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Research Article

Correlation of Surface Ecg and 2d-Echo to Locate the Site of Infarction and Left Ventricular Ejection Fraction in Myocardial infarction

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Introduction

Cardiovascular diseases comprise the most prevalent serious disorders in industrialized nations and are a rapidly growing problem in developing nations. Cardiovascular diseases remain the most common causes of death, responsible for 35% of all deaths, almost 1 million deaths each year. Approximately one-fourth of these deaths are sudden.(1)

In addition, cardiovascular diseases are highly prevalent, diagnosed in 80 million adults, or ~35% of the adult population. The growing prevalence of obesity, type 2 diabetes mellitus, and metabolic syndrome ,which are important risk factors for atherosclerosis, now threatens to reverse the progress that has been made in the age-adjusted reduction in the mortality rate of coronary heart disease.(1)

Acute myocardial infarction (AMI) is one of the most common diagnosis in hospitalized patients in the industrialized countries, which is a serious complication of atherosclerotic coronary heart disease.

In most patients (80-95%) it results from thrombotic occlusion of the related vessel resulting in infarct. Myocardial ischemia and necrosis set in within about 20-40 minutes. This occurs as a wavefront starting from the sub-endocardial region and progressing to the sub epicardial region. The entire process usually takes 6 hours to complete.

Therefore any intervention for limiting infarct size should be initiated in this time window of 6 hours.(2)

It is observed that various risk factors such as age, male sex, smoking, obesity, hyperlipidemia, diabetes mellitus, hypertension, family history of IHD, type A personality, play a role in the occurrence of myocardial infarction.

Various methods such as QRS scoring index by electrocardiogram(ECG) & left ventricular ejection fraction (LVEF) and wall motion abnormality by 2 dimensional echocardiography (2D-Echo) help in diagnosis and prognostification of myocardial infarction.

These investigations are non invasive and can be done at less advanced centres. Hence, this study is undertaken to correlate the site of infarction and LVEF by ECG and 2D Echo and also to assess the severity and prognosis of myocardial infarction.

Materials And Methods

Place Of Study : Intensive Cardiac Care Unit(ICCU) Osmania General Hospital, Tertiary care hospital,Hyderabad

Collaborative Department : Cardiology

Study Design: Random control hospital based study

Study Sample: 100 Patients

Ethical committee clearance: Approved

Period Of Study : November 2016 to May 2018

Methodology

SOURCE OF DATA: Patients admitted in ICCU of Osmania General Hospital,Tertiary care hospital, Hyderabad who satisfy the inclusion criteria.

METHOD OF COLLECTION OF DATA: The study was conducted for a period of 18 months, from November 2016 to May 2018 in a 100 randomly selected patients. Data is collected by taking a detailed history from the patients (as per the proforma) particularly keeping the following points in view.

a)Time of onset of typical chest pain, nature of pain, radiating, increasing with exertion, not relieved by rest and associated symptoms like excessive sweating, vomiting, breathlessness, diarrhoea, giddiness, fatigue and abdominal pain. history of smoking, alcohol consumption, hypertension, diabetes mellitus, obesity according to BMI, personality type and family history of IHD

b)A thorough clinical examination was carried out in each case with special reference to pulse, BP, CVS and respiratory examination for the presence of any cardiac enlargement, S3 gallop, rub, murmur and basal crepitations in the lungs.

c)Investigations like fasting lipid profile & enzymes like CKMB and SGOT were done. (Serums LDL was calculated by Fried-Walds formula i.e., LDL = total cholesterol – [HDL + (TG/5)].

d)ECG is taken at the time of admission for the ECG diagnosis of myocardial infarction, the criteria consisting of ST segment elevation of ≥ 2mm, 0.08 second from J point in ≥2 related electric fields, with typical evolutionary changes or presence of new pathological Q waves.

Further patients were classified into subgroups.

i)Inferior wall myocardial infarction.

ii) Anterior wall myocardial infarction. iii)Global myocardial infarction.

e)Continuous cardiac monitoring was done and patients were treated with generally accepted methods of coronary care unit.

f)As soon as feasible, a 2D-Echo was performed by means of commercially available mechanical sector scanner. With the patient in left lateral decubitus position, multiple parasternal long axis views, short axis and apical views were taken to study regional wall motion abnormalities and for estimation of LVEF in all 100 patients of AMI.

g) ECG was recorded on a standard ECG machine at a paper speed of 25 mm/sec.

Artifactual recordings were eliminated. ECG showing the presence of first Q wave in post MI were taken and the day of evolution of Q waves noted.

From such a reading the EF was estimated using the QRS scoring of Palmeri and Wagner etal as indicated in the table . The scoring is based primarily on the duration of the ‘Q’ and ‘R’ waves on a 12 – lead ECG and secondarily on the magnitude of the R/Q and R/S with a maximum of 29 points possible.

