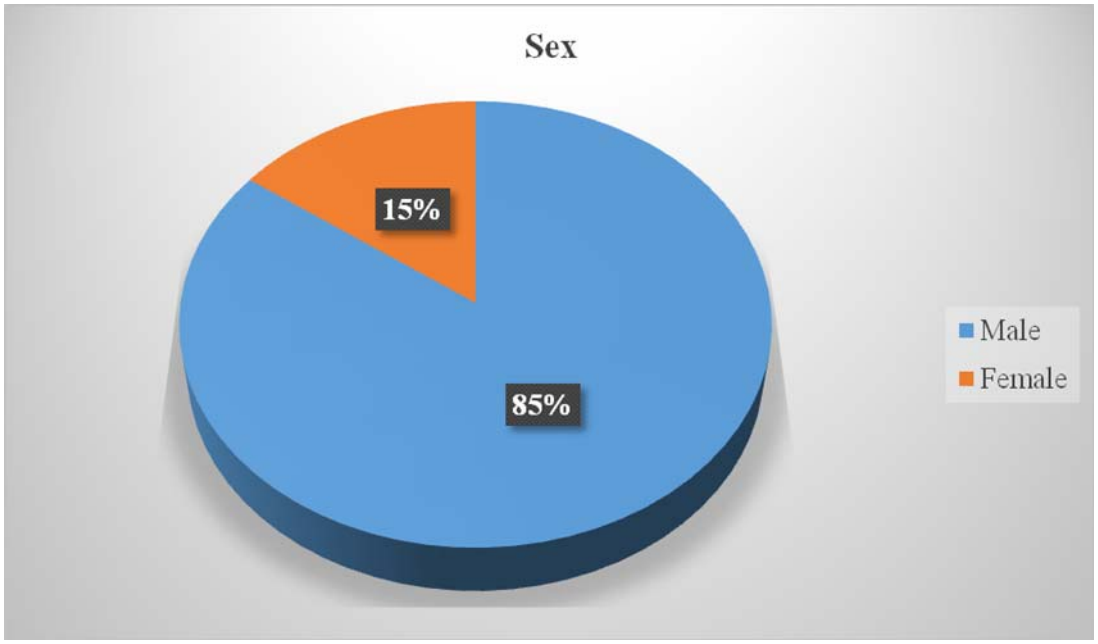

Figure 2: Pie Diagram showing sex distribution of the cases

Table 2: Showing Diabetic status among MI cases

	Frequency	Percent
Present	51	51
Absent	49	49
Total	100	100.0

In the study it was observed that majority of the cases were had diabetes i.e. 51%.

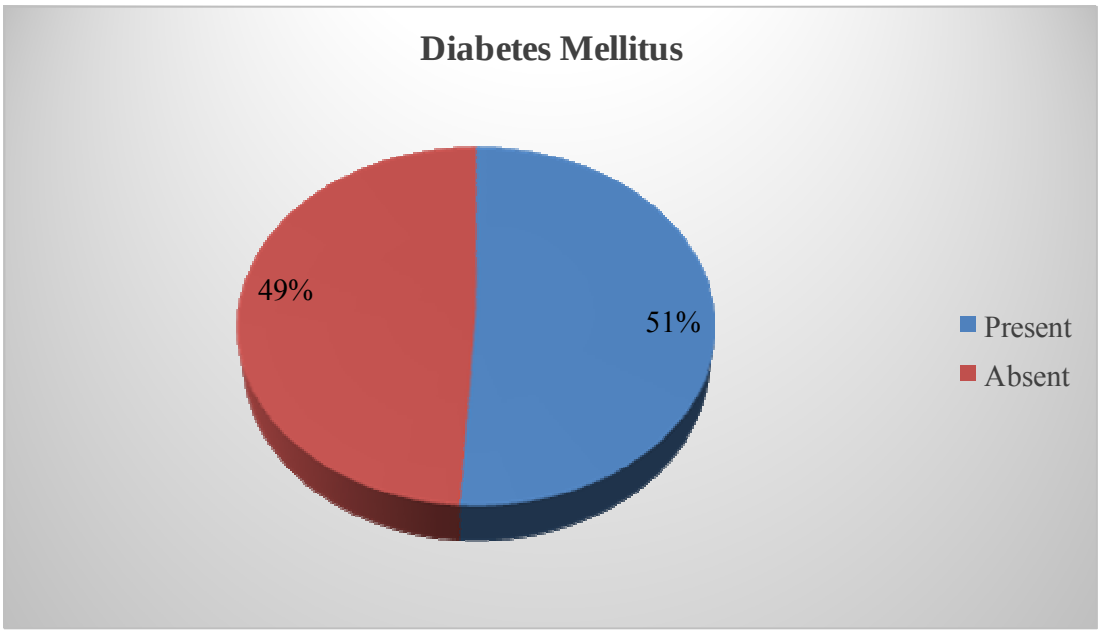

Figure 3: Pie Diagram Showing Diabetic status among MI cases

Table 3: Showing Hypertension status among MI cases

	Frequency	Percent
Present	46	46
Absent	54	54
Total	100	100.0

In the study it was observed that 46% of cases had Hypertension and 54% without hypertension.

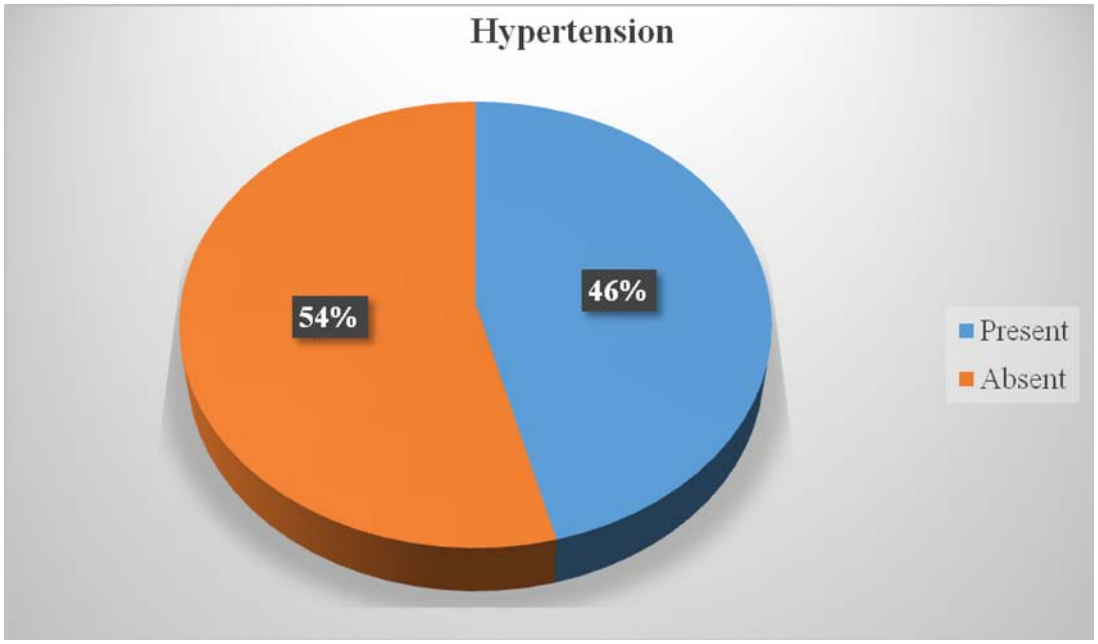

Figure 4: Pie Diagram Showing Hypertension status among MI cases

Table 4: Showing Distribution of MI cases according to presenting complaints

	Frequency	Percent
Chest pain	83	83.0
Breathlessness	11	11.0
Giddiness	6	6.0
Total	100	100.0

In the study it was observed that 83% of cases presented with chest pain, 11% with breathlessness and 6% with giddiness.

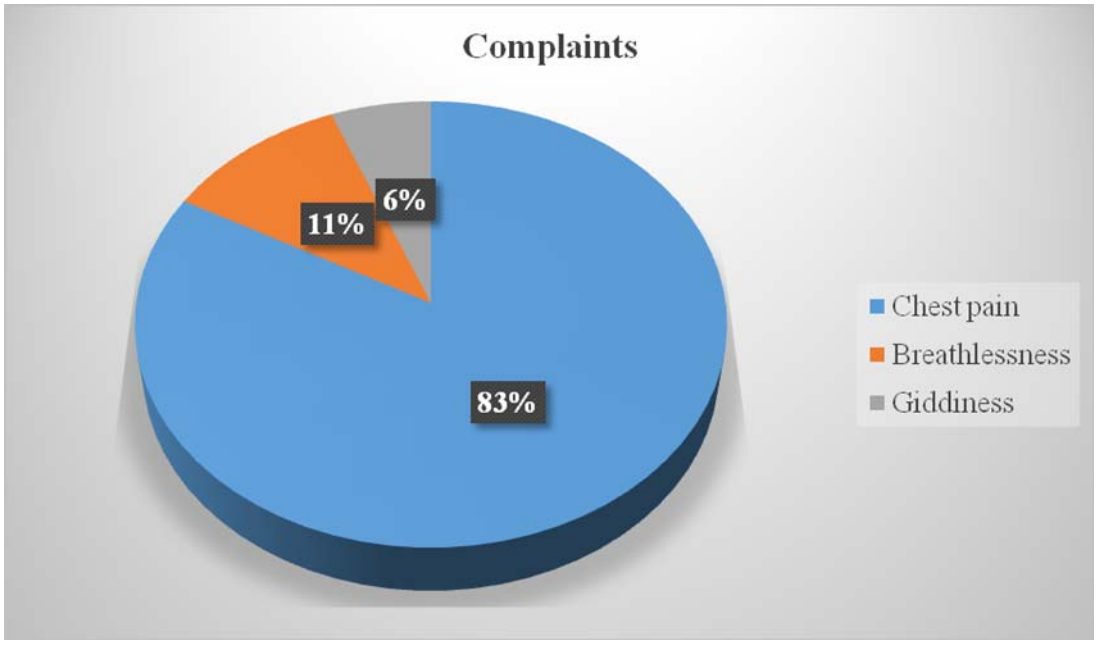

Figure 5: Pie Diagram Showing Presenting Complaints among MI cases

Table 5: Showing history of smoking among the cases

	Frequency	Percent
Yes	58	58.0
No	42	42.0
Total	100	100.0

In the study it was observed that 58% of MI cases were smokers and 42% were nonsmokers.

