"THE RELATIONSHIP BETWEEN GRACE RISK SCORE AND GLUCOSE FLUCTUATION IN PATIENTS WITH ACUTE CORONARY SYNDROME AND ABNORMAL GLUCOSE METABOLISM USING CONTINUOUS GLUCOSE MONITORING SYSTEM"

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

DOCTOR OF MEDICINE

IN

GENERAL MEDICINE

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ACKNOWLEDGEMENT

I would like to take this opportunity to thank all those who have been a part of this wonderful journey that has culminated in the completion of this thesis.

At the foremost I offer my gratitude and seek blessings from my parents, **M NAGARAJU, M RADHA**, my sisters **M SREEVANI and M LALITHA** whose countless sacrifices and endless love has made me who I am today in life.

I offer my salutations and thank all my teachers who have not only guided me through the maze of new information and skills but also shaped my personality by chiseling out all the rough edges.

I am deeply indebted and grateful to my guide, **Dr.Prabhakar K**, Professor, Department of General Medicine, Sri Devaraj Urs Medical College, for his able guidance, support, timely advice and constant encouragement throughout the period of the study.

I would like to express my sincere gratitude to **Dr. Raveesha A**, Professor and Head of the department, Department of General Medicine, Sri Devaraj Urs Medical College, for his expert advice, help and support in preparation of this dissertation.

I convey my sincere thanks to **Dr. V.Lakshmaiah, Dr. B.N. Raghavendra Prasad, Dr.Vidya Sagar C R, Dr. Srinivasa S V,Dr Niveditha, Dr Jayaprasad V, Dr AnithaA,Dr Vishwanath Reddy,DrPrasanna,DrSindhu,DrThanuj Reddy** for their advice and encouragement throughout the study.

If I have learnt to see far it is only by standing on the shoulders of my great teachers.

I am thankful to my postgraduate colleagues **Dr Kishore V, Dr Sreenath, Dr Dhruva, Dr Sanmitha, Dr Deepth, Dr Charchith and Dr Meghasri** for their motivation and for being a constant source of strength.

I am thankful to all my seniors especially **Dr Dwarak , Dr Maharaj, DrSanketh ,Dr Tameem** and dear juniors for their love, motivation and help.

I am highly indebted to my patients for providing me an opportunity to carry out this study.

Last but not least, I am thankful to all Technical Staff and non-teaching staff for their invaluable help without which this study would not have been possible.

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Paper ID	188705
Submission Date	2020-11-28 12:01:01

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ABSTRACT

BACKGROUND: Acute coronary syndrome is an important global cause of death and also the major cause of morbidity and mortality in India. The importance of glucose metabolism in patients with "acute coronary syndrome" has been increasingly recognized.

AIMS: "To determine the association between grace risk score and glucose fluctuation in patients with acute coronary syndrome and abnormal glucose metabolism using Continuous Glucose Monitoring System".

MATERIALS & METHODS: A Prospective Cohort study conducted for a period of 18 months from January 2019 to June 2020.Based on GRACE risk score the study population were divided into low risk , moderate risk and High risk.

RESULTS: A total of 77 participants were included in the study. The mean age of the participants was identified as 52.31 ± 7.9. Majority of the participants were belonged to killip class II with 58.44%. Elevated Cardiac Enzymes and ST Deviation were identified in 55.84% and 44.16% of participants. The mean Grace risk score and mean 24 Hours Mean Blood Glucose (mmol/l) were 129.35 ± 31.15 and 9.67 ± 3.28. Majority of the participants were belonged to the high-risk group with 35.06%. The median 24 hours mean blood glucose (mmol/l) in low risk, moderate and high risk were 6.32 (IQR 6.03 to 8.5), 9.08 (IQR 7.983 to 9.93) and 11.3 (IQR 10.16 to 13.8) respectively.

CONCLUSION: "High prevalence of abnormal glucose metabolism was found in ACS patients. Higher blood glucose fluctuation is associated with moderate and high GRACE risk scores in patients with ACS and abnormal glucose metabolism".

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

GLOSSARY	ABBREVIATIONS
ACS	Acute coronary syndrome
ANS	Autonomic nervous system
APG	Admission plasma glucose
CAD	Of coronary artery disease
CGMS	Continuous glucose monitoring system
CHD	Coronary heart disease
CI	Confidence interval
CVD	Cardiovascular disease
DM	Diabetes mellitus
ECG	Electrocardiogram
FPG	Fasting plasma glucose
GLP-1	Glucagon-like peptide 1
GRACE	Global registry of acute coronary events
GRACE	Global registry of coronary events
GRS	GRACE risk score
GV	Glycemic variability
HbA1c	Hemoglobin
HOMA-IR	Homeostasis model assessment of insulin resistance
IB-IVUS	Integrated backscatter intravascular ultrasound
IGT	Impaired glucose tolerance
MACE	Major adverse cardiac events
MI	Myocardial infarction
NSTEMI	Non-ST segment elevation myocardial infarction
OCT	Optical coherence tomography
PCI	Percutaneous coronary interventions
PPG	Postprandial glucose
SMBG	Self-monitored blood glucose
STE	ST-segment elevation

STE-ACS	STE acute coronary syndrome
STEMI	Segment elevation myocardial infarction
USA	United states America

INTRODUCTION

INTRODUCTION:

The influence of glucose metabolism in acute coronary syndrome and acute myocardial infarction has been increasingly recognized. Glycated hemoglobin (HbA1c) levels correlate well with the average levels of glucose crossing above 8 to 12 weeks and are used in diagnosing diabetes mellitus.[1]The presence of acute coronary syndrome in individuals with CVD can enhance the risk of abnormal glucose metabolism as compared to the normal population (25.2%).[2] Some investigators found an association between higher HbA1c levels and mortality inCAD population without diabetes but not in patients with established diabetes.[3]Glycatedhemoglobin (HbA1c) level on admission can lead to mortality inthe presence or absence of diabetes after myocardial infarction.[4]The guidelines for the management of non-ST-elevation acute coronary syndrome prefer the utilization of scoring systems such asGRACE score to calculate risk and guide management decisions.[5]The GRACE score is considered as a validated and established score for the risk stratification in ACS.[6]

ACS is important global causes of mortality and also the major cause of deaths and various diseases in India. In Urban India, coronary heart disease (CHD) prevalence in adult has increased considerably and occurred at a much younger age as compared to North America and Western Europe. CHD global fatality was estimated to be 17.5 million/year, 31% of deaths - 75% in low- and middle-income countries; the prevalence of CHD in rural India was estimated to be 3%–4% and 8%–10% in urban areas.[7]

Many studies have indicated the association between increased intermittent blood glucose, variations in blood glucose, oxidative stress, dysfunction of endothelium and atherosclerosis.[8] Hyperglycemia at presentation,while often reflecting undiagnosed and persisting

abnormalities of glucose handling, may also represent a transient stress response mediated through the ANS with the release of catecholamines and adrenal corticosteroids.[9] Hyperglycemia is associated with large infarction and depressed left ventricular function, heart failure on admission and elevated Brain Natriuretic Peptide.[10] Onthe opposite side, whatever the cause of hyperglycemia in acute myocardial infarction, it has got a detrimental effect on myocardium itself. Effects of hyperglycemia include the promotion of oxidative stress, impairment of endothelial function, promotion of coagulation, non-enzymatic glycation of platelet glycoproteins with abrupt changes in agreeability, amplification of inflammation, suppression of immunity and direct toxicity to myocytes and promotion of apoptosis. Acute hyperglycemia has been shown to impair ischemic preconditioning, attenuate the protective effect of preinfarction angina on microvascular function and reduce the effectiveness of collateral blood supply into ischemic zones.[11]An association between high glucose levels in ACS patients and increased overall mortality has been shown.[10] Nevertheless, hyperglycemia remains unrecognized and untreated inthe majority of cases with acute coronary syndrome.[12]

Previous studies have indicated that the disruption or erosion of vulnerable plaques and subsequent thrombus formation are the most frequent causes of ACS.[13]In the pathologic study assessing vulnerable plaque after ACS, larger lipid core is recognized as the marker for plaque vulnerability.[14] In the integrated backscatter intravascular ultrasound (IB-IVUS) study evaluating plaque morphology before the occurrence of ACS[15], the percent lipid area was greater, and percent fibrous area was smaller in coronary plaques inacute coronary syndrome. Also, one study indicated thatthe increased percent of lipid area and lower percent fibrous area are related to the thin-cap fibroatheroma as per OCT.[16] All these observations indicate that the levels of lipid and fibrous contents in coronary plaques are suggestive for vulnerable plaques. Previously, some studies suggested the close relationship between the blood glucose variability and atherogenic factors.[17]Teraguchi et al[18], concluded that the increase in blood

glucose variability is related with coronary plaque vulnerability in lesions of acute myocardial infarction.

Indians have a high risk of both Diabetes mellitus and coronary artery diseases. Early recognition of the glycemic status of ACS patients at a time of admission to the coronary care unit can determine the future cardiovascular events and increased risk of death.[19]

NEED FOR THE STUDY:

It has been established that glucose fluctuations, more often hyperglycemia,are commonly encountered among patients with ACS. There has been a lot of research done regarding ACS management, and newer and more effective therapeutic options have become available.The GRACE risk score has been developed from a registry data and accounts with newer prognostic variables to estimate the risk of death or a consequent myocardial infarction MI in patients following an initial ACS. It is important to provide the correct treatment based on the risk score of the patient. The current study is an attempt at understanding "the relationship between blood glucose fluctuation and GRACE risk score in ACS patients and how blood glucose fluctuation in patients withabnormal glucose metabolism affect GRACE score using Continuous Glucose Monitoring System".

AIMS & OBJECTIVES

AIMS AND OBJECTIVES:

To determine the relationship between glucose fluctuation and GRACE risk score in patients with acute coronary syndrome(ACS) and abnormal glucose metabolism using a continuous glucose monitoring system(CGMS).

REVIEW

OF

LITERATURE

REVIEW OF LITERATURE:

ACUTE CORONARY SYNDROME

The term acute coronary syndromeindicates various clinical symptoms that are compatible with acute myocardial ischemia.It includes unstable angina, non—ST-segment elevation myocardial infarctionand ST-segment elevation myocardial infarction. Unstable angina and NSTEMI are the conditions that are associated closely to each other. They are similar in both the pathophysiologic origins and clinical presentations but vary in level of severity. Myocardial damage can be caused by severe ischemia which causes the release of myocardial necrosis biomarker into the circulation that leads to a diagnosis of NSTEMI. On another hand, in the absence of such biomarker in the blood, a diagnosis of unstable angina can be confirmed.[20]

A diagnosis of ACS should be considered in all patients presenting with ischemic symptoms. Clinical signs and symptoms of ischemia include various combinations of chest pain, upper extremity, mandibular or epigastric discomfort, dyspnea, diaphoresis, nausea, fatigue, or syncope. The pain and discomfort associated with an ACS event may occur with exertion or at rest and is often diffuse rather than localized. Atypical symptoms of ACS may occur in certain patient populations such as women, the elderly, diabetics, or postoperatively. In these situations, ACS may be associated with palpitations, cardiac arrest, or with an asymptomatic clinical presentation.[21]

The current classification of acute coronary syndromes in two main categories (acute myocardial infarction with ST-segment elevation—STEMI and acute coronary syndromes without ST-segment elevation—non-STE ACS) is historically based on the need to define

patients indicated for thrombolytic therapy. Thrombolytic therapy was shown to be effective in STEMI, while it is ineffective in non-STE ACS.[22,23]

The electrocardiogram (ECG) findings in acute coronary syndrome should always be interpreted in the context of the clinical findings and symptoms of the patient when these data are available. It is important to acknowledge the dynamic nature of ECG changes in acute coronary syndrome. In patients with myocardial ischemia due to the decreased blood supply, the initial 12-lead electrocardiogram (ECG) typically shows 1) predominant ST-segment elevation (STE) as part of STE acute coronary syndrome (STE-ACS), or 2) no predominant STE, i.e. non–STE ACS (NSTE-ACS). Patients with predominant STE are categorized as either aborted myocardial infarction (MI) or ST-elevation MI (STEMI) based on the absence or presence of biomarkers of myocardial necrosis. NSTE-ACS patients are classified as having either unstable angina or NSTEMI, based also on the absence or presence of biomarkers of myocardial necrosis. Classifying ECG changes in ACS can help in the risk stratification of individual patients, but also in the planning of epidemiological and clinical studies to produce comparable data.[24]

Acute coronary syndromes should be classified according to the first medical contact decision were to transport the patient: (a) immediately (within <2 h from the first medical contact) to the catheterization laboratory of the nearest PCI-capable hospital or (b) to the nearest coronary care unit (including hospitals without PCI facilities). In principle, the (a) category includesall patients with ongoing (evolving or recurrent) signs of acute myocardial ischemia with any ECG pattern (ST elevations, ST depressions, bundle branch block, or even non-diagnostic ECG if the clinical suspicion is very stronge.g. in left circumflex artery occlusion) and also patients with any form of acute coronary syndrome

complicated by hemodynamic or electric instability (Killip II-IV class or malignant arrhythmias—of course only when combined with clinical symptoms of the possible acute coronary syndrome). The (b) category includes all other forms of acute coronary syndromes—i.e. situations when a delay of 24–72 h (with a decision about CAG/PCI) is unlikely to cause any risk for the patient.[25]

ACS is responsible for one-third of total deaths in people older than 35. Some forms of CHD can be asymptomatic, but ACS is always symptomatic.In the year 2016,around 15.5 million persons ≥20 years of age are reported with CHD in the USA as per Heart Disease and Stroke Statistics update of the American Heart Association. The prevalence of CHD increases with advancing age for both the gender.[26] In 1990, the absolute number of mortality due to cardiovascular diseases had a notable increase at the same time the age standardization mortality reduced by 22%.[27]

In India, cardiovascular disease is one among the leading reason for the mortality rate in which the ischemic heart disease and stroke accounts around> 80% of CVD mortality. In India, the age-standardized CVD mortality is 272 per 100 000 individuals whereas, globally, 235 per 100 000 individuals. The advanced age and high case fatality rate are the factors that contribute to the increased mortality rate in India. The premature death rate in years of life lost due to cardiovascular diseases increased by 59%, by the year 1990 to 2010 in India.[28]

NSTEMI and STEMI are the two subtypes of ACS are not always but most frequently, a manifestation of coronary artery disease (CAD).[29]

Predisposing risk factors for MI are generally divided into two categories. Non-modifiable risk factors include age, sex, family history of premature coronary heart disease, malepattern baldness.[30] While modifiable risk factors include smoking or other tobacco use,diabetes mellitus (with or without insulin resistance), obesity, hypertension, Hypercholesterolemia, hypertriglyceridemia, including inherited lipoprotein disorders, dyslipidemia, obesity, sedentary lifestyle and/or lack of exercise, psychosocial stress, poor oral hygiene, type A personality.[31] According to INTERHEART study, risk factors for MI are categorized into the emerging risk factors (homocysteine, glucose abnormalities, nutritional factors, abdominal obesity and psychosocial factors) and conventional risk factors (hypertension, diabetes, smoking and elevated cholesterol) between people of varying geographic and ethnic origin. However, these known risk factors would explain only about 50% of cases of heart disease.[32] Biomarkers have a major role in the diagnosis and risk stratification of patients with ischemic heart disease. Currently, troponin continues as the reference biomarker in acute coronary syndromes. Troponins T and I are currently the gold standard for the detection of myocardial injury and are key to clinical decision making in ACS. ACS is commonly associated with elevated levels of CRP, probably reflecting widespread vascular inflammation.[33]

Considering the known prognostic impact of poor renal function in ACS patients, it seems reasonable to hypothesize that early stages of kidney dysfunction would provide additional prognostic information. Jernberg T. et al. were the first to demonstrate that measurement of cystatin-C substantially improves the early risk stratification of a large population with suspected or confirmed non-ST elevation ACS.[34]

In vitro and in vivo data demonstrated the mechanisms that are at the basis of the adverse CV effects of GV, which are mainly associated with oxidative stress; the atherogenic action of postprandial glucose (PPG) also involves insulin sensitivity, the postprandial increase of serum lipids and the glycemic index of food.[35]

ABNORMAL GLUCOSE METABOLISM AND ACS:

Current classification of hyperglycemia in the hospital includes diabetes diagnosed and managed before admission (known case of diabetes); existing, but unrecognized, diabetes (fasting glucose higher than 6.9 mmol/liter or RBSmore than 11.1 mmol/liter during the period of hospital stay and confirmed after discharge; new-onset stress hyperglycemia or hospital-related hyperglycemia (FBS higher than 6.9 mmol/liter or RBS more than 11.1 mmol/liter during the period of hospital stay that reverts to normal range after discharge). The prevalence of hyperglycemia in different epidemiological studies ranges from 3% to 71% incases with ACS.[36]

Abnormal glucose metabolic status at admission is an indicative marker of future cardiovascular events and long-term mortality after ACS, whether or not they are known diabetics. Elevated admission plasma glucose (APG) levels are common in patients admitted with ACS's and are associated with a high incidence of adverse clinical outcomes compared with patients with normoglycemic ACS.[19]Impaired glucose metabolism is also frequently observed subsequent to an acute coronary event in nondiabetic subjects. The glycemic metabolic status indicated by the blood glucose and glycosylated hemoglobin (A1C) concentrations during the acute myocardial infarction in diabetic subjects, and even in the case of nondiabetic subjects, are determinants of future cardiovascular events and the increased risk of death.[37]

A higher proportion of proinsulin to insulin is indicative of abnormal metabolism of insulin, and this is uniformly observed in cases of ACS irrespective of the glucose concentration. It had been suggested by Haffner et al[38], in the San Antonio Heart Study that the level of proinsulin was strongly predictive of several metabolic and hemodynamic variables in nondiabetic subjects. Similarly, Yudkin et al[39], found that proinsulin-like molecules were a marker of vascular disease, although it was unlikely to be involved directly in the etiology of coronary artery disease. Their study group included nondiabetic European and South Asian subjects.