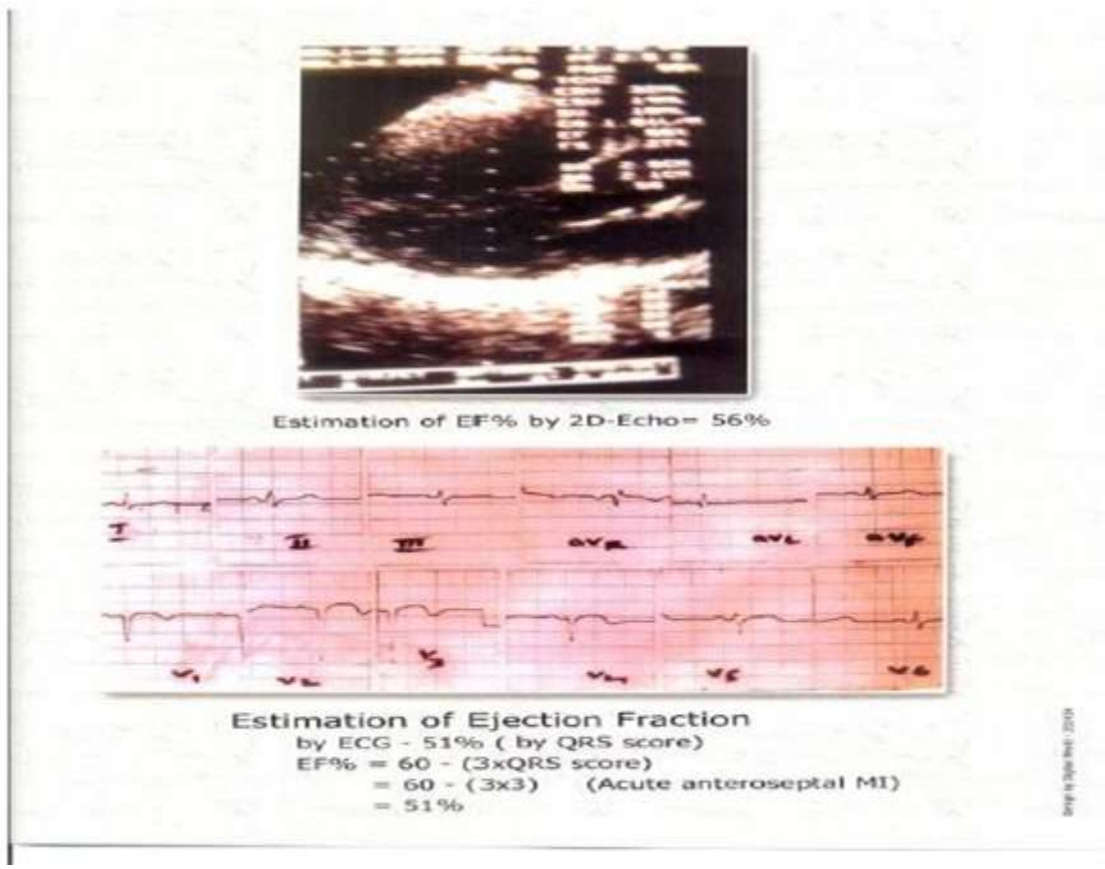
Left ventricular Ejection Fraction (LVEF) has been estimated from the QRS score by means of the formula.

LVEF (%) = 60 – (3 x QRS score)