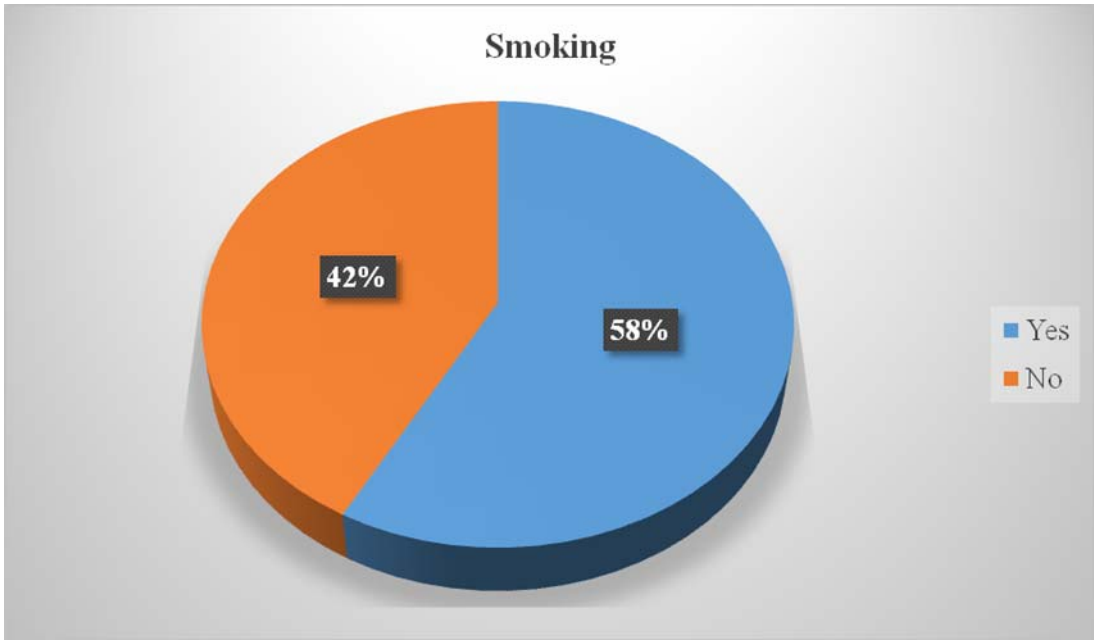

Figure 6: Pie Diagram Showing Smoking History among MI cases

Table 6: Showing type of MI

	Frequency	Percent
STEMI	72	72.0
NSTEMI	28	28.0
Total	100	100.0

In the study it was observed that STEMI was the most common type of MI i.e. in 72% of cases and 28% with NSTEMI.

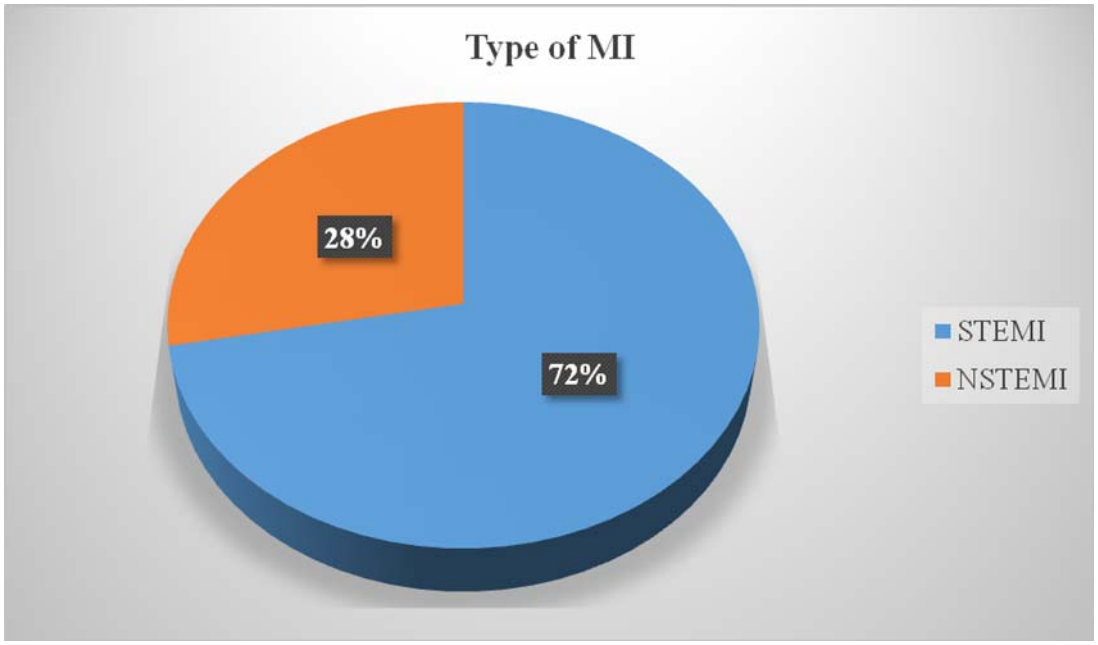

Figure 7: Pie Diagram Showing Type of MI

Table 7: Showing association between NT pro BNP and LVEF in MI cases

		LVEF		Total		
		>40	<40			Odds Ratio
NT pro BNP	Normal (<126 in <75yrs and <450 in >75yrs)	21	0	21	$X^2 = 9.34$, df = 1, p = 0.002**	20.6
	Increased	53	26	79		
Total		74	26	100		

In the study it was observed that among 26 cases who had LVEF <40, 100% i.e. all the 26 cases had Raised NT pro BNP and there was highly significant association between NT pro BNP and LVEF among MI cases. Strength of association between NT pro BNP and LVEF was 20.6 i.e. Patients with raised NT pro BNP had 20.6 times higher risk of Left ventricular failure.

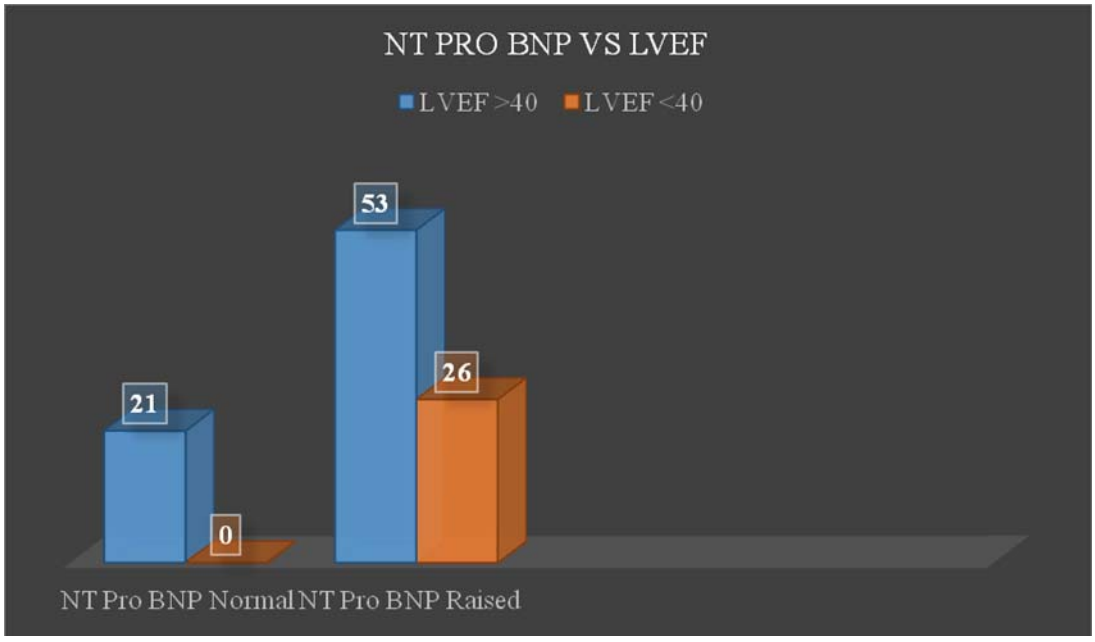

Figure 8: Bar Diagram showing association between NT pro BNP and LVEF in MI cases

Table 8: Showing association between NT pro BNP and Arrhythmia in MI cases

		Arrhythmia		Total		
		No	**Yes**			**Odds Ratio**
NT pro BNP	**Normal**	20	1	21	$X^2 = 1.884$, df = 1, p = 0.289 Fisher Exact Test	3.93
	Increased	66	13	79		
Total		86	14	100		

In the study it was observed that among 14 cases who had Arrhythmia, 92.7% i.e. 13 cases had Raised NT pro BNP and but there was no significant association between NT pro BNP and arrhythmia among MI cases. Strength of association between BNP and arrhythmia was 3.93 i.e. Patients with raised NT pro BNP had 3.93 times higher risk of arrhythmia.

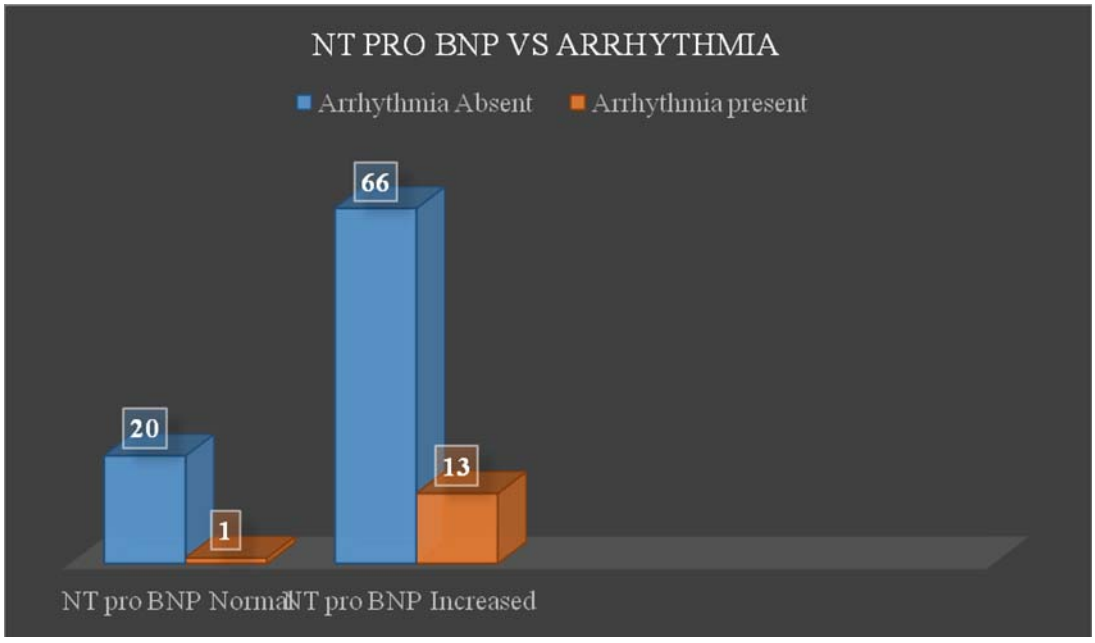

Figure 9: Bar Diagram showing association between NT pro BNP and Arrhythmia in MI cases

Table 9: Showing association between NT pro BNP and Other complications in MI cases

		Other Complications		Total		
		No	**Yes**			**Odds Ratio**
NT pro BNP	**Normal**	21	0	21	X^2 = 9.832, df = 1, p = 0.002**	21.8
	Increased	52	27	79		
Total		73	27	100		

In the study it was observed that among 27 cases who had other complications, 100% i.e. all the 27 cases had Raised NT pro BNP and there was highly significant association between NT pro BNP and other complications among MI cases. Strength of association between NT pro BNP and other complications was 21.8 i.e. Patients with raised NT pro BNP had 21.8 times higher risk of other complications.

