"A STUDY ON PREVALENCE OF HYPONATREMIA AND ITS OUTCOME ON MORTALITY IN ACUTE CORONARY SYNDROME IN NON-DIABETIC PATIENTS"

Dissertation Submitted to

THE TAMIL NADU DR.M.G.R.MEDICAL UNIVERSITY

In partial fulfilment of the regulations for the award of the degree of

M.D. BRANCH – I

GENERAL MEDICINE

GOVERNMENT VELLORE MEDICAL COLLEGE

THE TAMIL NADU DR.M.G.R.MEDICAL UNIVERSITY

TAMILNADU, INDIA

APRIL 2020

CERTIFICATE

This is to certify that **Dr.T.RADHIKA**, postgraduate student (2017-2020) in the Department of General medicine, Government Vellore Medical College and Hospital has done this dissertation titled **"A STUDY ON PREVALENCE OF HYPONATREMIA AND ITS OUTCOME ON MORTALITY IN ACUTE CORONARY SYNDROME IN NON-DIABETIC PATIENTS"**, under the direct guidance and supervision of guide **PROF.DR.S.P.KUMARESAN M.D.,DCH,** in partial fulfilment of the regulations laid down by the **Tamilnadu Dr.M.G.R. Medical University**, Chennai, for M.D., General Medicine Degree Examination.

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Title of the Study	–	An Observational study on prevalence of Hyponatremia and its outcome on mortality in acute coronary syndrome in non-diabetic patients.
Principal Investigator	–	Dr.Radhika. T, I year PG,General Medicine.
Guide	–	Dr.S.P.Kumaresan, MD, DCH. Associate Professor of General Medicine.

The request for an approval from the Institutional Ethical committee (IEC) was considered on the IEC meeting held on 25.04.2018 at the Conference Hall, Govt. Vellore Medical College, Vellore-11.

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This is to certify that this dissertation work titled **"A STUDY ON PREVALENCE OF HYPONATREMIA AND ITS OUTCOME ON MORTALITY IN ACUTE CORONARY SYNDROME IN NON-DIABETIC PATIENTS"**, of the candidate **DR.T.RADHIKA** with registration number **201711657** for the award of **M.D DEGREE** in the branch of **GENERAL MEDICINE.** I personally verified the urkund.com website for the purpose of plagiarism check. I found that the uploaded thesis file contains from introduction to conclusion pages and result shows 10 % of plagiarism in the dissertation.

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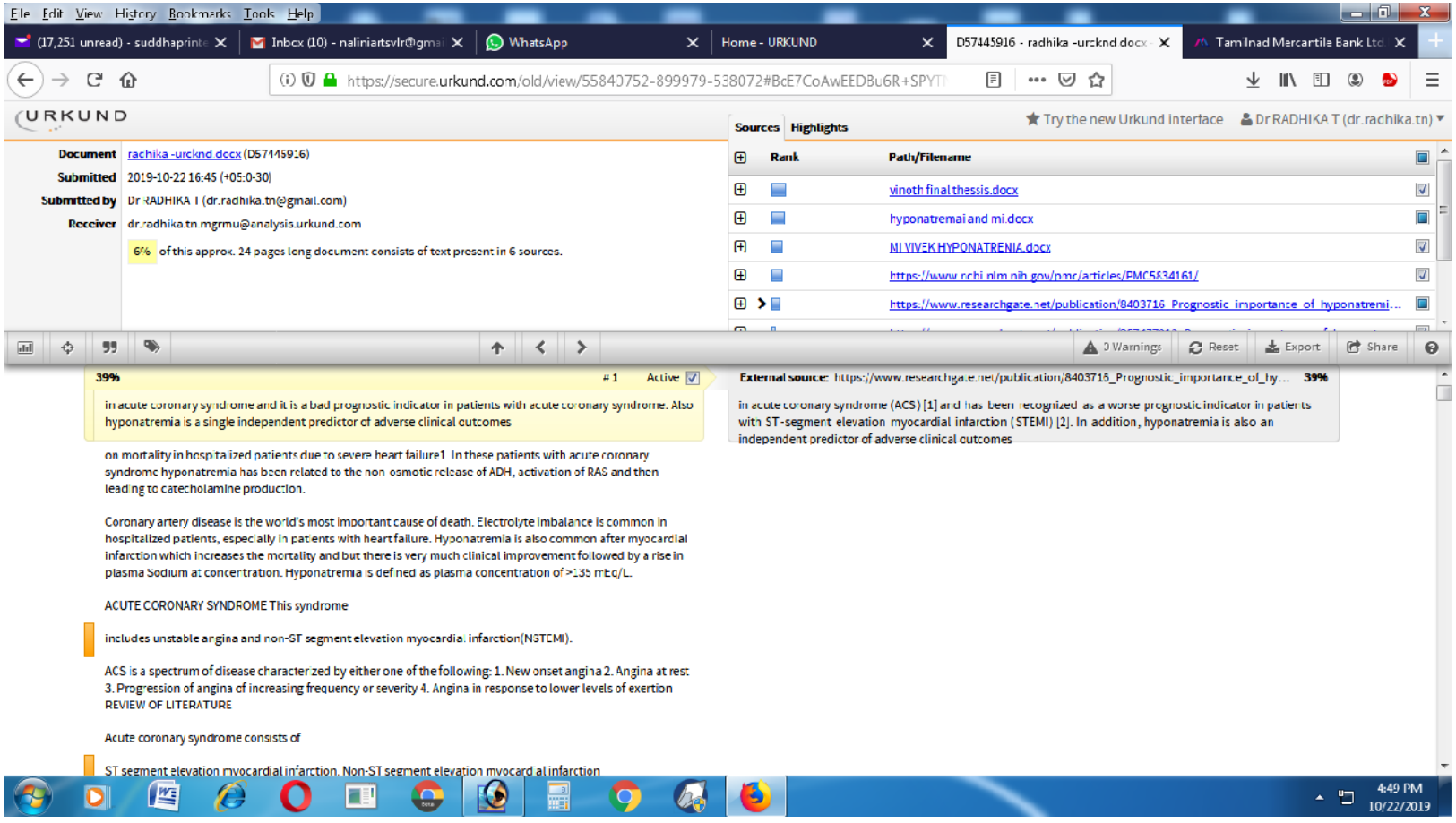
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in acute coronary syndrome and it is a bad prognostic indicator in patients with acute coronary syndrome. Also hyponatremia is a single independent predictor of adverse clinical outcomes
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in acute coronary syndrome (ACS) [1] and has been recognized as a worse prognostic indicator in patients with ST-segment elevation myocardial infarction (STEMI) [2]. In addition, hyponatremia is also an independent predictor of adverse clinical outcomes
on mortality in hospitalized patients due to severe heart failure1. In these patients with acute coronary syndrome hyponatremia has been related to the non osmotic release of ADH, activation of RAS and then leading to catecholamine production.
Coronary artery disease is the world's most important cause of death. Electrolyte imbalance is common in hospitalized patients, especially in patients with heart failure. Hyponatremia is also common after myocardial infarction which increases the mortality and but there is very much clinical improvement followed by a rise in plasma Sodium at concentration. Hyponatremia is defined as plasma concentration of >135 mEq/L.
ACUTE CORONARY SYNDROME This syndrome
includes unstable angina and non-ST segment elevation myocardial infarction(NSTEMI).
ACS is a spectrum of disease characterized by either one of the following: 1. New onset angina 2. Angina at rest: 3. Progression of angina of increasing frequency or severity 4. Angina in response to lower levels of exertion
REVIEW OF LITERATURE
Acute coronary syndrome consists of
ST segment elevation myocardial infarction. Non-ST segment elevation myocardial infarction
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DECLARATION

I, **DR.T.RADHIKA** solemnly declare that this dissertation titled **"A STUDY ON PREVALENCE OF HYPONATREMIA AND ITS OUTCOME ON MORTALITY IN ACUTE CORONARY SYNDROME IN NON-DIABETIC PATIENTS"** is a bonafide work done by me in Department of General Medicine, Government Vellore Medical College and Hospital, Vellore under the guidance and supervision of **Prof. Dr.S.P.KUMARESAN M.D., DCH**

This dissertation is submitted to the Tamilnadu Dr. M.G.R. Medical University, Chennai, in partial fulfilment of the university regulation for the award of M.D., Degree in General Medicine (Branch – 1).

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ACKNOWLEDGEMENT

It gives immense pleasure for me to thank everyone who has helped me during the course of my study and in preparing dissertation.

My sincere thanks to **PROF. Dr.R.SELVI M.D.,** the Dean, Govt. Vellore Medical College for permitting me to conduct the study and use the resources of the College.

I am very thankful to the Chairman of the Ethical Committee and members of the Ethical Committee, Government Vellore Medical College And Hospital for their guidance and help in getting the ethical clearance for this work.

I consider it a privilege to have done this study under the supervision of my beloved teacher, guide and Head of the Department **Prof. Dr.S.P.KUMARESAN M.D., DCH.,** who has been a source of constant inspiration and encouragement to accomplish this work.

I express my sincere gratitude to **Prof. Dr. S. MURUGESAN M.D.,** Professor & Chief, Unit I who has been a constant encouragement.

I express my deepest sense of thankfulness to my Assistant Professors **Dr. B. GOWRI SHANKAR M.D., DCH, Dr. IMRAN NIAZI M.D., DR.G.THIRUMAL M.D., DR. BIJIN OLIVER JOHN M.D., DR.J.T.SATHISH M.D.,** for their valuable inputs and constant encouragement without which this dissertation could not have been completed.

I also thank **Prof. Dr. RANGASWAMI M.D., DMRD.,** Professor of General Medicine and **Dr. D.ANBARASU M.D.,** Former Professor & Head of the Department of General Medicine, **Prof. DR.N.JAYAPRAKASH M.D.** Professsor of General Medicine, **Prof. DR. H. SRI PRIYA M.D.,** Professor of General Medicine, **Prof Dr. THIRUMAL BABU M.D., DM** former Professor of Cardiology**, Prof. DR. SABAPATHY M.D.,D.M.,** Professor of Cardiology and **DR. SRINIVASAN M.D.,D.M.,** Assistant Professor of Cardiology for their valuable inputs and supports.

I am particularly thankful to my seniors, my fellow postgraduate **DR.B.H.PRAWIN VEL, DR. C. HEMNATH** and my colleagues for their valuable support in the time of need throughout the study.

I thank my junior Post Graduates **Dr.P.DANUSH VEL, DR. HEMA CHANDRIKA, DR.J.NITHYA & DR.K.GOKULAKANNAN** who supported me in completing the dissertation. I extend my sincere thanks to all the other junior postgraduates & CRRIs for helping me in the preparation of this dissertation.

It is my earnest duty to thank my close friends **DR.P.VIVEK BALA, DR. TAMILVANI** and my father **MR.P.THANGAVEL** & other family members without whom accomplishing this task would have been impossible.

I am extremely thankful to my patients who consented and participated to make this study possible.

ABBREVIATIONS

AMI	Acute Myocardial Infarction
AF	Atrial Fibrillation
ASMI	Anteroseptal Myocardial infarction
AVP	Arginine Vasopressin
AWMI	Anterior Wall Myocardial infarction
CAD	Coronary Artery Disease
CCF	Congestive Cardiac Failure
CK-MB	Creatinine Kinase-MB
CVD	Cardiovascular Disease
ECF	Extra Cellular Fluid
ECG	Electrocardiogram
IHD	Ischemic Heart Disease
ICF	Intra cellular Fluid
IWMI	Inferior Wall Myocardial infarction

IPWI Inferior Posterior Wall Myocardial infarction

LV Left Ventricle

LVF Left Ventricular Failure

LWMI Lateral Wall Myocardial infarction

MR Mitral Regurgitation

PSVT Paroxysmal SupraVentricular Tachycardia

SIADH Syndrome of Inappropriate Antidiuretic Hormone Secretion

TR Tricuspid Regurgitation

VF Ventricular Fibrillation

VPC Ventricular Premature Complex **VT** Ventricular Tachycardia

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INTRODUCTION

Hyponatremia mostly occur very common in acute coronary syndrome and it is a bad prognostic indicator in patients with acute coronary syndrome. Also hyponatremia is a single independent predictor of adverse clinical outcomes on mortality in hospitalized patients due to severe heart failure[1]. In these patients with acute coronary syndrome hyponatremia has been related to the non-osmotic release of ADH, activation of RAS and then leading to catecholamine production.

Coronary artery disease is the world's most important cause of death. Electrolyte imbalance is common in hospitalized patients, especially in patients with heart failure. Hyponatremia is also common after myocardial infarction which increases the mortality and but there is very much clinical improvement followed by a rise in plasma Sodium at concentration. Hyponatremia is defined as plasma concentration of <135 mEq/L.

ACUTE CORONARY SYNDROME

This syndrome includes unstable angina and non-ST segment elevation myocardial infarction(NSTEMI). ACS is a spectrum of disease characterized by either one of the following:

1. New onset angina
2. Angina at rest
3. Progression of angina of increasing frequency or severity
4. Angina in response to lower levels of exertion

REVIEW OF LITERATURE

Acute coronary syndrome consists of ST segment elevation myocardial infarction, Non-ST segment elevation myocardial infarction and unstable angina. ACS is the most common cause of mortality.

Acute coronary syndrome occurs 5-10 times earlier in India than other populations around the world[2]. In India, acute coronary syndrome is the highest burden.. This incidence is due to lifestyle modifications, western food practices, increased incidence of diabetes mellitus and sometimes genetic factors etc.

Only the Asian Indians have a little higher incidence of coronary artery disease than other ethnic groups in the world. The occurrence of serious complications and increased mortality at a much younger age is also common in Asian Indians.

The annual incidence of ACS is >7,80,000 events, with 70% being NSTEMI/UA[3].

Among ACS patients, 60% present with UA and 40% have MI (one third – acute STEMI). After 1 year, patients with NSTEMI/UA are at risk of death(~6%), recurrent MI(~11%), and need for revascularisation (~50-60%).

Women with NSTEMI/UA have worst short-term and long-term outcomes and more complications compared to men.