Several cohort studies have shown that people with pre-diabetic conditions such as IGT(Impaired glucose tolerance) are at high risk for cardiovascular disease. In fact, patients with pre-diabetic IGT are compromised because they have atherogenic risk factors which can lead to the coronary arteries. A systematic meta-analysis on twenty clinical studies suggested that a blood glucose concentration even below the threshold for diagnosing DM is associated with a significantly higher risk of coronary artery disease.[40]

Fasting plasma glucose (FPG) and HbA1c are the most commonly measured glycemic parameters for secondary measures taken after the development of cardiovascular disease in a clinical setting. Although the relevance of glycemic exposure is indisputable, FPG does not completely explain the risk. The Diabetes Epidemiology: Collaborative Analysis of Diagnostic Criteria in Europe study demonstrated that fasting glucose concentrations alone do not identify individuals at increased risk of death and CVD associated with hyperglycaemia; however, the OGTT(oral glucose tolerance test) provides additional prognostic information.[41]

ASSOCIATION BETWEEN GLYCEMIC VARIABILITY AND ACS:

GV corresponds to swings in blood glucose levels in the same individual within-day, day-to-day, or even over longer periods of time. Increasing GV may contribute to diabetes-related complications, including retinopathy, nephropathy, and cardiovascular events.[42]The presence of glycemic disorder can lead to the development of coronary plaque progression, instability and subsequent ACS. Mainly, hemoglobin A1c (HbA1c), fasting plasma glucose (FPG), homeostasis model assessment of insulin resistance (HOMA-IR), advanced glycation end products (AGEs), and glucagon-like peptide 1 (GLP-1) are focused by previous studies to evaluate the severity of diabetes-related vascular complications, another important measure in recent investigations is the blood glucose variability.[17] Continuous glucose monitoring system (CGMS) favors direct visualization of blood glucose variability, that helps to identify the various glycemic disorder as compared to other conventional glucose indicators (HbA1c, FPG, HOMA-IR).[43]

In patients with an ACS, a high GV during hospitalization is related to more risk in the 30 days following the admission of a major cardiovascular event, intracerebral hemorrhage, and isolated cardiac valvular surgery.[44]Recently, a high GV in patients with ACS was demonstrated to be one of the most powerful predictive factors for the development of major adverse cardiac events (MACE) in ACS and T2DM patients. In this study, GV remained the best predictor of a greater risk of midterm MACE in this population.[45]Some studies have shown that an elevated GV, especially those in the highest GV quartile, was showing significant association with short-term cardiovascular composite outcomes. This associated risk was described in both hyperglycemic and normoglycemic groups.[46]Even in non-diabetic patients or recently diagnosed diabetic patients with optimal metabolic control, GV has related to the increase in markers of endothelial and cardiovascular damage.[47]

There is a significant association between GV and the increased incidence of hypoglycemia. Hypoglycemic events may trigger inflammation by inducing the release of inflammatory cytokines. Hypoglycemia also induces increased platelet and neutrophil activation. The sympathoadrenal response during hypoglycemia increases adrenaline secretion and may induce arrhythmias and increase the cardiac workload. Underlying endothelial dysfunction leading to decreased vasodilation may contribute to CV risk. Overall, the pathophysiological evidence is more suggestive of GV being a major key determinant of vascular damage.[48]

GLYCEMIC VARIABILITY AS A MARKER OF POOR PROGNOSIS IN ACS:

While the measurement of glycated hemoglobin A1c (A1C) is considered the gold standard for assessing glycemic control in patients with diabetes, this measure does not take into account fluctuations in blood glucose levels known as glycemic variability (GV). Optimization of glycemic control requires a careful balance that allows patients to reach target A1C while avoiding hypoglycemia.[46]GV refers to swings in blood glucose levels, has a broader meaning because it alludes to blood glucose oscillations that occur throughout the day, including hypoglycemic periods and postprandial increases, as well as blood glucose fluctuations that occur at the same time on different days. The broad definition of GV considers the intraday glycemic excursions, including episodes of hyperglycemia and hypoglycemia.[48]

GV is becoming a vital metric to consider when assessing glycemic control in clinical practice. GV can show inter-day and intra-day variations, which can increase both glycemic swings and hypoglycemia risk. Also, a reduction in GV is closely correlated with reductions in both hyperglycemic and hypoglycemic episodes.[45] Postprandial spikes in blood glucose, as

well as hypoglycemic events, are blamed for increased CV events, and GV includes both of these events; hence, minimizing GV can prevent future cardiovascular events.[48]

The traditional approach to measuring GV consists of assessing the amplitude of glycemic excursions, which relies on self-monitored blood glucose (SMBG) data or on CGM. Mean amplitude of glycemic excursions was the first to be developed, primarily to capture mealtime-related glucose excursions, and has been used widely for assessing GV. While most physicians in clinical practice are familiar with the use of standard deviation (SD; total SD, intra-day SD and inter-day SD), GV-related research utilizes CV (which is the SD divided by the mean) as the preferred amplitude measure. CV is a metric related to mean blood glucose, and it is easier to describe hypoglycemic excursions using CV (compared with using SD alone) as GV is significantly influenced by mean blood glucose.A recent international consensus statement for CGM recommends that when measuring GV, a CV should be used as the primary measure, with SD as a secondary measure because of its familiarity to physicians. Other important aspects to consider, when measuring the amplitude component of GV is that the hyperglycemic range is much broader than the hypoglycemic range and that the risk for hyperglycemia and hypoglycemia are clinically independent.[46]

There are 3 basic types of CGM devices: "real-time" CGM devices, which continuously track glucose concentrations in the interstitial fluid; intermittently viewed CGM devices, which show continuous glucose measurements retrospectively at the time the patient or physician checks the data; and diagnostic CGM, which the patient is blinded to, and is intended to inform the physician about the patient's blood glucose levels in their day-to-day lives. All 3 types of CGM provide detailed information about glucose variability. While both real-time and intermittently viewed CGM devices monitor the TIR, real-time CGM can also warn users

in real-time if their blood glucose is trending toward the hypoglycemic or hyperglycemic ranges.[46]

Various CGM devices of these types are commercially available, each of which has certain advantages and disadvantages. Overall, the new-generation CGM devices are becoming simpler and less expensive to use. For example, the FreeStyle Libre "flash" CGM device (Abbott Diabetes Care) is related to lower daily costs and does not require daily finger pricks for calibration with an SMBG device. However, this is an intermittently viewed CGM device, with data being stored and downloaded later, and so it does not provide hypoglycemia or hyperglycemia alarms.[49] Another example, Dexcom's CGM system, is a real-time device which can communicate directly with the patient, caregiver and physician smart devices, and can send increased and decreased blood glucose alerts. While the older versions of this device needed to be calibrated against SMBG at least twice a day; the new G6 generation is now finger-prick free using a factory calibration.[46] Finally, a diagnostic CGM system, such as the iPro CGMS (Medtronic Diabetes, Northridge, CA)[46], is capable of sensing blood glucose at 5-minute intervals throughout the course of the day and is used over a 3-day period to obtain information regarding blood glucose levels. Patients are instructed to carry a log of daily activities, such as mealtimes and therapy administration. Patients are unable to view their blood glucose values during the time of recording; however, this information is downloaded later to provide a report to the physician regarding the 3-day time period. This data, alongside the patient log, can provide valuable information regarding the effectiveness of the patient's diabetes management. Currently, CGM, used in conjunction with A1C monitoring, is recommended for determining glycemic status and as a basis for adjusting therapy in all type 1 diabetes patients and certain patients with T2D, such as those failing to achieve target A1C on intensive insulin therapy (particularly if the patient has significant hypoglycemia).[50]

In the context of AMI, Su et al. [44] described an association between high GV (measured by continuous glucose monitoring) and 1-year occurrence of MACE. There is a lack of data regarding GV as a predictive risk factor for cardiovascular complications. In the face of growing interest in this variable, some authors have reported a connection between GV and not only microvascular diabetes complications but also macrovascular complications such as CAD severity. Other groups have found an interesting association between GV and coronary plaque vulnerability.[42]

GRACE Risk score:

GRACE is a large, prospective, multinational observational study in admitted patients with the acute coronary syndrome. The aim of GRACE is to improve the quality of care for patients with ACS by describing differences in, and relationships between, patient characteristics, treatment practices, and in-hospital and post discharge outcomes at hospitals around the world.[51]The GRACE risk score (GRS) for mortality and re-infarction up to 6 months post-discharge is a powerful predictor of short and long-term prognosis after ACS.[52] The GRACE 6-month post discharge prediction model is a simple, robust tool for predicting mortality in patients with ACS. Clinicians may find it simple to use and applicable to clinical practice. Clinical prediction models may be helpful for medical decision making as patients judged to be at higher risk may receive more aggressive surveillance and/or earlier treatment, while patients estimated to be at lower risk may be reassured and managed less aggressively. By using simple yet valid risk calculations, clinicians can accurately advise patients about their likelihood of an event, and how this likelihood translates into treatment decisions.[53]

In a diverse range of hospitals in fourteen countries worldwide, with on-site angiographic facilities, the frequency of catheterizations and percutaneous coronary interventions (PCI) exhibited a paradoxical pattern, whereby most interventions were performed in low-risk rather than high-risk population (the 'treatment-risk paradox'). It is possible to estimate the 'deficit' in the frequency of revascularization as per the actual differences between increased rate and low rate hospitals observed in the GRACE programme.[54]

The GRACE is considered as one of the greatest multinational programme in ACD. It was conducted to confirm that all the participants included were reflective of a broad spectrum of population with the acute coronary syndrome. They were trained, audited, and quality control steps were taken during the study period. The evaluation of long term outcomes with complete mortality data to 5 years is made possible with the utilization of a UK cohort.[54]

The GRACE risk score was derived from an original population of 26 267 patients with suspected ACS which is validated in a further set of 22 122 patients prospectively and externally also.[54]

The hospital risk of mortality or the combination of death or MI and the same outcomes up to 6 months post-discharge are estimated in original GRACE score. The new version of the GRACE risk score for a period of one-year outcomes was derived in the more recent data set of 32, 037 population from the GRACE registry between the period of January 2002 and December 2007. The UK cohort of 1274 participants with long-term follow-up was employed for three 3-year mortality.[54]

The GRACE 2.0 ACS Risk Calculator uses eight prognostic variables: age, heart rate, systolic bloodpressure, ST-segment deviation, Killip class, cardiac arrest at admission, serum creatinine and elevated cardiac biomarkers. If Killip class or serum creatinine levels are not available, diuretic use and renal failure can be substituted.[54]

ASSOCIATION BETWEEN "GRACE RISK SCORE AND GLUCOSE FLUCTUATION IN ACUTE CORONARY SYNDROME AND ABNORMAL GLUCOSE METABOLISM"

In patients with the acute coronary syndrome, the short term and six-month mortality are associated with higher glucose levels at the time of admission as per GRACE registry report.[55]H Li et al in their study suggested higher blood glucose variation is relatedto the moderate and high GRACE risk scores in acute coronary syndrome and abnormal glucose metabolism. However, glucose variation is inthe normal range "(24-h MBG is < 6.5 mmol/L, and 24-h MAGE is < 3.9 mmol/L) even in moderate and high GRACE risk scores patients".[8] Higher MAGE or HbA1c level is associated with high CV risk factors including advanced age, DM, HF or renal insufficiency. The correlation between GRACE risk scores and MAGE or HbA1c is unclear.[56]

High GRACE risk score (=155) and elevated admission blood sugar (=11) was found significantly higher in-hospital death whereas only high GRACE risk score (=155) and normal admission blood sugar (<11) was found non-significant regarding in-hospital death.[55]

In a multivariate analysis, high MAGE was an independent predictive factor of poor prognosis for major adverse cardiovascular and cerebrovascular events. The study also concluded that glycemic variability determined with a CGMS is a predictor of prognosis in

patients with ACS without severe DM. Here GRACE score >140 was found in 47% of the patients in the group with low MAGE and 58% in high MAGE group.[57]In their study. Timóteo et al found that in medium-term follow-up,a blood glucose level of ≥ 160 mg/dl on admission was an independent predictor for mortality.[58]While investigating to find out whether 2 h post-load plasma glucose could improve GRACE risk score (GRS) based prognostic models in patients with an acute coronary syndrome without known diabetes mellitus, Chattopadhyay et al noted that two-hour post-load plasma glucose, but not fasting plasma glucose, is an independent predictor of adverse outcome after ACE even after adjusting for the GRS.[52]

MOST RELEVANT STUDIES:

E Gerbaud et al[42] (2019), conducted a study to determine the prognostic value of GV in patients with DM and ACS. The study included consecutive patients with diabetes and ACS between January 2015 and November 2016. GV was assessed using SD during initial hospitalization. MACE, acute heart failure and cardiac death are noticed.A total of 327 participants are enrolled in the study. MACE occurred in 89 patients (27.2%) for a mean follow-up of 16.9 months. During follow-up, 24 patients (7.3%) died of cardiac causes, 35 (10.7%) had a new-onset myocardial infarction, and 30 (9.2%) were hospitalized for acute heart failure. For GV >2.70 mmol/L, a Synergy between PCI with Taxus and Cardiac Surgery (SYNTAX) score >34, and reduced left ventricular ejection fraction of <40% were independent predictors of MACE, with odds ratios (ORs) of 2.21 (95% CI 1.64–2.98; $P < 0.001$), 1.88 (1.26–2.82; $P = 0.002$), and 1.71 (1.14–2.54; $P = 0.009$), respectively, whereas a GRACE risk score >140 was not (OR 1.07 [0.77–1.49]; $P = 0.69$). It was concluded that a GV cutoff value of >2.70 mmol/L was the strongest independent predictive factor for midterm MACE in patients with diabetes and ACS.

Huiqin Li et al[8] **(2018),**conducted a study in 76 patients in which the association between "blood glucose fluctuation and GRACE score" were determined. The study results revealed abnormal glucose metabolism in 52 patients. Among them, low risk, moderate risk and the high-risk group were identified in 8 patients, 19 patients and 25 patients. Out of 24 patients with normal glucose metabolism, low risk, moderate risk and the high-risk group were observed in 6 patients, 6 patients and 12 patients. Among the patients of ACS, the prevalence of "abnormal glucose metabolism" was high. The study concluded that moderate and high GRACE risk scores are related to high blood glucose fluctuation.

Md Mesbahul Islam et al[55]**(2018),**conducted a study to assess whether the inclusion of admission blood glucose with GRACE risk score can improve the risk stratification of ACS patients admitted in a tertiary hospital of Bangladesh. A cross-sectional comparative study was the study design. A total of 249 cases of ACS patients were selected. Majority of the participants belonged to 5th and 6th decades 25.3% vs 37.3% and 55.7±11.7 years was the mean age. Most of the patients were male. High GRACE risk score (>=155) and elevated admission blood sugar (>=11) was found significantly higher in-hospital death. Test of validity showed a sensitivity of GRACE risk score regarding in-hospital death was 85.29%, specificity 57.7%, accuracy 61.4%, positive and negative predictive values were 24.2% and 96.1% respectively. The sensitivity of GRACE risk score + admission blood sugar regarding in-hospital death was 85.29%, specificity 62.33%, accuracy 65.46%, positive and negative predictive values were 26.36% and 96.4% respectively. "The sensitivity and specificity of GRACE score for predicting in-hospital death were found to be 79.4% and 58.1%, respectively. Whereas after adding admission blood sugar value to GRACE score, both the sensitivity and specificity increased to 82.4% and 58.6% respectively." The study concluded

that in patients with acute coronary syndrome, the blood glucose level at the time of admission can add prognostic information to the established risk factors.

H Takahashi et al[57] **(2018),** conducted a study in 417 patients to determine the relationship between GV and prognosis in patients with ACS. All patients underwent calculation of the global registry of coronary events (GRACE) score. GRACE score >140 was found in 47% of subjects in low MAGE group and 58% in the high MAGE group. The groups were followed up for a median of 39 months [IQR 24–50 months]. The primary endpoint was the incidence of MACCE. During follow-up, 66 patients experienced MACCE (5 patients had cardiovascular death, 14 had a recurrence of ACS, 27 had angina requiring revascularization, 8 had acute decompensated heart failure, and 16 had a stroke). MACCE was more frequently observed in the high MAGE group. In multivariate analysis, high MAGE was an independent predictive factor of poor prognosis for MACCE. This study concluded that glycemic variability determined with a CGMS is a predictor of prognosis in patients with ACS without severe DM.

J Xia et al[59] **(2017),**conducted a study in 864 patients in which the relationship between the glycemic variability and MACCE in ACS was concluded. A 30-day incidence of MACCE is considered as the primary endpoint. The study results revealed that 15.2% of participants in the high glycemic variability group showed primary endpoint, whereas 9.7% in low glycemic variability group. The incidence of AF in both the groups during the hospital stay was identified with 14.5% and 8.9% respectively. The duration of hospital stay was high in H group as compared to the L group. The study concluded the correlation between blood glucose variability and incidence of MACCE.

A Timóteo et al[58] **(2014),** conducted a study to determine the association between the blood glucose at the time of admission with a grace risk score. 64±13 years was the mean age of the study population. Majority of the participants were males with 69%. ST-segment elevation ACS and Killip class ≥ 2 were identified with 55.1% and 13.1% respectively. In-hospital mortality and one year follow up mortality was 5.8% and 9.7% respectively. One-year mortality identified in the hyperglycemia group was 17.2%. The study concluded that the blood glucose level at the time of admission can be considered as an independent predictor of mortality in the medium-term follow-up.

S Chattopadhyay et al[52] **(2018),** investigated whether 2 h post-load plasma glucose (2h-PG) could improve GRACE risk score (GRS) based prognostic models in ACE patients without known diabetes mellitus (DM). A retrospective cohort study of 1056 ACE survivors without known DM who had fasting plasma glucose (FPG) and 2h-PG measured pre-discharge. GRS for discharge to 6 months was calculated. During 40.8 months follow-up, 235 MACEs (22.3%) occurred, more frequently in the upper 2h-PG quartiles. Two-hour PG, but not FPG, adjusted for GRS independently predicted MACE (hazard ratio 1.091, 95% confidence interval 1.043–1.142; $P = 0.0002$). Likelihood ratio test showed that 2h-PG significantly improved the prognostic models, including GRS ($\chi 2 = 20.56$, 1 df; $P = 0.000$). Models containing GRS and 2h-PG yielded lowest corrected Akaike's information criteria, compared to that with only GRS. 2h-PG, when added to GRS, improved net reclassification significantly (NRIe>0 6.4%, NRIne>0 24%, NRI>0 0.176; $P = 0.017$ at final follow-up). Two-hour PG improved integrated discrimination of models containing GRS (IDI of 0.87%, $P = 0.008$ at final follow-up). Two-hour PG, but not FPG, improve the predictability of prognostic models containing GRS.

Xiao-Jun Liu et al[60] **(2015)**, conducted a study in 549 patients in which the role of MACEs with the GRACE score in patients with ACS was determined. The study results revealed that 12.9% was identified with MACs. All-cause mortality was 9.6%, and nonfatal infarction was identified in 3.4% cases. There was a positive correlation identified between the GRACE score and HbA1c content. The risk of MACEs was increased with increasing content of HbA1c. The study concluded the association between HbA1c content and GRACE score.