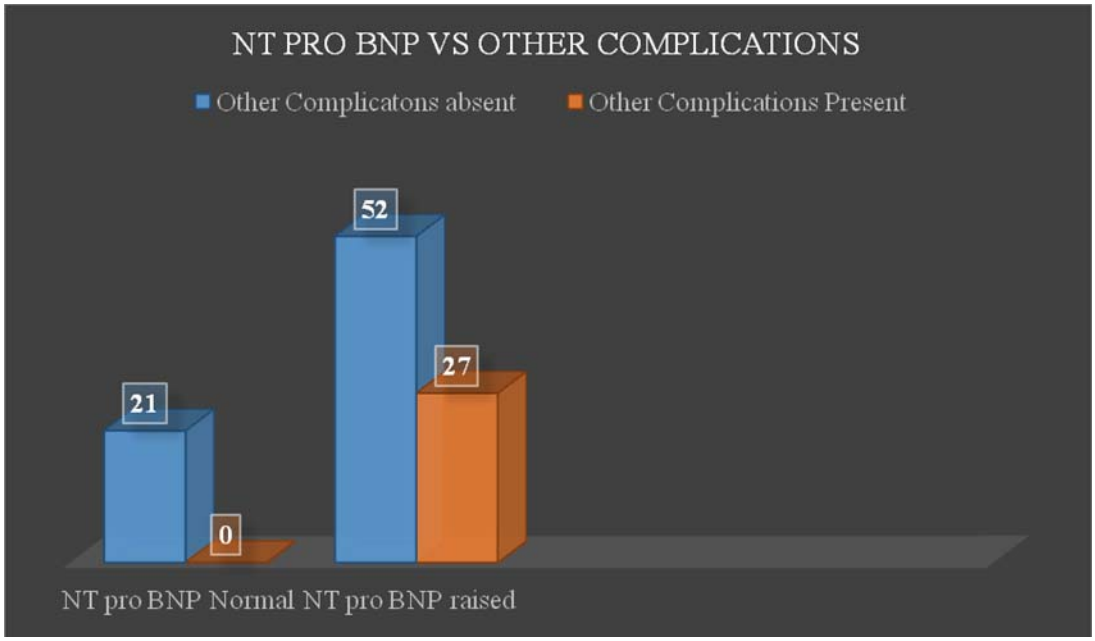

Figure 10: Bar Diagram showing association between NT pro BNP and other complications in MI cases

Table 10: Showing association between NT pro BNP and Death in MI cases

		Death		Total		
		No	Yes			Odds ratio
BNP	Normal	21	0	21	$X^2 = 1.697$, df = 1, p = 0.338 Fisher Exact Test	3.45
	Increased	73	6	79		
Total		94	6	100		

In the study it was observed that among 6 cases who died, 100% i.e. all the 6 cases had Raised NT pro BNP and but there was no highly significant association between NT pro BNP and death among MI cases. Strength of association between NT pro BNP and death was 3.45 i.e. Patients with raised NT pro BNP had 3.45 times higher risk of death.

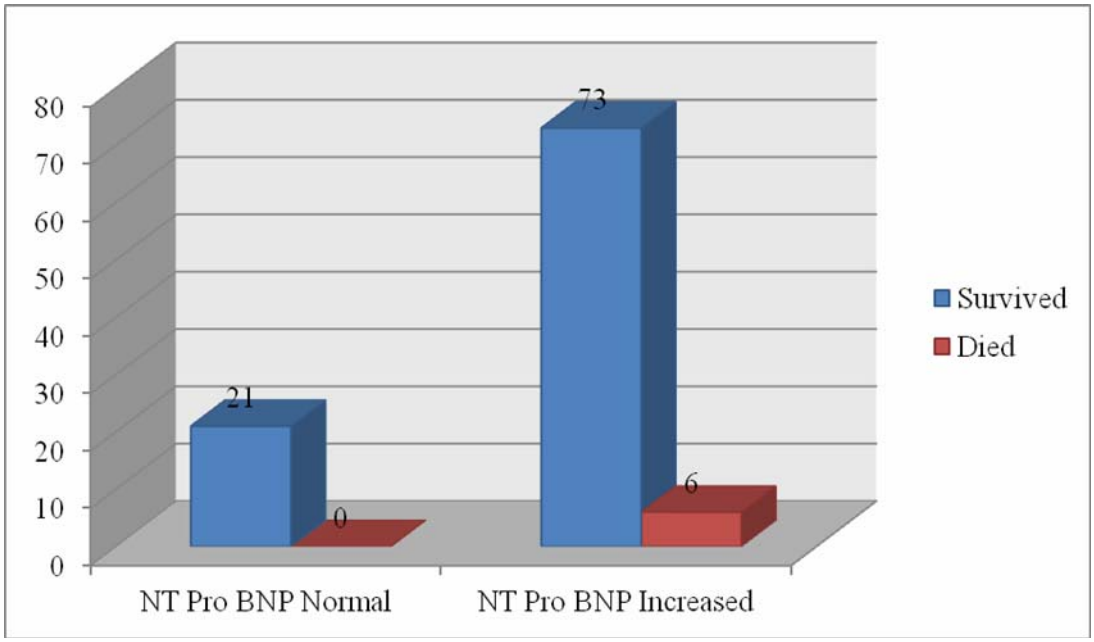

Figure 11: Bar Diagram showing association between NT pro BNP and Death in MI cases

Table 11: Showing association between HbA1c and LVEF in MI cases

		LVEF		Total		
		>40	**<40**			**Odds Ratio**
HbA1c	**<6.5**	20	8	28	$X^2 = 0.134$, df = 1, p = 0.715	0.83
	>6.5	54	18	72		
Total		74	26	100		

In the study it was observed that among 26 cases who had LVEF <40, 70% i.e. 18 case had HbA1c >6.5. But there was no significant association between HbA1c and Left ventricular ejection fraction among MI cases. Strength of association between HbA1c and LVEF was 0.83 i.e. HbA1c with in normal limits is protective to patients.

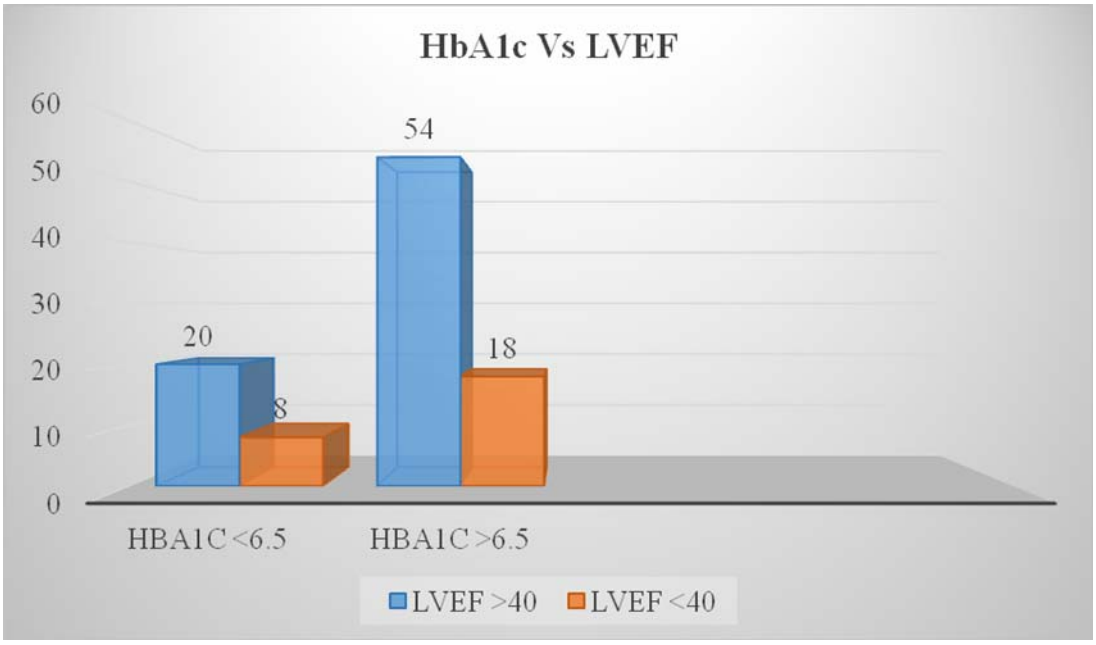

Figure 12: Bar Diagram showing association between HbA1c and LVEF in MI cases

Table 12: Showing association between HbA1c and Arrhythmia in MI cases

		Arrhythmia		Total		
		No	**Yes**			**Odds Ratio**
HbA1c	**<6.5**	24	4	28	$X^2 = 0.003$, df = 1, p = 1.00 Fisher exact test	0.96
	>6.5	62	10	72		
Total		86	14	100		

In the study it was observed that among 14 cases who had Arrhythmia, 71% i.e. 10 cases had HbA1c >6.5. But there was no significant association between HbA1c and Arrhythmia among MI cases. Strength of association between HbA1c and Arrhythmia was 0.96 i.e. HbA1c with in normal limits is protective to patients.