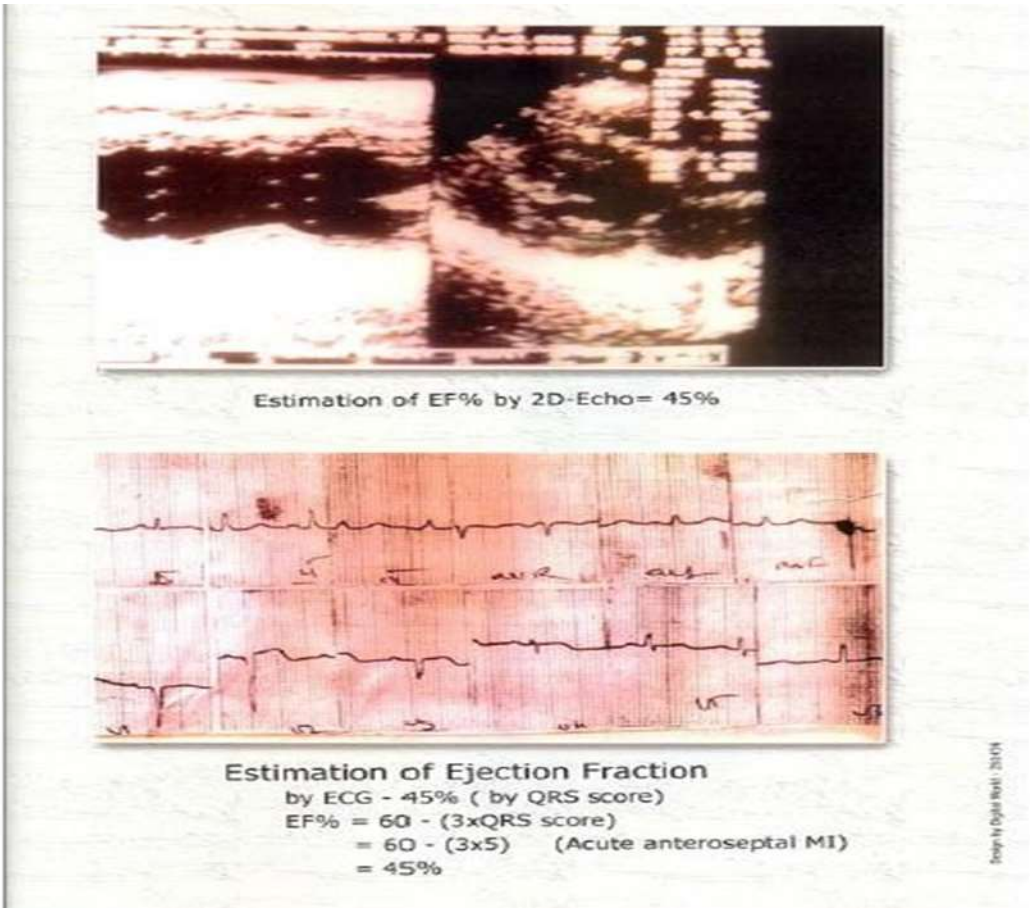
Echocardiographic correlation was obtained on the same day of ECG QRS scoring by direct estimation

of Ejection Fraction in 'Q' wave infarction.

Example 1:



Example 2



Inclusion Criteria:

Patients above 25 years of age and WHO criteria for the diagnosis of acute MI are included

a)A history of ischemic type of chest pain

b)Evolutionary changes on serially obtained ECG tracings and

c)A rise and fall in serum cardiac markers.

Exclusion Criteria:

a)Patients above the age of 70 yrs were not considered for the study.

b)Patients presenting with:

Previous history of MI

•Subendocardial infarction, true posterior wall infarction.

•LVH, hemi-block, bundle branch blocks, intraventricular conduction defects and complete heart blocks.

•Valvular heart disease

•Cardiomyopathy

•Pericardial diseases

•Congenital heart disease

•Previous cardiac surgeries were excluded from the study

STATISTICAL ANALYSIS

The study involved 100 patients in the Department of Cardiology, Osmania General Hospital, Hyderabad. The data was collected, compiled and compared statistically by frequency distribution and percentage proportion.

Qualitative data variables were expressed by using frequency and Percentage (%). Quantitative data variables were expressed by using Descriptive statistics (Mean ± SD.).Chi-square ($\chi 2$) test was applied to know the statistically significant difference (p value) between different groups. Pearson's correlation test was used to draw correlations between variables. P-values of < 0.05 were considered significant. Data analysis was performed by using SPSS Version 25.0 (Chicago, SPSS Inc.).

Observations And Results

Table 1: Age And Sex-Wise Distribution

Age Groups	Gender				P value
	Males		Females		
	Count	Row N %	Count	Row N %	
</= 30 Years	2	100.0%	0	0.0%	NS
31 - 40 Years	8	57.1%	6	42.9%	
41 - 50 Years	16	69.6%	7	30.4%	
51 - 60 Years	29	78.4%	8	21.6%	
61 - 70 Years	14	58.3%	10	41.7%	