ANATOMY OF THE HEART

FIGURE 1: ANTERIOR SURFACE OF HEART

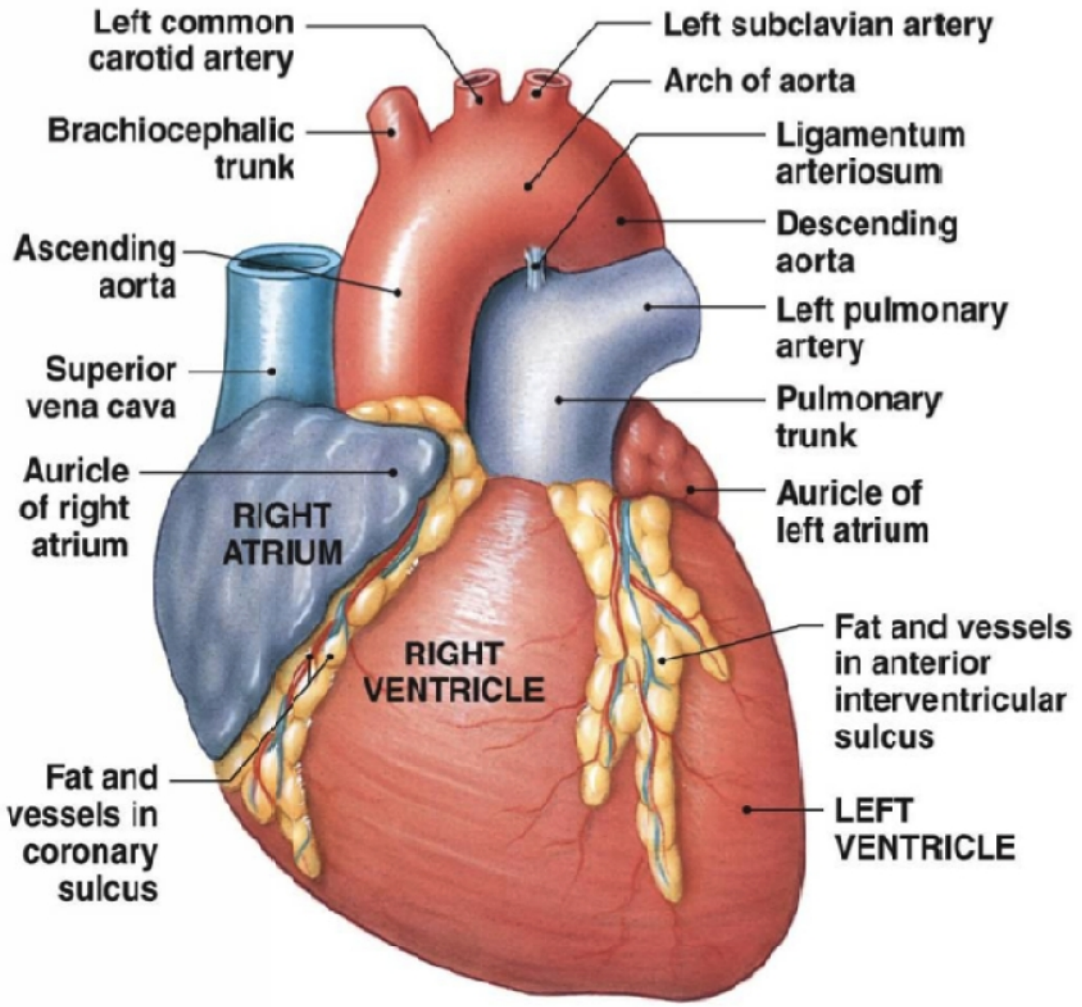
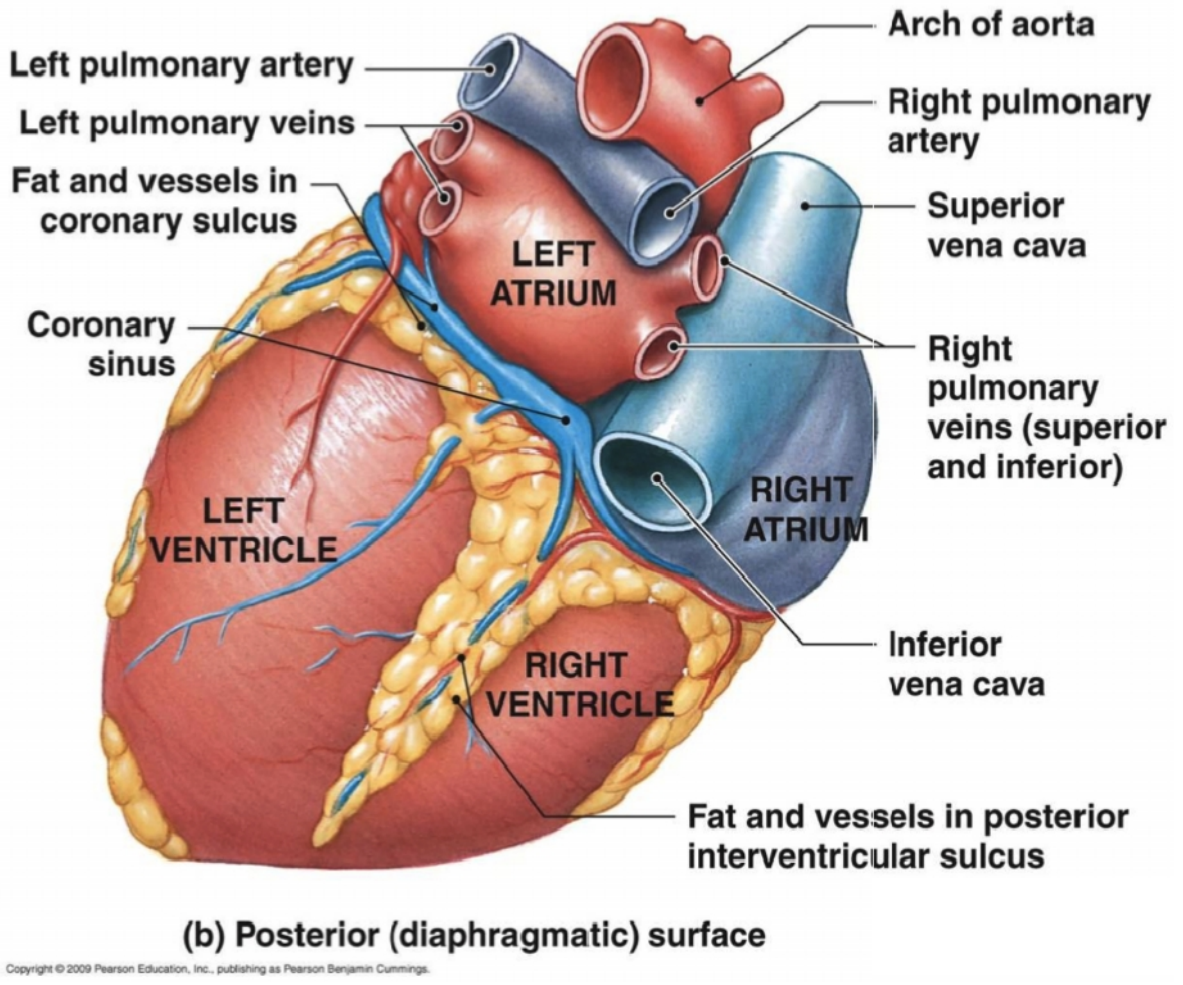
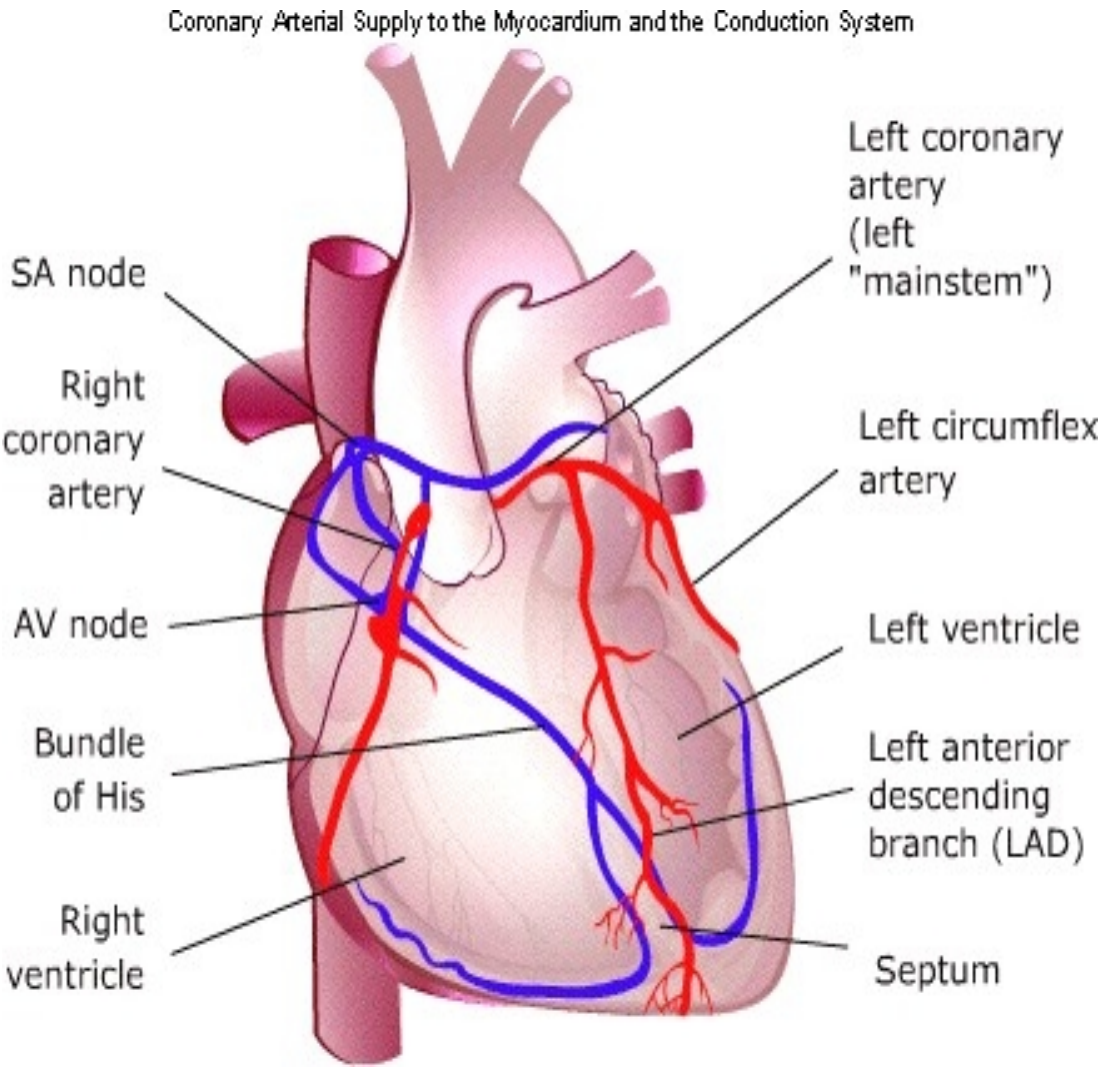


FIGURE 2: POSTERIOR SURFACE OF THE HEART



- ✓ **Right border -** it is found slightly convex and is long formed by right atrium above and right ventricle below, it is in line with superior vena cava.
- ✓ **Left border -** is formed majorly by left ventricle and a small portion by left auricle.
- ✓ **Inferior border -** is formed by right and left ventricle.
- ✓ **Superior border -** is formed by right and left atrium and great vessels.
- ✓ **Ligamentum arteriosum-** it extends from the origin of left pulmonary artery to the arch of aorta.
- ✓ **Arch of aorta-** it gets arched into two planes, superiorly and to the left. The pulmonary artery bifurcates inferior to it.
- ✓ **Pulmonary artery-** it get divided into right and left branch inferior to arch of aorta. Right branch passes under the arch. He branches lie just superior and parallel to the pulmonary vein.
- ✓ **Pulmonary veins-** the right and the left pulmonary veins drain into left atrium.
- ✓ **Azygos vein-** it begins from the abdomen and it arches over the right pulmonary vessels (and bronchus) and drain into SVC

FIGURE 3: BLOOD SUPPLY OF THE HEART



- ✓ **Coronary artery-** both right and left coronary artery oginate from left side of heart at the beginning of aorta.[11]
- ✓ **Right coronary artery-** it is a smaller branch which arise from right aortic sinus and reaches the posterior surface of the heart by traveling in the coronary sulcus or groove, here it anastomose with the circumflex branch of left coronary artery. It gets lodged in anterior IV groove. It mainly supplies Right Atrium, small part of Left Ventricle near posterior IV groove, posterior part of IV septum, conducting system of heart except a part of LBB. In its course it gives off sinoartrial(SA) nodal branch which supplies right atrium and SA node; the marginal branch is a major branches which supplies anterior wall of right ventricle, in the posterior interventricular groove the posterior interventricular artery anastomose with anterior interventricular artery which is a branch of left coronary artery, near the posterior interventricular septum it gives off arteriventricular nodal artery.
- ✓ **Left coronary artery-** it's a larger branch which arise from left posterior aortic sinus, it gets lodged in the posterior IV groove. It mainly supplies Left Atrium, great part of Left Ventricle, Anterior part of IV groove, RBB, part of LBB and 35% SA node. It gives a circumflex branch which get anastomose with right coronary artery on the posterior surface of heart by running posteriorly, in the interventricular groove it gives an anterior descending branch.
- ✓ Anterior 2/3rd of interventricular septum is supplied by ascending branch of left anterior descending artery, while posterior part of interventricular septumis supplied by right coronary artery.

RISK FACTORS OF CORONARY ARTERY DISEASE

The risk factors may be modifiable and non-modifiable risk factors

NON-MODIFIABLE RISK FACTORS

- Age
- Gender
- Family history

MODIFIABLE RISK FACTORS

- Hypertension
- Smoking
- Diabetes mellitus
- Obesity
- Sedentary lifestyle
- Dyslipidemia
- Homocysteine > 10mmol/l

PROTECTIVE FACTORS

- Exercise
- HDL cholesterol
- Decreased stress

ALTERNATIVE LIPID AND LIPOPROTEIN MEASURES

The better indicator in clinical practice is LDL's major apolipoprotein apoB than LDL cholesterol.

This apoB is correlated with non HDL cholesterol and HDL cholesterol.

TCL/HDL is a very much strong clinical predictor even superior to apoB/apoA-1

Inspite of higher cholesterol, 50% of ACS occurs in patients without dyslipidemia.

Although use of global prediction models has improved the detection of heart disease, 20% of CAD occurs in the absence of classic risk factors.

RISK FACTORS AND INTERVENTIONS FOR CORONARY ARTERY DISEASE

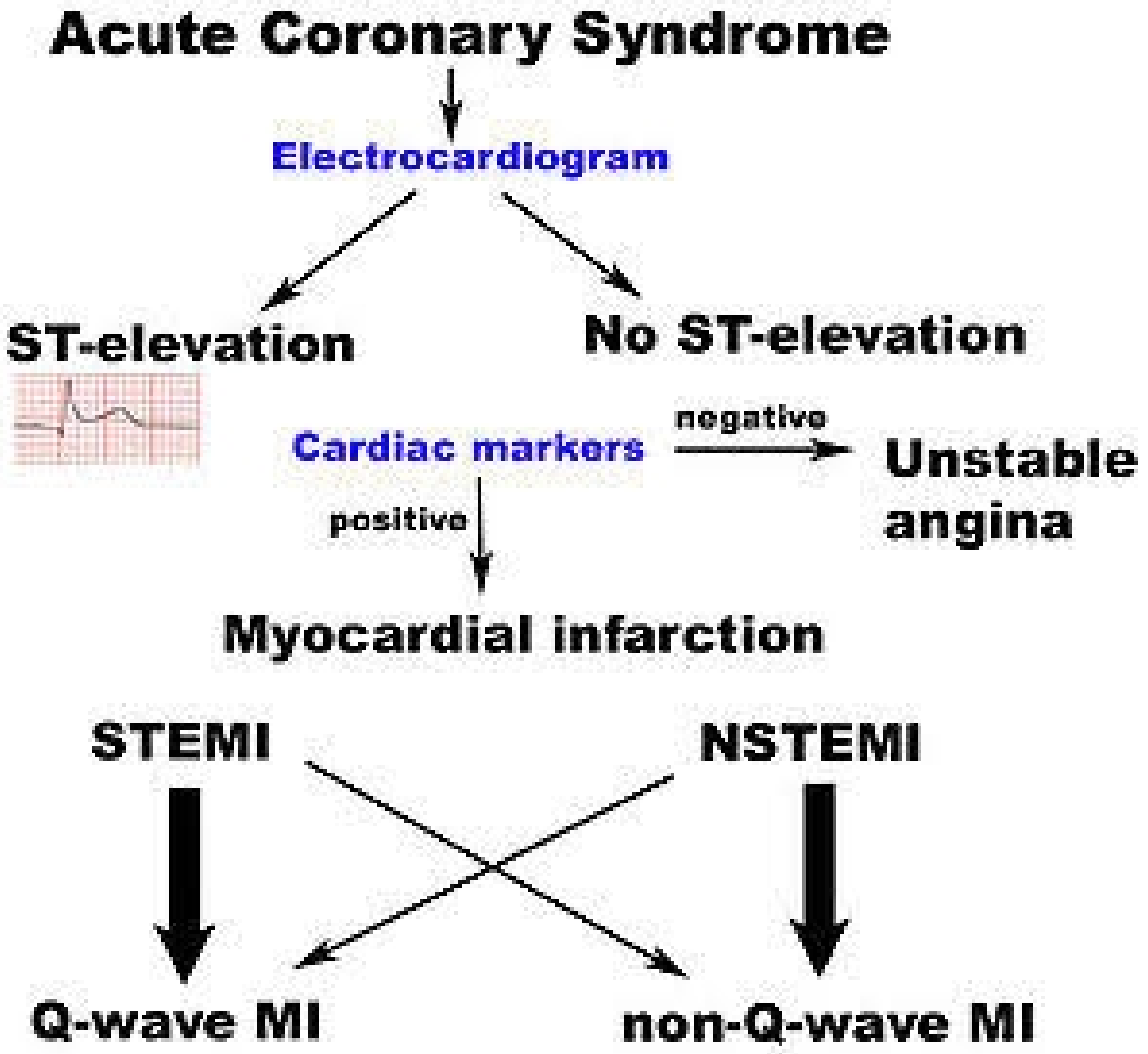
TABLE 1: RISK FACTORS OF CAD

CLASS	RISK FACTORS	INTERVENTION
1	Smoking High BP Dyslipidemia	Cessation of smoking BP control Lipid management
2	Diabetes, Prediabetes Sedentary lifestyle Obesity Diet, alcohol	Diabetes control Physical activity Weight control Improved diet
3	Menopause Micronutrients Psychological factors Novel biomarkers	Hormone replacement therapy

DEFINITION

Stable angina usually presents as deep, poorly localized chest discomfort or arm discomfort, that can be reproducibly precipitated by an emotional stress or an exertion and relieved within a period of 5-15 minutes by rest or by sublingual NTG.

FIGURE 4 – ACUTE CORONARY SYNDROME



UNSTABLE ANGINA

UA has atleast on of the following three factors

1. Occurs at rest(or with minimal exertion) and lasts >20 minutes
2. Usually severe and described a as frank pain of new onset (i.e within a period of one month)
3. Occurs with a crescendo pattern

When patients are having evidence of myocardial necrosis in the form of elevated serum biomarkers, a diagnosis of NSTEMI is made.

REVISED DEFINITION FOR MYOCARDIAL INFACTION

The classical rise and fall of Troponin levels or rapid rise and fall of CK-MB levels indicate myocardium has developed necrosis with atleast one of the following

- Symptoms of ischemia
- Formation of pathological Q waves on the ECG
- New changes in th ECG suggesting ischemia (new formation of ST segment elevation/depression)
- Coronary artery intervention like coronary angioplasty)
- Findings of acute MI like non-viability of myocardium

CRITERIA FOR FULL FORMED MI

- Presence of one of the criterias indicate the presence of established MI
- Formation of pathological Q waves on repated ECG's
- Findings suggestive of healing or healed MI like scaring of myocardium.