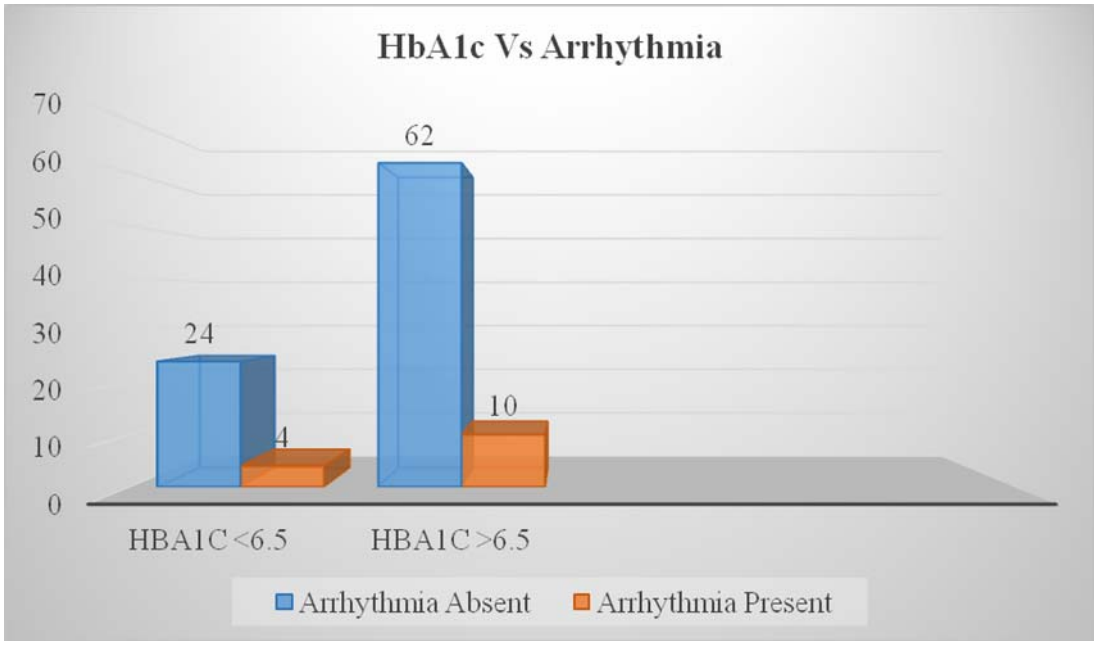

Figure 13: Bar Diagram showing association between Arrhythmia and LVEF in MI cases

Table 13: Showing association between HbA1c and other complications in MI cases

		Other complications		Total		
		No	Yes			Odds Ratio
HbA1c	**<6.5**	20	8	28	X^2 = 0.049, df = 1, p = 0.825	0.89
	>6.5	53	19	72		
Total		73	27	100		

In the study it was observed that among 27 cases who had other complications, 70% i.e. 19 cases had HbA1c >6.5. But there was no significant association between HbA1c and Other complications among MI cases. Strength of association between HbA1c and other complications was 0.89 i.e. HbA1c within normal limits is protective to patients.

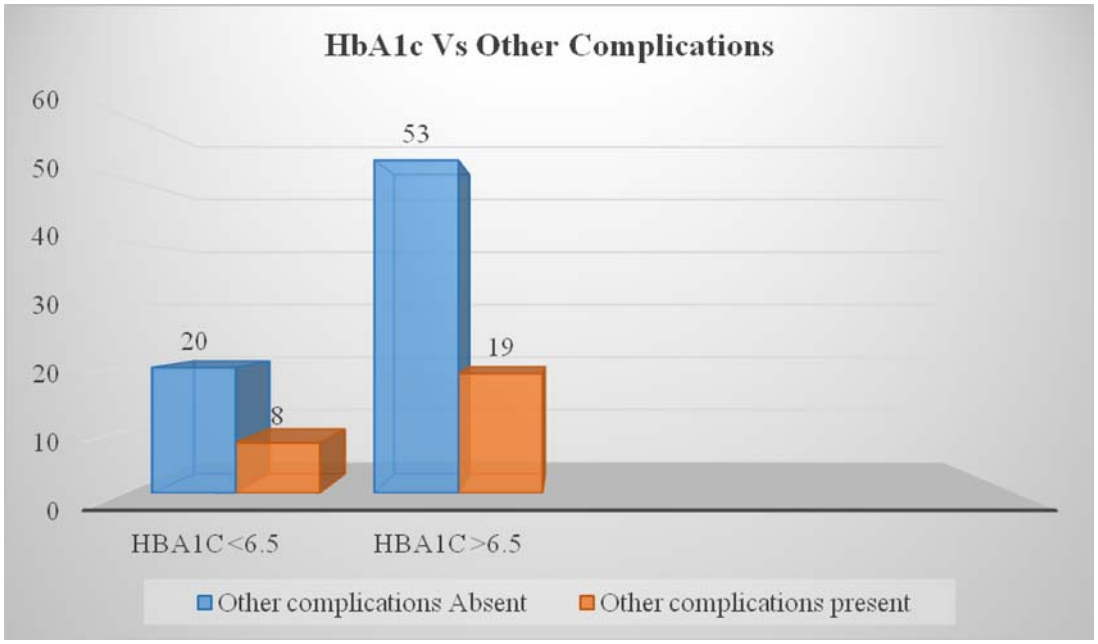

Figure 14: Bar Diagram showing association between HbA1c and other complications in MI cases

Table 14: Showing association between HbA1c and Death in MI cases

		Death		Total		
		No	Yes			Odds Ratio
HbA1c	<6.5	25	3	28	$X^2 = 1.532$, df = 1, p = 0.216	0.36
	>6.5	69	3	72		
Total		94	6	100		

In the study it was observed that among 6 cases who died, 50% i.e. 3 cases had HbA1c >6.5. But there was no significant association between HbA1c and Other complications among MI cases. Strength of association between HbA1c and Death was 0.36 i.e. HbA1c with in normal limits is protective to patients.

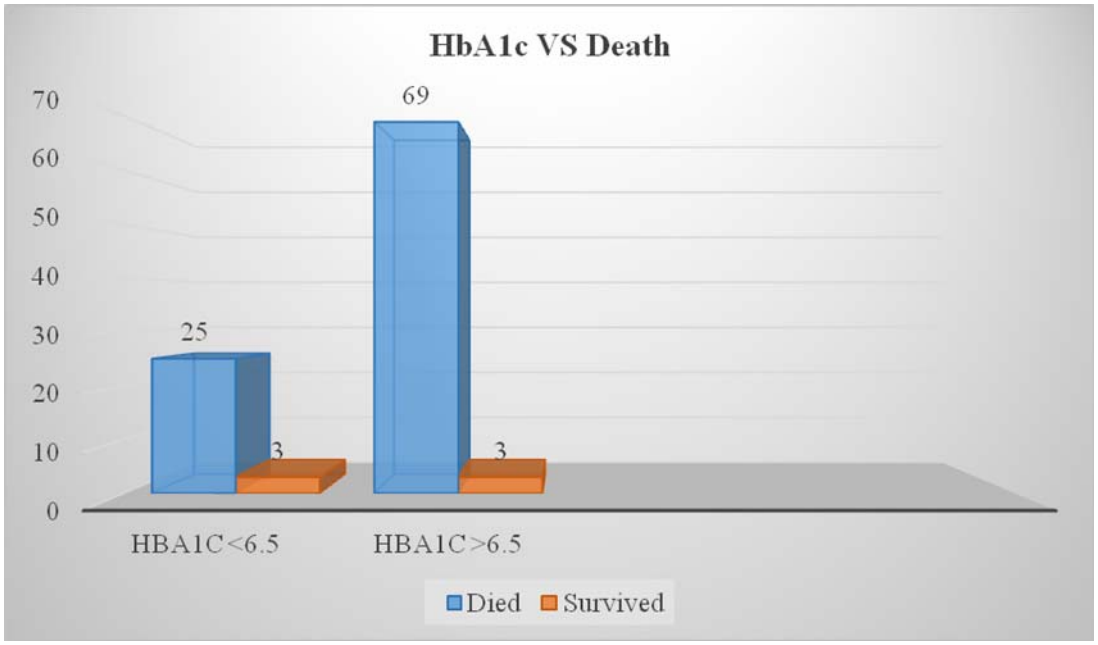

Figure 15: Bar Diagram showing association between HbA1c and Death in MI cases

Table 15: Showing association between Hb% and LVEF in MI cases

		LVEF		Total		
		>40	<40			Odds Ratio
Hb	**Normal**	62	17	79	X^2 = 3.936, df = 1, p = 0.048*	2.73
	Anemia	12	9	21		
Total		74	26	100		

In the study it was observed that among 26 cases who had LVEF <40, 35% i.e. 9 cases had Anemia. There was significant association between Hb% and LVEF among MI cases. Strength of association between Hb% and LVEF was 2.73 i.e. Patients with anemia had 2.73 times higher risk of Left ventricular failure.

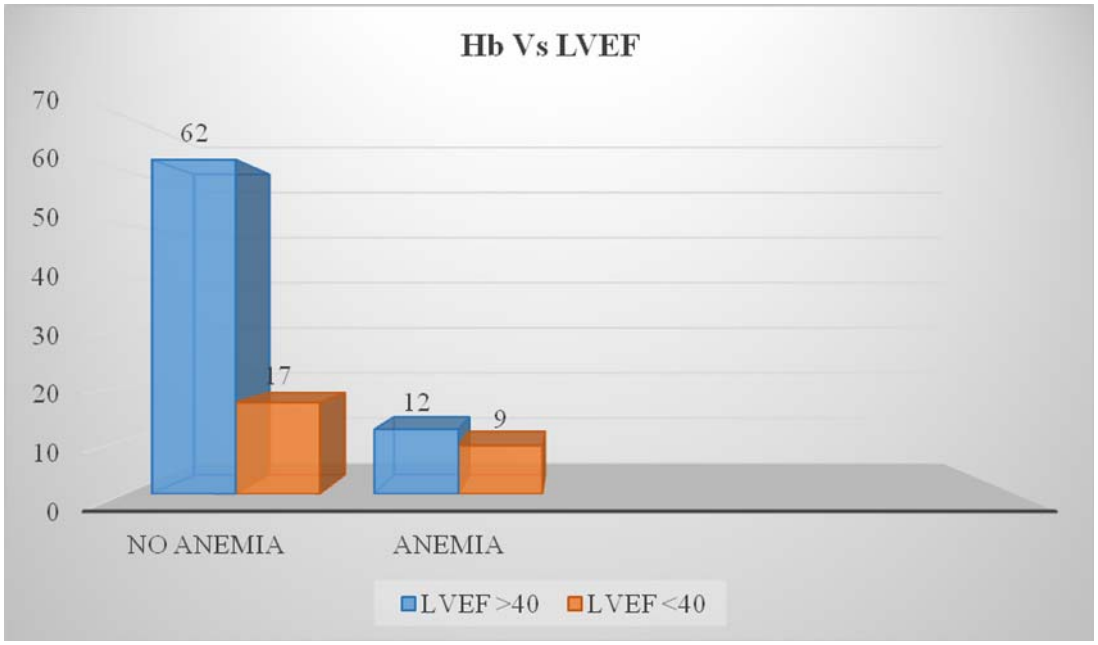

Figure 16: Bar Diagram showing association between Hb% and LVEF in MI cases

Table 16: Showing association between Hb% and other Arrhythmia in MI cases

		Arrhythmia		Total		
		Absent	Present			Odds Ratio
Hb	**Normal**	71	8	79	X^2 = 4.688, df = 1, p = 0.03*	3.55
	Anemia	15	6	21		
Total		86	14	100		

In the study it was observed that among 14 cases who had Arrhythmia, only 42% i.e. 6 cases had Anemia. There was significant association between Hb% and Arrhythmia among MI cases. Strength of association between Hb% and Arrhythmia was 3.55 i.e. Patients with anemia had 3.55 times higher risk of Arrhythmia.