FIGURE 1 SIMPLE BAR PERCENT OF AGE GROUPS

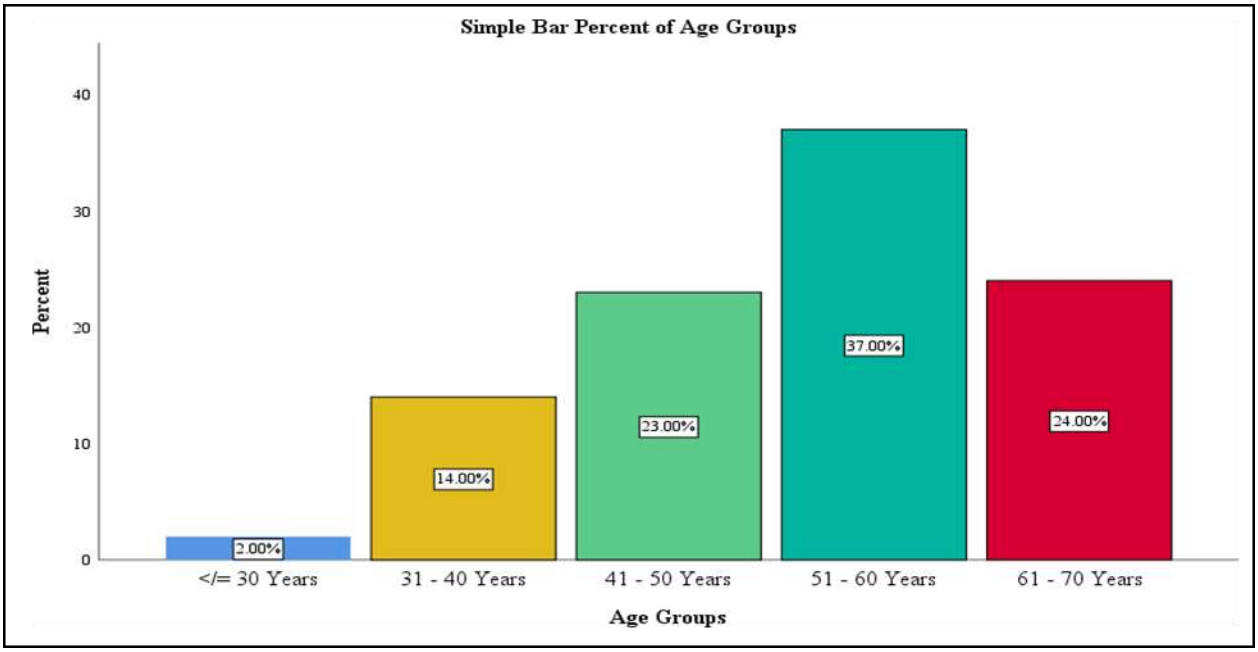
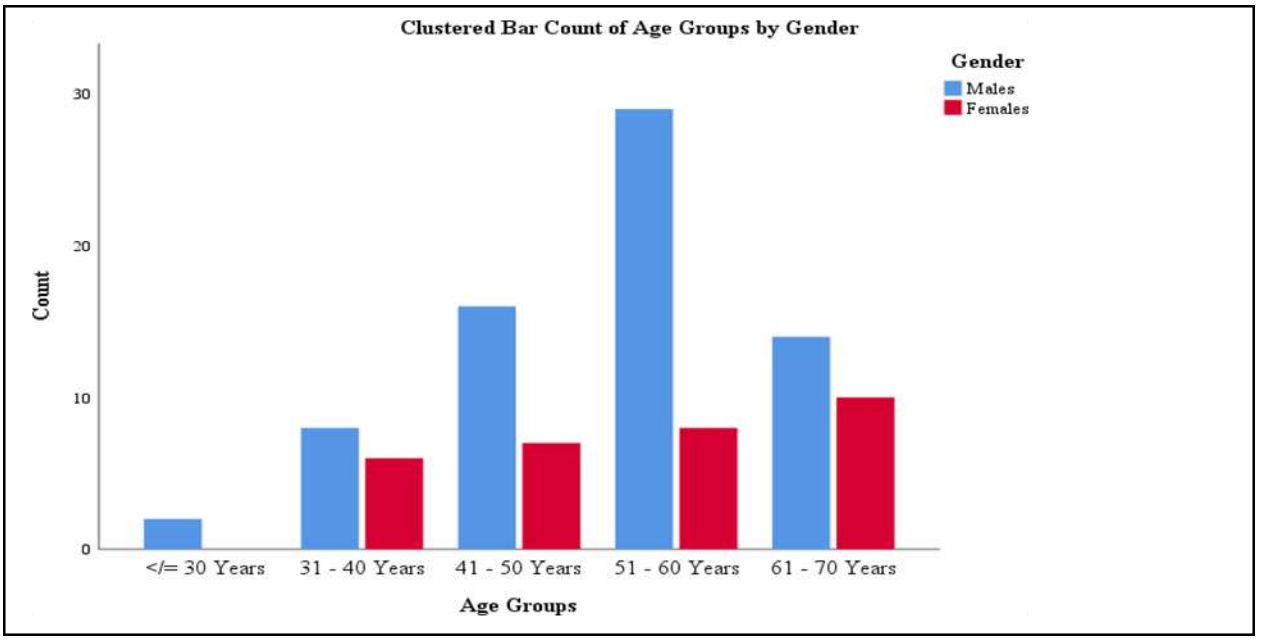


Figure 2: CLUSTERED BAR COUNT OF AGE GROUPS BY GENDER



Symptoms	Present/Absent	N	Percentage
Chest Pain	Present	89	89 %
	Absent	11	11 %
Breathlessness	Present	17	17 %
	Absent	83	83 %
Palpitations	Present	4	4 %
	Absent	96	96 %
Sweating	Present	82	82 %
	Absent	18	18 %