J Kuhl et al[61] **(2015),** performed a study in 1062 patients to determine the influence of glucose tolerance in patients with ACS. There was an increased ($p < 0.001$) mortality identified in known diabetes cases as compared to the other groups. Reinfarction was identified in 28% of cases with known diabetes whereas, 15% in NGT and 17% in dysglycemia during the period of follow up. Around 72% of participants admitted for acute coronary syndrome had disturbed glucose metabolism. The study concluded that the clinical prognosis is poor in ACS patients with diabetes mellitus and dysglycaemia.

G Su et al[56] **(2013),** conducted a study in 186 patients to determine the prognostic value of in-hospital glycemic excursion and HbA1c for a period of a one-year major adverse cardiac event in AMI patients. There was an association identified between increased MAGE level and GRACE score. The rate of MACE by MAGE tertiles were 30.2%, 14.8%, 8.1% respectively. In elderly patients with a higher MAGE level identified with increased cardiac mortality. The study concluded the predictors of mortality in AMI patients.

R Giraldez et al[62] **(2013),** examined the prevalence of undiagnosed diabetes or prediabetes and associations with ischemic outcomes among non–ST-segment elevation acute coronary syndrome (ACS) patients. 8795 EARLY ACS trial patients were categorized into one of the following groups: “known diabetes” (n = 2860 [32.5%]; reported on the case report form),

"undiagnosed diabetes" (n = 1069 [12.2%]; no diabetes history and fasting glucose ≥126 mg/dL or hemoglobin A1c ≥6.5%), "prediabetes" (n = 947 [10.8%]; fasting glucose ≥110 to <126 mg/dL, or "normal" (n = 3919 [44.5%]). Adjusted associations of known diabetes, undiagnosed diabetes, and prediabetes (versus normal) with 30-day and 1-year outcomes were determined. Undiagnosed DM was related with higher 30-day death or myocardial infarction (MI) (ORadj 1.28, 95% CI 1.05-1.57), driven primarily by greater 30-day mortality (ORadj 1.65, 95% CI 1.09-2.48). Known diabetic patients had 30-day death or MI outcomes similar to those of normal patients, but 30-day mortality was higher (ORadj 1.40, 95% CI 1.01-1.93). Prediabetic patients had 30-day death or MI outcomes similar to those of normal patients. One-year mortality was greater among known diabetic patients (HRadj 1.38, 95% CI 1.13-1.67) but not among those with undiagnosed diabetes or prediabetes. The study concluded that undiagnosed diabetes and prediabetes were common among high-risk non–ST-segment elevation ACS patients. Routine screening for undiagnosed diabetes may be useful since these patients seem to have worse short-term outcomes and deserve consideration of alternative management strategies.

K Tamita et al[40](2012), conducted a study to assess the long-term clinical cardiovascular outcomes in AMI patients with abnormal FBS. A prospective study was performed in 275 consecutive patients with AMI, 85 of whom had pre-diagnosed diabetes mellitus (DM). The association between the glucometabolic status and long-term major adverse cardiovascular event rates was evaluated. Kaplan–Meier survival curves indicated that the AGT group had a worse prognosis than the NGT group and an equivalent prognosis to the DM group ($p<0.0005$). Cox HR of IFG to NFG for major adverse cardiovascular event rates was 1.83 (0.86 to 3.87), which was not significant. The study concluded that AMI patients, an

abnormal OGTT, is a better risk factor for further adverse cardiovascular events than impaired fasting blood glucose.

M de Mulder et al[63] **(2011),**conducted a study to analyses if admission plasma glucose (APG) may improve risk stratification based on the GRACE risk score. Data were collected on baseline characteristics and long-term (median 55 months) outcome of 550 MI patients who entered our hospital in 2003 and 2006.GRACE risk score at admission was determined for each patient, which was entered in a logistic regression model, together with APG, to evaluate their prognostic value for 6-month and 5-year mortality. Patients with APG ≥7.8 mmol/l had a higher mortality than those with APG levels <7.8 mmol/l; 6 months: 13.7 versus 3.6%, p value <0.001; 5 years: 20.4 versus 11.1%, p value 0.003. APG appeared a significant predictor of 6-month and 5-year mortality, adjusted OR 1.17 (1.06-1.29) and 1.12 (1.03-1.22). Combining the GRACE risk score and APG reclassified 12.9% of the patients, but the net reclassification improvement was nonsignificant (p = 0.146). Their study concluded that APG is a predictor of 6-month and 5-year mortality, each mmol/l increase in APG being associated with a mortality increase of 17 and 12%, respectively, independent of the GRACE risk score.

P **Sinnaeveet al**[64] **(2009)**, studied the relationship between increased FBS levels and outcome across the spectrum of ST-segment elevation and non–ST-segment elevation acute coronary syndromes.: FBS values were noticed for 13 526 patients. A multivariate logistic regression analysis was used for assessing the association between admission or fasting glucose level and in-hospital or 6-month outcome, adjusted for the variables from the registry risk scores. Higher fasting glucose levels were associated with an increased risk of in-hospital death. When taken as a continuous variable, higher fasting glucose level was associated with a

higher probability of in-hospital death, without a detectable threshold and irrespective of whether patients had a history of diabetes mellitus. Higher fasting glucose levels were found to be related to a higher risk of post discharge death up to 6 months. The risk of post discharge death at 6 months was significantly increased with FBS values between 126 and 199 mg/dL (1.71 [1.25-2.34]) and 300 mg/dL or greater (2.93 [1.33-6.43]), but not within the 200- to 299-mg/dL range (1.08 [0.60-1.95]). The relation between fasting glucose level and risk of adverse short-term outcomes is graded across different glucose levels with no detectable threshold for diabetic or nondiabetic patients.

LACUNAE OF LITERATURE:

There are several observational studies demonstrating that hyperglycemia in ACS is a powerful predictor of survival. The GRACE risk score was developed and validated for patients with ACS, with the aim of guiding the triage and early management of ACS. Abnormal glucose metabolism increases the risk of immediate and long-term complications in ACS patients both with and without previously known diabetes mellitus. This adversely affects prognosis in ACS and associated with less favorable clinical outcomes. It is relatively not known how these blood glucose fluctuations among "patients with abnormal glucose metabolism affect GRACE score". This study is an attempt to bridge this gap as knowing the effect of glucose fluctuations on GRACE score can help optimally manage ACS patients during admission and after the discharge.

MATERIALS AND METHODS

MATERIALS AND METHODS:

Study site: This study was conducted in the department of General Medicine at RL JALAPPA HOSPITAL and NH HOSPITAL

Study population:"Patients with Acute Coronary Syndrome and abnormal glucose metabolism in General Medicine department at RL JALAPPA HOSPITAL and NH HOSPITALwere considered as study population".

Based on the GRACE risk score, they were divided into low risk, moderate risk and high risk.

Study design: The current study is a Prospective Cohort study

Sample size: The sample size for the study is estimated by keeping the fluctuation change between high risk and low risk group to be 1.85 with SD of 0.45 as per the study by Huiqin Li et al.,[65] And other parameters for sample size calculation was 95% Confidence Interval and the formula used for the sample size calculation was below.[66]

$$N = \frac{(u+v)^2\sigma^2}{(\mu - \mu_0)^2}$$

N	Sample Size
$\mu-\mu_0$	Difference between the means, $\mu_1$and null hypothesis value μ_0
σ	Standard deviations
u	one-sided percentage point of the normal distribution corresponding to 100 % – the power e.g. if power = 90%, u = 1.28, If the power is = 80%, u =0.84
v	Percentage point of the normal distribution corresponding to the (two-sided) significance level e.g. if significance level = 5%, v = 1.96

According to the above calculations the required number of subjects in to the stud was 70. Considering the 10% lost to follow- up 7 more subjects were added to the final subjects and hence the minimum required sample was 77 subjects.

Sampling method: All the eligible subjects were recruited into the study consecutively by convenient sampling till the sample size is reached.

Study duration: The data collection for the study was done between January 2019 to June 2020 for a period of 18 months.

Inclusion Criteria:

1. Patients who had unstable angina pectoris.
2. Patients who had ST elevated MI.
3. Patients who had non-ST elevated MI.
4. "Patients who had a history of diabetes."
5. Patients who were newly diagnosed as diabetes.
6. Patients who had impaired glucose tolerance.

Exclusion criteria:

1. Patients who had a history of mental illness and are not suitable for using CGMS.

Ethical considerations: Study was approved by the institutional human ethics committee. Informed written consent was obtained from all the study participants, and only those participants willing to sign the informed consent were included in the study. The risks and benefits involved in the study and the voluntary nature of participation were explained to the participants before obtaining consent. Confidentiality of the study participants was maintained.

Data collection tools: All the relevant parameters were documented in a structured study proforma.

Methodology:

Patients with abnormal glucose metabolism include

1. Patients who had a history of diabetes,
2. Newly diagnosed patients with HbA1C >/=6.5%.
3. Patients who had glucose intolerance with HbA1C 5.7 -6.4%

INVESTIGATIONS :

ECG

Urea nitrogen

Creatinine

HbA1c

Haemoglobin

CK MB

Uric acid

Triglycerides

Cholesterol

HDL

LDL

BLOOD GLUCOSE LEVELS FOR 72 HOURS USING CGMS

A continuous glucose monitoring system (CGMS) was used to real-time monitor blood glucose for 72 hrs after the patient was admitted into CCU.

Using CGMS 24 hours of mean blood glucose was measured.

“The GRACE risk score was the sum of eight quantified parameters including age, heart rate, systolic blood pressure, creatinine level, heart failure (Killip class), elevated cardiac enzymes, ST-segment elevation, and cardiac arrest at admission”.

"By giving a score based on each of the parameters, we can make a risk score which was useful for making predictions on in-hospital mortality and risk of death within 6 months after discharge from the hospital, the long-term prognosis".

Statistical methods:

24 hours mean blood glucose (mmol/l) was considered as the primary outcome variable. Grace risk score group was considered as Primary Explanatory Variables. Age, gender, pulse (per minute) etc., were considered as Other explanatory variables.

Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency, and proportion for categorical variables. Data was also represented using appropriate diagrams like bar diagram & pie diagrams.

All the quantitative parameters will be checking the normal distribution within each category. A shapiro- wilk's test ($p>0.05$) and a visual inspection of their histograms, normal Q-Q plots and box plots showed that the 24 hours mean blood glucose (mmol/l) parameter were non-normally distributed.

The comparison between and 24 hours mean blood glucose (mmol/l) and Grace risk score grouping was assessed by comparing the median values. Kruskal Wallis test was used to assess statistical significance.

Association between quantitative explanatory and outcome variables was assessed by calculating the Spearman correlation coefficient, and the data was represented in a scatter diagram.

P value < 0.05 was considered statistically significant. IBM SPSS version 22 was used for statistical analysis.[67]

OBSERVATIONS

AND

RESULTS

Result:

A total of 77 subjects were included in the final analysis.

Table 1: Descriptive analysis of age in study population (n=77)

Parameter	Mean ± SD	Median	Minimum	Maximum	95% C. I	
					Lower	Upper
Age	52.31 ± 7.9	52.00	41.00	76.00	50.52	54.11

The mean age was 52.31 ± 7.9 in the study population, minimum and maximum were 41 and 76 in the study population with (95% C. I from 50.52 to 54.11). (Table 1)

Table 2: Descriptive analysis of gender in the study population (n=77)

Gender	Frequency	Percentages
Male	57	74%
Female	20	26%

Among the study population, 57 (74%) were male, and 20 (26%) were female. (Table 2 & Figure 1)

Figure 1: Bar chart of gender in the study population (n=77)

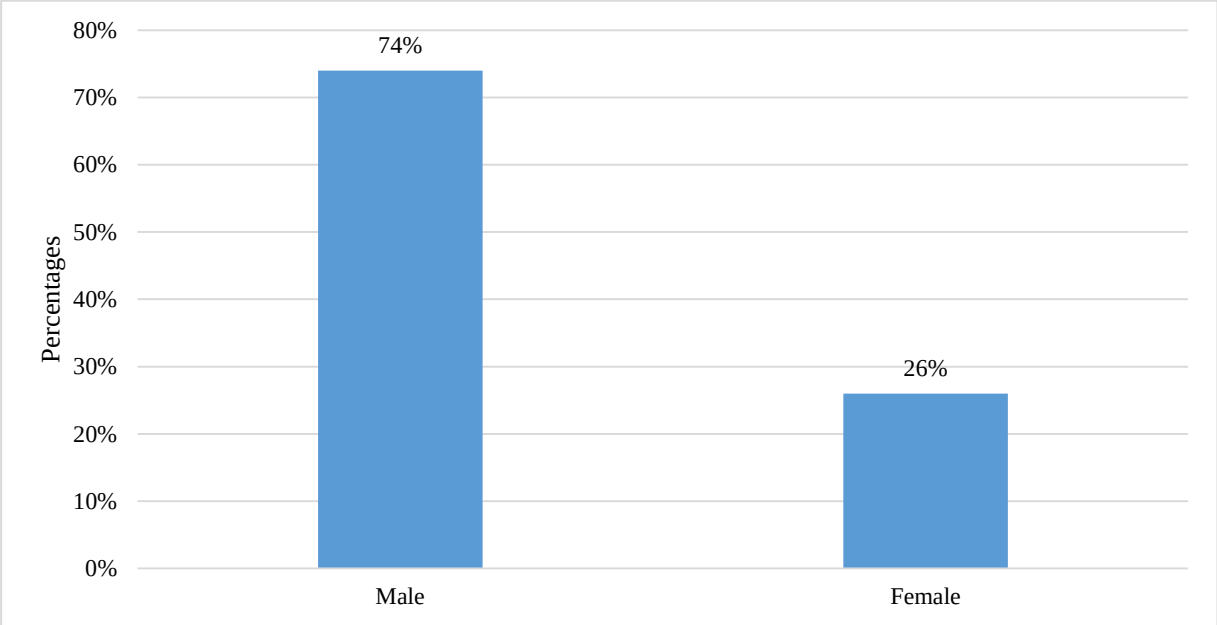

Table 3: Descriptive analysis of pulse (per minute) in the study population (n=77)

Parameter	Mean ± SD	Median	Minimum	Maximum	95% C. I	
					Lower	Upper
Pulse (Per Minute)	89.29 ± 16.83	84.00	68.00	150.00	85.46	93.11

The mean Pulse (per minute) was 89.29 ± 16.83 in the study population, minimum and maximum were 68 and 150 in the study population with (95% C. I from 85.46 to 93.11). (Table 3)

Table 4: Descriptive analysis of systolic blood pressure (in mm) in the study population (n=77)

Parameter	Mean ± SD	Median	Minimum	Maximum	95% CI	
					Lower	Upper
Systolic Blood Pressure (In Mm)	125.06±12.85	130.00	100.00	160.00	122.15	127.98

The mean Systolic Blood Pressure (in mm) was 125.06 ± 12.85 in the study population, minimum and maximum was 100 and 160 in the study population with (95% C. I from 122.15 to 127.98). (Table 4)

Table 5: Descriptive analysis of serum creatinine (in mg/dl) in the study population (n=77)

Parameter	Mean ± SD	Median	Minimum	Maximum	95% C. I	
					Lower	Upper
Serum Creatinine (In Mg/Dl)	1.35 ± 0.82	1.30	0.20	5.00	1.16	1.54

The mean Serum Creatinine (In mg/dl) was 1.35 ± 0.82 in the study population, minimum and maximum was 0.20 and 5.00 in the study population with (95% C. I from 1.16 to 1.54). (Table 5)

Table 6: Descriptive analysis of Killip'sclass in the study population (n=77)

Killip Class	Frequency	Percentages
Class 1	28	36.36%
Class 2	45	58.44%
Class 3	4	5.19%

Among the study population, 28 (36.36%) were in Class 1, 45 (58.44%) were in Class 2, and 4 (5.19%) were in class 3. (Tale 6 & Figure 2)

Figure 2: Pie chart of Killip'sclass in the study population (n=77)

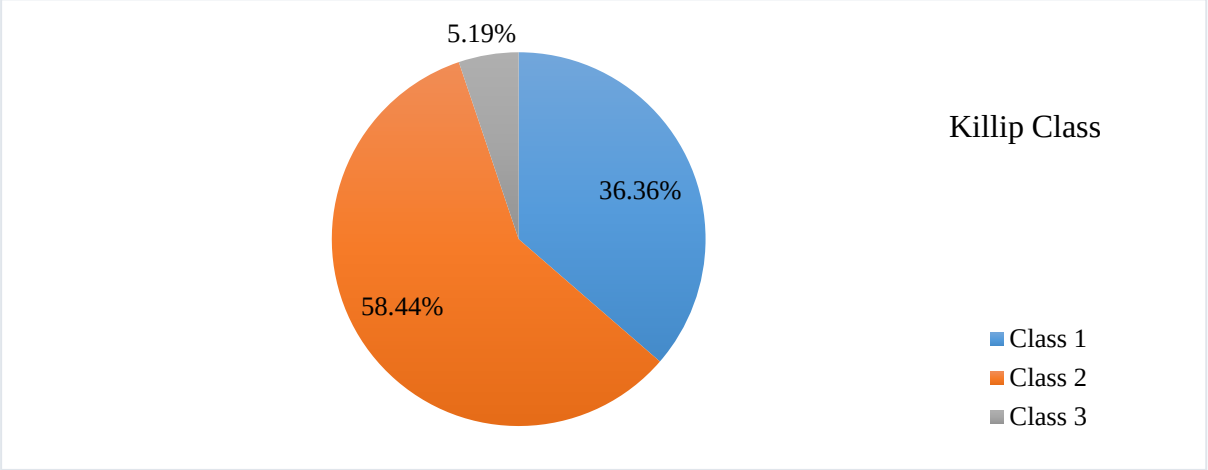

Table 7: Descriptive analysis of other risk factors in the study population (n=77)

Other Risk Factors	Frequency	Percentages
Elevated Cardiac Enzymes	43	55.84%
ST Deviation	34	44.16%

Among the study population, 43 (55.84%) were in Elevated Cardiac Enzymes, and 34 (44.16%) were in ST Deviation. (Table 7 & Figure 3)

Figure 3: Bar chart of other risk factors in the study population (n=77)