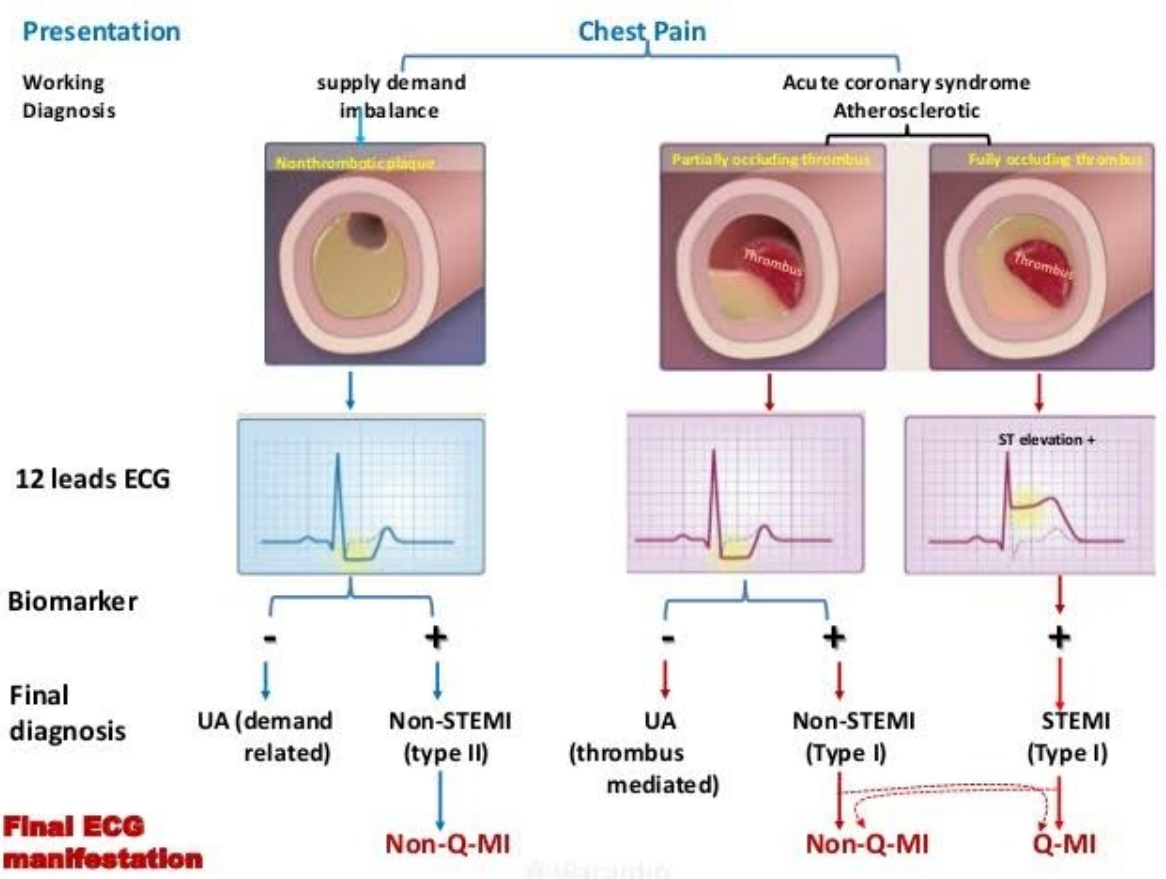
PATHOPHYSIOLOGY OF MYOCARDIAL INFARCTION

Myocardial ischemia results from decreased myocardial oxygen supply and/or increased demand. In majority of cases, NSTEMI is due to sudden decrease in blood supply via partial occlusion of the affected vessel. In some cases, increased oxygen demand can lead to NSTEMI(demand ischemia), as in severe anaemia, hypertensive crisis, acute decompensated heart failure, surgery, or any other physiologic stress.

UA/NSTEMI often represents severe coronary artery narrowing or acute atherosclerotic plaque rupture/erosion and superimposed thrombus formation. Alternatively, it may also be due to progressive mechanical obstruction from advancing atherosclerotic disease, in-stent restenosis, or bypass graft disease.

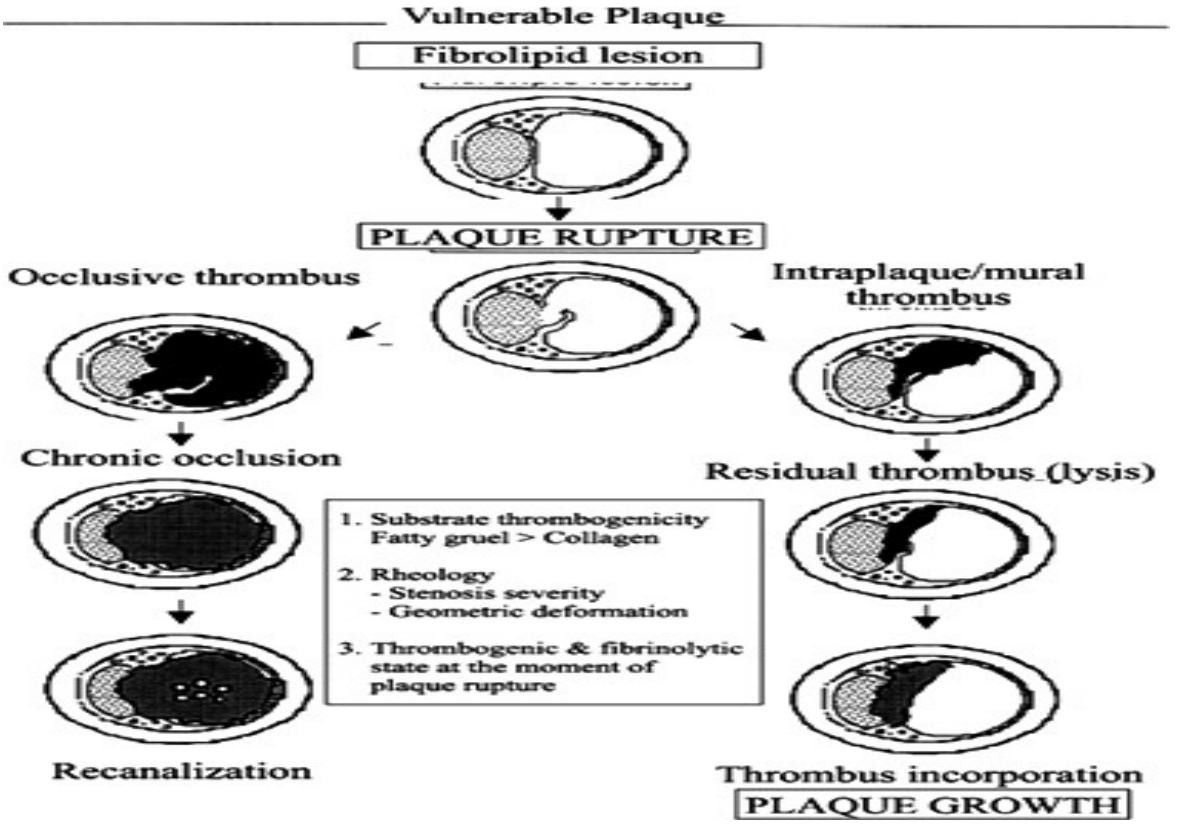
Plaque rupture may be triggered by local or systemic inflammation as well as shear stress. Rupture allows exposure of lipid –rich subendothelial components to circulating platelets and inflammatory cells, serving as a potent substrate for thrombus formation. A thin fibrous cap (thin-cap fibroathetoma) is more vulnerable to rupture and is most frequently represented as only moderate stenosis on angiography.

FIGURE 5 – PLAQUE FORMATION WITH ECG CHANGES



Other causes include dynamic obstruction of the coronary artery due to vasospasm (Prinzmetal angina, cocaine), coronary artery dissection (more common in women), coronary vasculitis and embolus.

FIGURE 6: PATHOLOGY OF PLAQUE FORMATION



CLINICAL PRESENTATION

Generally patients are restless, attempting to relieve pain by altering position and rolling in bed. Patients with anterior wall MI have sympathetic features and patients with inferior wall MI will have parasympathetic features.

Apical impulse will be difficult to palpate. Intensity of S1 may be reduced and S2 will be split paradoxically. Gallop sounds(S3, S4) will be heard.

Jaw, neck, arm, back or epigastric pain and/or dyspnoea can be angina equivalents.

TABLE 2: KILLIP CLASSIFICATION

CLASS	DEFINITION	MORTALITY
I	NO SIGNS OR SYMPTOMS OF HEART FAILURE	6%
II	HEART FAILURE: S3 GALLOP OR BASAL RALES	17%
III	SEVERE HEART FAILURE: PULMONARY EDEMA	38%
IV	CARDIOGENIC SHOCK	81%

TABLE 3: HEMODYNAMIC SUBSET IN ACUTE MI

SUBSETS	BASED ON INVASIVE MONITORING
I	PCWP<18, CI>2.2
II	PCWP>18, CI>2.2
III	PCWP<18, CI<2.2
IV	PCWP>18, CI<2.2

INVESTIGATIONS

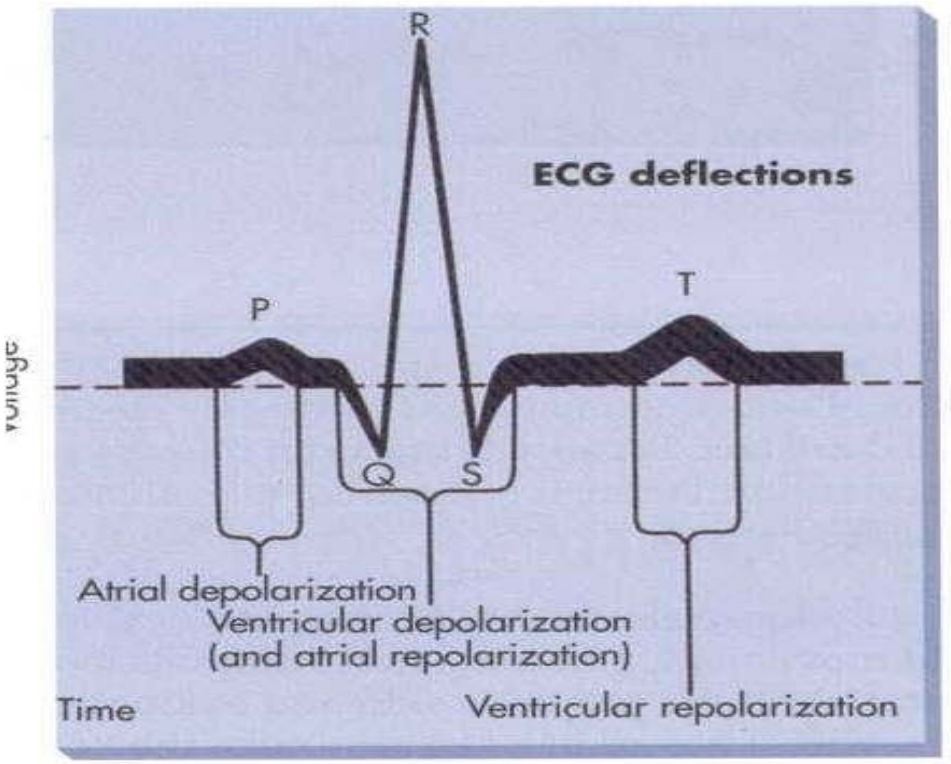
1. ELECTROCARDIOGRAM:

ECG is useful in confirming the diagnosis in acute coronary syndrome. Depending on the factors given below the findings may get altered.

- Duration-acute or evolving / chronic
- Extent – transmural /nontransmural
- Topography- anterior / inferior / posterior / right ventricular

Classic pattern may get altered or masked in the presence of underlying abnormalities like bundle branch blocks and arrhythmias. ECG remains the most cost effective investigation in the diagnosis of acute as well as in chronic myocardial infarction. The ECG changes depends upon duration of ischemic process, extend of infarction. ECG leads are very helpful in localization of involved vessels.

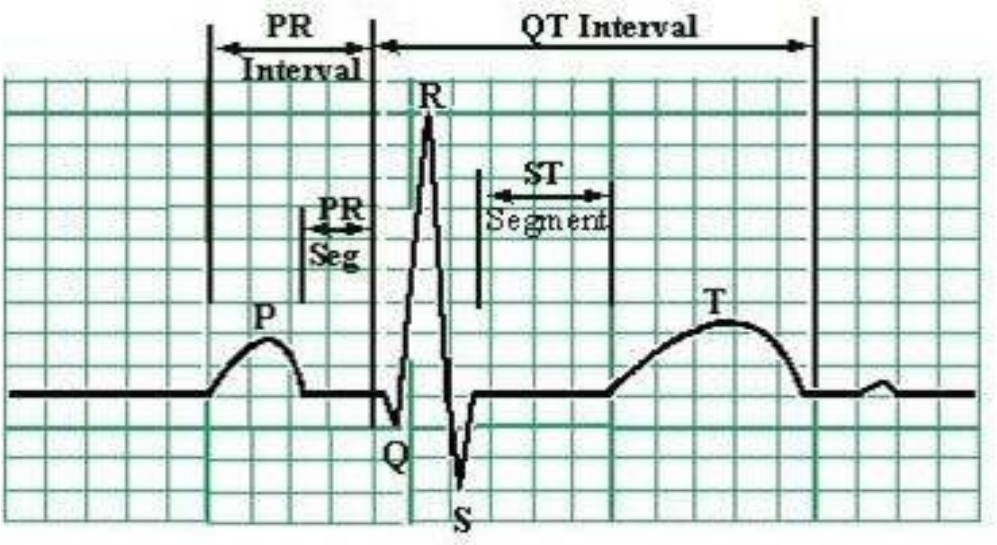
FIGURE 7: NORMAL ECG FORMATION



- ✓ **P wave -** upright wave in limb leads, biphasic in lead V1& V2. It occurs due to atrial depolarization. It always precedes the QRS complex.

- ✓ **Q wave** -occurs due to septal depolarization. First there is negative deflection, it always precedes the R wave.
- ✓ **R wave** -it is first positive deflection of QRS complex and it occurs due to ventricular depolarization
- ✓ **S wave** - follows R wave, it is negative deflection of QRS complex
- ✓ **T wave** -it occurs due to ventricular depolarization it is usually upright
- ✓ **U wave** - it occurs due to late ventricular repolarization of purkinje fibers.

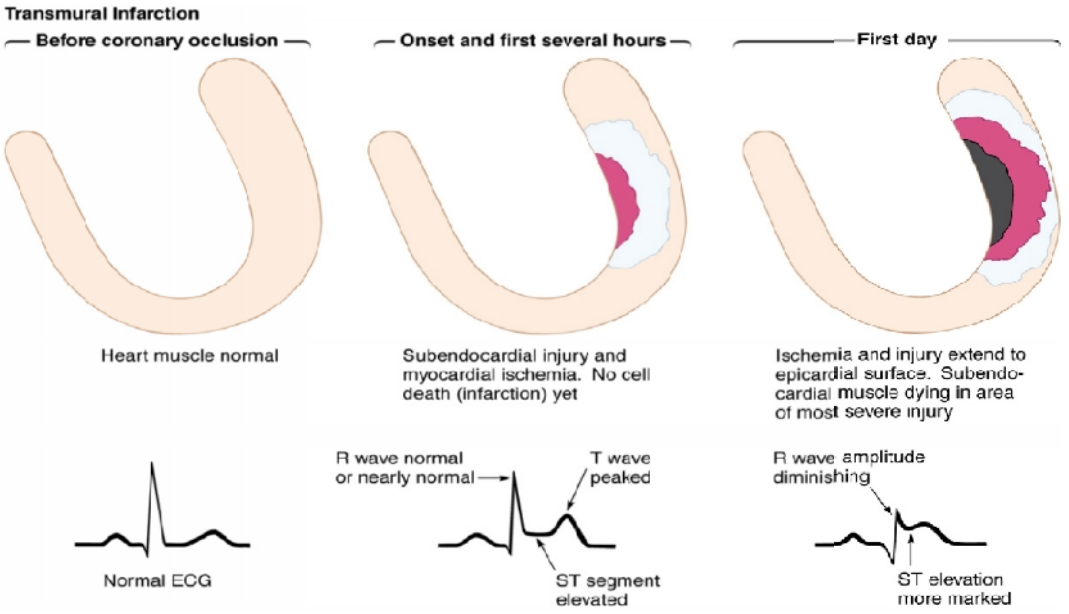
FIGURE 8: ELECTROCARDIOGRAM



- ✓ **PR interval**- Impulse travel from SA node to both ventricles, the time taken is called PR interval, it indicated AV nodal period of conduction. It can be measured from starting point of P wave to starting point of QRS. Normal PR interval is 0.12-0.21 sec.

- ✓ **RR interval**- useful in counting the heart rate.
- ✓ **QT interval**- it occurs due to ventricular depolarization as well as repolarisation. Normal QT interval is 0.35-0.45 sec.
- ✓ **QRS complex**- the normal QRS occurs due to ventricular depolarization. Normal QRS duration is 0.10-0.12 sec

FIGURE 9: ECG CHANGES IN MYOCARDIAL INFARCTION ACCORDING TO THE TIME OF INFARCT



The above picture shows the ECG changes in myocardial infarction according to time.

In the first day of infarction the ischemia and injury extend to the epicardial surface and at the site of severe injury there is area of subendocardial muscle dying, there is marked ST segment elevation and diminishing of R wave amplitude.

Approximately 50% of patients with UA/NSTEMI have significant ECG abnormalities including transient ST-segment elevations, ST depressions and T-wave inversions.

ST – segment depression in two contiguous leads is a sensitive indicator of myocardial ischemia, especially if dynamic and associated with symptoms.

Threshold value for abnormal J point depression should be 0.5mm in leads V2 and V3 and 1mm in other leads

ST-segment depression in multiple leads plus ST segment elevation in aVR and/or V1 suggests ischemia due to multivessel or left main disease.

Deeply inverted T waves (>5mm) with QT prolongation in leads V2 to V4 (Wellens waves)are suggestive of critical lesion in LAD artery occlusion.

CARDIAC BIOMARKERS

It is a most essential diagnostic marker, obtained in all patients who present with chest discomfort. In patients with negative biomarkers within 6 hours of onset of pain, a second sample should be sent 8-12 hrs after onset of symptoms. Troponin is used as the best biomarker for myocardial necrosis.

Troponin I and T are highly specific and sensitive markers. MI size and prognosis are directly proportional to increase in troponin values. Myoglobin is the first marker and the last marker is LDH.

Troponin T is positive by 4-6 hrs and peaks at 48hrs and normalizes by 7-10 days. Creatine phosphor kinase is positive by 2-4 hrs and peaks at 24hrs and normalizes by 48-72 hrs. CK-MB fraction>5% suggests myocardial injury. CK-MB is useful assay for detecting post infarct ischemia.

Brain natriuretic peptide can be a useful biomarker of myocardial stress in ACS and elevations are associated with worse outcomes.

IMAGING :

A) CHEST X ray :

In the chest X ray bilateral congestion of both lung fields and presence of cardiomegaly will be useful in defining the subsets of patients with failure. Alongside kerley B lines may be found.