Table 2: SHOWING PERCENTAGE SYMPTOM DISTRIBUTION

Figure 3: SYMPTOMATOLOGY VARIATIONS

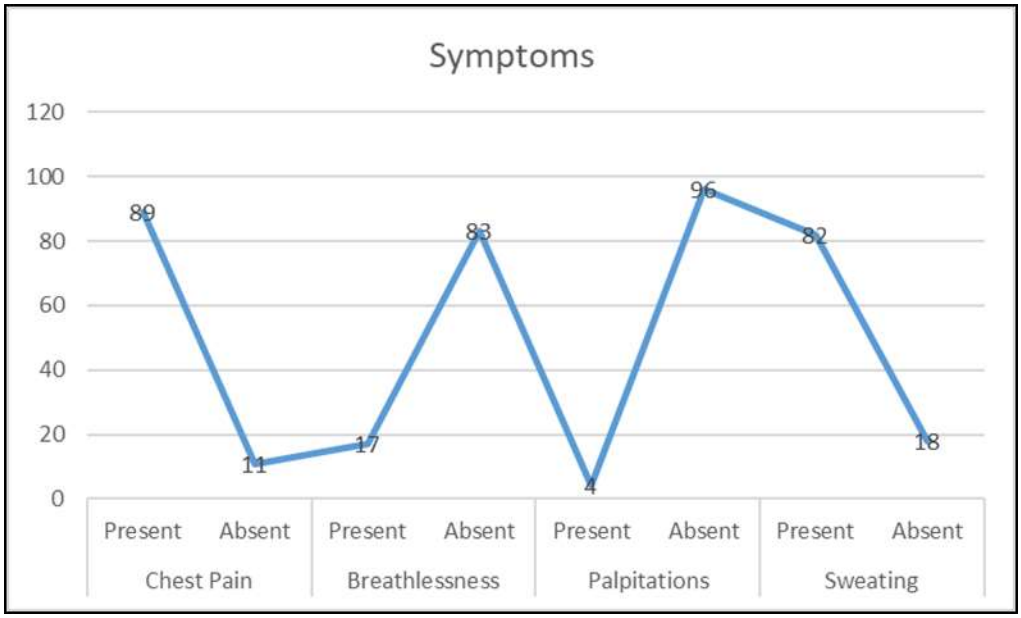


TABLE 3:OTHER ASSOCIATED COMPLAINTS AND THEIR PERCENTAGES

Associated Complaints	**N**	**Percentage**
Vomiting	27	27.0%
Epigastric Pain	5	5.0%
Backache	1	1.0%
Left arm pain	1	1.0%
Syncope/Giddiness	2	2.0%
Others	3	3.0%
None	61	61.0%