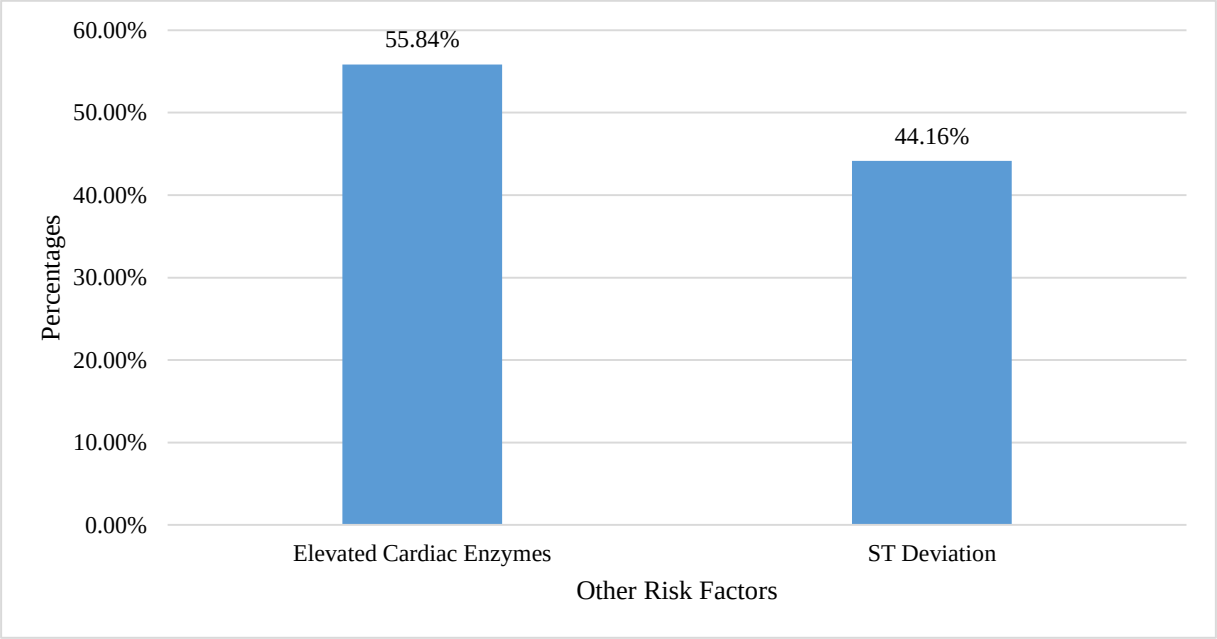

Table 8: Descriptive analysis of grace risk score in the study population (n=77)

Parameter	Mean ± SD	Median	Minimum	Maximum	95% C. I	
					Lower	Upper
Grace Risk Score	129.35 ± 31.15	122.00	84.00	211.00	122.28	136.42

The mean Grace risk score was 129.35 ± 31.15 in the study population, minimum and maximum were 84 and 211 in the study population with (95% C. I from 122.28 to 136.42). (Table 8)

Table 9: Descriptive analysis of grace risk score grouping in the study population (n=77)

Grace Risk Score Grouping	Frequency	Percentages
Low Risk	26	33.77%
Moderate Risk	24	31.17%
High Risk	27	35.06%

Among the study population, 26 (33.77%) were at low risk, 24 (31.17%) were at moderate risk, and 27 (35.06%) were at high risk. (Table 9 & Figure 4)

Figure 4: Pie chart of grace risk score grouping in the study population (n=77)

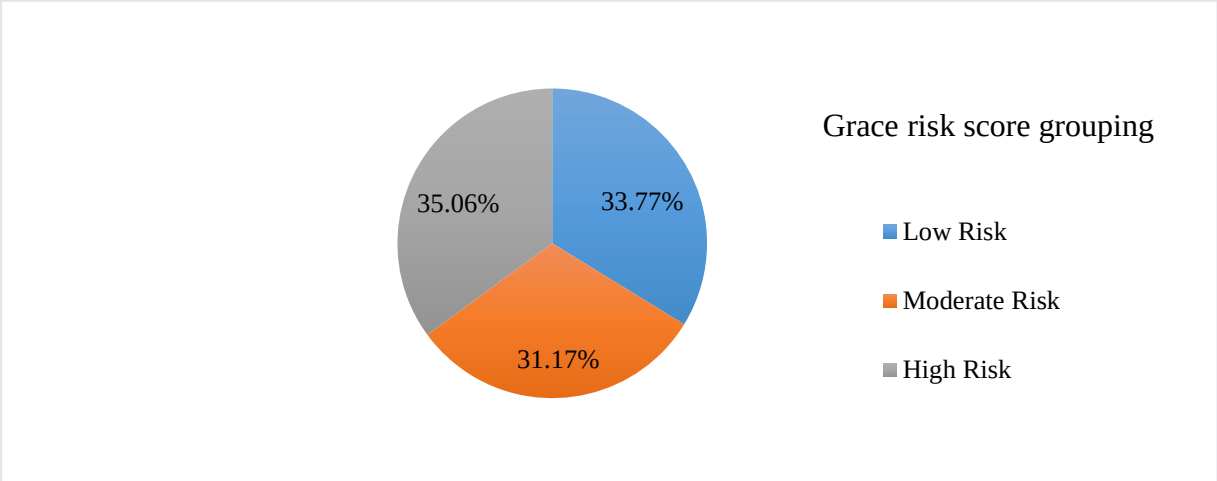

Table 10: Descriptive analysis of 24 hours mean blood glucose (mmol/l) in the study population (n=77)

Parameter	Mean ± SD	Median	Minimum	Maximum	95% C. I	
					Lower	Upper
24 Hours Mean Blood Glucose (Mmol/L)	9.67 ± 3.28	9.10	5.11	21.00	8.92	10.41

The mean 24 Hours Mean Blood Glucose (mmol/l) was 9.67 ± 3.28 in the study population, minimum and maximum were 5.11 to 21.00 in the study population with (95% C. I from 8.92 to 10.41). (Table 10)

Table 11: Descriptive analysis of hypertension in the study population (n=77)

Hypertension	Frequency	Percentages
Yes	59	76.62%
No	18	23.38%

Among the study population, 59 (76.62%) had hypertension. (Table 11 & Figure 5)

Figure 5: Bar chart of hypertension in the study population (n=77)

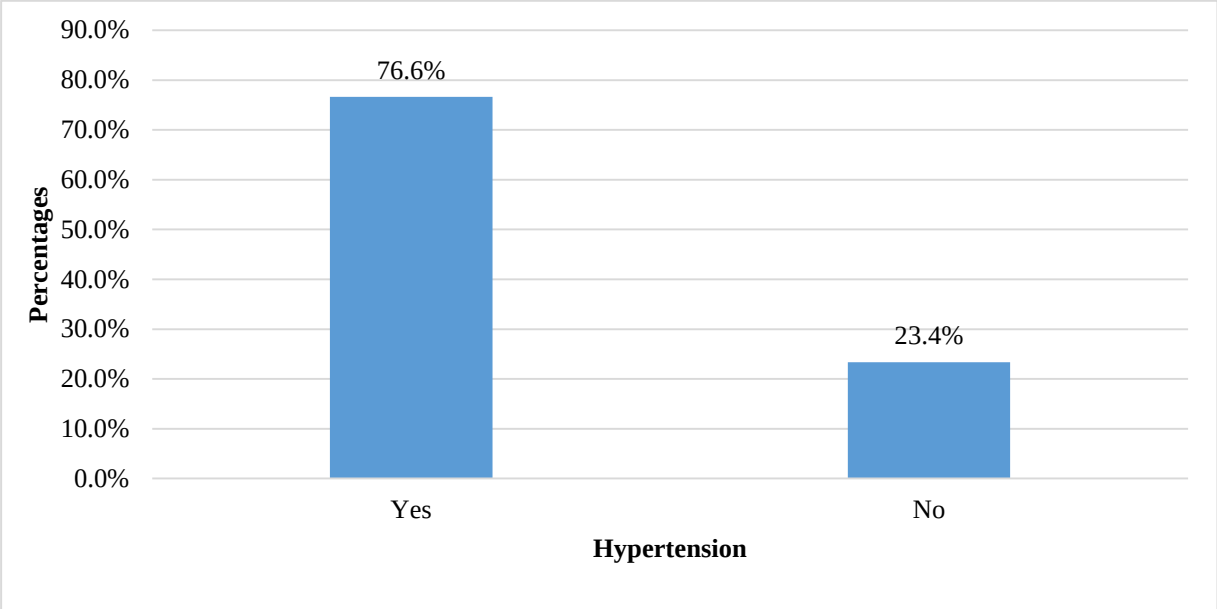

Table 12: Descriptive analysis of smoking in the study population (n=77)

Parameter	Frequency	Percentages
Smoking		
Yes	53	68.83%
No	24	31.17%
Alcohol		
Yes	39	50.65%
No	38	49.35%

Among the study population, 53 (68.83%) were smoking, and 39 (50.65%) consumed alcohol.

(Table 12 & Figure 6, 7)

Figure 6: Bar chart of smoking in the study population (n=77)

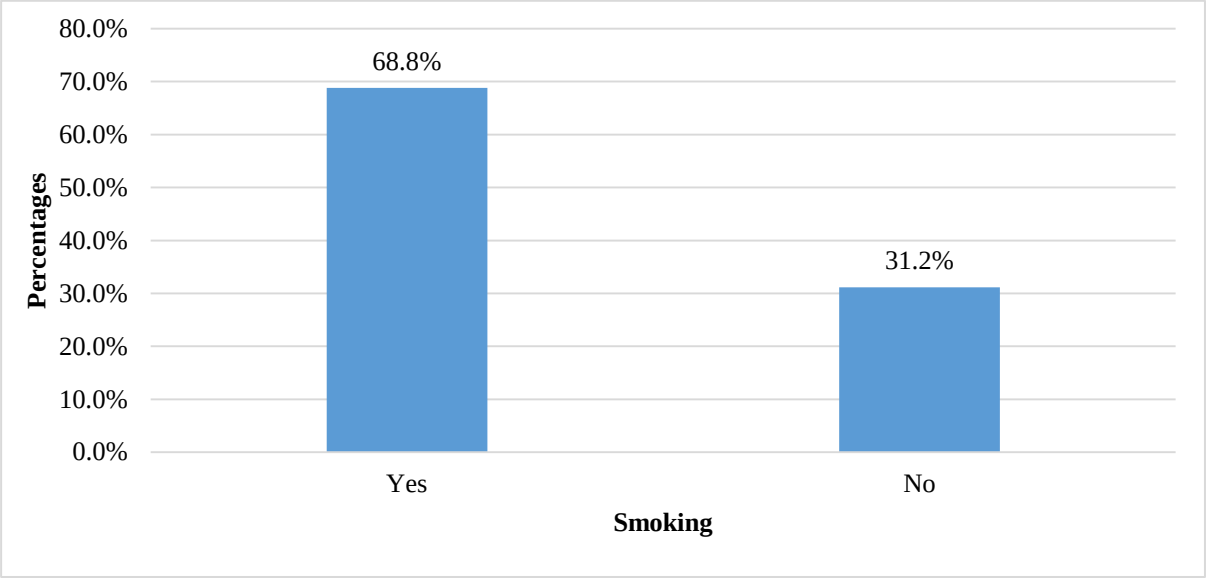

Figure 7: Bar chart of alcohol in the study population (n=77)

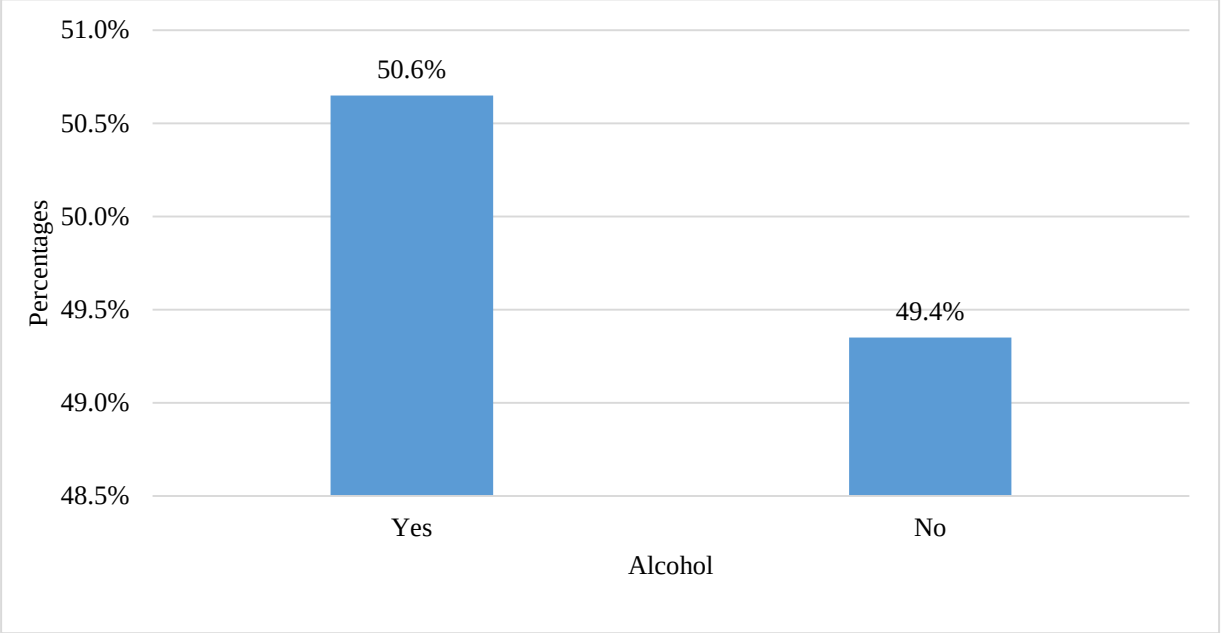

Table 13: Descriptive analysis of dyspnoea&chest pain in the study population (n=77)

Parameter	Frequency	Percentages
Dyspnoea		
Yes	70	90.91%
No	7	9.09%
Chest Pain		
Yes	74	96.10%
No	3	3.90%

Among the study population, 70 (90.91%) had Dyspnoea, and 74 (96.10%) had chest pain. (Table 13 & Figure 8, 9)

Figure 8: Bar chart of dyspnoea in the study population (n=77)

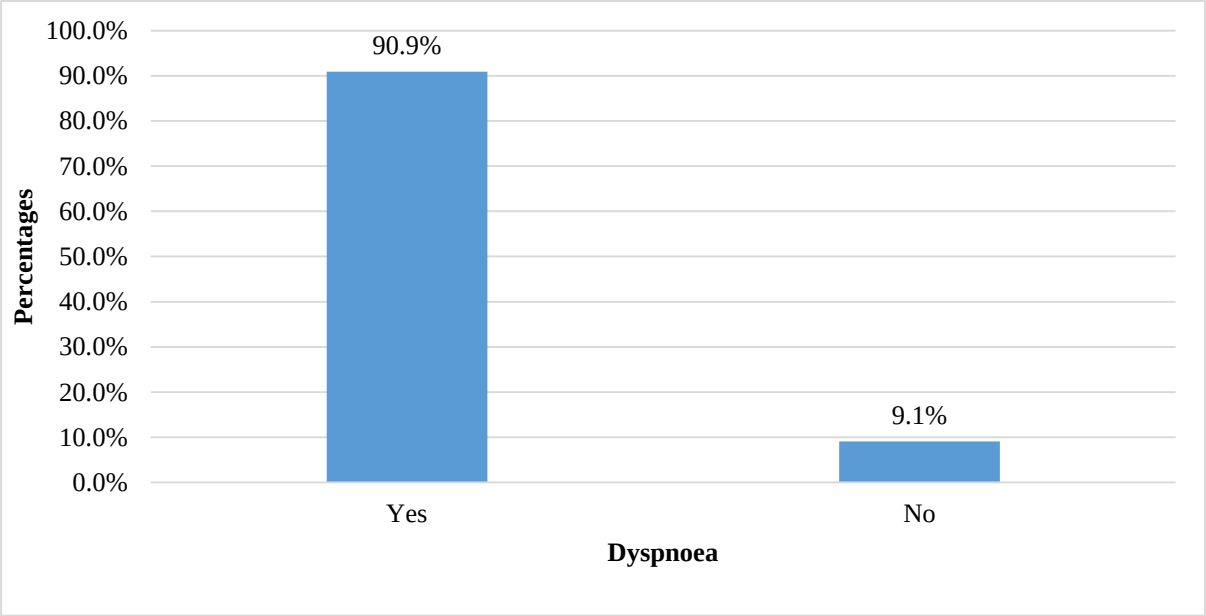

Figure 9: Bar chart of chest pain in the study population (n=77)

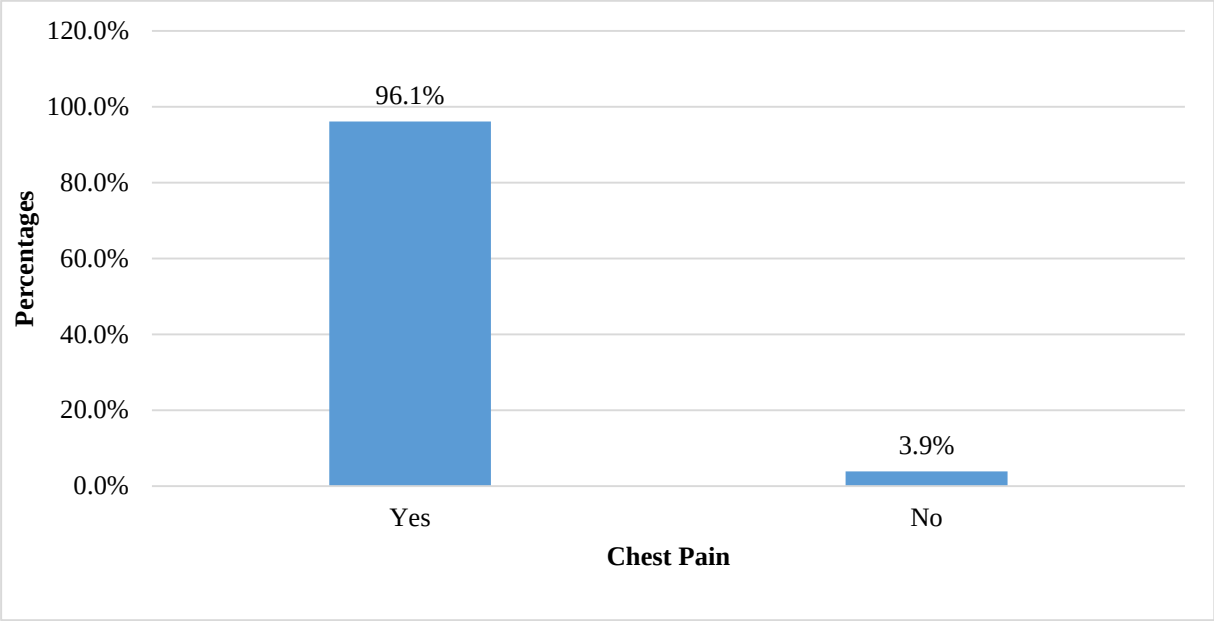

Table 14: Descriptive analysis of body mass index in the study population (n=77)