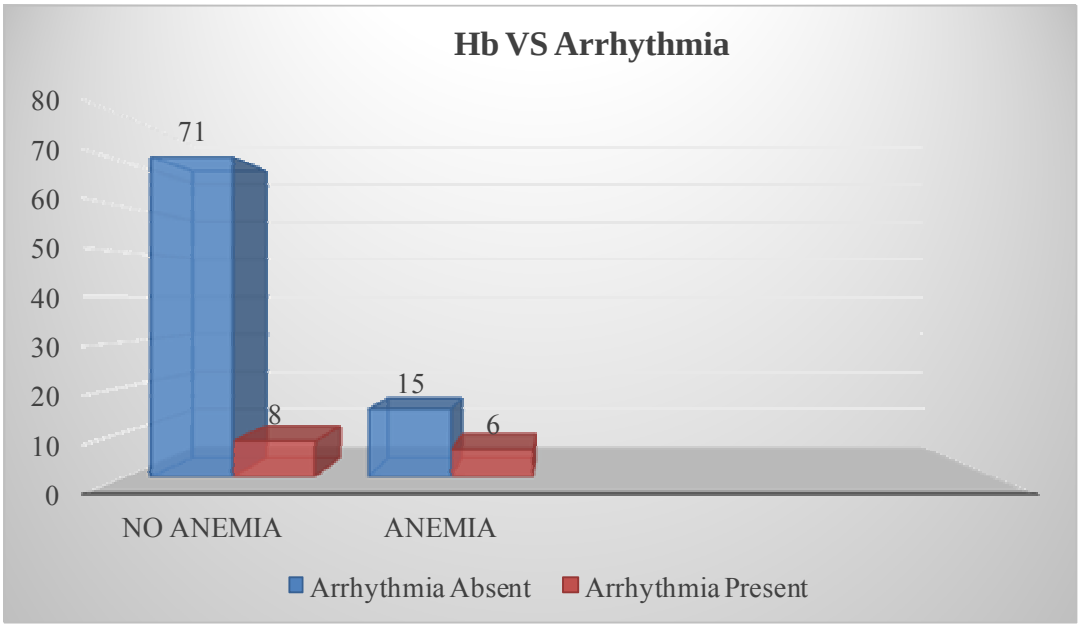

Figure 17: Bar Diagram showing association between Hb% and Arrhythmia in MI cases

Table 17: Showing association between Hb% and other complications in MI cases

		Other complications		Total		
		Absent	Present			Odds Ratio
Hb	**Normal**	61	18	79	X^2 = 3.391, df = 1, p = 0.066	2.54
	Anemia	12	9	21		
Total		73	27	100		

In the study it was observed that among 27 cases who had other complications only 33.3% i.e. 9 cases had Anemia. There was no significant association between Hb% and other complications among MI cases. Strength of association between Hb% and other complications was 2.54 i.e. Patients with anemia had 2.54 times higher risk of other complications.

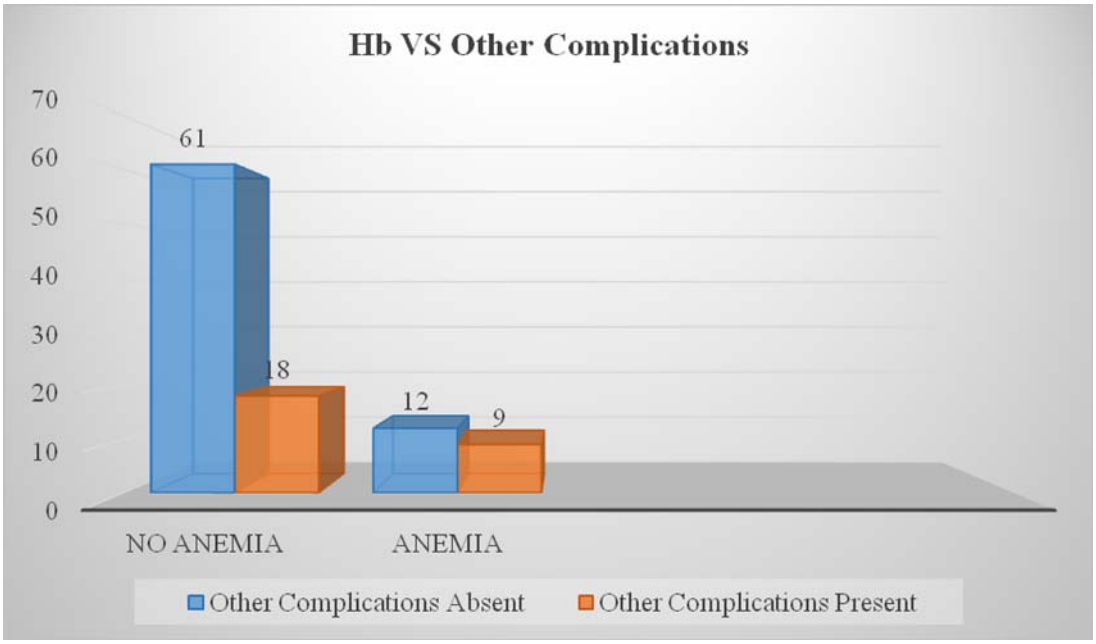

Figure 18: Bar Diagram showing association between Hb% and other complications in MI cases

Table 18: Showing association between Hb% and Deaths in MI cases

		Deaths		Total		
		No	**Yes**			**Odds Ratio**
Hb	**Normal**	75	4	79	$X^2 = 0.585$, df = 1, p = 0.468 Fisher exact test	1.97
	Anemia	19	2	21		
Total		94	6	100		

In the study it was observed that among 6 cases who died, only 33.3% i.e. 2 cases had Anemia. There was no significant association between Hb% and deaths among MI cases. Strength of association between Hb% and Deaths was 1.97 i.e. Patients with anemia had 1.97 times higher risk of Death.

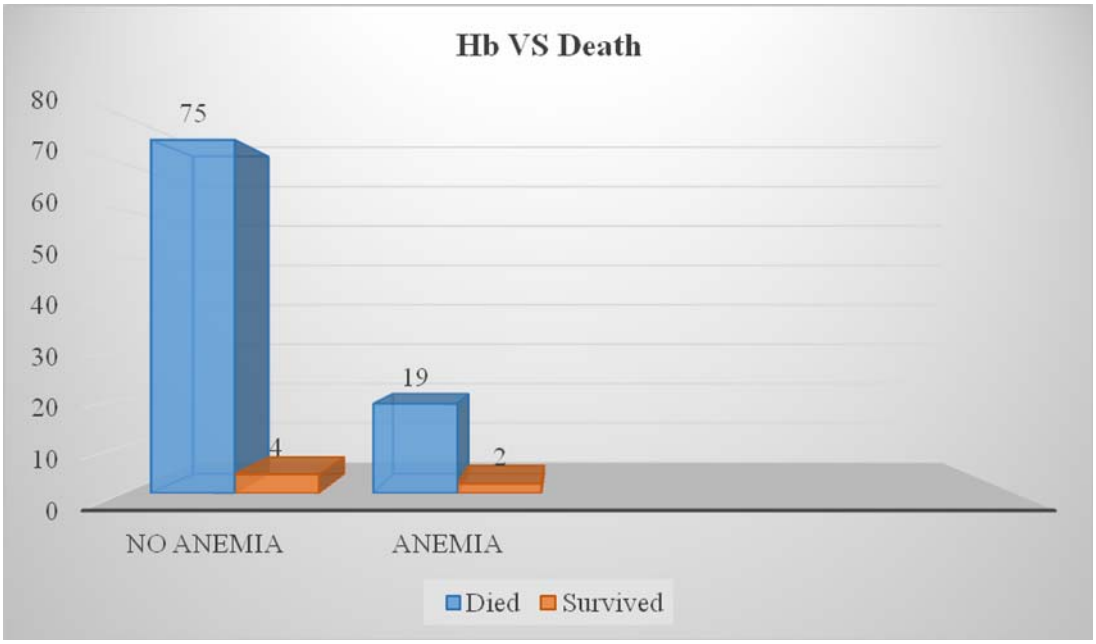

Figure 19: Bar Diagram showing association between Hb% and Death in MI cases

Quantitative analysis:

Table 19: Correlation between LVEF and HbA1c, Hb%, NT pro BNP.

		HbA1c	Hb	NT pro BNP
LVEF	**Pearson Correlation**	0.009	0.129	-0.724**
	p value	0.929	0.200	0.000

**. Correlation is significant at the 0.01 level (2-tailed).

In the study it was observed that there was no significant correlation between LVEF, HbA1c and Hb%. But there was highly significant negative correlation between LVEF and NT pro BNP levels i.e. with increase in NT pro BNP there is significant reduction in LVEF and Viz.