FIGURE 4: PIE CHART OF ASSOCIATEDCOMPLAINTS

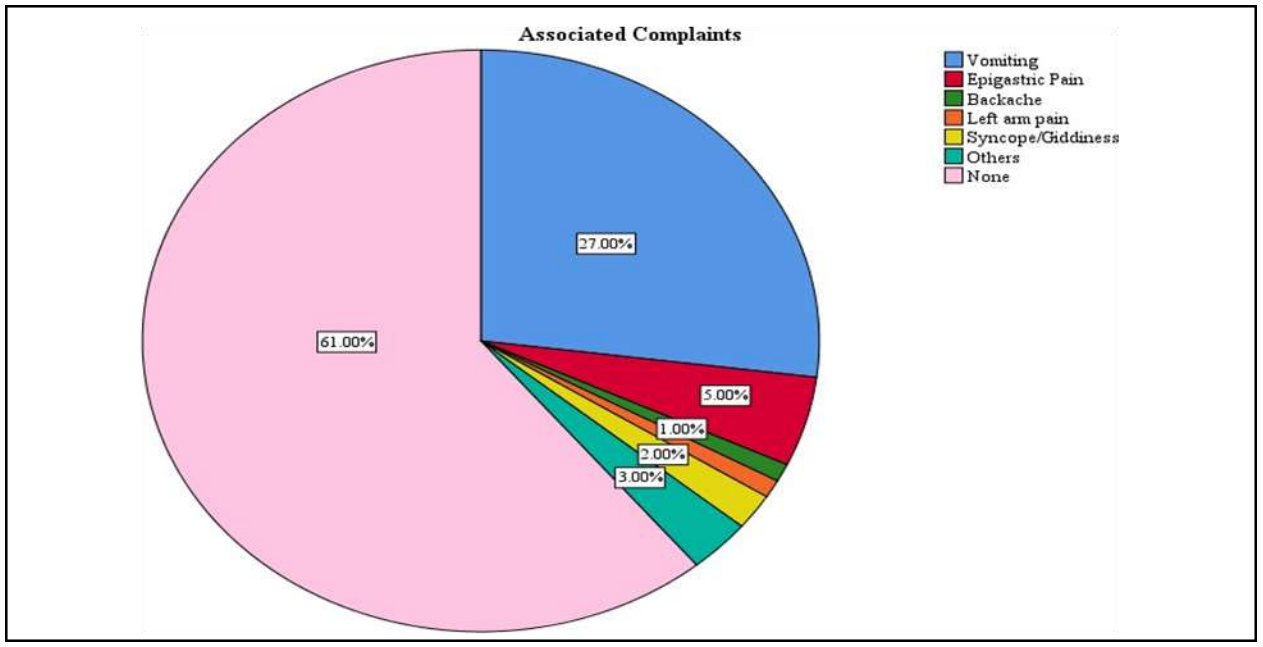


TABLE 4:ASSOCIATION WITH OTHER RISK FACTORS

Family H/o DM/HTN/IHD	**N**	**Percentage**
HTN	11	11.0%
IHD	8	8.0%
DM + HTN	11	11.0%
DM + IHD	7	7.0%
HTN + IHD	7	7.0%
DM + HTN + IHD	10	10.0%
None	46	46.0%

FIGURE 5: PIE CHART OF SIGNIFICANT FAMILY HISTORY

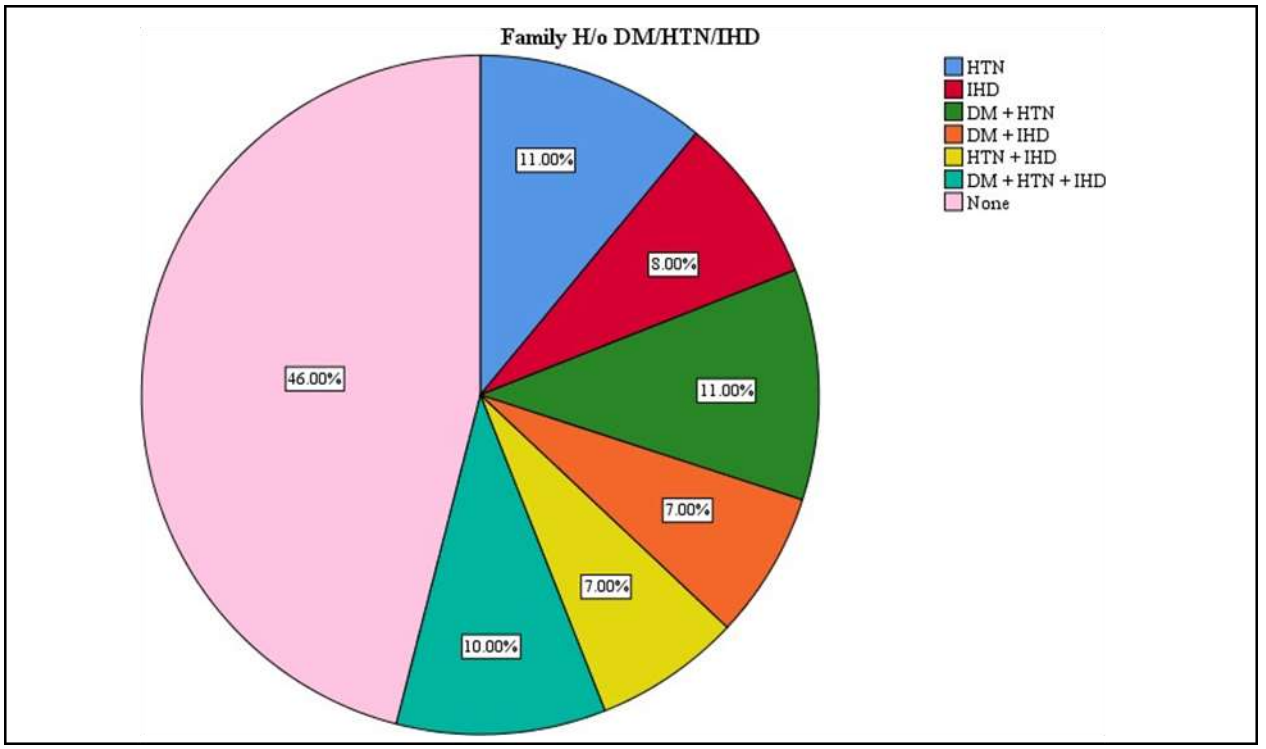


TABLE 5: OTHER SIGNIFICANT PAST HISTORY

Past H/o Illness	**N**	**Percentage**
APD	2	2.0%
Asthma	1	1.0%
CVA	5	5.0%
Others	2	2.0%
None	90	90.0%