Parameter	Mean ± SD	Median	Minimum	Maximum	95% C. I	
					Lower	Upper
Body Mass Index	22.22 ± 1.36	22.00	19.00	26.00	21.91	22.53

The mean Body Mass Index was 22.22 ± 1.36 in the study population, minimum and maximum were 19 and 26 in the study population with (95% C. I from 21.91 to 22.53). (Table 14)

Table 15: Descriptive analysis of clinical parameters in the study population (n=77)

Clinical Parameters	Mean ± SD	Median	Minimum	Maximum	95% C. I	
					Lower	Upper
Blood Urea	37.4 ± 12.59	34.0	19.0	92.00	34.55	40.26
Hba1C	7.82 ± 1.99	7.6	5.1	14.90	7.37	8.27
Hemoglobin	11.58 ± 1.69	12.0	8.0	15.00	11.20	11.96
Total Leucocyte Count	15.5 ± 2.57	14.32	11.20	22.00	14.92	16.09
Creatinine Kinase MB	6.55 ± 3.05	5.0	2.0	11.52	5.86	7.25
TROPONIN I	1.49 ± 3.62	0.72	0.12	21.02	0.67	2.31
Uric Acid	3.82 ± 0.91	4.2	0.3	6.00	3.62	4.03
Triglycerides	261.62±57.53	266	140.0	450.0	248.57	274.68
Cholesterol	220.81±33.65	220	152.0	292.0	213.17	228.44
High Density Cholesterol	43.7 ± 7.21	42.0	25.0	72.0	42.06	45.34
Low Density Cholesterol	111.4 ± 53.76	92.0	36.0	222.0	99.2	123.6

The mean Blood Urea was 37.4 ± 12.59 in the study population, minimum and maximum were 19 and 92 in the study population with (95% C. I from 34.55 to 40.26).The mean Hba1C was 7.82 ± 1.99 in the study population, minimum and maximum were 5.10 and 14.90 in the study population with (95% C. I from 7.37 to 8.27). The mean Hemoglobin was 11.58 ± 1.69 in the study population, minimum and maximum were 8 and 15 in the study population with (95% C. I from 11.20 to 11.96).The mean Total Leucocyte Count was 15.5 ± 2.57 in the study population, minimum and maximum were 11.20 and 22 in the study population with (95% C. I from 14.92 to 16.09).The mean Creatinine Kinase MB was 6.55 ± 3.05 in the study population, minimum and maximum were 2 and 11.52 in the study population with (95% C. I from 5.86 to 7.25).The mean TROPONIN I was 1.49 ± 3.62 in the study population, minimum and maximum was 0.12 and 21.02 in the study population with (95% C. I from 0.67 to 2.31).The mean Uric acid was 3.82 ± 0.91 in the study population, minimum and maximum

was 0.30 and 6 in the study population with (95% C. I from 3.62 to 4.03).The mean Triglycerides was 261.62 ± 57.53 in the study population, minimum and maximum were 140 and 450 in the study population with (95% C. I from 248.57 to 274.68).The mean Cholesterol was 220.81 ± 33.65 in the study population, minimum and maximum were 152 and 292 in the study population with (95% C. I from 213.17 to 228.44).The High-Density Cholesterol was 43.7 ± 7.21 in the study population, minimum and maximum were 25 and 72 in the study population with (95% C. I from 42.06 to 45.34).The Low-Density Cholesterol was 111.4 ± 53.76 in the study population, minimum and maximum were 36 and 222 in the study population with (95% C. I from 99.20 to 123.60). (Table 15)

Table 16: Comparison of median 24 hours mean blood glucose (mmol/l) across different grace risk score grouping in the study population (n=77)

Grace Risk Score grouping	24 hours mean blood glucose (mmol/l)Median (IQR)	Kruskal Wallis test (P value)
Low risk (N=26)	6.32 (6.03 to 8.5)	<0.001
Moderate risk (N=24)	9.08 (7.983 to 9.93)	
High risk (N=27)	11.3 (10.16 to 13.8)	

The median 24 hours mean blood glucose (mmol/l) was 6.32 (IQR 6.03 to 8.5) in Low risk, it was 9.08 (IQR 7.983 to 9.93) and 11.3 (IQR 10.16 to 13.8) in moderate and high risk respectively. The difference in Grace risk score groups and 24 hours mean blood glucose (mmol/l) was statistically significant. (P value<0.05) (Table 16 & Figure 10)

Figure 10: Line chart of 24 hours mean blood glucose (mmol/l) across different grace risk score grouping in the study population (n=77)

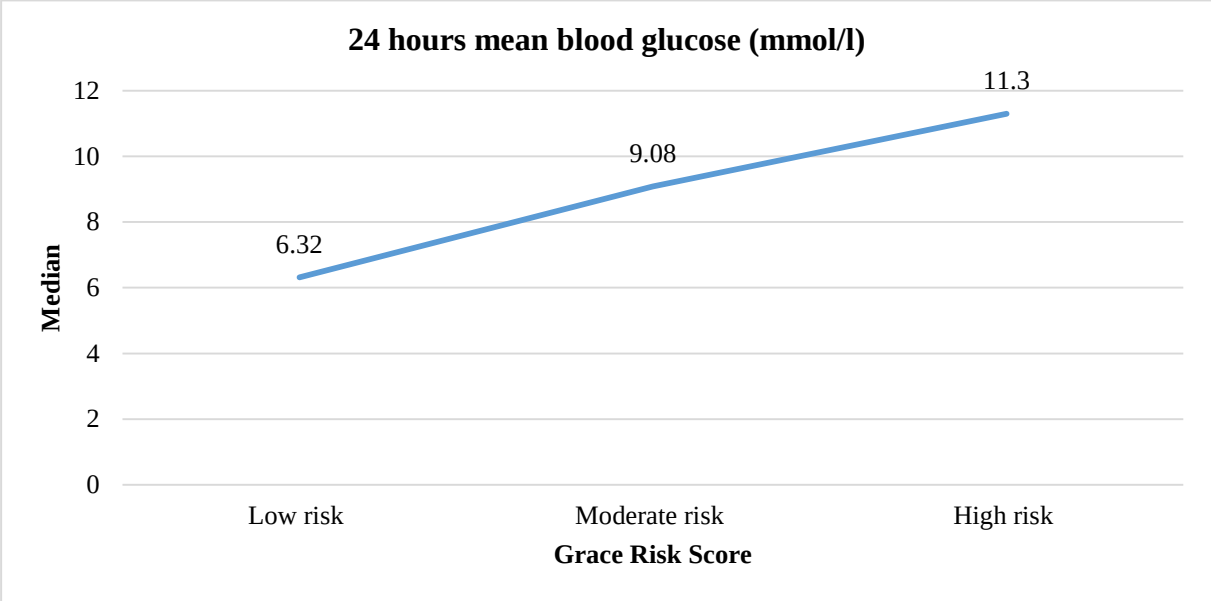

Table 17: Intragroup comparisons of grace risk score groups with 24 hours mean blood glucose (n=77)

Variable name	Low vs moderate risk	Moderate vs high risk	Low vs high risk
P value	<0.001	<0.001	<0.001

There was a statisticall significant difference in low vs moderate risk, moderate vs high risk and low vs high risk with (P value <0.001).

Table 18: Correlation between grace risk score and 24 hours mean blood glucose (mmol/l) in the study population (n=77)

Parameter	Spearman correlation (Rs)	P value
Grace risk score vs 24 hours mean blood glucose (mmol/l)	0.698	<0.001

There was a moderate positive correlation between Grace risk score and 24 hours mean blood glucose (rs value: 0.068, P value: <0.001). (Table 18 & Figure 11)

Figure 11: Scatter plot between grace risk score and 24 hours mean blood glucose (mmol/l) in the study population (n=77)

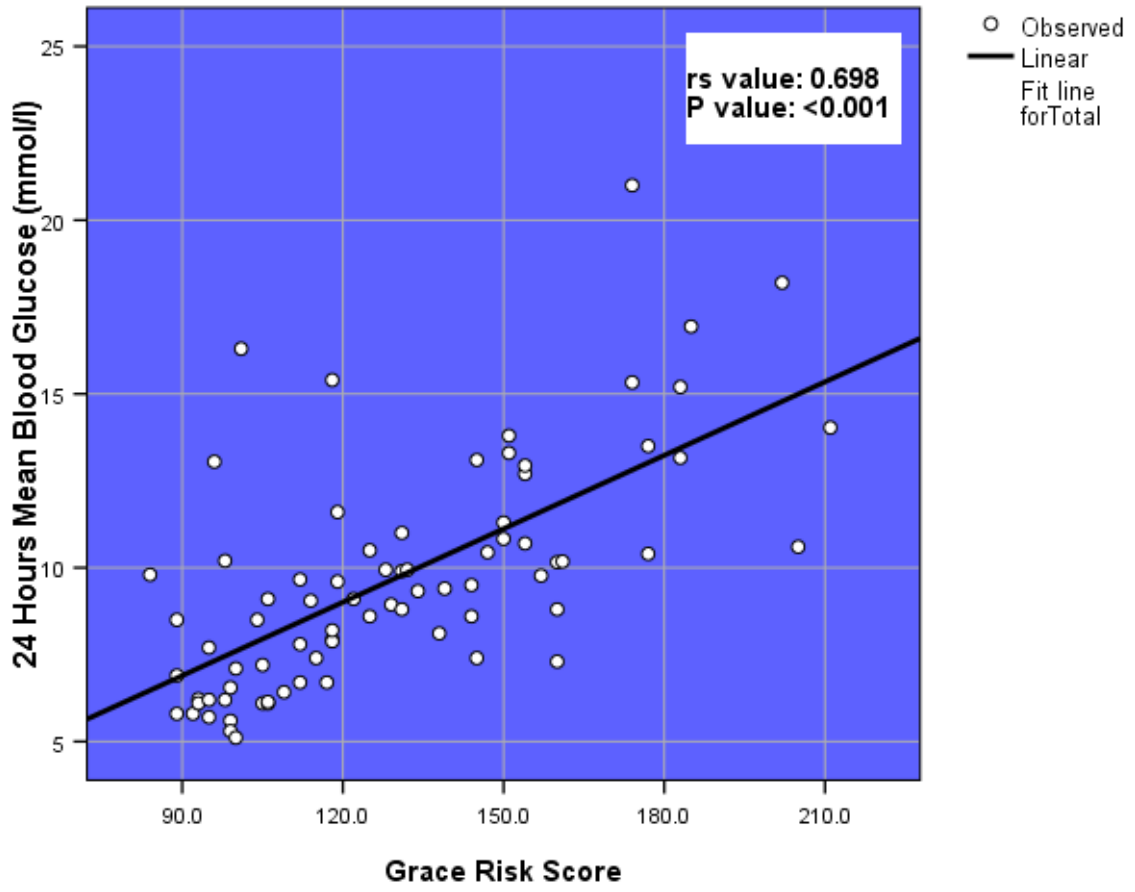

Table 19: Descriptive analysis of grace risk score system in different demographic and clinical parameters (n=77)

Parameters	Low Risk (n=26)	Moderate Risk (n=24)	High Risk (n= 27)
Age groups (in years)			
<50	23 (88.5%)	6 (25%)	4 (14.8%)
50-60	3 (11.5%)	16 (66.7%)	12 (44.4%)
61-70	0	2 (8.3%)	8 (29.6%)
>70	0	0	3 (11.1%)
Pulse rate groups (in minutes)			
<70	2 (7.7%)	0	0
70-80	13 (50%)	9 (37.5%)	0
81-90	10 (38.5%)	8 (33.3%)	3 (11.1%)
91-100	1 (3.8%)	7 (29.2%)	8 (29.6%)
101-110	0	0	7 (25.9%)
111-120	0	0	6 (22.2%)
121-130	0	0	2 (7.4%)
131-140	0	0	0
>140	0	0	1 (3.7%)
Systolic Blood Pressure (in mm)			
<110	5 (19.2%)	6 (25%)	10 (37%)
110-120	2 (7.7%)	2(8.3%)	5 (18.5%)
121-130	12 (46.2%)	10 (41.7%)	9 (33.3%)
131-140	5 (19.2%)	5 (20.8%)	2 (7.4%)
141-150	2 (7.7%)	0	1 (3.7%)
>150	0	1 (4.2%)	0
Serum Creatinine (mg/dl)			
<1	17 (65.4%)	10 (41.7%)	3 (11.1%)
1-1.99	8 (30.8%)	14 (58.3%)	18 (66.7%)
2-2.99	0	0	4 (14.8%)

3-3.99	0	0	1 (3.7%)
>3.99	1 (3.8%)	0	1 (3.7%)
Killip class			
I	18 (69.2%)	10 (41.7%)	0
II	8 (30.8%)	14 (58.3%)	23 (85.2%)
III	0	0	4 (14.8%)
IV	0	0	0
Other Risk Factors			
Elevated Cardiac Enzymes	24 (92.3%)	14(58.3%)	5(18.5%)
ST Deviation	2 (7.7%)	10 (41.7%)	22 (81.5%)

**No test is applied due to zero subjects in the cells.*

Among the low risk in the study population, 23 (88.5%) were aged <50 years, 13 (50%) had pulse rate (in minutes) in the range 70-80, 12 (46.2%) had Systolic Blood Pressure (in mm) in the range 121-130, 17 (65.4%) had serum creatinine (mg/dl) <1, 18 (69.2%) were in Killip Class I and 24 (92.3) had Elevated Cardiac Enzymes in Other Risk Factors.Among the moderate risk in the study population, 16 (66.7%) were aged between 50-60 years, 9 (37.5%) had pulse rate (in minutes) in the range 70-80, 10 (41.7%) had Systolic Blood Pressure (in mm) in the range 121-130, 14 (58.3%) had serum creatinine (mg/dl) in the range 1-1.99, 14 (58.3%) were in Killip Class II, and 14 (58.3) had Elevated Cardiac Enzymes in Other Risk Factors.Among the high-risk in the study population, 12 (44.4%) were aged between 50-60 years, 8 (29.6%) had pulse rate (in minutes) in the range 91-100, 10 (37%) had Systolic Blood Pressure (in mm) <110, 18 (66.7%) had serum creatinine (mg/dl) in the range 1-1.99, 23 (85.2%) were in Killip Class II, and 22 (81.5) had ST Deviation in Other Risk Factors. (Table 19)

DISCUSSION

DISCUSSION:

ACS is an important global cause of death and also the major cause of morbidity and mortality in India. In Urban India, coronary heart disease prevalence in adult has increased considerably and occurred at a much younger age as compared to North America and Western Europe. The importance of glucose metabolism in acute coronary syndrome and acute myocardial infarction has been increasingly recognized. The present study was conducted to determine the association between grace risk score and glucose fluctuation in acute coronary syndrome and abnormal glucose metabolism.

A total of 77 subjects were enrolled in the study. In the present study, 52.31± 7.9 was the mean age of the study population, in a population of 2099 participants. Timoteo, AT et al[58],performed a study in which 64 ± 13 years was the mean of age in the study population.

Table 20: Comparison of the mean age in various studies.

Study	Population	Mean age ± SD
Present study	77	52.31± 7.9
Timoteo, ATet al.[58]	2099	64 ± 13
Islam, MM. et al.[55]	249	55.7±11.7

In the current study, 74% of the participants were males and 26% females. Takahashi, H., et al[57], performed a study in which 83% of the patients were males and 17% females.

Table 21: Comparison of gender prevalence in different studies.

Study	Population	Gender (%)
Present study	77	Males (74%) Females (26%)
Islam, MMet al.[55]	249	Males (73.9%) Females (26.1%)
Takahashi, Het al.[57]	417	Males (83%) Females (17%)
Timoteo, ATet al.[58]	2099	Males (69%) Females (31%)

Among the study population, 89.29± 16.83 was the mean pulse per minute observed in the participants. In 4087, participants Tscherry K., et al[68] performed a study in which 80±16 was the mean pulse rate observed in the study population.

In the current study, 125.06 ± 12.85 was the mean systolic blood pressure in the study population. Tscherry K. et al[68] conducted a study in 4087 patients in which the mean of systolic blood pressure was observed as 136±28.

In the present study, 1.35 ± 0.82 was the mean serum creatinine (mg/dl) identified in the study population.

In the current study, participants in the Killip class 1, 2 and 3 were identified with 36.36%, 58.44% and 5.19% respectively.In a population of 334 patients Gerbaud, E. et al[42], conducted a study in which 75.6% of participants were belonged to Killip score 1 whereas 14.1%, 9.1% and 1.2% were belonged to Killip score 2, 3 and 4 respectively.

Table 22: Comparison of Killip scores in various studies.

Study	Population	Killip score
Present study	77	Killip score 1 (36.36%) Killip score 2 (58.44%) Killip score 3 (5.19%)
Gerbaud, E., et al.[42]	334	Killip score 1 (75.6%) Killip score 2 (14.1%) Killip score 3 (9.1%) Killip score 4 (1.2%)
Tscherry K., et al[68]	4087	Killip score 1 (69.6%) Killip score 2 (4.5%) Killip score 3 (2%) Killip score 4 (2.8%)

In the present study, 55.84% had elevated cardiac enzymes, whereas, 44.16% had St deviation.Timoteo, AT et al[58], performed a study in 2099 patients in which 55.1% of participants were identified with ST deviation.

In the current study, 129.35 ± 31.15 was the mean grace risk score observed in the study population.Gerbaud, E et al[42], conducted a study in 334 participants in which the mean of Grace score was 135±32.

In the present study, low risk, moderate risk and high-risk groups were identified with 33.77%, 31.17% and 35.06% respectively. Li, H., et al[8], conducted a study in 76 participants in which 18.42% were identified in the low-risk group while moderate and high risk were identified with 32.89% and 48.68% respectively.

In the current study, 9.67 ± 3.28 was the 24 hours mean blood glucose level identified in the study population.

In the present study, 76.62% of the participants had a history of hypertension. In 417 patients, Takahashi, H et al[57], performed a study in which hypertension was noted in 61% of the participants.

In the current study, 68.83% of participants were identified with a history of smoking, whereas, 50.65% had a history of alcohol consumption. Islam, MM. et al[55]**,** conducted a cross-sectional comparative study in which 53.4% of the participants were smokers.

In the present study, dyspnoea and chest pain were observed in 90.91% and 96.10% of participants. In 4087, participants Tscherry K., et al[68] performed a study in which chest pain was identified in 66% of the population.

In the current study, 22.22 ± 1.36 was the body mass index noticed in the participants. Gerbaud, E et al[42], conducted a study in 334 patients in which 28.5±4.7 was the mean BMI of the study population.