B) 2D echo cardiography:

Presence of regional wall motion abnormalities and measurement of ejection fraction are useful in prognostication after developing MI. Echo detects potentially viable and stunned myocardium, residual ischemia and patients who are at risk of developing failure and other mechanical complications of MI like mitral regurgitation.

C) Doppler echocardiography:

It is useful in assessing blood flow in the chambers and across the valves. It detects severity of MR/TR. It can identify the site of acute ventricular septal

rupture. Flow of blood against shunt is detected that indicates acute cardiac tamponade.

COMPLICATIONS OF MYOCARDIAL INFARCTION :

1) Left ventricular failure
2) Cardiogenic shock
3) Mechanical complications: rupture of AV valve, interventricular septal rupture, papillary muscle dysfunction or rupture and mitral regurgitation.
4) Arrythmias
5) VT/VF
6) AF/ TSVT
7) AV blocks/ junctional escape rhythms.
8) Dressler`s syndrome, left ventricular aneurysm.

MORTALITY :

The mortality rate in STEMI is around 4-10% as per published trials[4]. However in create registry , mortality rate of 8.6% was recorded. A study from Vellore reported 16.9% in-hospital mortality.

MORBIDITY

STEMI has the highest number of complications due to transmural involvement. The large size of infarct which cause tissue hypoperfusion at microvascular level are important factors in predicting morbidity.

HYPONATREMIA

Hyponatremia, which is defined as a plasma Sodium at concentration of less than 135 mmol per liter, is the most common electrolyte abnormality in hospitalized patients; it affects approximately 15 to 30% of children and adults who are hospitalized.

PSEUDO HYPONATREMIA:

A increase in plasma lipids or proteins increase the plasma volume and this increase in proteins and lipids can cause reduction in the plasma Sodium at concentration. The hyponatremia due to this does not present with decrease in extra cellular Sodium at relative to extra cellular water. Hyponatremia with

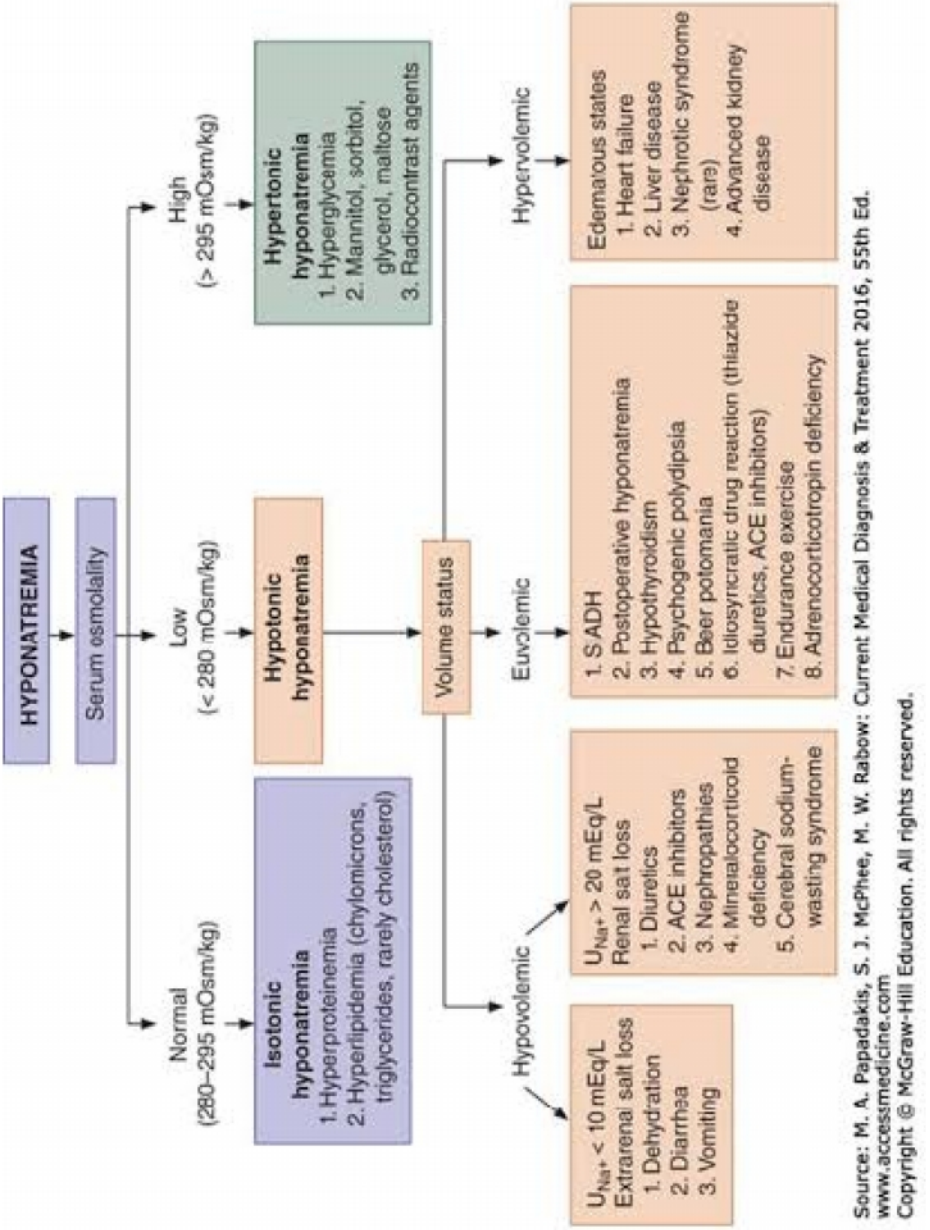
I. Normal plasma osmolality:
   - Hyperlipidemia
   - Hyperproteinaemia
   - Post TURP

II. Increased plasma osmolality
   - Hyperglycemia
   - Mannitol

Hyponatremia is sub divided as:

1. Hypovolemic
2. Euvolemic
3. Hypervolemia

FIGURE 10 – HYPONATREMIA CLASSIFICATION



Source: M. A. Papadakis, S. J. McPhee, M. W. Rabow: Current Medical Diagnosis & Treatment 2016, 55th Ed.
www.accessmedicine.com

HYPOVOLEMIC HYPONATREMIA:

It can be divided as

1. Urinary Sodium at > 20mmol/l - renal loss
2. Urinary Sodium at<20mmol/l - extra rena loss

Causes of renal loss:

- Diuretic excess
- Salt losing nephropathy
- Mineralo-corticoid deficiency
- Osmotic diuresis
- Cerebral salt wasting
- Renal tubular acidosis
- Metabolic alkalosis

Causes of extra renal loss:

1. Vomiting
2. Diarrohea

EUVOLEMIC HYPONATREMIA:

Euvolemic hyonatremia is associated with increased total body water but total body Sodium at is normal and no edema

Causes:

1. Gluco corticoid deficiency
2. Hypothroidism
3. Psychosis
4. Post operative hyponatremia
5. Exercise induced hyponatremia
6. Drugs- Thiazide diuretics, Selective Seratonin Reuptake Inhibitors (SSRI`s), Desmopressin, IV Ig.
7. Syndrome of inappropriate ADH secretion (SIADH)

HYPERVOLEMIC HYPONATREMIA:

Urinary Sodium at < 20mmol/l.

Causes :

- CHF
- Liver cirrhosis
- Nephrotic syndrome

Urinary Sodium at > 20mmol/l ,

- AKI or CRF.

CLINICAL FEATURES

Most patients with serum Sodium at concentration >125mmol/l are asymptomatic.

When Sodium at concentration is < 125 mmol/l there is,

1. Headache
2. Yawning
3. Lethargy
4. Nausea
5. Reversible ataxia
6. Psychosis
7. Seizures
8. Coma

MECHANISM OF HYPONATREMIA IN ACUTE CORONARY SYNDROME:

During the early onset of myocardial infarction, loss of blood supply to the myocardium and reduced oxygen lead to increased sympathetic neural hyperactivity. This leads to stimulation of sympathetic nervous system and Renin-Angiotensin-Aldosterone system, causing peripheral vasoconstriction and redistribution of whole blood. And also, the hormone level of catecholamines, AT II, aldosterone and AVP rapidly rises. Vasopressin level in plasma does not relate with serum level of Sodium at in patients with STEMI and there is increase in permeability of water in distal convoluted tubule and collecting duct cells of the kidney and this finally cause reabsorption of water. The process of water reabsorption happens via transcription and insertion of water channels(aquaporin-2) into the apical membrane of distal convoluted tubules, finally leading to hyponatremia

TREATMENT IN SYMPTOMATIC PATIENTS

- Childrens, post operative patients, brain injury, premenopausal females, pulmonary disease and hypoxia - These are the patients who are at high risk in symptomatic hyponatremia.
- In this patients with *impending herniation* presents with seizures, hyperemesis, neurogenic pulmonary edema, hypercapnic respiratory failure, dilated pupil and must be treated with 3% Sodium at chloride bolus over 10 min, until symptoms improve repeat bolus once or twice (2-4mmol/l), then continue treatment as for hyponatremic encephalopathy
- *Hyponatremic encephalopathy* presents with headache, nausea, vomiting, altered mental status and seizure, and this must be treated with 3% Sodium at chloride and for every 2 hours serum Sodium at levels must be checked. When patient is symptom free or when rise in serum Sodium at is 10mmol/l in the first 5hours - 3% Sodium at chloride can be stopped.
- Therefore in the first 48 hour the correction must not exceed 15-20mmol, correction to hypernatremic or normonatremic level must be avoided

TREATMENT IN ACUTE AND CHRONIC HYPONATREMIC PATIENTS

- The rate of correction, the intervention required, and the underlying disorders are the factors which determine the treatment of hyponatremia without complications. The rate of correction depends on the neurological symptoms present.
- The correction of hyponatremia requires addition of Sodium at, removal of water or both and also includes correction of the underlying disorder.
- *Asymptomatic hyponatremia:* In mild asymptomatic patients generally no treatment is required. In general isotonic saline is used for Na^+ repletion, when hyponatremia is associated with ECF volume contraction. There is normalization of Sodium at due to reduction in renal water retention if euvolemic state is restored.
- *Chronic asymptomatic hyponatremia:* Usually no treatment is required due to the risk of treatment induced toxicity which is very high. It is because cells get adapted to hypoosmolar state, so sudden normalization leads to increase in volume over load. The rate of correction in this type of patients is 6-8mEq/l over 24hours. If the underlying cause in this case is life threatening then the correction can be done as same as acute symptomatic hyponatremia.
- *Asymptomatic hypovolemic hyponatremia:* Isotonic saline is used to restore the intravascular volume. If the duration is not known 1L of 0.9% of normal saline can be given over 24 hours. Renal water retention is reduced and Sodium at level becomes normal if hypovolemic is brought to euvolemic state.

- *Asymptomatic hypervolemic hyponatremia:* most common causes are congestive cardiac failure and cirrhosis of liver. As effective circulatory blood volume is decreased in this case, administration of fluid lead to worsening of volume overload state due to increased interstitial fluid.

The definitive treatment is to treat the underlying condition with supportive measures such as

- ✓ Fluid restriction which must be less than the daily urine output
- ✓ Loop diuretics which increase the water excretion by diuresis.
- ✓ Vasopressin antagonists such as coivaptan and tolvaptan. These also promotes diuresis
- ✓ High dietary solute intake like high salt diet, high protein diet or oral urea increases water excretion and normalization of hyponatremia.

The amount of fluid restriction necessary depends upon extent of elimination of water.

Formula used usually is

(Urine Na^+ + urine K^+) / Serum Na^+ □ if value <0.5, 1L fluid can be given, if value is 0.5-1.0, 500ml/day can be given, if value >1 the fluid given gets retained so in this patients high dietary solute and medications like diuretics and vasopressin antagonist must be considered.

Symptomatic hyponatremia: This can be divided into acute and chronic symptomatic hyponatremia.[22]

Acute symptomatic hyponatremia: The usual presentations are neurological dysfunction like cramps, weakness, fatigue, mental confusion, disorientation, coma and convulsion. In this rapid correction should be avoided, the rate of correction must not be more than 0.6mEq/L/hour.

The most important complication of rapid correction are

- ✓ Volume overload
- ✓ Shrinkage of brain – it occurs when there is loss of organic acids leading to normalization of brain volume.
- ✓ Central pontine myelinosis- quadriplegia, dysarthria, dysphagia with altered level of consciousness are the major manifestation found in CPM. It occurs due to rapid osmotic shift leading to neuronal damage. MRI is the investigation of choice. Patient with hypokalemia, malnutrition and alcoholism are more prone to develop CPM. In these cases rapid correction must be done 1-2mEq/l/hr for first 3-5 hours followed by 0.5mEq/l/hr for next 24hours.[22]

Chronic symptomatic hyponatremia: In this case rate of correction must be around 6-8mEq/l over 24hour period.

Modalities of treatment: Addition of Sodium at or removal of excessive water must be done. Removal of excessive water load is required in most of the cases of hyponatremia because excessive water is the cause of hyponatremia. Hypertonic normal saline and loop diuretics are given in this case to remove excessive water and salt, in this hypertonic saline leads to addition of salt. Loop diuretics administration does not alter the amount of Sodium at as there is excretion of isotonic urine occurs, so amount of Sodium at administered can determine the increase in amount of Sodium at in the serum.

Restriction of fluid is done if slow correction is requires in volume expanded subjects. Loop diuretics and increase Sodium at and potassium intake is advised if above is not possible.

The formula for rate of correction is

$$Na^{+} = [\ Na_f^{+} + K_f^{+} - Na_s^{+}\ ]/\ [TBW+1]$$

Total body water can be calculated by lean body weight in kg×0.6 for men and 0.5 for women. It does not estimate the ongoing water or solute loss, it is only a rough guide.[23]

Hypertonic saline:

- ✓ It is the main stay treatment for all type of hyponatremia includes acute and chronic symptomatic hyponatremia
- ✓ The usual indications are seizures, altered mental status, coma, muscle weakness and fatigue.

- ✓ 3% normal saline is commonly used, if not available 0.45% normal saline can be used.
- ✓ Rate of correction for acute cases is 1-2mEq/l/hr. If 1.2ml/kg hypertonic saline will increases the serum Sodium at by around 1mEq/l. 2^{nd}, 3^{rd} and 6^{th} hourly Sodium at level must be monitored.
- ✓ *Vasopressin receptor antagonist* like conivaptan, tolvaptan can be used in the case of SIADH.
- ✓ Lithium and Demeclocyclin can be given if unresponsive to other medications. It is not commonly used due to its side effect

AIMS & OBJECTIVES OF THE STUDY

The aim and objective of this study is to study the prevalence of hyponatremia and to determine that hyponatremia is a predictor for short term and long-term mortality in patients with acute coronary syndrome in non-diabetic patients.

MATERIALS AND METHODS OF THE STUDY

Study design: prospective study

Setting: ICCU in Government Vellore Medical College, Adukamparai, Vellore.

Period of study: 1 year

Sample size: 100

Study population: 100 patients admitted as acute coronary syndrome

INCLUSION CRITERIA:

100 clinically diagnosed cases of acute coronary syndrome.

Patients with chest pain > 20 min and ST segment elevation in ECG.

EXCLUSION CRITERIA:

Patients with renal failure

Diabetic patients

Acute and chronic liver failure

Acute gastroenteritis

Adrenal insufficiency

Hypertensive patients on potassium sparing diuretics

COPD patients on beta agonists.

PROCEDURE:

Acute coronary syndrome patients confirmed clinically and showing ST segment elevation in ECG.

Patients will be evaluated for hyponatremia by serum Sodium at levels.

Other electrolytes will also be considered for supporting evidence.

Fasting and post prandial sugars will also be done to exclude diabetes.

Evaluation of hyponatremia in different subgroups of patients and analysis.

STATISTICAL TOOLS:

1. Questionnaires
2. Serum Sodium at levels
3. Chi square test
4. Mid ‘P’ Exact
5. Odds ratio
6. Risk ratio

Methodology flow:

- Selecting patients with acute coronary syndrome according to inclusion criteria
- Questionnaire s for excluding patients listed as exclusion criteria
- Lab investigations for serum Sodium at levels
- Evaluating hyponatremia as predictor of mortality in acute myocardial infarction

DATA COLLECTION :

AFTER obtaining informed consent, detailed history was taken and blood sample taken and sent for investigation and the data were entered in the proforma designed for the study.

DEFINITIONS:

Antro septal MI	:	ST elevation in V1-V4.
Antro lateral MI	:	ST elevation in L1, avL, V4-V6
Extensive anterior wall MI	:	ST elevation in I, aVL,V1-V6
Inferior wall MI	:	ST elevation in LII, III, aVF
Right ventricular wall MI	:	ST elevation in V3R, V4R
Posterior wall MI	:	There is tall and wide R wave, ST segment depressed and concave upwards, widened and upright T wave in V2.

LABORATORY INVESTIGATIONS:

1. ELECTROCARDIOGRAM
2. ECHOCARDIOGRAM
3. SERUM SODIUM AT LEVELS
4. SERUM GLUCOSE LEVELS
5. SEUM UREA & CREATININE LEVELS

Plasma Sodium at concentration was measured by using an ISE (Ion Selective Electrode) . Hyponatremia was considered as Sodium at < 135mmol/l.

COLLABORATING DEPARTMENTS:

Department of Cardiology

Department of Biochemistry

Benefits of the study:

The main outcome of the study is to consider hyponatremia as an important predictor of short term mortality in patients with acute ST elevation myocardial infarction, which is a preventable cause for mortality.

Ethical issues:

The objectives and procedure of the study was explained to all patients.

1. Informed consent was taken from all patients willing to participate in the study.
2. The option to opt out of the study was kept open without any clause.
3. Complete confidentiality regarding patient information was maintained through all the stages of the study.