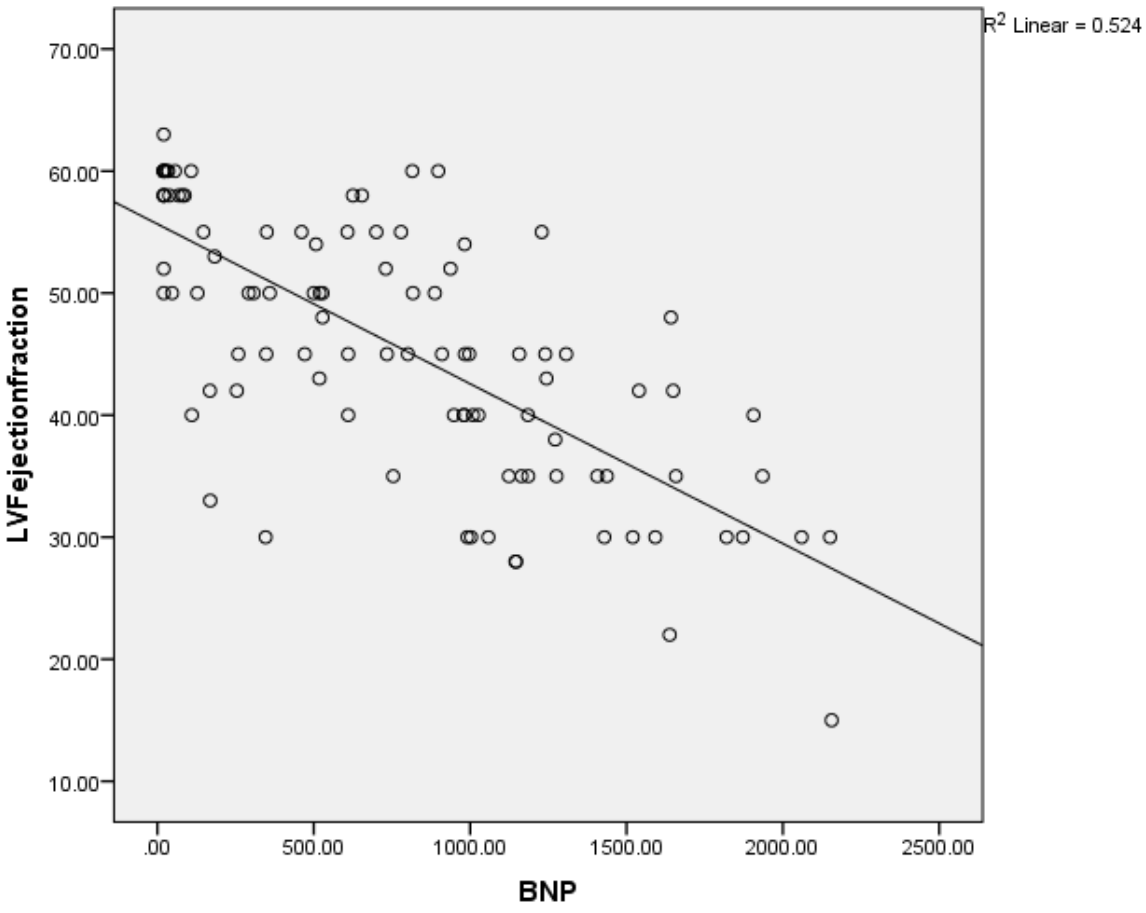

Figure 20: Scatter plot showing Correlation between LVEF and NT pro BNP

Table 20: Showing mean difference of LVEF with respect to HbA1c, Hb% and NT pro BNP

		LVEF			
		Mean	**Standard Deviation**	**t value**	**p value**
HbA1c	**<6.5 (n = 28)**	44.46	11.76	-0.632	0.529
	>6.5 (n = 72)	45.98	10.42		
Hb%	**Normal (n = 79)**	46.73	10.38	2.152	0.034*
	Anemia (n = 21)	41.14	11.31		
BNP	**Normal (n = 21)**	57.19	5.17	6.677	0.00001**
	Increased (n = 79)	42.46	9.71		

In the study it was observed that when NT pro BNP levels was normal the mean LVEF was 57 ± 5.17 and 42.46 ± 9.71 when NT pro BNP was increased and it can inferred that this mean difference was significant. Similarly there was significant mean difference for LVEF with respect to Hb% and there was no significant difference for HbA1c. Hence BNP can act as better indicator of LVEF in MI patients.

DISCUSSION

NT pro BNP is released from the stretch of the left ventricle and hence it is used in cases of congestive heart failure to diagnose and also to prognosticate. However studies have shown that myocardial ischemia also stimulates the release of natriuretic peptides. Studies have suggested that NT pro BNP to be a more sensitively and an effective prognostic tool in all cases of ACS. Glycated Hemoglobin not only is an indicator of long term glycemic state of an individual, it also is a marker of endothelial dysfunction. There has been a conflicting evidence for considering HbA1c as a sensitive prognostic tool in cases of acute myocardial infarction. Anemia at admission in cases of myocardial ischemia decreases the oxygen carrying capacity to the vulnerable myocardium and also increases the myocardial oxygen demand by increasing need to pump to maintain the oxygen delivery to systemic circulation.

In this study we evaluated the prognostic significance of NTproBNP, Hb1Ac and Hb, measured at admission, in patients of acute myocardial infarction with respect to outcomes and complications within the first seven days post event.

In the study it was observed that among 26 cases had LVEF <40%, there was highly significant association between NT pro BNP and LVEF among MI cases. (p - 0.002) Strength of association between NT pro BNP and LVEF was 20.6 i.e. Patients with raised NT pro BNP had 20.6 times higher risk of Left ventricular failure. There was highly significant association between raised NT pro BNP and other complications among MI cases (p-0.002). The complications observed were heart failure (20), reinfarction (4) and mitral regurgitation (3).

We observed that 14 patients had arrhythmia; there was no significant association between NT pro BNP and arrhythmia among MI cases. There was no

significant association between raised NT pro BNP with deaths. The most exciting part of our results was that NT pro BNP was a significant predictor of risk, even in patients with no signs or symptoms of CHF. Similar results have been presented by others, which support the notion that the release of BNP is more complex than originally thought and that ischemia constitutes a potent stimulus.

There was no significant association between HbA1c and Left ventricular ejection fraction among MI cases. HbA1c was found not to be significantly associated with risk of arrhythmias, all cause morbidity and mortality. There was significant association between Hb% and LVEF (p – 0.04), Arrhythmia (p-0.03) among MI cases.

In the present NT-pro BNP(levels > 125pg/dL in <75y and > 450 pg/dL >75y) was found to be a powerful predictor of adverse out comes, especially LV systolic dysfunction, within 1 week in all cases of myocardial infarction. NT pro BNP was also found to be elevated in 92% cases developing arrhythmias and also in all cases of mortality. NT-pro BNP levels varied widely may due to the varying infarct size and the extent of myocardial damage and functional impairment which directly correlates with adverse out comes including mortality. Similar pattern has been observed in other studies too.

A multicentric study by Galvani et al done in 2004 at Florence, Italy, included all patients of acute coronary syndrome from 31 coronary care units across the country. It included a total of 1971 patients. The study inferred that NT-pro-BNP levels, measured at admission early after the onset of the ischaemic episode, improve the early risk stratification of patients with acute coronary syndrome and are strongly predictive of short term mortality ($p<0.0001$) and also heart failure ($p=0.0001$)[72]

A study was done by Puri et al at King George Medical University, Lucknow in 2005; where a total of 120 patients of myocardial infarction both ST elevation and Non ST elevation were admitted and admission levels of NT pro BNP were compared with in-hospital outcomes. NT pro BNP levels above the median (>1403 pg/mL) were associated with low ejection fraction ($p<0.05$) and adverse out comes at the end of 30 days (p-0.001) [73]

In a study by Kwon et al patients with NT- proBNP > 991 pg/mL had lower LVEF (47. 8 ± 11. 8% vs.53.0 ±10.8%, $p<0.001$), needed longer intensive care (3.7±3.6 days vs. 2.8±2.4 days, $p<0.001$) and had higher in-hospital mortality (1.3% vs. 7.4%, $p<0.001$) than those with NT- proBNP level = 991 pg/mL. [111]

The main findings of a study by Mayr and others in Austria were significant correlation of NT-pro BNP measured on day 3 after admission with acute and chronic infarct size, ejection fraction and segmental wall thickening after AMI assessed by cardiac magnetic resonance imaging as well as with biomarkers of myocardial necrosis.($p<0.004$)[75]

Ranjith et al in their study found that NT- proBNP levels were significantly increased in patients with STEMI (p = 0. 005) and NSTEMI (p = 0. 002) who developed adverse events during their hospital stay, compared with those who did not. NT- proBNP concentrations were superior to those of troponin T as prognostic markers in both STEMI and NSTEMI. [79]

In our study elevated HbA1c was found not to be significantly associated with increased risk of adverse out comes. The strength of association of HbA1c with left ventricular systolic dysfunction and other complications was 0.83 and 0.96, respectively; indicating that an HbA1c of within normal limits conferred protection to the patients from these complications. Hence the underlying glycometabolic profile of

the patient plays role in the outcome of the patients, although this couldn't be proved beyond doubt in our study.

Similar findings were seen in a large scale multi center study done in Beijing, China by Tian et al. A total of 608 patients of ST elevation myocardial infarction were included in this study. HbA1c measurement was done at admission and these patients were followed up and observed of adverse outcomes at 7 days and 30 days. After adjusting the baseline characteristics, HbA1c was not an independent predictor of short-term outcomes. (p-0.067).[112]

Patients with anemia had higher incidence of arrhythmias in our study (p-0.03). Low Hb was associated with significant risk of LV systolic dysfunction (p-0.048). Strength of association between Hb% and LVEF was 2.73 i.e. Patients with anemia had 2.73 times higher risk of Left ventricular failure. Strength of association between Hb% and Arrhythmia was 3.55 i.e. Patients with anemia had 3.55 times higher risk of Arrhythmia. There was no significant association between low Hb% and all cause morbidity and mortality.

The decreased oxygen delivery to the tissues, in the setting of anemia, causes tissue hypoxia and also decreases the coronary blood flow reserve; this in turn leads to myocardial ischemia. This might explain these findings of increased adverse outcomes in such patients. However, low Hb was not associated with increased risk of death or other complications.