In the present study the mean of blood urea, HbA1C, Hb, TLC, creatinine kinase MB, troponin I, uric acid, triglycerides, cholesterol, HDL and LDL were identified with 22.22±1.36, 7.82±1.99, 11.58±1.69, 15.5±2.57, 6.55±3.05,1.49±3.62, 3.82±0.91, 261.62±57.53, 220.81±33.65, 43.7±7.21 and 111.4±53.76 respectively. Gerbaud, E et al[42], conducted a study in 334 participants in which the mean of HBA1c, troponin I, triglycerides, cholesterol, high-density cholesterol and low-density cholesterol were observed with 7.55±1.44, 22.6±56.8, 4.56±3.96, 4.55±1.40, 1.06±0.51 and 2.72±1.19 respectively.

In the current study, the median 24 hours mean blood glucose (mmol/l) in low risk, moderate and high risk were 6.32 (IQR 6.03 to 8.5), 9.08 (IQR 7.983 to 9.93) and 11.3 (IQR 10.16 to 13.8) respectively. In a population of 76 patients, Li, H. et al (6) performed a study in which 15.38% of participants with abnormal glucose metabolism belonged to low-risk group whereas, 36.53% and 48.08% to moderate and high-risk group. Also, 25% of patients with normal glucose metabolism were belonged to low risk while 25% and 50% to the moderate and high-risk group, respectively.

There was a moderate positive correlation between Grace risk score and 24 hours mean blood glucose. In the current study majority of the participants in the low-risk group were aged < 50 years, 50% had pulse rate (in minutes) in the range 70-80, 46.2% had Systolic Blood Pressure (in mm) in the range 121-130, 65.4% had serum creatinine (mg/dl) <1, 69.2% were in Killip Class I and 92.3% had Elevated Cardiac Enzymes in Other Risk Factors.

In the present study, 66.7% of the participants in the moderate risk group were aged between 50-60 years, 37.5% had pulse rate (in minutes) in the range 70-80, 41.7% had Systolic Blood Pressure (in mm) in the range 121-130, 58.3% had serum creatinine (mg/dl) in the range 1-1.99, 58.3% were in Killip Class II, and 58.3% had Elevated Cardiac Enzymes in Other Risk Factors. Whereas among the high-risk, 44.4% were aged between 50-60 years, 29.6% had pulse rate (in minutes) in the range 91-100, 37% had Systolic Blood Pressure (in mm) <110, 66.7% had serum creatinine (mg/dl) in the range 1-1.99, 85.2% were in Killip Class II, and 81.5% had ST Deviation in Other Risk Factors.

CONCLUSION:

- A total of 77 subjects were enrolled in the study.
- The mean age of the study population was 52.31 ± 7.9.
- The prevalence of males and females were observed with 74% and 26%.
- The mean Pulse (per minute) and mean Systolic Blood Pressure (in mm) in the study population were 89.29 ± 16.83 and 125.06 ± 12.85,respectively.
- The mean Serum Creatinine (In mg/dl) was identified as 1.35 ± 0.82.
- Majority of the participants were belonged to Killip class II with 58.44%, followed by class I and class III with 36.36% and 5.19% respectively.
- Elevated Cardiac Enzymes and ST Deviation were identified in 55.84% and 44.16% of participants.
- The mean Grace risk score was observed as 129.35 ± 31.15
- Most of the patients were belonged to the high-risk group with 35.06%, followed by low risk and moderate risk group with 33.77% and 31.17% respectively.
- The mean 24 Hours Mean Blood Glucose (mmol/l) in the population was 9.67 ± 3.28.
- The history of hypertension was noted in 76.62% of participants.
- Smoking and alcohol consumption were identified in 68.83% and 50.65% of the population.
- Dyspnoea and chest pain were observed in 90.91% and 96.10% of the population.
- The mean Body Mass Index in the study population was 22.22 ± 1.36.
- The mean of blood urea, HbA1C, Hb, TLC, creatinine kinase MB, troponin I, uric acid, triglycerides, cholesterol, HDL and LDL were identified with 22.22±1.36, 7.82±1.99, 11.58±1.69, 15.5±2.57, 6.55±3.05, 1.49±3.62, 3.82±0.91, 261.62±57.53, 220.81±33.65, 43.7±7.21 and 111.4±53.76 respectively.

- The median 24 hours mean blood glucose (mmol/l) in low risk, moderate and high risk were 6.32 (IQR 6.03 to 8.5), 9.08 (IQR 7.983 to 9.93) and 11.3 (IQR 10.16 to 13.8) respectively.
- There was a moderate positive correlation between Grace risk score and 24 hours mean blood glucose
- Among the low risk in the study population, majority of the patients were aged < 50 years, 50% had pulse rate (in minutes) in the range 70-80, 46.2% had Systolic Blood Pressure (in mm) in the range 121-130, 65.4% had serum creatinine (mg/dl) <1, 69.2% were in Killip Class I and 92.3% had Elevated Cardiac Enzymes in Other Risk Factors.
- Among the moderate risk in the study population, 66.7% were aged between 50-60 years, 37.5% had pulse rate (in minutes) in the range 70-80, 41.7% had Systolic Blood Pressure (in mm) in the range 121-130, 58.3% had serum creatinine (mg/dl) in the range 1-1.99, 58.3% were in Killip Class II, and 58.3% had Elevated Cardiac Enzymes in Other Risk Factors. Whereas among the high-risk, 44.4% were aged between 50-60 years, 29.6% had pulse rate (in minutes) in the range 91-100, 37% had Systolic Blood Pressure (in mm) <110, 66.7% had serum creatinine (mg/dl) in the range 1-1.99, 85.2% were in Killip Class II, and 81.5% had ST Deviation in Other Risk Factors.

LIMITATIONS:

- The current study is a single-centre study with small sample size.
- We only used SD as a parameter of blood glucose variabilities more parameters such as MAGE and MODD can be used more convincingly.
- Follow up was not performed in the study population.

RECOMMENDATIONS:

- The study can be conducted in a large sample size for a long duration of time.
- Management and follow up can be performed in future studies.

SUMMARY:

The importance of glucose metabolism in acute coronary syndrome and acute myocardial infarction has been increasingly recognized. Glycated hemoglobin (HbA1c) levels correlate well with the average glucose levels over the preceding 8 to 12 weeks and are used in diagnosing diabetes mellitus. The Global Registry of Acute Coronary Events risks score is a validated and established score for risk stratification in acute coronary syndromes. The current study is an attempt at understanding the relationship between blood glucose fluctuation and GRACE risk score in ACS patients and how blood glucose fluctuation in patients with abnormal glucose metabolism affect GRACE score using Continuous Glucose Monitoring System.

A total of 77 participants were included in the study. The mean age of the participants was identified as 52.31 ± 7.9. Majority of the participants were males with 74%. The mean Pulse (per minute) and mean Systolic Blood Pressure (in mm) were 89.29 ± 16.83 and 125.06 ± 12.85. Majority of the participants were belonged to Killip class II with 58.44%. Elevated Cardiac Enzymes and ST Deviation were identified in 55.84% and 44.16% of participants. The mean Grace risk score and mean 24 Hours Mean Blood Glucose (mmol/l) were 129.35 ± 31.15 and 9.67 ± 3.28. Majority of the participants were belonged to the high-risk group with 35.06%. Dyspnoea and chest pain were observed in 90.91% and 96.10% of the population. The median 24 hours mean blood glucose (mmol/l) in low risk, moderate and high risk were 6.32 (IQR 6.03 to 8.5), 9.08 (IQR 7.983 to 9.93) and 11.3 (IQR 10.16 to 13.8) respectively. There was a moderate positive correlation between Grace risk score and 24 hours mean blood glucose.

BIBLIOGRAPHY

REFERENCE:

1. Orellana-Barrios MA, Fries JW, Nugent K, Shurmur S. Glycated hemoglobin, admission blood glucose delta, and associated mortality in patients with acute ST-segment elevation myocardial infarction. Proc (Bayl Univ Med Cent). 2019;32(3):325–30.
2. Yang W, Lu J, Weng J, Jia W, Ji L, Xiao J, et al. Prevalence of diabetes among men and women in China. N Engl J Med. 2010;362(12):1090–101.
3. Liu Y, Yang Y, Zhu J, Tan H, Liang Y, Li J. Prognostic significance of hemoglobin A1c level in patients hospitalized with coronary artery disease. A systematic review and meta-analysis. Cardiovasc Diabetol. 2011;10:98.
4. Cakmak M, Cakmak N, Cetemen S, Tanriverdi H, Enc Y, Teskin O, et al. The value of admission glycosylated hemoglobin level in patients with acute myocardial infarction. Can J Cardiol. 2008;24(5):375–8.
5. Widera C, Pencina MJ, Bobadilla M, Reimann I, Guba-Quint A, Marquardt I, et al. Incremental Prognostic Value of Biomarkers beyond the GRACE (Global Registry of Acute Coronary Events) Score and High-Sensitivity Cardiac Troponin T in Non-ST-Elevation Acute Coronary Syndrome. Clin Chem. 2013;59(10):1497–505.
6. Sala J, Masia R, de Molina FJG, Fernandez-Real JM, Gil M, Bosch D, et al. Short-term mortality of myocardial infarction patients with diabetes or hyperglycaemia during admission. J Epidemiol Community Heal. 2002;56(9):707–12.
7. Singh SS, Paul SK, Pal R, Thatkar PV. Acute coronary syndrome-related mortality audit in a teaching hospital at Port Blair, India. J Fam Med Prim care. 2017;6(3):502–8.
8. Li H, Lu C, Xu L, Tian N, Gao X, Fan Z, et al. The relationship between GRACE risk score and glucose fluctuation in patients with acute coronary syndrome and abnormal glucose metabolism. Int J Diabetes Dev Ctries. 2018;38(2):195–201.

9. Oswald GA, Smith CC, Betteridge DJ, Yudkin JS. Determinants and importance of stress hyperglycaemia in non-diabetic patients with myocardial infarction. Br Med J (Clin Res Ed). 1986;293(6552):917–22.

10. Meier JJ, Deifuss S, Klamann A, Launhardt V, Schmiegel WH, Nauck MA. Plasma glucose at hospital admission and previous metabolic control determine myocardial infarct size and survival in patients with and without type 2 diabetes: the Langendreer Myocardial Infarction and Blood Glucose in Diabetic Patients Assessment (LAMBD. Diabetes Care. 2005;28(10):2551–3.

11. Takahashi T, Hiasa Y, Ohara Y, Miyazaki S, Mahara K, Ogura R, et al. Acute hyperglycaemia prevents the protective effect of pre-infarction angina on microvascular function after primary angioplasty for acute myocardial infarction. Heart. 2008;94(11):1402–6.

12. de Mulder M, Oemrawsingh RM, Stam F, Boersma E, Umans VAWM. Current management of hyperglycemia in acute coronary syndromes: a national Dutch survey. Crit Pathw Cardiol. 2009;8(2):66–70.

13. Fuster V, Badimon L, Badimon JJ, Chesebro JH. The pathogenesis of coronary artery disease and the acute coronary syndromes. N Engl J Med. 1992;326(5):310–8.

14. Kawasaki M, Takatsu H, Noda T, Sano K, Ito Y, Hayakawa K, et al. In vivo quantitative tissue characterization of human coronary arterial plaques by use of integrated backscatter intravascular ultrasound and comparison with angioscopic findings. Circulation. 2002;105(21):2487–92.

15. Sano K, Kawasaki M, Ishihara Y, Okubo M, Tsuchiya K, Nishigaki K, et al. Assessment of vulnerable plaques causing acute coronary syndrome using integrated backscatter intravascular ultrasound. J Am Coll Cardiol. 2006;47(4):734–41.

16. Miyamoto Y, Okura H, Kume T, Kawamoto T, Neishi Y, Hayashida A, et al. Plaque

characteristics of thin-cap fibroatheroma evaluated by OCT and IVUS. JACC Cardiovasc Imaging. 2011;4(6):638–46.

17. Okada K, Hibi K, Gohbara M, Kataoka S, Takano K, Akiyama E, et al. Association between blood glucose variability and coronary plaque instability in patients with acute coronary syndromes. Cardiovasc Diabetol. 2015;14(1):111.

18. Teraguchi I, Imanishi T, Ozaki Y, Tanimoto T, Yamano T, Ino Y, et al. Impact of glucose fluctuation and monocyte subsets on coronary plaque rupture. Eur Heart J. 2013;34(suppl_1).

19. Mokta J, Kumar S, Ganju N, Mokta K, Panda PK, Gupta S. High incidence of abnormal glucose metabolism in acute coronary syndrome patients at a moderate altitude: A sub-Himalayan study. Indian J Endocrinol Metab. 2017;21(1):142–7.

20. Kumar A, Cannon CP. Acute coronary syndromes: diagnosis and management, part I. Mayo Clin Proc. 2009;84(10):917–38.

21. Thygesen K, Alpert JS, Jaffe AS, Simoons ML, Chaitman BR, White HD, et al. Third universal definition of myocardial infarction. Circulation. 2012;126(16):2020–35.

22. Group IC. Randomised trial of intravenous streptokinase, oral aspirin, both, or neither among 17,187 cases of suspected acute myocardial infarction: ISIS- 2. ISIS- 2 (Second International Study of Infarct Survival) Collaborative Group. Lancet. 1988;2(8607):349–60.

23. Investigators TIii. Effects of tissue plasminogen activator and a comparison of early invasive and conservative strategies in unstable angina and non-Q-wave myocardial infarction: results of the TIMI IIIB trial. Circulation. 1994;89(4):1545–56.

24. Nikus K, Birnbaum Y, Eskola M, Sclarovsky S, Zhong-Qun Z, Pahlm O. Updated electrocardiographic classification of acute coronary syndromes. Curr Cardiol Rev. 2014;10(3):229–36.

25. Widimský P, Rokyta R, Št J, Bělohlávek J, Červinka P, Kala P, et al. Acute coronary syndromes with ongoing myocardial ischemia (ACS with OMI) versus acute coronary syndromes without ongoing ischemia (ACS without OMI): The new classification of acute coronary syndromes should replace old classification based on ST segment e. Cor Vasa. 2013;55(3):e225–7.

26. Sanchis-Gomar F, Perez-Quilis C, Leischik R, Lucia A. Epidemiology of coronary heart disease and acute coronary syndrome. Ann Transl Med. 2016;4(13):256.

27. Collaborators G 2013 M and C of D. Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet (London, England). 2015;385(9963):117–71.

28. Dorairaj P, Jeemon P, Roy A. Cardiovascular Diseases in India: Current Epidemiology and Future Directions. Circulation. 2016;133:1605–20.

29. Moe KT, Wong P. Current trends in diagnostic biomarkers of acute coronary syndrome. Ann Acad Med Singapore. 2010;39(3):210–5.

30. Wilson PWF, D'Agostino RB, Levy D, Belanger AM, Silbershatz H, Kannel WB. Prediction of coronary heart disease using risk factor categories. Circulation. 1998;97(18):1837–47.

31. Yusuf S, Hawken S, Ounpuu S, Bautista L, Franzosi MG, Commerford P, et al. Obesity and the risk of myocardial infarction in 27 000 participants from 52 countries: a case-control study. Lancet. 2005;366(9497):1640–9.

32. Rosengren A, Hawken S, Ôunpuu S, Sliwa K, Zubaid M, Almahmeed WA, et al. Association of psychosocial risk factors with risk of acute myocardial infarction in 11 119 cases and 13 648 controls from 52 countries (the INTERHEART study): case-control study. Lancet. 2004;364(9438):953–62.

33. del Val Martin D, Fernández MS, Gómez JLZ. Biomarkers in acute coronary syndrome. IJC Metab Endocr. 2015;8:20–3.

34. Jernberg T, Lindahl B, James S, Larsson A, Hansson L-O, Wallentin L. Cystatin C: a novel predictor of outcome in suspected or confirmed non–ST-elevation acute coronary syndrome. Circulation. 2004;110(16):2342–8.

35. Cavalot F. Do data in the literature indicate that glycaemic variability is a clinical problem? Glycaemic variability and vascular complications of diabetes. Diabetes Obes Metab. 2013;15 Suppl 2:3–8.

36. Angeli F, Reboldi G, Poltronieri C, Lazzari L, Sordi M, Garofoli M, et al. Hyperglycemia in acute coronary syndromes: from mechanisms to prognostic implications. Ther Adv Cardiovasc Dis. 2015;9(6):412–24.

37. Ramachandran A, Chamukuttan S, Immaneni S, Shanmugam RM, Vishnu N, Viswanathan V, et al. High incidence of glucose intolerance in Asian-Indian subjects with acute coronary syndrome. Diabetes Care. 2005;28(10):2492–6.

38. Haffner SM, Mykkänen L, Stern MP, Valdez RA, Heisserman JA, Bowsher RR. Relationship of proinsulin and insulin to cardiovascular risk factors in nondiabetic subjects. Diabetes. 1993;42(9):1297–302.

39. Yudkin JS, Denver AE, Mohamed-Ali V, Ramaiya KL, Nagi DK, Goubet S, et al. The relationship of concentrations of insulin and proinsulin-like molecules with coronary heart disease prevalence and incidence: a study of two ethnic groups. Diabetes Care. 1997;20(7):1093–100.

40. Tamita K, Katayama M, Takagi T, Yamamuro A, Kaji S, Yoshikawa J, et al. Newly diagnosed glucose intolerance and prognosis after acute myocardial infarction: comparison of post-challenge versus fasting glucose concentrations. Heart. 2012;98(11):848–54.

41. Borch-Johnsen K, Neil A, Balkau B, Larsen S, Nissinen A, Pekkanen J, et al. Glucose tolerance and mortality: comparison of WHO and American Diabetes Association diagnostic criteria. Lancet. 1999;354:617–21.

42. Gerbaud E, Darier R, Montaudon M, Beauvieux M-C, Coffin-Boutreux C, Coste P, et al. Glycemic Variability Is a Powerful Independent Predictive Factor of Midterm Major Adverse Cardiac Events in Patients With Diabetes With Acute Coronary Syndrome. Diabetes Care. 2019;42(4):674–81.

43. Tylee TS, Trence DL. Glycemic variability: looking beyond the A1C. Diabetes Spectr. 2012;25(3):149–53.

44. Su G, Mi S, Tao H, Li Z, Yang H-X, Zheng H, et al. Impact of admission glycemic variability, glucose, and glycosylated hemoglobin on major adverse cardiac events after acute myocardial infarction. Diabetes Care. 2013;36(4):1026–32.