RESULTS

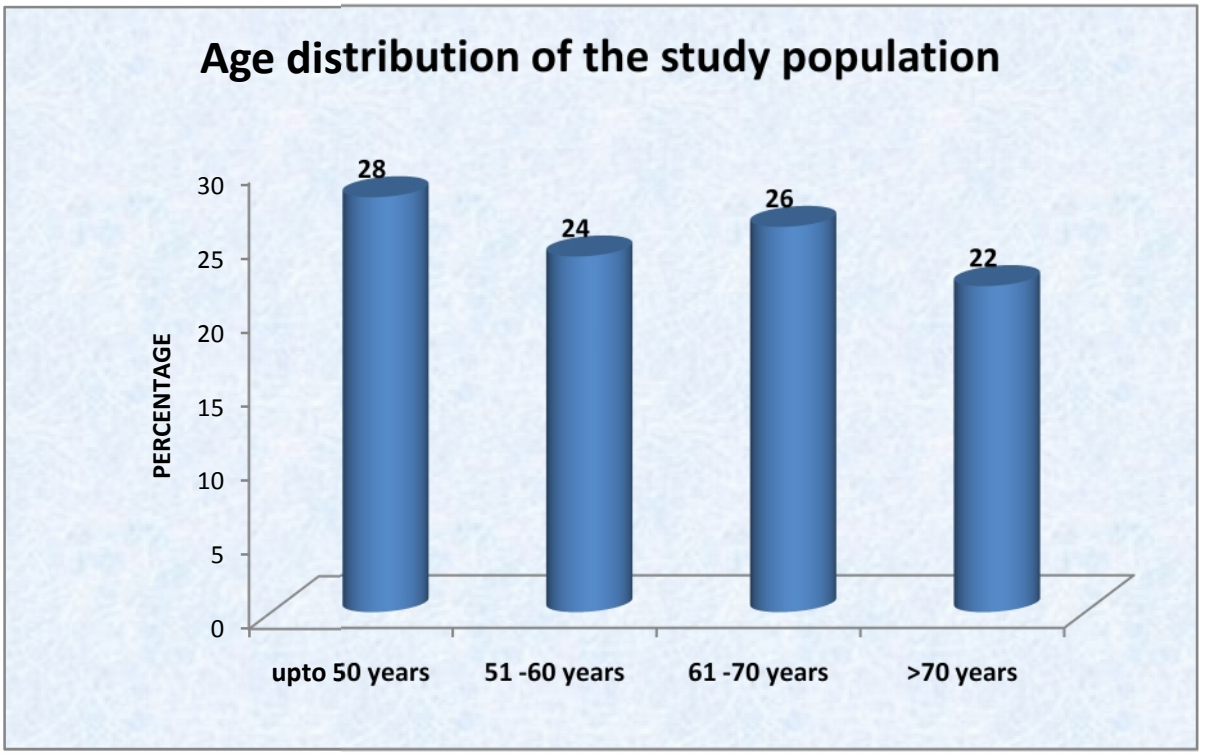
A study on prevalence of hyponatremia and its outcome on mortality in acute coronary syndrome was studied during the period of September 2018 to August 2019 at Government Vellore Medical College, Vellore. Results and analysis of the study are follows:

Analysis done using SPSS Software

TABLE 4: AGE DISTRIBUTION

S.NO	AGE GROUP	NO.OF CASES	% DISTRIBUTION
1	21-30 YEARS	0	0
2	31-40 YEARS	6	66
3	41-50 YEARS	22	22
4	51-60YEARS	24	24
5	61-70YEARS	26	26
6	71-80YEARS	19	19
7	≥ 81 YEARS	3	3
	TOTAL	100	100

GRAPH 1 AGE DISTRIBUTION

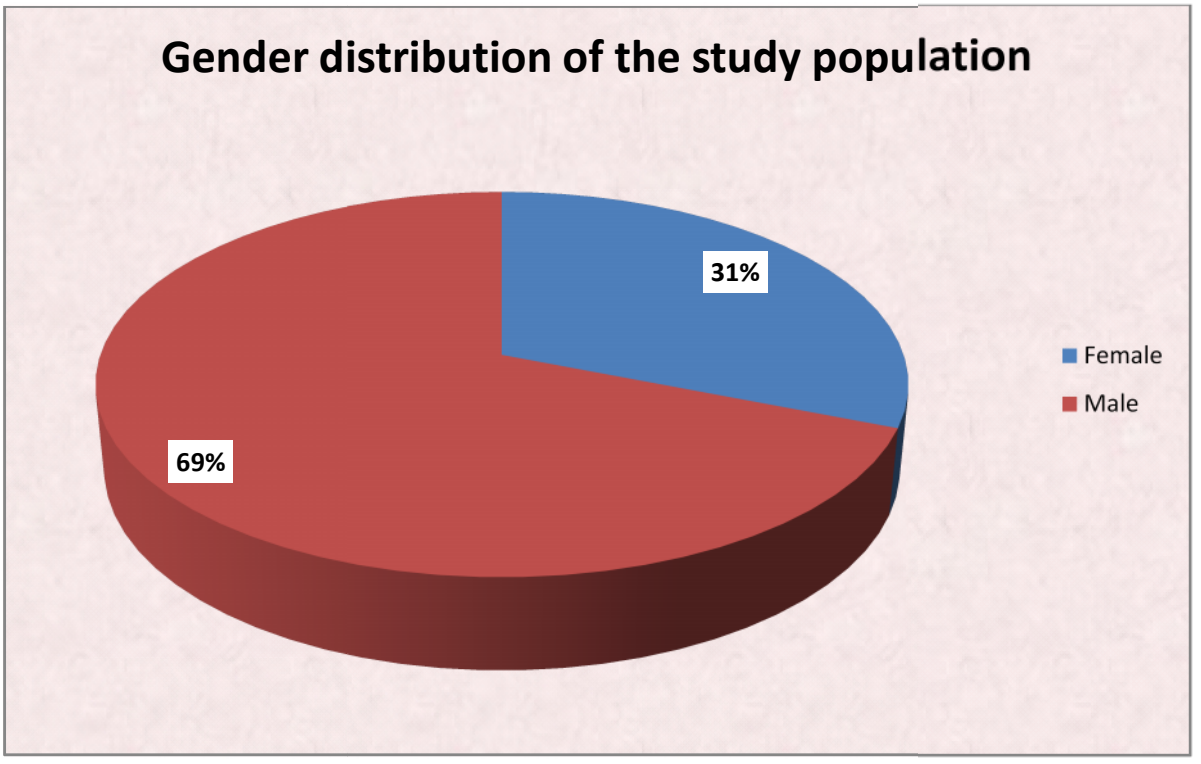


The above table and graph explains the incidence of cases in different age groups. The maximum number of cases is found among the 6th decade group. The minimum incidence is found in the third decade among this study.

TABLE 5: SEX DISTRIBUTION

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	F	31	31.0	31.0	31.0
	M	69	69.0	69.0	100.0
	Total	100	100.0	100.0	

GRAPH 2: SEX DISTRIBUTION



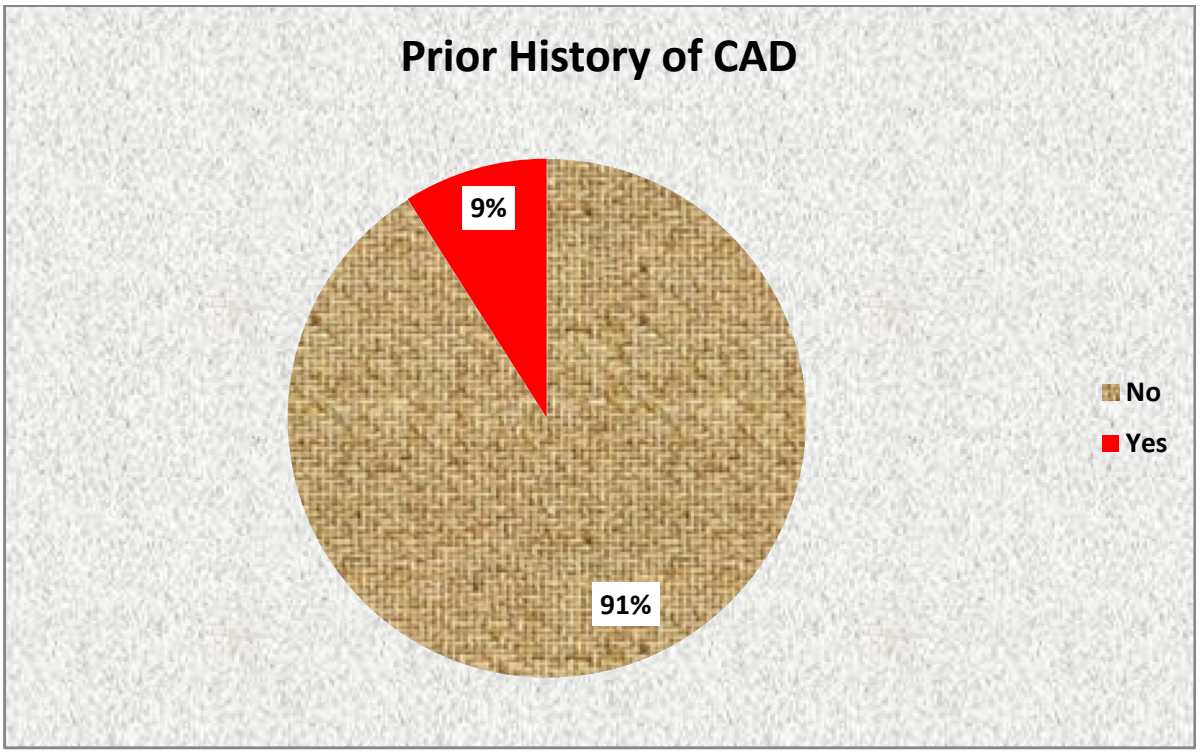
The above table and graph clearly explains the prevalence of CAD is common in males compared to females. In my study 69% were males and 31% were females.

TABLE 6: PREVIOUS HISTORY OF CAD

PRIOR CAD

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	N	91	91.0	91.0	91.0
	Y	9	9.0	9.0	100.0
	Total	100	100.0	100.0	

GRAPH – 3 PRIOR HISTORY OF CAD

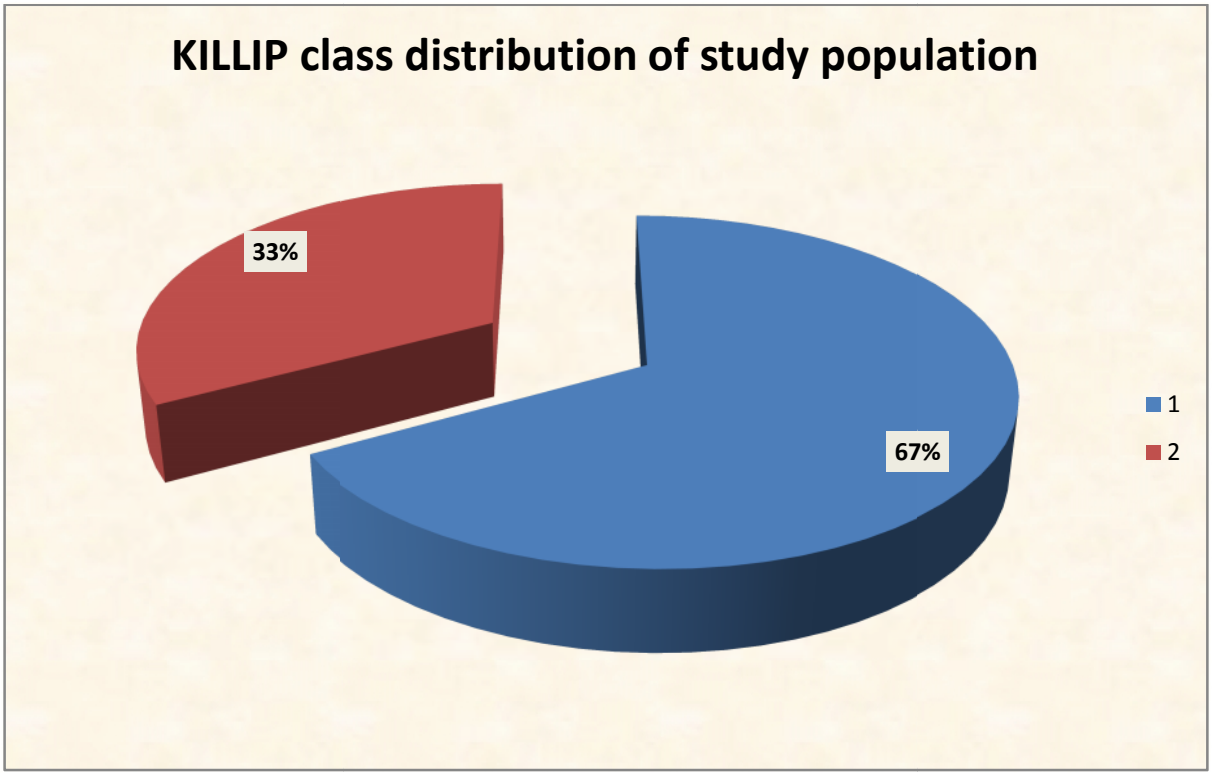


The above table and graph explains the previous history of CAD of patients in my study. 9 % of patients were detected to have previous history of CAD.

TABLE 7: KILLIP CLASSIFICATION

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	67	67.0	67.0	67.0
	2	33	33.0	33.0	100.0
	Total	100	100.0	100.0	

GRAPH – 5 KILLIP CLASSIFICATION



The above table and pie chart represents the killip classification of acut myocardial infarction. Among the 4 class of killip my patients had only class 1 and class 2, of which 33% were class 2 and remaining 67% had class 1.

TABLE 8: POSITIVITY OF TROPONIN I

TRO I

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid +	100	100.0	100.0	100.0

The study population taken by me was acute coronary syndrome of which every patient had a positive troponin levels. 100% positive troponin levels were illustrated in my study

TABLE 9: DIAGNOSIS OF MI

DIAGNOSIS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	ASMI	16	16.0	16.0	16.0
	AWMI	62	62.0	62.0	78.0
	IPWMI	5	5.0	5.0	83.0
	IWMI	13	13.0	13.0	96.0
	LWMI	4	4.0	4.0	100.0
	Total	100	100.0	100.0	

This table 9 explains the distribution of myocardial infarction of different sites of occlusion. The most common type was the AWMI of which it is 62% and the least common type is LWMI which is only 4% of my study population.

TABLE 10: OUTCOME OF PATIENTS WITH ACUTE MI

O UTCOME

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		93	93.0	93.0	93.0
	2*HB	1	1.0	1.0	94.0
	ACUTE MR	1	1.0	1.0	95.0
	CCF	1	1.0	1.0	96.0
	CHB	1	1.0	1.0	97.0
	PE	1	1.0	1.0	98.0
	VT	2	2.0	2.0	100.0
	Total	100	100.0	100.0	

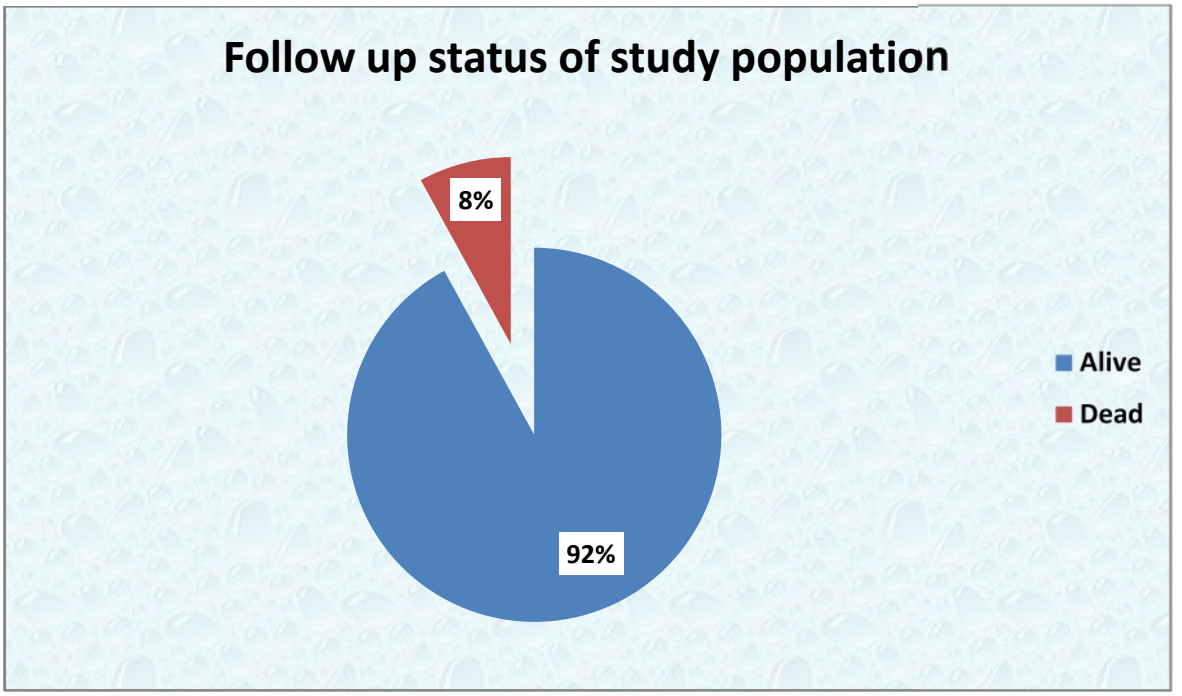
The above table explains the outcome after myocardial infarction. The common complications of myocardial infarction includes second degree heart block, complete heart block, acute MR, CCF, ventricular tachycardia, pulmonary embolism etc. of all these complications, ventricular tachycardia was found among 2 patients in my study.