In a study done by McKheine et al in Michigan, USA, a total of 48,851 consecutive patients undergoing percutaneous coronary interventions for acute myocardial infarctions were grouped according to their admission hemoglobin levels

and outcomes were observes. Anemia stood out to be an important independent predictor of adverse in-hospital outcomes. (p – 0.0004) [104]

Limitations of the study:

- Short period of follow up
- Relatively small number of events

SUMMARY

1. A total of 100 patients of acute myocardial infarction, presenting within 12 hours of onset of chest pain to R L Jalappa Hospital – Narayana Hrudayalaya Heart Center, were included in this study.
2. In the study it was observed that majority of the cases were males i.e. 85% and 15% were females.
3. Majority of cases i.e 51% had Diabetes Mellitus
4. In the study it was observed that 46% of cases had Hypertension and 54% without hypertension.
5. 83% of cases presented with chest pain, 11% with breathlessness and 6% with giddiness.
6. Majority patients about 58% of them were smokers and 42% were nonsmokers.
7. In the study it was observed that STEMI was the most common type of MI i.e. in 72% of cases and 28% with NSTEMI.
8. In the study it was observed that among 26 cases had LVEF <40%, there was highly significant association between NT pro BNP and LVEF among MI cases. Strength of association between NT pro BNP and LVEF was 20.6 i.e. Patients with raised NT pro BNP had 20.6 times higher risk of Left ventricular failure. p – 0.002
9. In the study it was observed that among 14 cases who had Arrhythmia, 92.7% i.e. 13 cases had Raised NT pro BNP and but there was no significant association between NT pro BNP and arrhythmia among MI cases.
10. There was highly significant association between NT pro BNP and other complications among MI cases. p – 0.002

11. There was no significant association between NT pro BNP and death among MI cases.
12. There was no significant association between HbA1c and Left ventricular ejection fraction among MI cases.
13. There was no significant association between HbA1c and adverse outcomes and death.
14. There was significant association between anemia and decreased LVEF. p-0.048
15. There was significant association between anemia and Arrhythmia among MI cases. p – 0.03
16. There was no significant association between Hb% and other complications among MI cases.
17. In the study it was observed that among 6 cases who died, only 33.3% i.e. 2 cases had Anemia. There was no significant association between Hb% and deaths among MI cases.
18. In the scatter diagram it was observed that there was no significant correlation between LVEF, HbA1c and Hb%. But there was highly significant negative correlation between LVEF and NT pro BNP levels i.e. with increase in NT pro BNP there is significant reduction in LVEF and Viz.
19. In the study it was observed that when NT pro BNP levels was normal the mean LVEF was 57 ± 5.17 and 42.46 ± 9.71 when NT pro BNP was increased and it can inferred that this mean difference was significant. Similarly there was significant mean difference for LVEF with respect to Hb% and there was no significant difference for HbA1c.

CONCLUSION

- NT- pro BNP and Hb are strong predictors of short term outcome in AMI
- NT- pro BNP and Hb are good tools for the risk stratification of acute MI patients so that appropriate treatment strategies could be planned.
- Further large scale studies are needed to evaluate the usefulness of HbA1C in risk assessment in cases of AMI
- NT pro BNP levels correlate with the degree of left ventricular systolic dysfunction and hence an indirect evidence of infarct size, which are amongst the major determinants of long term outcomes in such patients.

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ANNEXURES

PROFORMA

Case No:

Name: Hosp No:

Age: Ward:

Gender:

Address:

CHIEF COMPLAINTS:

HISTORY OF PRESENT ILLNESS:

PAST HISTORY:

Hypertension: Y/N duration:

Diabetes Mellitus: Y/N duration:

Congestive Heart Failure: Y/N duration:

Chronic Renal Failure: Y/N duration:

Valvular Heart Disease: Y/N duration:

Atrial Fibrillation: Y/N duration:

Others:

FAMILY HISTORY:

OCCUPATIONAL HISTORY:

PERSONAL HISTORY:

Economic status: Below poverty line/above poverty line

Diet: Vegetarian/Non-vegetarian/Mixed

Smoking: Y/N duration and intensity:

Alcohol consumption: Y/N duration and intensity:

GENERAL PHYSICAL EXAMINATION

Height: Weight:

BMI:

Pallor, Icterus, Clubbing, Cyanosis, Lymphadenopathy, Edema

Blood pressure: Pulse Rate: Perepheral puleses:

Respiratory Rate: Temperature:

Systemic Examination:

CVS:

RS:

ABDOMEN:

CNS:

ECG:

Troponin:

CK MB:

Clinical Diagnosis:

2D Echocardiogram:

Thrombolysis:

CAG:

PCI:

DAYS 1-3:

Complications:

DAYS 3-7:

Complications:

FINAL OUTCOME:

INVESTIGATIONS:

Hemoglobin:

Blood Urea:

Serum Creatinine:

Sodium:

Potassium:

HbA1c:

NT –proBNP:

Others:

Comments:

KEY TO MASTER CHART

M	-	Male
F	-	Female
YRS	-	Year's
DM	-	Diabetes Mellitus
HTN	-	Hypertension
IWMI	-	Inferior wall myocardial infarction
ALWMI	-	Antero- lateral wall myocardial infarction
ASMI	-	Antero-septal myocardial infarction
MI	-	Myocardial Infarction
NSTEMI	-	Non ST elevation myocardial infarction
STEMI	-	ST elevation myocardial infarction.
PCI	-	Percutaneous Coronary Intervention
MR	-	Mitral Regurgitation
LVEF	-	Left ventricular ejection fraction
RWMA	-	Regional wall motion abnormality
NTproBNP	-	N Terminal Pro B Type Natriuretic Peptide

MASTER CHART

Sl No	Hospital No	Age	DM	HTN	MI - NSTEMI, STEMI	Sex	HbA1C %(Glycated Hemoglobin)	Hb gm/dL (Hemoglobin)	NTproBNP	Left Ventricular Ejection Fraction	Regional Wall Motion Abnormality	PCI/Lysis (PCI/ Thrombolysis)	Arrhythmias	Other complications	Smoking	Complaint
1	821109	63	N	Y	NSTEMI	M	5.3	14.5	<20	60%	None	PCI	No	None	No	Chestpain
2	822408	52	N	N	STEMI	M	5	14.5	898	60%	None	Lysis	No	No	Y	Chestpain
3	821524	60	N	Y	STEMI	M	6.4	16.7	1642	48%	Anterior, Septum, Apical hypokinesis	Lysis	No	No	Y	Chestpain
4	821499	70	N	Y	STEMI	M	6.4	14.8	507	54%	Inferior Hypokinetic	PCI	Transient Heart block	No	Y	Chestpain
5	821088	65	Y	Y	NSTEMI	M	6	14.5	815	60%	None	NA	Non	None	Y	CHestpain
6	822715	58	Y	N	NSTEMI	M	4.7	14.4	254	42%	Inferior &posterior	PCI	No	No	Y	Chestpain
7	822723	50	N	Y	STEMI	M	6.9	16.9	937	52%	Inferior, posterior hypokinetic	Lysis	No	No	No	Chestpain
8	822505	42	Y	Y	NSTEMI	F	9.7	10.5	1145	28%	Septal, Inferior, Posterior hypokinesis	Lysis	No	Heart Failure	No	Breathlessness
9	823184	45	N	N	NSTEMI	M	6.9	15	779	55%	Mid, Apical	NA	No	No	Y	Chestpain
10	825158	38	Y	N	STEMI	M	8.5	13.7	1272	38%	Inferior	PCI	No	No	Y	Breathlessness
11	824488	62	Y	N	STEMI	M	6	12.7	68	58%	Inferior Hypokinetic	PCI	No	No	No	CHestpain
12	823888	52	Y	Y	STEMI	M	8.3	15.3	<20	52%	Inferior mild	PCI	No	No	Y	Chestpain
13	823828	61	Y	Y	NSTEMI	M	8.6	14.2	80	58%	Septum, inferior hypokinetic	NA	No	No	Y	Chestpain
14	825554	60	N	N	STEMI	M	7.4	12.7	346	30%	Septum, Anterior, Lateral Hypokinetic	Lysis	Tachycardia	MR	Y	CHestpain
15	825568	56	Y	Y	STEMI	M	7	15.6	169	33%	Antero Lateral	Lysis	No	Heart Failure	Y	Chestpain
16	826287	65	N	N	STEMI	M	8.3	15.6	1276	35%	Anterior, Septum, Apical hypokinesis	Lysis	No	Heart Failure	Y	CHestpain
17	825953	78	Y	N	STEMI	M	6.6	14.5	1540	42%	Inferior & posterior	Lysis	No	ICH(IntraCerebral Hemorrhage)	Y	Chestpain
18	826308	52	N	Y	STEMI	M	8.3	14.2	1229	55%	Inferior	Lysis	No	No	Y	Chestpain

MASTER CHART

Sl No	Hospital No	Age	DM	HTN	MI - NSTEMI, STEMI	Sex	HbA1C %(Glycated Hemoglobin)	Hb gm/dL (Hemoglobin)	NTproBNP	Left Ventricular Ejection Fraction	Regional Wall Motion Abnormality	PCI/Lysis (PCI/ Thrombolysis)	Arrhythmias	Other complications	Smoking	Complaint
19	826066	45	Y	Y	STEMI	M	7.5	15.5	980	40%	Inferior, posterior hypokinetic	Lysis	No	No	Y	CHestpain
20	826881	60	N	N	STEMI	M	10.4	15.5	982	54%	Inferior Hypokinetic	Lysis	No	No	Y	Breathlessness
21	826929	58	Y	Y	STEMI	M	8.2	14.8	1649	42%	Anterior	Lysis	RBBB(RightBundleBranchBlock)	No	Y	giddiness
22	826668	61	Y	Y	STEMI	M	8.3	11.4	56	60%	None	PCI	No	No	Y	CHestpain
23	823812	45	N	N	STEMI	M	6.8	14.8	168	42%	Anterior Hypokinetic	Lysis	RBBB	No	No	Chestpain
24	869021	61	Y	Y	STEMI	F	7.2	12.5	1027	40%	Anterior, Septum hypokinesis	Lysis	No	No	Np	Chestpain
25	869296	60	Y	N	STEMI	M	8	12.5	2151	30%	Mid, Apical, Lateral akinetic	Lysis	No	Heart Failure	Y	Chestpain
26	880568	55	Y	N	STEMI	M	11	16.3	528	50%	Inferior Hypokinetic	PCI	Transient Heart block	No	No	CHestpain
27	886069	55	N	Y	STEMI	F	6.1	14.1	610	45%	Inferior Hypokinetic	Lysis	No	No	No	Chestpain
28	885377	50	Y	Y	STEMI	M	7.4	17.3	1872	30%	Global hypokinesis	NA	No	No	Y	Chestpain
29	888053	80	Y	N	NSTEMI	F	6.2	16.7	1658	35%	Septum, Anterior, Lateral Hypokinetic	Lysis	No	Reinfarction	Y	Chestpain
30	887215	49	Y	N	STEMI		7.1	14.2	1437	35%	Apical, Anterior, Septum hypokinetic	Lysis	RBBB	Heart Failure	No	CHestpain
31	888635	60	Y	Y	STEMI	M	11.8	16.5	1407	35%	Apical, Anterior, Lateral Hypokinetic	PCI	No	Heart Failure	Y	Chestpain
32	888343	65	N	N	STEMI	M	6.4	12.2	1520	30%	Global hypokinesis	Lysis	No	Heart Failure	No	Breathlessness
33	888321	65	Y	N	NSTEMI	M	7.1	15.5	730	52%	Inferior, posterior hypokinetic	NA	No	No	No	Chestpain
34	888367	45	N	N	NSTEMI	M	6.2	13.2	910	45%	Apical, Anterior Hypokinetic	PCI	No	No	No	Chestpain