TABLE 6: WITHOTHER RISK FACTORS

Other Risk Factors		**N**	**Percentage**
Smoking/Tobacco Use	Smoker	66	66.0%
	Tobacco Chewer	8	8.0%
	None	26	26.0%
Obesity	Obese	42	42.0%
	Non-Obese	58	58.0%
Diet	Vegetarian	56	56.0%
	Mixed Diet	44	44.0%
Personality	Type 'A' personality	55	55.0%
	Type 'B' personality	45	45.0%

FIGURE 6 PIE CHART SHOWING PAST HISTORY OF ILLNESS

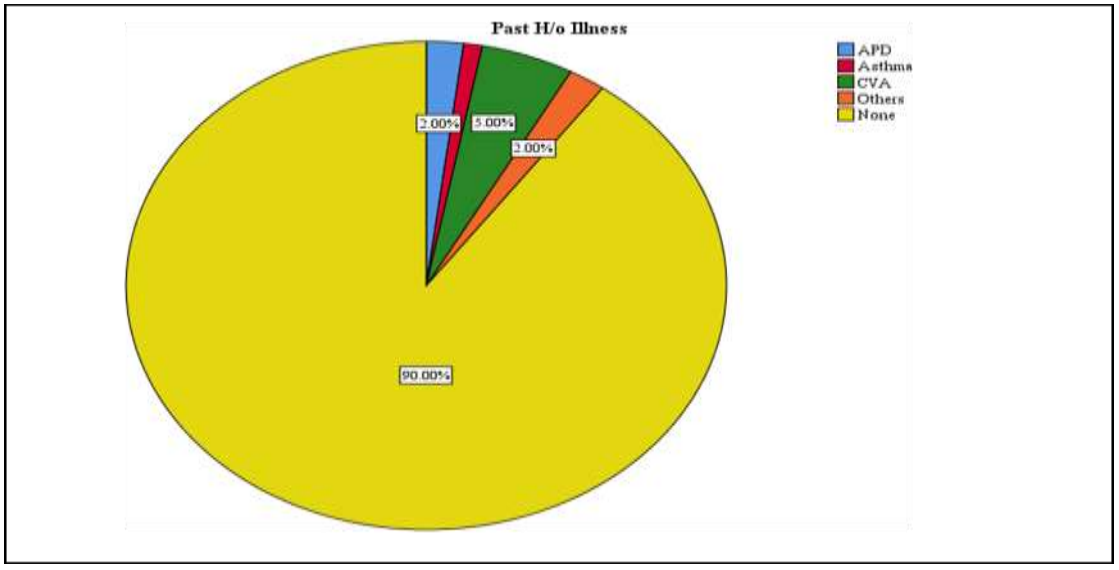


FIGURE 7 OTHER RISK FACTORS

TABLE 7: WITH VITALS

Vital Parameters	N	Minimum	Maximum	Mean	Std. Deviation
Pulse Rate (bpm)	100	44.00	150.00	81.80	17.88
Systolic Blood Pressure (in mmHg)	100	70.00	210.00	135.30	29.82
DiastolicBlood Pressure (in mm Hg)	100	50.00	120.00	85.78	18.95