TABLE 11:

FOLLOW UP

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A	92	92.0	92.0	92.0
	D	8	8.0	8.0	100.0
	Total	100	100.0	100.0	

GRAPH – 5 FOLLOW UP STATUS OF THE STUDY



The above table demonstrates the percentage of mortality in my study. 8% mortality was shown in my study.

TABLE 12: **AGE * SODIUM AT ADMISSION**

			Sodium at Admission		Total
			<135	>=135	
AGE	upto 50 years	Count	3	25	28
		% within AGE	10.7%	89.3%	100.0%
	51 -60 years	Count	1	23	24
		% within AGE	4.2%	95.8%	100.0%
	61 -70 years	Count	7	19	26
		% within AGE	26.9%	73.1%	100.0%
	>70 years	Count	3	19	22
		% within AGE	13.6%	86.4%	100.0%
Total		Count	14	86	100
		% within AGE	14.0%	86.0%	100.0%

P Value – 0.122

The above table analyses the levels of Sodium at admission in different age groups upto 50 years, it is 10.7% of hyponatremia and 89.3% of Normonatremia. 61- 70 years has the maximum of 26.9% of hyponatremia cases.

TABLE 13: . AGE * SODIUM AT 48HRS

			Sodium at48hrs		Total
			<135	>=135	
Age	upto 50 years	Count	1	27	28
		% within AGE	3.6%	96.4%	100.0%
	51 -60 years	Count	0	24	24
		% within AGE	0.0%	100.0%	100.0%
	61 -70 years	Count	2	23	25
		% within AGE	8.0%	92.0%	100.0%
	>70 years	Count	2	20	22
		% within AGE	9.1%	90.9%	100.0%
Total		Count	5	94	99
		% within AGE	5.1%	94.9%	100.0%

P Value – 0.456

The above table analyses the levels of Sodium at 48 hrs in different age groups upto 50 years, it is 3.6% of hyponatremia and 96.4% of Normonatremia. More than 70 years has the maximum of 9.1% of hyponatremia cases.

TABLE 14: . AGE * SODIUM AT DISCHARGE

			Sodium at discharge		Total
			<135	>=135	
Age	upto 50 years	Count	0	28	28
		% within AGE	0.0%	100.0%	100.0%
	51 -60 years	Count	1	23	24
		% within AGE	4.2%	95.8%	100.0%
	61 -70 years	Count	2	24	26
		% within AGE	7.7%	92.3%	100.0%
	>70 years	Count	4	18	22
		% within AGE	18.2%	81.8%	100.0%
Total		Count	7	93	100
		% within AGE	7.0%	93.0%	100.0%

P Value – 0.084

The above table analyses the levels of Sodium at discharge in different age groups upto 50 years, it is 0.0% of hyponatremia and 100% of Normonatremia. More than 70 years has the maximum of 18.2% of hyponatremia cases.

TABLE 15: SEX * . SODIUM AT ADMISSION

			Sodium at Admission		Total
			<135	>=135	
SEX	F	Count	4	27	31
		% within SEX	12.9%	87.1%	100.0%
	M	Count	10	59	69
		% within SEX	14.5%	85.5%	100.0%
Total		Count	14	86	100
		% within SEX	14.0%	86.0%	100.0%

P Value – 0.832

The above table analyses the levels of Sodium at admission with both male and female. Among 31 females, 4 presented hyponatremia. Among 69 males, 10 presented hyponatremia.

TABLE 16: SEX * SODIUM AT 48HRS

			Sodium at48hrs		Total
			<135	>=135	
SEX	F	Count	1	30	31
		% within SEX	3.2%	96.8%	100.0%
	M	Count	4	64	68
		% within SEX	5.9%	94.1%	100.0%
Total		Count	5	94	99
		% within SEX	5.1%	94.9%	100.0%

P Value – 0.576

The above table analyses the levels of Sodium at 48 hrs with both male and female. Among 31 females, 1 presented hyponatremia. Among 69 males, 4 presented hyponatremia.

TABLE 17: SEX * SODIUM AT DISCHARGE

			Sodium at Discharge		Total
			<135	>=135	
SEX	F	Count	1	30	31
		% within SEX	3.2%	96.8%	100.0%
	M	Count	6	63	69
		% within SEX	8.7%	91.3%	100.0%
Total		Count	7	93	100
		% within SEX	7.0%	93.0%	100.0%

P Value – 0.321

The above table analyses the levels of Sodium at discharge with both male and female. Among 31 females, 1 presented hyponatremia. Among 69 males, 6 presented hyponatremia.

TABLE 18: PRIOR CAD * SODIUM AT ADMISSION

			Sodium at Admission		Total
			<135	>=135	
PRIOR CAD	N	Count	13	78	91
		% within PRIOR CAD	14.3%	85.7%	100.0%
	Y	Count	1	8	9
		% within PRIOR CAD	11.1%	88.9%	100.0%
Total		Count	14	86	100
		% within PRIOR CAD	14.0%	86.0%	100.0%

P Value – 0.793

The above table explains history of prior CAD with sodium levels at admission. Among 9 patient with history of prior CAD, 1 patient with hyponatremia.

TABLE 19: PRIOR CAD * SODIUM AT48HRS

			Sodium at 48hrs		Total
			<135	>=135	
PRIOR CAD	N	Count	5	86	91
		% within PRIOR CAD	5.5%	94.5%	100.0%
	Y	Count	0	8	8
		% within PRIOR CAD	0.0%	100.0%	100.0%
Total		Count	5	94	99
		% within PRIOR CAD	5.1%	94.9%	100.0%

P Value – 0.496

The above table explains history of prior CAD with sodium levels at 48 hrs. Among 9 patient with history of prior CAD, no patient with hyponatremia.

TABLE 20: PRIOR CAD * SODIUM AT DISCHARGE

			Sodium at discharge		Total
			<135	>=135	
PRIOR CAD	N	Count	7	84	91
		% within PRIOR CAD	7.7%	92.3%	100.0%
	Y	Count	0	9	9
		% within PRIOR CAD	0.0%	100.0%	100.0%
Total		Count	7	93	100
		% within PRIOR CAD	7.0%	93.0%	100.0%

P Value – 0. 388

The above table explains history of prior CAD with sodium levels at dischage. Among 9 patient with history of prior CAD, no patient with hyponatremia.

TABLE 21: KILLIP CLASS * SODIUM AT ADMISSION

			Sodium at admission		Total
			<135	>=135	
KILLIP CLASS	1	Count	11	56	67
		% within KILLIP CLASS	16.4%	83.6%	100.0%
	2	Count	3	30	33
		% within KILLIP CLASS	9.1%	90.9%	100.0%
Total		Count	14	86	100
		% within KILLIP CLASS	14.0%	86.0%	100.0%

P Value – 0.321

The above table explains history of prior CAD with sodium levels at admission. Among KILLIP Class I -11 patients presented hyponatremia. Among Class II -3 patients presented hyponatremia

TABLE 22: KILLIP CLASS * SODIUM AT 48HRS

			Sodium at 48hrs		Total
			<135	>=135	
KILLIP CLASS	1	Count	2	64	66
		% within KILLIP CLASS	3.0%	97.0%	100.0%
	2	Count	3	30	33
		% within KILLIP CLASS	9.1%	90.9%	100.0%
Total		Count	5	94	99
		% within KILLIP CLASS	5.1%	94.9%	100.0%

P Value – 0.194

The above table explains history of prior CAD with sodium levels at 48 hrs. Among KILLIP Class I -2 patients presented hyponatremia. Among Class II -3 patients presented hyponatremia

TABLE 23: KILLIP CLASS * SODIUM AT DISCHARGE

			Sodium at discharge		Total
			<135	>=135	
KILLIP CLASS	1	Count	5	62	67
		% within KILLIP CLASS	7.5%	92.5%	100.0%
	2	Count	2	31	33
		% within KILLIP CLASS	6.1%	93.9%	100.0%
Total		Count	7	93	100
		% within KILLIP CLASS	7.0%	93.0%	100.0%

P Value – 0.796

The above table explains history of prior CAD with sodium levels at discharge. Among KILLIP Class I -5 patients presented hyponatremia. Among Class II -2 patients presented hyponatremia

TABLE 24: SODIUM AT ADMISSION * DIAG

			DIAG		
			ASMI	AWMI	IPWMI
.Sodium atadmission	<135	Count	4	7	0
		% within Sodium atadmission	28.6%	50.0%	0.0%
	>=135	Count	12	55	5
		% within Sodium atadmission	14.0%	64.0%	5.8%
Total		Count	16	62	5
		% within Sodium atadmission	16.0%	62.0%	5.0%

			DIAG		Total
			IWMI	LWMI	
Sodium at admission	<135	Count	3	0	14
		% within .Sodium atadmission	21.4%	0.0%	100.0%
	>=135	Count	10	4	86
		% within .Sodium atadmission	11.6%	4.7%	100.0%
Total		Count	13	4	100
		% within .Sodium atadmission	13.0%	4.0%	100.0%

P Value – 0.362

TABLE 25: SODIUM AT ADMISSION * OUTCOME

			OUTCOME		
				2*HB	ACUTE MR
Sodium at admission	<135	Count	11	0	1
		% within Sodium at admission	78.6%	0.0%	7.1%
	>=135	Count	82	1	0
		% within Sodium at admission	95.3%	1.2%	0.0%
Total		Count	93	1	1
		% within Sodium at admission	93.0%	1.0%	1.0%

			OUTCOME		
			CCF	CHB	PE
Sodium at admission	<135	Count	0	1	0
		% within Sodium at admission	0.0%	7.1%	0.0%
	>=135	Count	1	0	1
		% within Sodium at admission	1.2%	0.0%	1.2%
Total		Count	1	1	1
		% within Sodium at admission	1.0%	1.0%	1.0%

			OUTCOME	Total
			VT	
Sodium at admission	<135	Count	1	14
		% within Sodium at admission	7.1%	100.0%
	>=135	Count	1	86
		% within Sodium at admission	1.2%	100.0%
Total		Count	2	100
		% within Sodium at admission	2.0%	100.0%

P Value – 0.018

The above table compares the sodium levels at admission with outcome of patients presented with Acute Coronary Syndrome.

TABLE 26: SODIUM AT48 HRS * DIAGNOSIS

Crosstab						
			DIAG			
			ASMI	AWMI	IPWMI	IWMI
Sodium at 48hrs	<135	Count	2	2	1	0
		% within Sodium at48hrs	40.0%	40.0%	20.0%	0.0%
	>=135	Count	14	60	4	12
		% within Sodium at48hrs	14.9%	63.8%	4.3%	12.8%
Total		Count	16	62	5	12
		% within Sodium at48hrs	16.2%	62.6%	5.1%	12.1%

			DIAG	Total
			LWMI	
Sodium at 48hrs	<135	Count	0	5
		% within Sodium at 48hrs	0.0%	100.0%
	>=135	Count	4	94
		% within Sodium at 48hrs	4.3%	100.0%
Total		Count	4	99
		% within Sodium at 48hrs	4.0%	100.0%

P Value – 0.243

TABLE 27: SODIUM AT48 HRS * OUTCOME

			OUTCOME		
				2*HB	ACUTE MR
Sodium at 48hrs	<135	Count	5	0	0
		% within Sodium at 48hrs	100.0%	0.0%	0.0%
	>=135	Count	87	1	1
		% within Sodium at 48hrs	92.6%	1.1%	1.1%
Total		Count	92	1	1
		% within Sodium at 48hrs	92.9%	1.0%	1.0%

			OUTCOME			
			CCF	CHB	PE	VT
Sodium at 48hrs	<135	Count	0	0	0	0
		% within Sodium at 48hrs	0.0%	0.0%	0.0%	0.0%
	>=135	Count	1	1	1	2
		% within Sodium at 48hrs	1.1%	1.1%	1.1%	2.1%
Total		Count	1	1	1	2
		% within Sodium at 48hrs	1.0%	1.0%	1.0%	2.0%

			Total
Sodium at 48hrs	<135	Count	5
		% within Sodium at 48hrs	100.0%
	>=135	Count	94
		% within Sodium at 48hrs	100.0%
Total		Count	99
		% within Sodium at 48hrs	100.0%

P Value – 0.999

TABLE 28: SODIUM AT DISCHARGE * DIAGNOSIS

			DIAG		
			ASMI	AWMI	IPWMI
Sodium at discharge	<135	Count	4	3	0
		% within Sodium at discharge	57.1%	42.9%	0.0%
	>=135	Count	12	59	5
		% within Sodium at discharge	12.9%	63.4%	5.4%
Total		Count	16	62	5
		% within Sodium at discharge	16.0%	62.0%	5.0%

			DIAG		Total
			IWMI	LWMI	
Sodium at discharge	<135	Count	0	0	7
		% within Sodium at discharge	0.0%	0.0%	100.0%
	>=135	Count	13	4	93
		% within Sodium at discharge	14.0%	4.3%	100.0%
Total		Count	13	4	100
		% within Sodium at discharge	13.0%	4.0%	100.0%

P Value – 0.039

TABLE 29: SODIUM AT DISCHARGE * OUTCOME

			OUTCOME		
				2*HB	ACUTE MR
Sodium at discharge	<135	Count	6	0	0
		% within Sodium at discharge	85.7%	0.0%	0.0%
	>=135	Count	87	1	1
		% within Sodium at discharge	93.5%	1.1%	1.1%
Total		Count	93	1	1
		% within Sodium at discharge	93.0%	1.0%	1.0%

			OUTCOME		
			CCF	CHB	PE
Sodium at discharge	<135	Count	0	0	0
		% within Sodium at discharge	0.0%	0.0%	0.0%
	>=135	Count	1	1	1
		% within Sodium at discharge	1.1%	1.1%	1.1%
Total		Count	1	1	1
		% within Sodium at discharge	1.0%	1.0%	1.0%

			OUTCOME	Total
			VT	
Sodium at discharge	<135	Count	1	7
		% within Sodium at discharge	14.3%	100.0%
	>=135	Count	1	93
		% within Sodium at discharge	1.1%	100.0%
Total		Count	2	100
		% within Sodium at discharge	2.0%	100.0%

P Value – 0.412

The above tables compares the sodium levels at admission, at 48 hrs and at discharge with the outcome of patients presented with Acute Coronary Syndrome.

TABLE 30: SODIUM AT ADMISSION * FOLLOW UP

			FOLLOW UP		Total
			A	D	
Sodium at admission	<135	Count	10	4	14
		% within Sodium at admission	71.4%	28.6%	100.0%
	>=135	Count	82	4	86
		% within Sodium at admission	95.3%	4.7%	100.0%
Total		Count	92	8	100
		% within Sodium at admission	92.0%	8.0%	100.0%

P Value - 0.002

Table 31 SODIUM AT 48HRS * FOLLOW UP

			FOLLOW UP		Total
			A	D	
Sodium at 48hrs	<135	Count	1	4	5
		% within Sodium at 48hrs	20.0%	80.0%	100.0%
	>=135	Count	90	4	94
		% within Sodium at 48hrs	95.7%	4.3%	100.0%
Total		Count	91	8	99
		% within Sodium at 48hrs	91.9%	8.1%	100.0%

P Value – 0.000

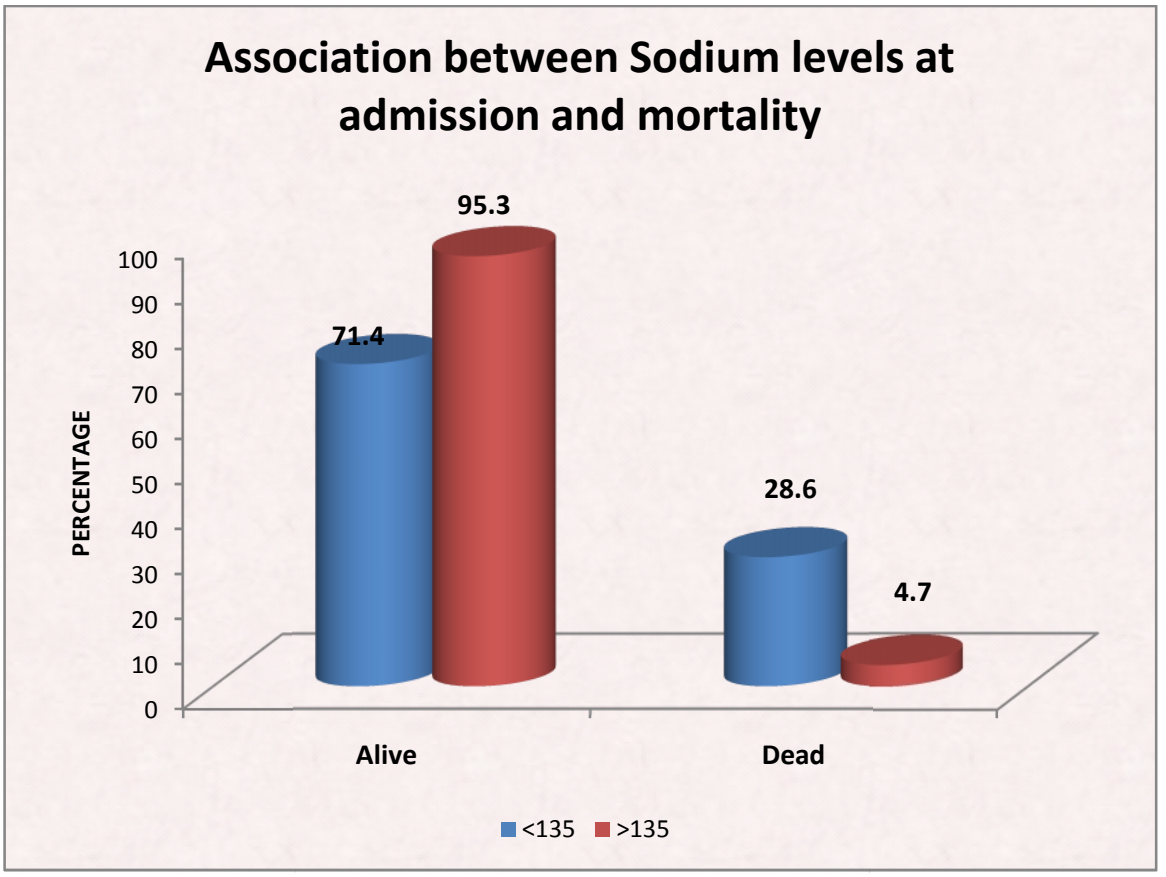
TABLE 31: SODIUM AT DISCHARGE * FOLLOW UP

			FOLLOW UP		Total
			A	D	
Sodium atdischarge	<135	Count	3	4	7
		% within Sodium at discharge	42.9%	57.1%	100.0%
	>=135	Count	89	4	93
		% within Sodium at discharge	95.7%	4.3%	100.0%
Total		Count	92	8	100
		% within Sodium at discharge	92.0%	8.0%	100.0%

P Value – 0.000

The above tables compares the sodium levels at admission, at 48 hrs and at discharge with follow up data. Of the 7 hyponatremia patients 3 were alive and 4 patients was dead.