MASTER CHART

Sl No	Hospital No	Age	DM	HTN	MI - NSTEMI, STEMI	Sex	HbA1C %(Glycated Hemoglobin)	Hb gm/dL (Hemoglobin)	NTproBNP	Left Ventricular Ejection Fraction	Regional Wall Motion Abnormality	PCI/Lysis (PCI/ Thrombolysis)	Arrhythmias	Other complications	Smoking	Complaint
35	889144	52	N	N	STEMI	M	10.9	10	1186	35%	Inferior, posterior hypokinetic	Lysis	No	Heart Failure	No	Chestpain
36	898733	46	N	Y	NSTEMI	M	7.5	15	308	50%	Inferior Hypokinetic	Lysis	No	No	Y	Chestpain
37	898670	58	N	N	STEMI	M	6.2	13.4	2156	15%	Global hypokinesis	PCI	No	Heart Failure	Y	Chestpain
38	898643	65	Y	Y	STEMI	M	7.1	12.6	528	48%	Inferior, posterior hypokinetic	NA	No	No	No	Breathlessness
39	898278	62	Y	Y	NSTEMI	M	6.8	18.3	700	55%	Anterior Hypokinetic	PCI	No	No	Y	Chestpain
40	879896	50	N	N	STEMI	M	6.2	12.6	1906	40%	Anterior, Septal, Inferior Hypokinetic	Lysis	No	No	No	Chestpain
41	880695	65	N	Y	STEMI	M	6.2	16.8	1935	35%	Septum, Anterior, Lateral Hypokinetic	Lysis	RBBB	Heart Failure	Y	CHestpain
42	880968	40	N	N	STEMI	M	7.1	15.2	1244	43%	Anterior, Hypokinetic	Lysis	No	No	Y	CHestpain
43	880679	65	N	Y	STEMI	M	6.6	15.5	30	60%	None	PCI	No	No	Y	Chestpain
44	875848	43	N	N	STEMI	M	7.1	13.5	110	40%	Apical, Lateral Hypokinetic	PCI	No	No	Y	Breathlessness
45	881573	62	N	Y	STEMI	m	6.6		147	55%	Inferior Hypokinetic	Lysis	No	No	No	Chestpain
46	881460	40	N	N	STEMI	M	6.2	16.5	47	50%	Posterior Hypokinetic	Lysis	No	No	No	Chestpain
47	882158	70	N	N	STEMI	M	6.2	15.2	23	60%	None	PCI	No	No	No	Chestpain
48	882276	74	Y	Y	NSTEMI	F	8.3	14.5	625	58%	RV mildly Hypokinetic	Lysis	No	No	No	Chestpain
49	883093	40	N	N	STEMI	M	6.3	15	20	50%	Mild hyopokinesis of Anterior	PCI	No	No	No	Breathlessness
50	881299	50	N	N	STEMI	M	6.4	15.5	1157	45%	Septum, Anterior Hypokinetic	PCI	No	No	Y	giddiness
51	883487	70	Y	N	NSTEMI	M	10.4	10.3	1240	45%	Inferior Hypokinetic	PCI	CHB(Complete HeartBlock)	No	Y	Chestpain
52	883439	38	N	N	STEMI	M	9.1	11.9	887	50%	Inferior Hypokinetic	PCI	No	No	No	chestpain
53	883439	45	Y	N	STEMI	M	8.5	17.3	500	50%	Inferior Hypokinetic	pci	No	no	No	CHestpAIN

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54	884654	70	Y	N	STEMI	M	9.6	9	20	58%	Inferior mildly hypokinetic	PCI	No	No	Y	Chestpain
55	883883	79	Y	N	NSTEMI	M	11.7	16	1009	40%	Anterior Hypokinetic	Lysis	No	No	No	Breathlessness
56	884269	36	Y	N	STEMI	M	6.9	16.5	348	45%	Septal, Anterior Hypokinetic	PCI	No	No	Y	Chest pain
57	883170	55	N	N	NSTEMI	M	6.6	12.6	1185	40%	Apical, Anterior, Lateral Hypokinetic	Lysis	No	No	Y	Chestpain
58	884233	62	Y	N	STEMI	M	8.6	10.9	980	40%	Septal, Anterior Hypokinetic	PCI	RBBB	No	No	Chest pain
59	885653	72	Y	Y	NSTEMI	F	8.1	13.7	<20	60%	None	PCI	No	No	No	Chestpain
60	885152	60	N	N	STEMI	M	6.8	17.1	461	55%	Inferior Hypokinetic	PCI	No	No	No	Chestpain
61	885846	52	N	N	STEMI	M	6.9	13	35	60%	None	NA	No	No	No	Chestpain
62	884911	65	N	Y	STEMI	F	6.5	11.5	1638	22%	Global hypokinesis	PCI	No	Heart Failure	Y	Breathlessness
63	885038	43	N	N	STEMI	M	6.9	13.2	608	55%	Inferior Hypokinetic	NA	No	no	Y	Chestpain
64	884376	53	N	Y	STEMI	M	6	10.2	1307	45%	Apical, Anterior Hypokinetic	NA	No	No	No	Chestpain
65	886028	68	Y	Y	STEMI	M	9.8	14.8	183	53%	Anterior, Apical Hypokinetic	PCI	No	No	Y	Chestpain
66	885965	50	Y	Y	STEMI	M	7.4	15.3	108	60%	None	PCI	No	No	Y	Chestpain
67	884367	75	Y	Y	STEMI	M	7.9	14.2	1592	30%	Septal, Anterior Hypokinetic	Lysis	No	Heart Failure	No	Chest pain
68	885967	45	N	N	STEMI	M	6.7	12.2	350	55%	Inferior Hypokinetic	NA	No	No	No	Breathlessness
69	886750	75	N	N	NSTEMI	F	7.2	15.4	292	50%	Inferior, posterior hypokinetic	PCI	No	No	No	CHestpain
70	885275	65	Y	N	NSTEMI	M	9.2	16.7	<20	60%	None	PCI	No	No	Y	Chestpain
71	885045	75	Y	Y	STEMI	M	10	16.2	20	58%	None	PCI	No	No	Y	Chestpain
72	886679	47	Y	N	STEMI	M	9.1	15.5	87	58%	Inferior Hypokinetic	Lysis	No	No	No	Chestpain
73	886764	55	N	N	STEMI	M	6.4	13.1	801	45%	Inferior Hypokinetic	Lysis	CHB	No	Y	giddiness

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74	841523	65	Y	Y	STEMI	M	6.3	12.8	21	58%	None	PCI	No	No	Y	CHestpain
75	876534	65	Y	N	STEMI	M	9.4	12.5	2060	30%	Apical, Septal, Anterior hypokinetic	Lysis	CHB	Reinfarction	Y	Breathlessness
76	886434	65	Y	N	STEMI	M	8.3	15.9	<20	63%	None	PCI	No	No	No	Chestpain
77	887656	65	Y	N	STEMI	M	6.3	15.9	1820	30%	Anterior, Septum, Apical hypokinesis	PCI	Arrest revived	Heart Failure	No	Chestpain
78	888093	45	N	N	NSTEMI	M	6.6	13.2	519	50%	Inferior, posterior hypokinetic	NA	No	No	No	Chestpain
79	890122	65	Y	N	STEMI	M	8.2	14.9	1124	35%	Inferior, posterior hypokinetic	PCI	No	Heart Failure	Y	Chestpain
80	890149	39	Y	Y	STEMI	M	7.3	14.9	1147	28%	Apical, anterior, lateral akinetic	PCI	No	Reinfarction	Y	Chestpain
81	889661	44	N	N	STEMI	M	6.8	14.1	997	45%	Anterior Hypokinetic	Lysis	No	No	Y	Chestpain
82	890557	60	N	Y	STEMI	M	9.4	12.2	734	45%	Inferior Hypokinetic	Lysis	No	No	Y	Chestpain
83	891377	70	N	Y	NSTEMI	F	6.9	16.2	1429	30%	Apical, Anterior, Lateral Hypokinetic	Lysis	No	Heart Failure	Y	Chestpain
84	891317	48	N	N	STEMI	M	6.4	17.3	359	50%	Inferior Hypokinetic	PCI	No	No	No	Chestpain
85	891712	68	Y	Y	NSTEMI	F	8.2	12.2	128	50%	Anterior Hypokinetic	NA	No	No	No	Chestpain
86	891136	50	N	Y	NSTEMI	M	7.5	13.8	259	45%	Inferior Hypokinetic	Lysis	No	No	Y	Chestpain
87	890820	55	Y	N	STEMI	M	7.3	17.2	610	40%	Anterior Hypokinetic	Lysis	No	No	Y	Chestpain
88	891713	55	Y	Y	NSTEMI	F	10	16.8	20	60%	None	PCI	Transient Heart block	No	Y	Chestpain
89	892074	55	Y	Y	NSTEMI	F	6.8	10.7	654	58%	None	NA	Tachycardia	No	No	Breathlessness
90	892066	51	N	Y	STEMI	M	6.3	13.2	817	50%	Septal, inferior, anterior hypokinetic	NA	No	No	No	Chestpain
91	891986	75	Y	Y	NSTEMI	F	6.7	15.2	983	45%	Inferior, posterior hypokinetic	NA	No	No	Y	Chestpain

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92	892048	38	N	N	STEMI	M	6.1	14.1	518	43%	Apical, Septal, Anterior hypokinetic	PCI	No	No	Y	Chestpain
93	892076	42	Y	Y	NSTEMI	F	9	15.8	948	40%	Anterior, lateral hypokinetic	Lysis	No	no	Y	Chestpain
94	892597	47	N	Y	NSTEMI	M	8.3	14.2	1058	30%	Anterior, lateral hypokinetic	NA	No	Heart Failure	No	Chestpain
95	893004	52	Y	N	STEMI	M	7.1	14.1	1003	30%	Anterior, lateral, septum hypokinetic	Lysis	No	Heart Failure	Y	Chestpain
96	893355	75	N	N	STEMI	M	6.5	11.4	754	35%	Septum, Anterior, Lateral Hypokinetic	NA	No	Heart Failure	No	Chestpain
97	894353	52	N	Y	STEMI	M	7.4	14	991	30%	Inferior, posterior hypokinetic	Lysis	No	MR	Y	giddiness
98	893926	60	Y	Y	NSTEMI	F	8.3	15.5	38	58%	Septum, inferior hypokinetic	NA	No	No	Y	Chestpain
99	891952	59	Y	Y	STEMI	M	7.3	14.2	471	45%	Anterior Hypokinetic	NA	No	no	No	Chestpain
100	895091	30	N	N	STEMI	M	6.3	12.7	1164	35%	Septum, Anterior,Apical hypokinetic	Lysis	No	Heart Failure	Y	Chestpain