45. Del Olmo-García MI, Hervás Marín D, Caudet Esteban J, Ballesteros Martin-Portugués A, Cerveró Rubio A, Arnau Vives MA, et al. Glycemic variability in type 2 diabetes mellitus and acute coronary syndrome: liraglutide compared with insulin glargine: a pilot study. J Int Med Res. 2020;48(6):300060520926063.

46. Umpierrez GE, P Kovatchev B. Glycemic Variability: How to Measure and Its Clinical Implication for Type 2 Diabetes. Am J Med Sci. 2018;356(6):518–27.

47. Di Flaviani A, Picconi F, Di Stefano P, Giordani I, Malandrucco I, Maggio P, et al. Impact of glycemic and blood pressure variability on surrogate measures of cardiovascular outcomes in type 2 diabetic patients. Diabetes Care. 2011;34(7):1605–9.

48. Suh S, Kim JH. Glycemic Variability: How Do We Measure It and Why Is It Important? Diabetes Metab J. 2015;39(4):273–82.

49. Petrie JR, Peters AL, Bergenstal RM, Holl RW, Fleming GA, Heinemann L. Improving the Clinical Value and Utility of CGM Systems: Issues and Recommendations: A Joint

Statement of the European Association for the Study of Diabetes and the American Diabetes Association Diabetes Technology Working Group. Diabetes Care. 2017;40(12):1614–21.

50. Danne T, Nimri R, Battelino T, Bergenstal RM, Close KL, DeVries JH, et al. International Consensus on Use of Continuous Glucose Monitoring. Diabetes Care. 2017;40(12):1631–40.

51. Investigators G. Rationale and design of the GRACE (Global Registry of Acute Coronary Events) Project: a multinational registry of patients hospitalized with acute coronary syndromes. Am Heart J. 2001;141(2):190–9.

52. Chattopadhyay S, George A, John J, Sathyapalan T. Adjustment of the GRACE score by 2-hour post-load glucose improves prediction of long-term major adverse cardiac events in acute coronary syndrome in patients without known diabetes. Eur Heart J. 2018;39(29):2740–5.

53. Eagle KA, Lim MJ, Dabbous OH, Pieper KS, Goldberg RJ, Van de Werf F, et al. A Validated Prediction Model for All Forms of Acute Coronary SyndromeEstimating the Risk of 6-Month Postdischarge Death in an International Registry. JAMA. 2004;291(22):2727–33.

54. Fox KAA, FitzGerald G, Puymirat E, Huang W, Carruthers K, Simon T, et al. Should patients with acute coronary disease be stratified for management according to their risk? Derivation, external validation and outcomes using the updated GRACE risk score. BMJ Open. 2014;4(2):e004425.

55. Islam MM, Ahmed M, Ali M, Chowdhury AW, Rubayat KA. Impact of Admission Blood Glucose Added on GRACE Risk Score for All-Cause In-Hospital Mortality in Patients with Acute Coronary Syndrome. Bangladesh Hear J. 2018;33(2):94–9.

56. Su G, Mi S, Li Z, Tao H, Yang H, Zheng H. Prognostic value of early in-hospital

glycemic excursion in elderly patients with acute myocardial infarction. Cardiovasc Diabetol. 2013;12(1):33.

57. Takahashi H, Iwahashi N, Kirigaya J, Kataoka S, Minamimoto Y, Gohbara M, et al. Glycemic variability determined with a continuous glucose monitoring system can predict prognosis after acute coronary syndrome. Cardiovasc Diabetol. 2018;17(1):116.

58. Timóteo AT, Papoila AL, Rio P, Miranda F, Ferreira ML, Ferreira RC. Prognostic impact of admission blood glucose for all-cause mortality in patients with acute coronary syndromes: added value on top of GRACE risk score. Eur Hear journal Acute Cardiovasc care. 2014;3(3):257–63.

59. Xia J, Xu J, Li B, Liu Z, Hao H, Yin C, et al. Association between glycemic variability and major adverse cardiovascular and cerebrovascular events (MACCE) in patients with acute coronary syndrome during 30-day follow-up. Clin Chim Acta. 2017;466:162–6.

60. Liu X-J, Wan Z-F, Zhao N, Zhang Y-P, Mi L, Wang X-H, et al. Adjustment of the GRACE score by HemoglobinA1c enables a more accurate prediction of long-term major adverse cardiac events in acute coronary syndrome without diabetes undergoing percutaneous coronary intervention. Cardiovasc Diabetol. 2015;14(1):110.

61. Kuhl J, Jörneskog G, Wemminger M, Bengtsson M, Lundman P, Kalani M. Long-term clinical outcome in patients with acute coronary syndrome and dysglycaemia. Cardiovasc Diabetol. 2015;14(1):120.

62. Giraldez RR, Clare RM, Lopes RD, Dalby AJ, Prabhakaran D, Brogan Jr GX, et al. Prevalence and clinical outcomes of undiagnosed diabetes mellitus and prediabetes among patients with high-risk non–ST-segment elevation acute coronary syndrome. Am Heart J. 2013;165(6):918–25.

63. de Mulder M, van der Ploeg T, de Waard GA, Boersma E, Umans VA. Admission

glucose does not improve GRACE score at 6 months and 5 years after myocardial infarction. Cardiology. 2011;120(4):227–34.

64. Sinnaeve PR, Steg PG, Fox KAA, Van de Werf F, Montalescot G, Granger CB, et al. Association of elevated fasting glucose with increased short-term and 6-month mortality in ST-segment elevation and non–ST-segment elevation acute coronary syndromes: the Global Registry of Acute Coronary Events. Arch Intern Med. 2009;169(4):402–9.

65. Li H, Lu C, Xu L, Tian N, Gao X, Fan Z, et al. The relationship between GRACE risk score and glucose fluctuation in patients with acute coronary syndrome and abnormal glucose metabolism. Int J Diabetes Dev Ctries. 2017;38.

66. Kirkwood BR SJ. John Wiley & Sons; In: Essential medical statistics: John Wiley & Sons; 2010.

67. IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.

68. Tscherny K, Kienbacher C, Fuhrmann V, van Tulder R, Schreiber W, Herkner H, et al. Risk stratification in acute coronary syndrome: Evaluation of the GRACE and CRUSADE scores in the setting of a tertiary care centre. Int J Clin Pract [Internet]. 11/22. 2020;74(2):e13444–e13444. Available from: https://pubmed.ncbi.nlm.nih.gov/31667929

ANNEXURES

PROFORMA FOR DATA COLLECTION

NAME: IP NO:

AGE: SEX :

GENDER:

ADDRESS:

OCCUPATION:

DETAILED HISTORY:

PAST HISTORY:

FAMILY HISTORY:

PERSONAL HISTORY:

GENERAL PHYSICAL EXAMINATION:

PULSE:

BLOOD PRESSURE:

RESPIRATORY RATE

TEMPERATURE:

BMI:

SYSTEMIC EXAMINATION:

CARDIOVASCULAR EXAMINATION:

RESPIRATORY EXAMINATION:

PER ABDOMINAL EXAMINATION:

CENTRAL NERVOUS SYSTEM EXAMINATION

LABORATORY DATA:

ECG

Urea nitrogen

Creatinine

HbA1c

Haemoglobin

CK MB

Uric acid

Triglycerides

Cholesterol

HDL

LDL

BLOOD GLUCOSE LEVELS FOR 72 HOURS USING CGMS

INFORMED CONSENT FORM

SUBJECT'S NAME: **HOSPITAL NUMBER:**

AGE : **SEX:**

TITLE: The relationship between GRACE risk score and glucose fluctuation in patients with acute coronary syndrome and abnormal glucose metabolism using Continuous Glucose Monitoring System

If you agree to participate in the study we will collect information (as per proforma) from you or a person responsible for you or both. We will collect the treatment and relevant details from your hospital record. This information collected will be used for only dissertation and publication. This study has been reviewed by the institutional ethical committee. The care you will get will not change if you don't wish to participate. You are required to sign/ provide thumb impression only if you voluntarily agree to participate in this study.

I understand that I remain free to withdraw from the study at any time and this will not change my future care. I have read or have been read to me and understood the purpose of the study, the procedure that will be used, the risk and benefits associated with my involvement in the study and the nature of information that will be collected and disclosed during the study. I have had the opportunity to ask my questions regarding various aspects of the study and my questions are answered to my satisfaction. I, the undersigned agree to participate in this study and authorize the collection and disclosure of my personal information for publication.

DATE:
SIGNATURE/THUMBIMPRESSION

Subject name:

(Parents / Guardians name)

ರೋಗಿಯತಿಳುವಳಿಕೆಸಮ್ಮತಿನಮೂನೆ

ಸಂಶೋಧಕರ ಹೆಸರು: ಡಾ. ಎಂ. ಶಶಿ ಶೇಖರ್

ಸಂಸ್ಥೆಯ ಹೆಸರು: ಆರ್.ಎಲ್ಜಲಪ್ಪ ಆಸ್ಪತ್ರೆ ಮತ್ತು ಸಂಶೋಧನಾ ಕೇಂದ್ರ -
ಶ್ರೀದೇವರಾಜ್ ಅರಸ್ ಮೆಡಿಕಲ್ ಕಾಲೇಜ್ಗೆಜೋಡಿಸಲಾಗಿದೆ.

ಪಾಲ್ಗೊಳ್ಳುವವರ ಹೆಸರು: ಕ್ರಮಸಂಖ್ಯೆ :

ನಾನುಶ್ರೀ /ಶ್ರೀಮತಿನನಗೆ ಆರ್. ಎಲ್. ಜಲಪ್ಪಆಸ್ಪತ್ರೆಯಲ್ಲಿ ನಡೆಸಲಾಗುತ್ತಿರುವ ಅಧ್ಯಯನದಲ್ಲಿ ನನ್ನನ್ನು ಸೇರಿಸಲ್ಪಡಲಾಗುವುದು ಎಂದು ನನಗೆ ಅರ್ಥವಾಗುವ ಭಾಷೆಯಲ್ಲಿ ವಿವರಿಸಲಾಗಿದೆ.

ಈ ಸಂಶೋಧನಾ ಅಧ್ಯಯನದಲ್ಲಿಪಾಲ್ಗೊಳ್ಳಲುನನ್ನನ್ನುಆಹ್ವಾನಿಸಲಾಗಿದೆ. ಈದಾಖಲೆಯಲ್ಲಿರುವಮಾಹಿತಿಯುಅಧ್ಯಯನದಲ್ಲಿಪಾಲ್ಗೊಳ್ಳಬೇಕೇಅಥವಾಬೇಡವೇಎಂಬುದನ್ನು ನಿರ್ಧರಿಸಲು ನನಗೆನೆರವಾಗುವುದು.

ಪ್ರಧಾನಸಂಶೋಧಕನೊಂದಿಗೆ ನಾನು ಈಅಧ್ಯಯನಕ್ಕೆ ಸಂಬಂಧಿಸಿದಂತೆ ನನ್ನಅನುಮಾನಗಳನ್ನು ಸ್ಪಷ್ಟಪಡಿಸಿಕೂಂಡಿದ್ದೆನೆ.

ಈ ಅಧ್ಯಯನದಲ್ಲಿ ಪಾಲ್ಗೊಳ್ಳುವಂತೆ ನನಗೆಸೂಚಿಸಲಾಗಿದೆ ಏಕೆಂದರೆನಾನುಅರ್ಹತಾ ಮಾನದಂಡಗಳನ್ನುಪೂರೈಸುತ್ತೇನೆ.

ನನ್ನ ರಕ್ತದ ಮಾದರಿಯನ್ನು ಗೊತ್ತುಪಡಿಸಿದಪರೀಕ್ಷೆಗಳಿಗೆನಿರ್ವಹಿಸಲುನಾನುಡಾ.ಹಂಸಬಿಟೆ
ಅವರನ್ನು ವಿನಂತಿಸುತ್ತೇನೆ ಮತ್ತುಅಧಿಕಾರವನ್ನುನೀಡುತ್ತೇನೆ.ಕೆಳಗಿನ ನನ್ನ ಸಹಿಯು ಅರ್ಹಆರೋಗ್ಯ ವೃತ್ತಿಪರರಿಂದಪರೀಕ್ಷೆಯ ಅನುಕೂಲಗಳು,ಅಪಾಯಗಳು ಮತ್ತುಮಿತಿಗಳನ್ನು ನನ್ನ ತೃಪ್ತಿಗೆವಿವರಿಸಲಾಗಿದೆ ಎಂದು ನನ್ನಅಂಗೀಕಾರವನ್ನು ರೂಪಿಸುತ್ತದೆ

ಭಾಗವಹಿಸುವಿಕೆ ಸಂಪೂರ್ಣವಾಗಿಸ್ವಯಂಪ್ರೇರಿತವಾಗಿರುತ್ತದೆ ಮತ್ತು
ಮಾದರಿಸಂಗ್ರಹಣೆಗೆ ಯಾವುದೇ ಹಣಕಾಸಿನಪಾವತಿಯಿಲ್ಲ.

ಎಲ್ಲಾ ಪರೀಕ್ಷಾ ಫಲಿತಾಂಶಗಳನ್ನುವೈದ್ಯಕೀಯ ಗೌಪ್ಯತೆಯೊಂದಿಗೆಪರಿಗಣಿಸಲಾಗುತ್ತದೆ ಮತ್ತುಕಾನೂನಿನಅಗತ್ಯವಿದ್ದರೆ ಹೊರತುಪಡಿಸಿಯಾವುದೇಹೊರಗಿನವರಿಗೆಬಹಿರಂಗಪಡಿಸುವುದಿಲ್ಲ.

ನನ್ನ ಗೌಪ್ಯತೆ ನಿರ್ವಹಿಸಲ್ಪಡುವವರೆಗೆವೈದ್ಯಕೀಯ ಪರೀಕ್ಷೆ,
ಪರೀಕ್ಷೆಯಮೌಲ್ಯಮಾಪನ ಅಥವಾ ಶಿಕ್ಷಣಕ್ಕಾಗಿ ನನ್ನಮಾದರಿಯನ್ನು ಬಳಸಲುನನ್ನ ಒಪ್ಪಿಗೆಯನ್ನು ನೀಡುತ್ತೇನೆ.

ನಾನು ಈ ಅಧ್ಯಯನದಿಂದ ಯಾವುದೇಸಮಯದಲ್ಲಿ ಹಿಂತೆಗೆದುಕೊಳ್ಳಲುಮುಕ್ತವಾಗಿರುತ್ತೇನೆ ಮತ್ತು ಇದು ನನ್ನಮುಂದಿನಕಾಳಜಿಯನ್ನುಬದಲಿಸುವುದಿಲ್ಲಎಂದು ಅರ್ಥಮಾಡಿಕೊಂಡಿದ್ದೇನೆ.

ರೋಗಿಯ ಮಾಹಿತಿಪತ್ರವನ್ನು ನಾನುಓದಿದ್ದೇನೆ ಮತ್ತುಪ್ರತಿಯನ್ನುಸ್ವೀಕರಿಸಿದ್ದೇನೆ.ಈದಾಖಲೆಯಲ್ಲಿಒದಗಿಸಿದಮಾಹಿತಿಯನ್ನುನಾನುಅರ್ಥಮಾಡಿಕೊಂಡಿದ್ದೇನೆ ಮತ್ತು ಪರೀಕ್ಷೆ,
ಪ್ರಕ್ರಿಯೆ, ಸಂಬಂಧಿಸಿದ ಅಪಾಯ ಮತ್ತುಪರ್ಯಾಯಗಳ ಬಗ್ಗೆ ನಾನು ಹೊಂದಿರುವಪ್ರಶ್ನೆಗಳನ್ನುಕೇಳಲು ನನಗೆ ಅವಕಾಶಕಲ್ಪಿಸಲಾಗಿದೆ.

ಹೆಸರು ಮತ್ತು ಸಹಿ / ಹೆಬ್ಬೆರಳುಗುರುತು ದಿನಾಂಕ:

ಪೋಷಕರ / ಪಾಲಕರ ಹೆಸರು /ಹೆಬ್ಬೆರಳು ಗುರುತು ದಿನಾಂಕ:

ಒಪ್ಪಿಗೆ ತೆಗೆದುಕೊಳ್ಳುವ ವ್ಯಕ್ತಿಯ ಸಹಿ ದಿನಾಂಕ

PATIENT INFORMATION SHEET

Study Title: The relationship between GRACE risk score and glucose fluctuation in patients with acute coronary syndrome and abnormal glucose metabolism using Continuous Glucose Monitoring System

Principal investigator: Dr.SASI SEKHAR

Study site :R.L Jalappa Hospital and Research Center attached to Sri Devaraj Urs Medical College, Tamaka, Kolar.

Purpose of the study:

To determine the relationship between blood glucose fluctuations and GRACE risk score in ACS patients and abnormal glucose metabolism using Continuous glucose Monitoring system.

Voluntary Participation: Your participation in this study is entirely voluntary. There is no compulsion to participate in this study. You will be no way affected if you do not wish to participate in the study. You are required to sign only if you voluntarily agree to participate in this study. Further you are at a liberty to withdraw from the study at any time. We assure you that your withdrawal will not affect your treatment by the concerned physician in any way.

Procedure : We will take detailed history and send your blood samples for Urea nitrogen,Creatinine,HbA1c,Hemoglobin,CKMB,Uricacid,Triglycerides,,Cholesterol,HDL,LDL and measure blood glucose fluctuations for 72 hrs after the admission using continuous glucose monitoring system

Confidentiality: All information collected from you will be strictly confidential & will not be disclosed to anyone except if it is required by the law. This information collected will be used only for research. This information will not reveal your identity.

We would not compel you any time during this process; also we would greatly appreciate your cooperation to the study. We would like to get your consent to participate in the study.

For any information you are free to contact investigator. This study has been approved by the Institutional Ethics Committee & has been started only after their formal approval. The sample collected will be stored in the institute and I request you to permit us to store and use this sample for any future study.