GRAPH 7 : ASSOCIATION OF HYPONATREMIA AND MORTALITY



The above graph explains the association of sodium levels of admission and the mortality rate. 71.4% of people presented with less than 135 sodium level of which 28.6% were dead. 95.3% of people presented with sodium level >135 of which 4.7% were dead. Therefore the mortality rate of hyponatremia was higher compared to normonatremia

DISCUSSION

Acute coronary syndrome is an important cause of mortality and morbidity in the world. 100 cases of acute coronary syndrome was selected in our study conducted in Government Medical College, Vellore, from 2018 to 2019 and was found that hyponatremia was a major prognostic factor in acute myocardial infarction.

AGE AND MYOCARDIAL INFARCTION:

In my study 28 patients below 50 years presented with acute myocardial infarction, among which 6 were below 40 years. It is relatively a small proportion of all MI. Studies show that 900 people under the age of 30 die every day from heart disease in India[10]. Many risk factors like psychological stress, cocaine use, alcohol, APLA, family history, OCP, hypercoagulable states, etc have been attributed to the cause.

SEX PREDILECTION IN ACUTE CORONARY SYNDROME:

In my study, the incidence of male and female were 69 and 31 respectively among the 100 patients. The incidence is higher in males as compared to females.

HYPONATREMIA IN ACUTE CORONARY SYNDROME:

Hyponatremia is well known that it is a serum Sodium at level <135 mEq/L. The severity of hyponatremia was defined as mid(130-135mEq/L) and moderate to severe(<130mEq/L). serum Sodium at levels were documented as follows: baseline

measurement at the day of admission, the lowest Sodium at level during hospitalization i.e after 48 hrs of admission and during discharge.

[33]Goldberg et al suggested that hyponatremia on admission or shortly thereafter is an independent predictor of short term and long term mortality in STEMI.

Klopotowski et al investigated about the in hospital outcomes of Sodium at level on admission in STEMI patients treated with primary angioplasty.

Alexander,C et al showed in their study proved that acute STEMI patients with no evidence of hyponatremia developed mortality rate of 6.2% and patients with hyponatremia on admission had a mortality rate of 19.8% and hyponatremia developed after admission had a mortality of 16.8%.

[57]Flear CT et al conducted a similar study in patients with acute myocardial infarction and absorbed that when plasma Sodium at was <130mEq/l the mortality was found to be higher in intensive coronary care units.

We also observed that mortality was found to be increased in patients with hyponatremia in our study. Within 30 days of admission there were total of deaths about 9% (9 patients). In this 2.8% (2/71)of patients presented without hyponatremia, 27.5% (3/11) of patients who presented with hyponatremia at the time of admission and 16.67% (3/18) of patients who developed hyponaremia within 72 hours of admission.

[57]Flear CT, Hilton P22 in their study in patients who were admitted in a coronary care unit, concluded that the presence of hyponaetremia, hypochloraemia, and also uraemia were common in patients who were confirmed to have myocardial infarction. The degree of the infarct correlated with all the above indices. In hospital mortality rates of patients with hyponaetremia was higher in their study22.

[32]Szatalowicz et al have shown that the presence of AVP is essential for development of hyponatremia and also that AVP levels were detectable in 30 of 37 patients with CHF63.

[55]Siggurdson, Swedberg in their study conducted on 55 patients with acute MI have concluded that the sustained neurohormonal activation that follows MI usually occurs in patients in whom there is clinical heart failure and is also related to the magnitude of the myocardium that is damaged , even in patients without heart failure20.

[33]Goldberg et al in their study of 978 patients have concluded early hyponatremia is a simple marker of the neurohormonal activation that occurs during acute phase of MI and is a predictor of the long-term mortality.

[34]Rouleau JL et al in their study of 534 patients found that the presence of neurohormonal activation even at the time of discharge from the hospital in post MI patients is also by itself a sign of bad prognosis.

[56]Bogdan et al concluded in his study that presence of hyponatremia is more prevalent in the first 3 days of acute MI.

Kloptowski et al reported that the patients with acute MI develop hyponatremia on admission or within 48 hours of admission usually causing higher mortality rate.

CONCLUSION

In conclusion, hyponatremia has a significant prognostic value in short term and long term adverse events in patients diagnosed with acute myocardial infarction

It is a single strong predictive factor for prognosis of acute coronary syndrome. Prognosis worsens with increasing severity of hyponatremia.

The repeated monitoring of serum Sodium at levels will help physicians to identify high risk ACS patients earlier and they can stratify the risk for a better management.

In the conclusion of my study at follow up the percentage of mortality was highest among hyponatremia patients, both at admission and discharge.

Among the patients in my study hyponatremia was more common in the 6th decade without any previous illness like diabetes mellitus, chronic kidney disease or heart failure. The common causes of hyponatremia was ruled out of which acute myocardial infarction was the only cause for hyponatremia in the study population.

The study finally suggest that hyponatremia can be taken as a predictor for the prognosis in acute coronary syndrome which also has references among many studies done across the world.

BIBLIOGRAPHY

1. Antman EM, Braunwald E. ST segment elevation mycocardial Infarction In: Zipes, Libby, Bonow, Braunwald editors. Braunwalds heart disease a text book of cardiovascular medicine.7th edition. Philadelphia: Elsevier Saunders; 2005. p.1141-1142.
2. Anderson RJ, Chung HM, Kluge R, Schrier RW. Hyponatremia**:** a prospective analysis of its epidemiology and the pathogenetic role of vasopressin**.** Ann Intern Med. 1985 Feb; 102(2):164-8
3. Chung HM, Kluge R, Schrier RW Anderson RJ. Postoperative hyponatremia, A prospective study. Arch Intern Med. 1986; 146:333-336
4. Kluge R. Body fluid volume regulation in health and disease: unifying hypothesis. Ann Intern Med.1990; 113:155-159
5. Schrier RW, Abraham WT. Hormones and hemodynamics in heart failure. N Engl J Med.1999; 341:577-585
6. Lee WH, Packer M. Prognostic importance of serum Sodium at concentration And its modification by converting-enzyme inhibition in patients with severe Chronic hyponatremia. 1986; 73:257-267
7. Saxon LA, Stevenson WG, Middlekauff HR, et al. Predicting death from Progressive heart failure secondary to ischemic or idiopathic dilated cardiomyopathy. Am J Cardiol.1993; 72:62-65
8. Sigurdsson A, Held P, Swedberg K. Short- and long-term neurohormonal activation following acute myocardial infarction. Am Heart J.1993; 126:1068-1076.

9. Flear CT, Hilton P. Hyponatremia and severity and outcome of myocardial infarction. BMJ. 1979; 1: 1242-1246.
10. Oren RM. Hyponatremia in congestive heart failure. Am J Cardiol.2005; 95:2B-7B.
11. Agur AMR, Dalley AF. Grants Atlas of Anatomy. 11th edition. Baltimore: Lippincott Williams and Wilkins; 2005. p. 46, 47, 52.
12. Sethi KK. Ischemic Heart disease. In : Shash SN, Anand MP, Acharya VN, bichile SK, Karnad DR, Kamath SA, et al editors. API Text Book of Medicine. 7th editionn. Mumbai: API; 2003. p 432.
13. Gazino JM. Global burden of cardiovascular disease. In: Zipes, Libby, Bonow, Braunwald editors. Brauwnwalds Heart disease a text book of cardiovascular medicine. 7th edition. Philadelphia: Elsevier Saunders; 2005. P.11.
14. Sethi KK. Ischemic Heart disease. In : Shash SN, Anand MP, Acharya VN, bichile SK, Karnad DR, Kamath SA, etal editors. API Text Book of Medicine. 8th edition. Mumbai: API; 2003. p 433
15. Pahlajani DB. Myocardial infarction. In : Shash SN, Anand MP, Acharya VN, Bichile SK, Karnad DR, Kamath SA, etal editors. API Text Book of Medicine. 7th edition. Mumbai: API; 2003.p.441.
16. Antman EM, Braunwald E. ST segment elevation Myocardial infarction. In: Kasper, Brounwald, Fauci, Hauser, Longo, and Jameson editors. Harrison's Principles of Internal Medicine vol- 2.16th edn. Newyork: McGraw Hill; 2005.

17. Mirvis DM, Goldberger AL. Electrocardiography. In: Zipes, Libby, Bonow, Braunwald editors. Braunwalds Heart disease a text book of cardiovascular medicine. 7th edn. Philadelphia: Elsevier Saunders; 2005. p. 131-132
18. Cannon PC, Braunwald E. Unstable angina and Non ST Elevation MI. In: Kasper, Braunwald, Fauci, Hauser, Longo, and Jameson editors. Harrison's principles of Internal Medicine vol - 2.16 th edn. Newyork: McGraw Hill; 2005. p. 1444-1447.
19. Biswas M, Davies JS. Hyponatremia in clinical practice. Post grad Med J 2007; 83:373-378.
20. Saeed BO, Beaumont D, Handley JH, Weaver JU. Severe hyponatremia: investigation and management in district general hospital. Journal of Clinc Patho 2002; 55:893-896.
21. Kennedy PG, Mitchell DM, Hoff brand BI. Severe hyponatremia in hospital inpatients. BMJ 1978;2:1251-1253,
22. Singer GG, Brenner BM. Fluid and electrolyte disturbances. In: Kasper, Braunwald, Fauci, Hauser, Longo, and Jameson editors. Harrison's principles of Internal Medicine vol - 1.16th edn. Newyork: McGraw Hill; 2005.p. 254-256.
23. Adrogue HJ, Madias NE. Hyponatremia. N Engl J Med 2000; 342:1581-1589.
24. Rowe JW, Shelton RL, Helderman JH. Influence of the emetic reflex on vasopressin release in man. Kidney Int. 1979; 16:729- 735.

25. Mcalpine HM, Morton JJ, Leckie B, Rumley A, Gillen G, Dargie HJ. Neuroendocrine activation after acute myocardial infarction. Br Heart J 1988; 60:117-124.

26. Schaller MD, Nussberger J, Feihl F. Clinical and hemodynamic correlates of elevated plasma arginine vasopressin after acute myocardial infarction. Am J Cardiol 1987; 60:1178-1180.

27. Schrier RW, Berl T, Anderson RJ. Osmotic and nonosmotic control of vasopressin release. Am J Physiol 1979; 236:321-332.

28. Kumar S, Berl T. Sodium at. Lancet 1998; 352:220-228.

29. Cohn JN, Levine TB, Olivari MT. plasma nor epinephrine as a guide to prognosis in patients with chronic congestive heart failure. N Engl J Med 1984; 311:819-823.

30. Dzau VJ, Colucci WS, Hollenberg NK, Williams GH. Relation of rennin angiotension aldosterone system to clinical state in congestive heart failure. Circulation 1981; 63:645-651.

31. Schaer GL, Covit AB, Laragh JH, Cody RJ. Association of hyponatremia with increased rennin activity in chronic congestive heart failure: impact of diuretic therapy. Am J Cardiol 1983; 51:1635-1638.

32. Szatalowicz VL, Arnold PE, Chaimotivz C, Bichet D, Berl T, Schrier RW. Radioimmunoassay of plasma arginine vasopressin in hyponatremia patients with congestive heart failure. N Engl J Med. 1981;305:263-266

33. Rouleau JL, Packer M, Moye L, Champalain J, Bichet D, Klein M et al. Prognostic value of neurohumoral activation in patients with an acute myocardial infarction: effect of captopril. J Am Coll Cardiol 1994; 24:583-91.

34. Goldberg A, Hammerman H, Petcherski S. Zdorovyak A, Yalonetsky S.Kapeliovich M. Prognostic importance of hyponatremia in acute ST-elevation myocardial infarction. Am J Med. 2004; 117:242-248.

35. Lopez AD, Mathers CD, Ezatti M, et al .Global and regional burden of disease and risk factors2001: systematic analysis of population health data, Lancet 2006;367:1747-57

36. Castelli WP.Epidemiology of coronary heart disease; the Framingham study. Am J Med 1984 : 27 : 4 – 12.

37. Roger's WJ, Canto JG et.al., Temporal trends in the treatment of over 1.5 million patients with Myocardial Infarction in the US from 1990 through 1999. The national registry of Myocardial Infarction 1,2&3. J.Am.Coll Cardiol 36 ; 2056;2000.

38. Reddy KS, Cardiovascular disease in non -Western countries NEngl J Med 2004;350(24):2438-40

39. Ghaffer A, Reddy KS, Singhi M. Burden of non- communicable diseases in South Asia BMJ 2004; 328:807-10

40. Mohan V , Deepa R, Rani SS, Premlatha G. prevalence coronary artery disease and its relationship to lipids in selected population in South India .The Chennai Urban Population Study (CUPS No 5) J Am coll Cardiol 2001;38:682-8

41. Joshi P, Islam S,PaisP,etal. Risk factors for early myocardial infarction in South Asians compared with individuals in other countries JAMA 2007;297:286-9
42. Pais P, Xavier D, Gupta R, et al .Treatment and outcome of acute coronary syndrome in India the (CREATE):a prospective analysis of registry data Lancet 2008;371:1435-42
43. Brown N, Young T, Gray D etal. Inpatient deaths from acute myocardial infarction 1982-1992: analysis of data in Nottingham heart attack register BMJ1997;315:159-164
44. Every NR, Freiderick PD, Robinson M, et al .A comparison of the National registry of myocardial infarction -2 with the co-operative cardiovascular project J Am Coll Cardiol 1999;33:1886-94
45. .ZeymerU , Senges J. Why do we need prospective registries in patients with myocardial infarction Eu heart J 2003;24:1611-12
46. V Jacob Jose ,Satya N Gupta et al Morbidity and mortality of acute ST segment elevation myocardial infarction in the current era Indian Heart J2004;56:210-14
47. Upadhyay A, Jaber BL, Madias NE. Incidence and prevalence of hyponatremia. Am J Med. 2006;119(7 Suppl 1):S30-S35.
48. Clayton JA, Le Jeune IR, Hall IP. Severe hyponatraemia in medical in patients: aetiology, assessment and outcome. QJM. 2006;99:505-511

49. Zilberberg MD, Exuzides A, Spalding J, et al. Epidemiology, clinical and economic outcomes of admission hyponatremia among hospitalized patients. Curr Med Res Opin. 2008;24:1601-1608.
50. Chung HM, Kluge R, Schrier RW Anderson RJ. Postoperative hyponatremia.A prospective study. Arch Intern Med. 1986;146:333-336
51. Schrier RW, Abraham WT. Hormones and hemodynamics in heart failure. NEngl J Med.1999;341:577-585
52. Lee WH, Packer M. Prognostic importance of serum Sodium at concentration and its modification by converting-enzyme inhibition in patients with severe chronic Hyponatremia. Circulation. 1986;73:257-267
53. Saxon LA, Stevenson WG, Middlekauff HR, et al. Predicting death from progressive heart failure secondary to ischemic or idiopathic dilated cardiomyopathy. Am J Cardiol.1993;72:62-65
54. Sigurdsson A, Held P, Swedberg K. Short- and long-term neurohormonal activation following acute myocardial infarction. Am Heart J.1993; 126:1068-1076.
55. Bogdan M,Nartowicz E,Magnesium,potassium and Sodium at in acute MI kardiol pol 1993;38:263-266
56. Flear CT, Hilton P. Hyponatremia and severity and outcome of myocardial infarction. BMJ. 1979; 1: 1242-1246.
57. Oren RM. Hyponatremia in congestive heart failure. Am J Cardiol.2005;95:2B-7

59. Lee DS, Austin PC, Rouleau JL, Liu PP, Naimark D, Tu JV. Predicting mortality among patients hospitalized for heart failure: derivation and validation of a clinical model. JAMA 2003;290:2581–2587.

60. Klein L, O'Connor CM, Leimberger JD, et al. Lower serum Sodium at is associated with increased short-term mortality in hospitalized patients with worsening heart failure: results from the Outcomes of a Prospective Trial of Intravenous Milrinone for Exacerbations of Chronic Heart Failure (OPTIME-CHF) Study. Circulation.2005;111:2454-246

61. Gazino JM. Global burden of cardiovascular disease. In: Zipes, Libby, Bonow,Braunwald editors. Brauwnwalds Heart disease, a text book of cardiovascular medicine. 8th edn. Philadelphia: Elsevier Saunders; 2008. Part 1 p.1-13

62. Sethi KK. Ischemic Heart disease. In : siddharth N Shash , M Paul Anand , Aspi R.Billimoria, et al editors. API Text Book of Medicine. 8th edn. Mumbai: API; 2008. p 50

63. A.Fuster V, Badimon L, Badimon JJ, Chesebro JH. The pathogenesis of coronary artery disease and the acute coronary syndromes. Part 1. N Engl J Med 1992:326;242–250.

64. Fuster V, Moreno PR, Fayad ZA, Corti R, Badimon JS. Atherothrombosis and high-risk plaque: part 1: evolving concepts. J Am Coll Cardiol 2005;46:937–954.

PROFORMA

NAME: IP. NO:

AGE: DOA:

SEX: DOD:

OCCUPATION :

RELIGION :

MARITAL STATUS:

ADDRESS :

TELEPHONE NO:

STATUS AT DISCHARGE

I. HISTORY OF PRESENTING ILLNESS:

A. CHEST PAIN:

- Site: Precordial/ Restrosternal Epigastric/ Shoulder/ Neck
- Time of onset:
- Nature: Squeezing/ Crushing/ Compressive/ Tightness
- Radiation: Arm/ Back/ Epigastric/ Neck
- Frequency:
- Severity
- Aggravating Factor:
- Relieving Factor:
- Associated sweating:

B. BREATHLESSNESS:

- Onset: Sudden/ Gradual
- Grade: I/II/III/IV
- H/O Orthopnea: Yes/ No
- Wheeze: Present/ Absent
- H/O

PND:

Yes/No

Associated

symptoms

C. COUGH

- Onset: acute insidious
- Productive/ Non Productive
- Sputum: Quantity
- Quality
- Colour

- Postural Variation
- Haemoptysis: Yes/ NO

D. PALPATION

- Onset: Acute/ Insidious
- Duration
- Nature: intermittent/ continuous
- Aggravating Factors: Exertion/ Excitement
- Relieving Factors

E. PRESYNCOPE/ SYNCOPE

- Related to exertion : Yes
- Postural relation :

  Erect Supine
- Frequency :

  Isolated Frequent
- Loss of consciousness :

  Yes No
- Others :

F. SWELLING OF LEGS/ FACE

- Onset: Acute/ Insidious
- Duration:
- Associated with pain: yes/ No
- Diurnal Variation: Yes /No

G. NAUSEA /VOMITING

H. MISCELLANEOUS Present Absent

- General weakness/ Fatigue
- Altered sensorium
- Oliguria
- Convulsion
- Others

II. PAST HISTORY

- Past history : Present/Absent
- Duration

- Treatment

- IHD –Angina
- Infarction
- Hypertension
- Diabetes
- Rheumatic
- Syphilis
- Vascular heart disease
- TIA/ Stroke
- Any other

III. PERSONAL HISTORY

1. Diet	Vegetarian	Mixed
2. Sleep	Sound	Disturbed
3. Appetite	Good	Decreased
4. Bladder	Normal	Polyuria/ Anuria/Dysuria
5. Bowel	Normal	Constipated /Loose stools
6. Menstrual history	Normal /Irregular	

7. Postmenopausal

8. Habits

a) Smoking : Duration

b) Alcohol : Duration Type Quantity

c) Tobacco Chewing: Duration

Quantity

d) History of exposure to STD: Present/ Absent

IV. GENERAL PHYSICAL EXAMINATION

1) Built	Well/Moderate	Poor
2) Nourishment	Obese/Average	Poor
3) Emotional state	Calm/Anxious	Restless
4) Pallor	Present/ Absent	
5) Cyanosis	Present/ Absent	
6) Icterus	Present/ Absent	
7) Clubbing	Present/ Absent	
8) Pedal oedema	Present/ Absent	
9) Lymphadenopathy	Present/ Absent	
10) Extremities	Warm/ Cold	

VITAL SIGNS

-Pulse

-Blood pressure

-Respiratory rate

-Temperature

V. SYSTEMIC EXAMINATION

CVS EXAMINATION

1) Pulse

-Rate

-Rhythm

-Volume

-Character

-Condition of Vessel Wall

-Radio Femoral Delay

2) JVP –Normal /Raised

A. INSPECTION

Precordium Normal/Bulged

Apical impulse Visible /

Non Visible Other pulsation

B. PALPATION

Apical impulse Location, Character

Palpable Heart Sounds

Thrills Apex

Parasternal area

Any other

C. PERCUSSION

Cardiomegaly

Pericardial effusion

D. AUSCULTATION

Heart sounds

S3/S4 Present/ Absent

Murmur

Timing/Location/Character/Radiation/Grade

Pericardial rub Basal crepitations

Others

KILLIP CLASS:

RESPIRATORY SYSTEM:

PER ABDOMEN:

CENTRAL NERVOUS SYSTEM

INVESTIGATIONS

I. BLOOD

II.URINE

III.BIOCHEMISTRY

IV.ELECTROCARDIOGRAPHY

V. ECHOCARDIOGRAPHY

PATIENT CONSENT FORM

STUDY DETAIL:

STUDY CENTRE:

PATIENT'S NAME:

PATIENT'S AGE:

IDENTIFICATION NUMBER:

I confirm that I have understood the purpose and procedure of the above study. I have the opportunity to ask questions and all my questions and doubts have been answered to my complete satisfaction.

I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving reason, without my legal rights being affected.

I understand that the sponsor of the clinical study, others working on the sponsor's behalf, the ethical committee and the regulatory authorities will not need my permission to look at my health records, both in respect of the current study and any further research that may be conducted in relation to it, even if I withdraw from the study I agree to this access. However I understand that my identity would not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from this study.

I hereby consent to participate in this study.

I hereby give permission to undergo complete clinical examination and diagnostic tests including haematological, biochemical, radiological tests.

Signature/thumb impression:

Patient's name and address: Place: Date:

Signature of the investigator:

Name of the investigator: Place: Date:

<u>ஒப்புதல்படிவம்</u>

ஆராய்ச்சித்தலைப்பு :

முழுபெயர் :

தந்தை / தாயார்பெயர் :

பிறந்ததேதி / வயது :

I. நான் மேலே குறிப்பிட்டுள்ள ஆராய்ச்சி குறித்த விளக்க உரையை படித்துப்புரிந்து கொண்டேன் என்றும், எனக்கு கேள்விகேட்க வாய்ப்பு அளிக்கப்பட்டது என்றும் உறுதி செய்கிறேன்.

II. நான் இந்த ஆராய்ச்சியில் பங்குபெறுவது தன்னிச்சையானது தான் என்றும், நான் எப்பொழுதுவேண்டுமானாலும், காரணம் ஏதும் தெரிவிக்காமல் இந்த ஆராய்ச்சியிலிருந்து விலக முற்பட எனக்கு அதிகாரம் உண்டு என்றும், அப்படி செய்வதனால் என் சட்டரீதியான மற்றும் சிகிச்சை சம்பந்தப்பட்ட உரிமைகள் பாதிக்கப்படமாட்டாது என்றும் நான் அறிகிறேன்.

III. இந்த ஆராய்ச்சியின் புரவலர் மற்றும் அவர்கள் சார்பாக பணிபுரிபவர்கள் நெறிமுறைகள் குழு மற்றும் கட்டுப்பாட்டு குழுவினர் ஆகியோர், இந்த ஆராய்ச்சியின் போதும், பின்னர் இதன் சம்பந்தமாக வேறு ஆராய்ச்சி செய்யும்போதும், என் சம்பந்தப்பட்ட சிகிச்சை விவரங்களை மேலும் என் அனுமதி இன்றி காண அனுமதி அளிக்கிறேன். மூன்றாம் நபர்களுக்கு இந்த ஆராய்ச்சியை பற்றி விளக்கும் போதும், இந்த ஆராய்ச்சியின் முடிவுகளை பிரசுரிக்கும் போதும் என் அடையாளம் வெளியிடப்படமாட்டாது என்றும் நான் அறிகிறேன்.

IV. இந்த ஆராய்ச்சியின் மூலம் அறியப்படும் விஷயங்கள் மற்றும் முடிவுகள் அறிவியல் சார்ந்த காரணங்களுக்காக வெளியிடப் படுவதை நான் எப்போதும் தடுக்கமாட்டேன் என்று உறுதி அளிக்கிறேன்.

V. நான் இந்த ஆராய்ச்சியில் பங்கு பெறச்சம்மதம் தெரிவிக்கிறேன்.

1) ஆராய்ச்சியில் பங்கு பெறுபவர் / சட்டப்பூர்வ பாதுகாவலரின் கையெழுத்து / ஆள்காட்டி விரல் பதிப்பு

பெயர் / உறவுமுறை

2) ஆராய்ச்சியாளர் சாட்சி கையெழுத்து, தேதி

Master Chart

S.No.	NAME	AGE	SEX	PRIOR CAD	Na AT ADM	Na AT 48HRS	Na AT DIS	KILLIP CLASS	EF	TRO I	DIAG	OUTCOME	FOLLOW UP
1	KARESH	37	M	N	138	135	142	1	60	+	AWMI		A
2	SHAKEEL	45	M	N	137	138	135	1	62	+	ASMI		A
3	CHOKU	68	M	N	137	134	138	2	50	+	ASMI		A
4	IMTHIYAS	43	M	N	138	142	137	1	52	+	AWMI		A
5	SRINIVAS	72	M	N	139	144	139	2	55	+	IWMI		A
6	LAKSHMI	75	F	N	137	138	138	2	65	+	AWMI		A
7	JIKRIYA	75	M	N	136	138	142	1	63	+	IWMI		A
8	KRISHNA	47	M	N	139	137	145	1	50	+	LWMI		A
9	ARUMUGAM	58	M	N	138	136	135	1	55	+	AWMI		A
10	SUSHEELA	60	F	N	132	135	136	1	42	+	IWMI	CHB	A
11	KRISHNAN	62	M	N	131	136	136	1	56	+	AWMI		A
12	PERUMAL	35	M	N	136	135	136	2	58	+	IWMI		A
13	BEGAM	60	F	N	135	135	139	1	60	+	AWMI		A
14	ABDUL	75	M	N	128	139	127	1	54	+	ASMI		D
15	MATHI	54	M	N	136	142	138	1	58	+	AWMI		A
16	KAMALA	70	F	N	138	140	141	1	62	+	AWMI		A

17	SIVA	65	M	Y	134	140	144	1	65	+	IWMI		A
18	PAPAMMAL	45	F	N	137	138	145	2	66	+	AWMI		A
19	MAHALINGAM	48	M	N	136	140	146	1	40	+	IWMI		A
20	MOORTHI	37	M	N	135	138	138	2	55	+	AWMI		A
21	BASHEER	70	M	N	140	137	136	1	56	+	IPWMI	PE	A
22	SURESH	40	M	N	142	142	137	1	55	+	AWMI		A
23	PALANI	54	M	N	136	144	137	2	55	+	ASMI		A
24	ANSAR	54	M	N	136	145	144	1	58	+	AWMI		A
25	VASU	60	M	N	138	138	142	2	48	+	AWMI		D
26	GANESAN	50	M	N	129	138	135	2	65	+	ASMI		A
27	PANJU	60	M	N	135	138	135	1	62	+	IWMI		A
28	SURYA	47	M	N	137	136	137	1	45	+	LWMI		A
29	IMTHIYAZ	38	M	N	139	136	138	1	55	+	AWMI		A
30	MOHAN	43	M	N	134	140	144	1	52	+	AWMI		A
31	GOVIND	64	M	N	133	144	135	1	56	+	IWMI		A
32	MUNIYAMMA	70	F	Y	141	137	144	2	54	+	IWMI	2*HB	A
33	PUSHPA	65	F	N	132	135	141	1	62	+	AWMI		A
34	VENKATESH	77	M	N	138	139	142	1	35	+	AWMI		D
35	SADHAR	70	M	N	137	138	137	1	55	+	AWMI		A
36	BALARAMAN	60	M	N	139	136	134	2	52	+	ASMI		A

37	MURUGESAN	85	M	N	128	132	126	2	40	+	ASMI		D
38	PASUOATHI	74	M	N	139	140	139	1	35	+	LWMI		A
39	JAKIR	45	M	N	138	140	139	1	58	+	IPWMI		A
40	SRINIVAS	51	M	N	135	142	136	1	56	+	IWMI		A
41	GANDHI	63	M	N	142	138	138	2	68	+	AWMI		A
42	ANANDHAN	73	M	Y	145	136	145	1	66	+	AWMI		A
43	PATTU	65	F	Y	136	137	144	2	65	+	AWMI		A
44	AMUDHA	45	F	N	138	145	142	2	58	+	AWMI		A
45	MANORMANI	62	F	N	133	136	137	2	56	+	ASMI	ACUTE MR	A
46	ASHOK	48	M	N	137	136	137	1	64	+	ASMI		A
47	POOONGA	45	M	N	126	135	138	1	58	+	AWMI		A
48	RAMAN	56	M	N	138	146	136	1	55	+	AWMI		A
49	LAKSHMI	75	F	N	136	138	138	2	52	+	IWMI		A
50	MANIVEL	64	M	N	134	139	128	1	58	+	AWMI	VT	A
51	KAMALA	55	F	N	139	138	139	1	62	+	AWMI		A
52	VALLI	83	F	N	127	130	126	1	40	+	AWMI		D
53	KUPPU	53	F	N	142	140	138	2	68	+	AWMI		A
54	CHANDRA	80	F	Y	138	145	138	2	65	+	AWMI		A
55	CHANDRA	70	F	N	139	142	135	2	64	+	AWMI		A
56	MANI	55	M	N	138	144	135	1	55	+	AWMI		A

57	SULLIAMA	75	F	N	136	135	136	1	55	+	ASMI	CCF	D
58	RANI	63	F	N	138	137	136	1	55	+	ASMI		A
59	ANANDHAN	67	M	N	139	136	136	1	54	+	AWMI		A
60	KRISHNAMMA	72	F	N	142	138	135	1	58	+	AWMI		A
61	BAKTHAVAT	73	M	N	145	140	135	2	56	+	AWMI		A
62	PACHAIAMA	78	F	N	137	144	139	2	65	+	AWMI		A
63	SUBRAMANI	65	M	N	136	142	138	2	68	+	AWMI		A
64	GOWRAMAL	45	F	N	139	145	136	1	56	+	IWMI		A
65	BALU	46	M	N	142	138	144	1	58	+	AWMI		A
66	MANI	49	M	N	144	138	141	1	65	+	IPWMI		A
67	SIRAJ	47	M	N	138	136	142	1	55	+	AWMI		A
68	GOVINDAMA	65	F	N	135	136	137	1	58	+	ASMI		A
69	VELU	64	M	N	138	140	136	1	55	+	ASMI		A
70	SADHASIVAM	59	M	N	136	144	136	2	58	+	AWMI		A
71	NAGAMA	50	F	N	143	140	136	2	68	+	AWMI		A
72	GOVINDASMI	55	M	NN	135	145	138	1	65	+	AWMI		A
73	SARAVANAN	35	M	N	138	135	145	2	56	+	AWMI		A
74	MUNIAMMA	65	F	Y	137	136	142	1	60	+	AWMI		A
75	ARUMUGAM	73	M	N	141	138	136	2	58	+	AWMI		A
76	KRISHNAN	70	M	Y	145	1361	145	1	55	+	IWMI		A

77	KUMARES	50	M	N	136	35	135	2	45	+	IPWMI		D
78	PAPAMA	60	F	N	138	135	136	1	68	+	ASMI		A
79	RAGU	54	M	N	138	140	136	1	66	+	ASMI		A
80	JOHNY	70	M	N	139	142	138	1	65	+	AWMI		A
81	ABDUL	47	M	N	136	145	146	1	62	+	AWMI		A
82	RAJABATHAR	79	M	N	137	145	144	1	58	+	AWMI		A
83	CHINADURAI	55	M	N	144	144	135	2	56	+	AWMI		A
84	KUPPAMA	85	F	N	137	138	136	1	55	+	AWMI		A
85	ELUMALAI	49	M	N	138	138	139	2	65	+	AWMI		A
86	ALAMELU	60	F	N	139	145	140	1	65	+	IPWMI		A
87	RAJABATHAR	80	M	N	143	145	138	1	62	+	AWMI		A
88	MANI	75	M	Y	138	136	140	2	60	+	AWMI		A
89	GEETHA	43	F	N	139	138	142	1	55	+	AWMI	VT	A
90	MANICKAM	61	M	N	138	135	144	1	55	+	AWMI		A
91	CHINATHAI	60	F	N	137	140	137	1	54	+	AWMI		A
92	GIRIJA	55	F	N	142	135	135	1	52	+	AWMI		A
93	RAJAVEL	60	M	N	135	136	136	1	68	+	AWMI		A
94	PREMA	65	F	N	141	136	135	2	66	+	LWMI		A
95	MURUGESH	72	M	N	137	138	128	1	62	+	ASMI		A
96	SRINIVAS	61	M	N	129	134	130	1	55	+	AWMI		D

97	SUNDAR	48	M	N	136	145	136	1	56	+	AWMI		A
98	SHAKIR	54	M	N	138	144	135	2	42	+	AWMI		A
99	THANGAVEL	73	M	Y	142	136	136	1	36	+	AWMI		A
100	NATARJ	70	M	N	136	138	135	1	54	+	AWMI		A

KEY TO MASTER CHART

A - Alive

Acute MR - Acute Mitral Regurgitation

ASMI - Anteroseptal Myocardial infarction

AWMI - Anterior Wall Myocardial infarction

CCF - Congestive heart failure

CHB - Complete heart block

D - Dead

DIAG - Diagnosis

EF - Ejection fraction

F - Female

IWMI	-	Inferior Wall Myocardial infarction
IPWI	-	Inferior Posterior Wall Myocardial infarction
LWMI	-	Lateral Wall Myocardial infarction
M	-	Male
N	-	No
Na at ADM	-	Level of sodium at admission
Na at 48 hrs	-	Level of sodium at 48 hrs
Na at dis	-	Level of sodium at discharge
PE	-	Pulmonary Embolism
TRO I	-	Troponin I
VT	-	Ventricular Tachycardia
Y	-	Yes
2*HB	-	Second degree heart block