MASTER SHEET

S.NO	UHID NUM	Age	Gender	Pulse per minute	Systolic blood pressure in mm	Serum Creatinine in mg/dl	KILLIP CLS	ORF	Grace Risk Score _ A	Grace Risk Score Grouping	@24HoursMeanBloodGlucosemmoll	Hypertension	Smoking	ALCOHOL	Dyspnoea	Chest pain	Body Mass Index	Blood Urea	HbA1c	HB	TLC	CKMB	TROPI	Uric Acid	TGA
1	839696	56	1	94	110	1.4	2	2	157	3	9.8	1	1	1	1	1	22.0	26	7.7	11.0	13.0	5.0	0.1	4.0	266
2	832394	58	2	110	140	1.4	2	2	147	3	10.4	1	2	2	1	2	24.0	32	8.2	10.0	16.0	10.0	0.3	5.0	300
3	842249	62	1	110	144	1.2	3	2	183	3	13.2	1	1	1	1	1	22.0	26	9.9	9.0	18.0	10.0	0.4	5.0	300
4	758205	52	1	80	120	0.9	1	1	105	1	7.2	1	1	1	1	1	22.0	26	6.2	12.0	16.0	8.0	0.5	5.0	332
5	657006	42	1	72	140	0.9	2	1	99	1	6.6	1	1	1	2	1	23.0	19	5.7	12.0	14.0	9.0	0.8	5.0	330
6	839259	48	1	92	130	1.3	2	2	132	2	9.9	1	1	1	1	1	23.0	38	7.9	9.8	22.0	11.3	0.5	5.2	300
7	840750	55	2	94	140	1.5	2	2	138	2	8.1	1	2	2	1	1	24.0	34	6.7	10.0	18.0	10.0	0.4	4.0	332
8	840767	54	2	92	136	1.1	2	1	131	2	11.0	1	2	2	1	1	23.0	30	8.5	9.0	12.0	10.3	0.6	0.3	450
9	843826	44	1	82	140	0.3	2	1	93	1	6.2	2	1	1	2	1	23.0	26	5.7	13.0	11.3	9.6	0.8	4.6	320
10	843548	48	1	110	130	1.8	2	2	144	3	9.5	1	1	1	1	2	23.0	42	7.6	11.0	14.0	9.7	0.8	4.2	320
11	844552	48	1	92	124	1.4	3	2	151	3	13.8	2	1	1	1	1	22.0	36	10.3	8.0	13.0	10.3	0.5	6.0	323
12	847436	52	1	94	130	1.8	2	1	118	2	7.9	1	1	1	1	1	24.0	36	7.5	9.0	18.2	11.4	0.7	4.0	335
13	847808	52	1	74	140	1.4	2	1	118	2	7.9	1	1	1	1	1	25.0	28	6.6	9.0	22.0	10.2	0.5	4.2	323
14	843859	52	1	72	130	0.2	1	1	99	1	5.6	1	1	1	1	1	23.0	36	5.2	12.0	14.3	10.3	0.5	4.5	304
15	861777	54	1	92	130	1.4	2	1	134	2	9.3	2	1	1	1	1	22.0	38	7.5	9.0	16.0	11.2	0.7	4.5	250
16	863821	42	1	72	128	0.8	2	1	106	1	6.1	2	1	1	1	1	24.0	36	5.5	9.0	14.3	8.2	0.5	4.5	323
17	849276	74	1	110	120	1.4	2	1	177	3	13.5	1	2	1	1	1	19.0	36	10.1	8.0	19.0	8.2	0.6	4.5	260
18	865961	44	1	82	120	1.8	2	1	129	2	8.9	1	1	1	1	1	21.2	52	6.5	12.8	14.0	3.2	0.8	2.9	202
19	866484	52	1	92	130	0.9	3	1	144	3	8.6	1	1	1	2	1	23.0	26	7.1	9.5	14.2	9.3	0.5	4.5	303
20	861693	52	1	92	120	3.5	2	1	145	3	7.4	2	1	1	1	1	23.0	92	6.3	9.0	15.3	11.5	0.4	4.2	320
21	842225	44	2	77	100	0.9	2	1	118	2	8.2	1	2	2	1	1	23.4	28	6.8	9.2	16.2	9.2	0.4	4.2	320
22	835073	64	2	112	120	1.8	2	2	177	3	10.4	1	2	2	1	1	19.0	32	8.2	10.4	14.3	9.7	0.4	4.2	329

23	862619	62	1	114	110	1.8	3	2	205	3	10.6	1	1	1	1	1	23.0	27	8.2	10.4	19.1	9.8	0.8	4.2	273
24	840337	45	2	72	140	0.9	2	1	99	1	5.3	1	2	2	1	1	22.0	32	5.2	10.3	18.2	9.6	0.5	5.1	280
25	846413	42	1	74	124	1.1	2	1	109	1	6.4	1	1	1	1	1	23.0	34	6.1	13.0	17.2	9.6	0.4	4.2	324
26	862861	52	1	72	140	0.5	2	1	112	2	6.7	1	1	1	1	1	24.0	36	6.7	13.0	15.3	9.7	0.5	4.2	280
27	858209	64	1	110	100	0.3	2	1	160	3	8.8	2	1	1	1	1	25.0	36	7.1	10.8	14.2	9.3	0.7	4.8	272
28	840416	42	1	72	140	4.8	1	1	100	1	5.1	1	1	1	1	1	26.0	64	5.1	14.0	19.3	9.6	0.6	4.3	287
29	839965	52	2	92	110	5.0	2	1	161	3	10.2	2	2	2	1	2	23.0	72	7.6	14.2	19.2	9.2	0.7	4.3	272
30	844995	45	2	150	110	1.5	2	2	160	3	7.3	2	2	2	2	1	24.0	36	7.3	12.0	14.3	10.2	0.8	3.8	323
31	813892	48	1	68	120	0.5	2	1	100	1	7.1	2	1	1	1	1	22.0	42	6.4	12.0	19.2	8.9	1.0	4.5	305
32	841019	58	2	79	120	0.8	2	2	139	2	9.4	1	2	2	1	1	24.0	32	7.0	13.0	14.2	8.2	0.7	4.2	323
33	841991	41	2	84	140	0.9	2	2	115	2	7.4	1	2	2	1	1	20.0	32	5.9	13.0	14.2	9.2	0.5	4.2	303
34	841577	48	2	68	100	0.3	2	2	106	1	6.1	1	2	2	1	1	23.0	32	5.7	12.0	14.0	8.2	0.6	4.5	345
35	835449	41	1	72	146	0.5	2	2	96	1	13.1	2	1	1	1	1	23.0	26	7.0	12.0	19.2	7.2	0.7	4.2	274
36	841467	76	1	115	130	2.5	2	2	202	3	18.2	1	1	1	1	1	22.0	72	12.9	8.0	14.2	8.2	0.7	3.7	290
37	840732	65	2	110	120	2.5	2	2	183	3	15.2	1	2	2	1	1	22.0	60	12.1	8.0	15.0	9.9	0.8	5.2	300
38	842871	64	1	71	160	0.9	2	1	118	2	15.4	1	1	1	1	1	23.0	34	10.3	13.0	16.2	8.2	0.7	4.8	296
39	841953	54	1	72	108	0.5	2	2	131	2	8.8	2	1	1	1	1	23.0	30	8.4	12.0	15.0	9.4	0.7	3.2	290
40	841808	72	1	100	120	2.4	2	2	211	3	14.0	1	2	2	1	1	22.0	60	12.1	8.0	15.0	9.9	0.8	5.2	300
41	842414	50	1	72	140	0.7	1	1	106	1	9.1	1	1	2	2	1	22.1	26	7.4	12.0	14.0	2.0	0.4	4.5	156
42	852532	48	2	84	130	0.9	1	1	89	1	8.5	1	2	2	1	1	21.0	26	7.0	11.0	13.0	3.2	0.9	4.2	202
43	849562	57	2	86	130	0.9	1	1	119	2	11.6	1	2	2	1	1	23.0	34	9.0	13.0	13.0	3.2	0.3	2.3	180
44	846399	45	2	74	150	0.8	1	1	93	1	6.1	2	2	2	1	1	24.0	26	5.7	11.0	14.0	3.8	0.5	3.2	140
45	842807	46	1	72	130	1.1	1	1	89	1	6.9	1	2	2	1	1	21.0	26	5.8	13.0	14.0	3.8	0.6	4.2	160
46	842084	52	1	79	130	0.9	1	1	119	2	9.6	1	1	2	1	1	21.0	32	7.7	11.0	14.0	4.1	0.6	4.2	180
47	841289	56	2	82	110	1.7	2	2	154	3	12.7	2	2	2	1	1	21.0	30	9.7	12.0	12.0	3.2	0.7	2.8	180
48	842586	58	1	84	130	0.9	1	1	105	1	6.1	2	1	1	1	1	24.0	26	5.8	13.0	14.0	3.2	0.8	3.2	240
49	841559	52	2	92	130	1.1	1	2	125	2	10.5	1	2	2	1	1	21.0	32	8.2	13.2	14.1	3.6	0.5	2.8	220
50	848658	48	1	84	110	0.9	1	2	112	2	7.8	1	1	1	1	1	22.0	38	7.6	12.0	15.1	4.2	0.8	3.6	234
51	850204	58	1	82	130	1.8	2	2	145	3	13.1	1	1	2	1	1	21.0	28	9.8	13.2	15.0	3.4	0.8	2.9	232
52	849756	52	1	120	140	1.8	2	2	150	3	10.8	1	2	2	1	1	23.0	28	8.4	15.0	21.0	4.3	0.7	2.9	232

53	851081	54	1	82	130	1.4	1	2	122	2	9.1	1	1	2	1	1	22.0	28	7.7	13.0	18.0	3.9	0.7	2.9	240
54	849347	59	1	112	130	0.9	2	2	154	3	12.9	1	1	2	1	1	22.0	32	9.8	12.8	14.0	3.2	14.0	2.8	204
55	852994	48	1	82	110	0.9	1	1	98	1	6.2	1	2	2	2	1	21.0	24	5.8	12.6	13.0	4.1	0.8	2.9	202
56	850853	52	1	84	110	1.0	1	1	114	2	9.1	1	1	2	1	1	21.0	28	7.3	13.2	18.0	3.8	0.9	2.9	232
57	851147	62	1	92	110	1.4	2	2	174	3	15.3	1	1	2	1	1	20.8	42	11.2	10.8	18.0	4.1	18.0	3.2	240
58	852373	64	1	74	130	1.4	1	1	125	2	8.6	1	1	1	1	1	21.0	39	7.2	12.5	21.0	2.7	21.0	3.9	180
59	844526	52	1	78	110	1.2	1	1	117	2	6.7	1	1	1	1	1	21.0	46	5.8	11.2	18.0	4.6	0.7	3.2	242
60	845884	46	1	82	130	1.4	2	1	112	2	9.7	1	1	2	1	1	22.0	39	7.7	11.7	12.3	3.2	0.8	4.5	180
61	845658	64	1	130	130	2.4	2	2	185	3	16.9	1	1	1	1	1	24.0	52	12.2	12.0	18.2	3.4	0.6	4.2	202
62	860727	54	1	92	130	1.4	1	2	128	2	9.9	1	1	1	1	1	21.0	48	7.9	13.2	18.0	3.6	0.8	4.2	232
63	861099	48	1	82	110	0.5	1	1	95	1	6.2	1	1	1	1	1	21.0	28	6.9	11.2	13.0	4.2	0.9	2.9	202
64	835613	52	1	86	110	1.4	1	2	131	2	9.9	1	1	1	1	1	21.0	36	7.9	12.8	13.0	4.2	0.8	3.2	224
65	853045	44	1	82	110	0.5	1	1	104	1	8.5	1	1	2	1	1	21.0	26	6.2	12.7	13.0	4.1	13.0	3.2	180
66	866360	46	1	86	130	0.9	1	1	84	1	9.8	1	1	2	1	1	21.0	32	7.8	12.8	13.0	3.2	0.8	2.9	242
67	859369	48	1	130	110	1.3	2	2	150	3	11.3	1	1	2	1	1	21.0	38	8.8	12.7	11.2	3.6	0.9	2.9	292
68	840025	58	2	108	100	1.8	2	2	160	3	10.2	1	1	2	1	1	21.0	52	8.0	12.2	18.0	3.2	0.7	2.7	202
69	842808	62	1	120	130	1.4	2	2	174	3	21.0	1	1	2	1	1	20.0	44	14.9	13.2	19.0	3.7	0.9	2.6	160
70	849363	52	1	82	110	1.8	2	2	154	3	10.7	2	1	2	2	1	20.8	42	8.4	12.8	13.4	3.8	0.9	2.7	232
71	849630	54	1	92	130	1.8	2	2	151	3	13.3	1	1	1	1	1	21.0	49	10.0	12.6	14.0	3.9	0.8	3.4	232
72	849980	44	1	82	130	1.8	1	1	95	1	7.7	1	1	1	1	1	23.0	42	7.9	12.8	15.9	4.1	1.0	3.8	245
73	849520	42	1	74	130	1.4	1	1	92	1	5.8	2	2	2	1	1	21.8	48	5.9	12.8	14.2	3.2	0.8	3.6	262
74	805480	44	1	82	110	1.4	1	1	101	1	16.3	2	1	2	1	1	20.8	45	11.9	11.9	14.0	3.4	0.9	2.8	202
75	842748	47	2	88	128	1.7	1	1	95	1	5.7	2	1	1	1	1	22.9	52	5.8	12.3	13.3	3.4	0.9	2.6	256
76	843649	42	2	98	130	1.4	1	1	98	1	10.2	1	2	2	1	1	21.8	48	8.1	12.9	13.2	3.8	0.8	2.9	291
77	861275	48	1	72	122	1.1	1	1	89	1	5.8	1	1	1	1	1	21.0	36	6.1	13.0	15.1	4.2	0.9	3.5	234

S. NO	UHID NUM	Cholesterol	HDL	LDL	Low vs moderate	Moderate vs severe	Low vs severe	Age group	Pulse group	Serum group	SBP group
1	839696	250	40	222		3	3	2	4	2	1
2	832394	266	30	200		3	3	2	5	2	4
3	842249	250	40	170		3	3	3	5	2	5
4	758205	250	30	200	1		1	2	2	1	2
5	657006	250	25	200	1		1	1	2	1	4
6	839259	250	40	200	2	2		1	4	2	3
7	840750	260	40	160	2	2		2	4	2	4
8	840767	250	40	170	2	2		2	4	2	4
9	843826	220	55	172	1		1	1	3	1	4
10	843548	250	40	170		3	3	1	5	2	3
11	844552	230	40	172		3	3	1	4	2	3
12	847436	253	42	173	2	2		2	4	2	3
13	847808	220	40	190	2	2		2	2	2	4
14	843859	190	56	184	1		1	2	2	1	3
15	861777	220	40	220	2	2		2	4	2	3
16	863821	230	55	142	1		1	1	2	1	3
17	849276	280	40	170		3	3	4	5	2	2
18	865961	232	42	62	2	2		1	3	2	2
19	866484	252	40	172		3	3	2	4	1	3
20	861693	210	35	170		3	3	2	4	4	2
21	842225	221	42	172	2	2		1	2	1	1
22	835073	190	38	180		3	3	3	6	2	2
23	862619	180	45	172		3	3	3	6	2	1
24	840337	222	38	172	1		1	1	2	1	4

25	846413	170	42	160	1		1	1	2	2	3
26	862861	192	38	124	2	2		2	2	1	4
27	858209	220	72	108		3	3	3	5	1	1
28	840416	220	42	90	1		1	1	2	5	4
29	839965	210	52	108		3	3	2	4	5	1
30	844995	252	62	120		3	3	1	9	2	1
31	813892	272	42	108	1		1	1	1	1	2
32	841019	202	42	120	2	2		2	2	1	2
33	841991	292	45	160	2	2		1	3	1	4
34	841577	292	39	105	1		1	1	1	1	1
35	835449	210	42	108	1		1	1	2	1	5
36	841467	280	60	180		3	3	4	6	3	3
37	840732	292	42	120		3	3	3	5	3	2
38	842871	234	32	116	2	2		3	2	1	6
39	841953	180	37	160	2	2		2	2	1	1
40	841808	292	42	120		3	3	4	4	3	2
41	842414	190	45	50	1		1	1	2	1	4
42	852532	160	62	62	1		1	1	3	1	3
43	849562	202	45	65	2	2		2	3	1	3
44	846399	182	42	64	1		1	1	2	1	5
45	842807	152	42	36	1		1	1	2	2	3
46	842084	190	42	62	2	2		2	2	1	3
47	841289	200	42	60		3	3	2	3	2	1
48	842586	260	42	62	1		1	2	3	1	3
49	841559	200	42	58	2	2		2	4	2	3
50	848658	180	46	92	2	2		1	3	1	1
51	850204	240	44	64		3	3	2	3	2	3
52	849756	190	48	62		3	3	2	6	2	4
53	851081	260	52	60	2	2		2	3	2	3
54	849347	230	42	68		3	3	2	6	1	3

55	852994	214	42	62	1		1	1	3	1	1
56	850853	180	42	62	2	2		2	3	1	1
57	851147	202	42	68		3	3	3	4	2	1
58	852373	202	46	68	2	2		3	2	2	3
59	844526	202	44	68	2	2		2	2	2	1
60	845884	220	46	72	2	2		1	3	2	3
61	845658	184	42	70		3	3	3	7	3	3
62	860727	180	42	62	2	2		2	4	2	3
63	861099	182	42	62	1		1	1	3	1	1
64	835613	202	48	66	2	2		2	3	2	1
65	853045	202	38	62	1		1	1	3	1	1
66	866360	202	42	64	1		1	1	3	1	3
67	859369	205	46	62		3	3	1	7	2	1
68	840025	234	54	71		3	3	2	5	2	1
69	842808	180	42	62		3	3	3	6	2	3
70	849363	191	44	68		3	3	2	3	2	1
71	849630	202	46	62		3	3	2	4	2	3
72	849980	208	54	68	1		1	1	3	2	3
73	849520	232	45	64	1		1	1	2	2	3
74	805480	232	48	64	1		1	1	3	2	1
75	842748	234	42	68	1		1	1	3	2	3
76	843649	254	42	60	1		1	1	4	2	3
77	861275	186	46	56	1		1	1	2	2	3

KEY TO MASTER SHEET:

Gender	Male=1, Female=2
ORF	ECE=1, STD=2
Grace Risk Score Grouping	Low risk=1, Moderate=2, High risk=3
Hypertension	Yes=1, No=2
Smoking	Yes=1, No=2
Alcohol	Yes=1, No=2
Dyspnoea	Yes=1, No=2
Chest pain	Yes=1, No=2
Low vs moderate	Low risk=1, Moderate=2, High risk=3
moderate vs severe	Low risk=1, Moderate=2, High risk=3
low vs severe	Low risk=1, Moderate=2, High risk=3
Age group	<50=1, 51 to 60=2, 61 to 70=3, >70=4
Pule group (per minute)	<70=1, 71 to 80=2, 81 to 90=3, 91 to 100=4, 101 to 110=5, 111 to 120=6, 121 to 130=7, 131 to 140=8, >140=9
Serum Creatinine Group	<1=1, 1 to 1.99=2, 2 to 2.99=3, 3 to 3.99=4, >3.99=5
SBP Group	<110=1, 110 to 120=2, 121 to 130=3, 131 to140=4, 141 to 150=5, >150=6