FIGURE 8 BAR CHART OF VITALS

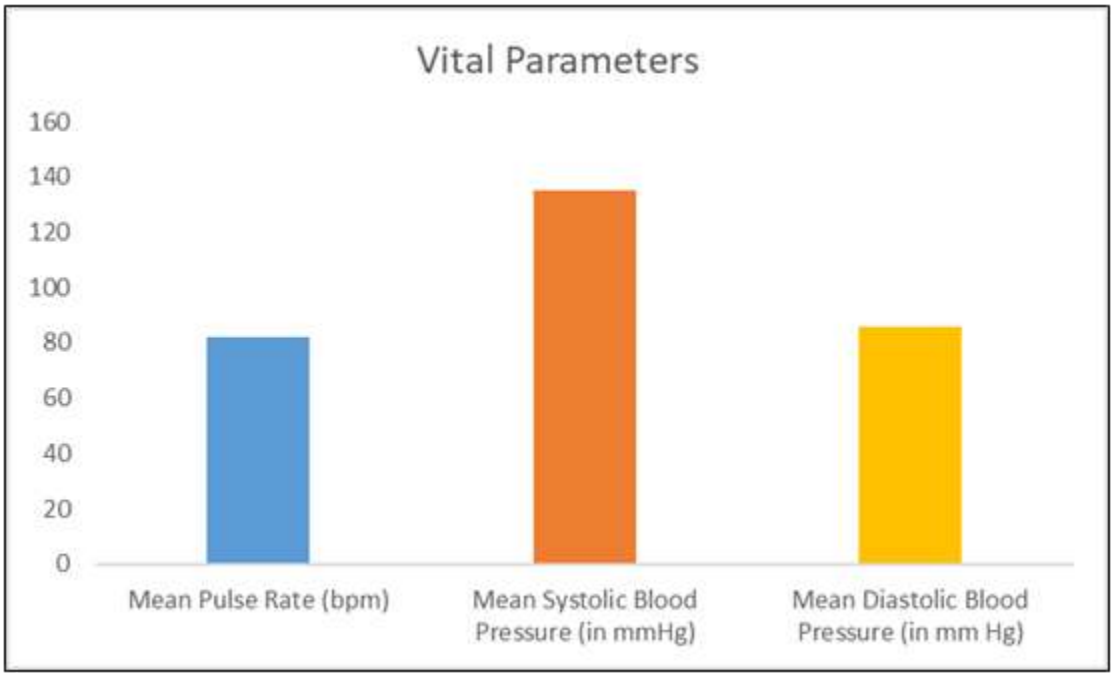


TABLE 8 : SHOWING OTHER SYSTEMS INVOLVEMENT

System	Findings	N	Percentage
CVS	NAD	100	100.0%
RS	NAD	90	90.0%
	Bilateral Crepitations	10	10.0%
PA	NAD	100	100.0%
CNS	NAD	98	98.0%
	Right Hemiplegia	2	2.0%

FIGURE 9 BAR CHART REPRESENTATION OF SYSTEMIC FINDINGS

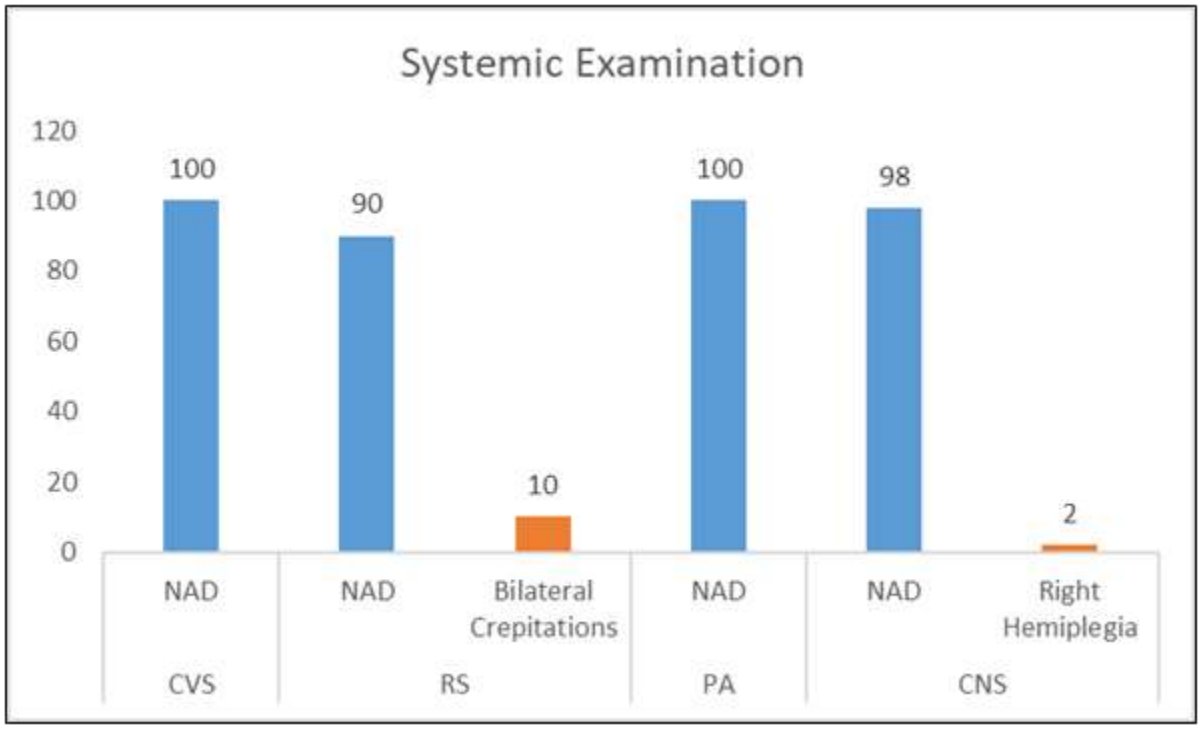


TABLE 9: VARIATION OF LIPID PROFILE

Lipid Profile	N	Minimum	Maximum	Mean	Std. Deviation
Serum Cholesterol	100	86.00	310.00	209.61	49.49
Serum Triglycerides	100	65.00	327.00	179.76	61.30
HDL	100	29.00	46.00	37.79	3.52
LDL	100	50.00	240.00	137.96	43.41

FIGURE 10 BAR CHART OF MEAN VALUE OF LIPIDS

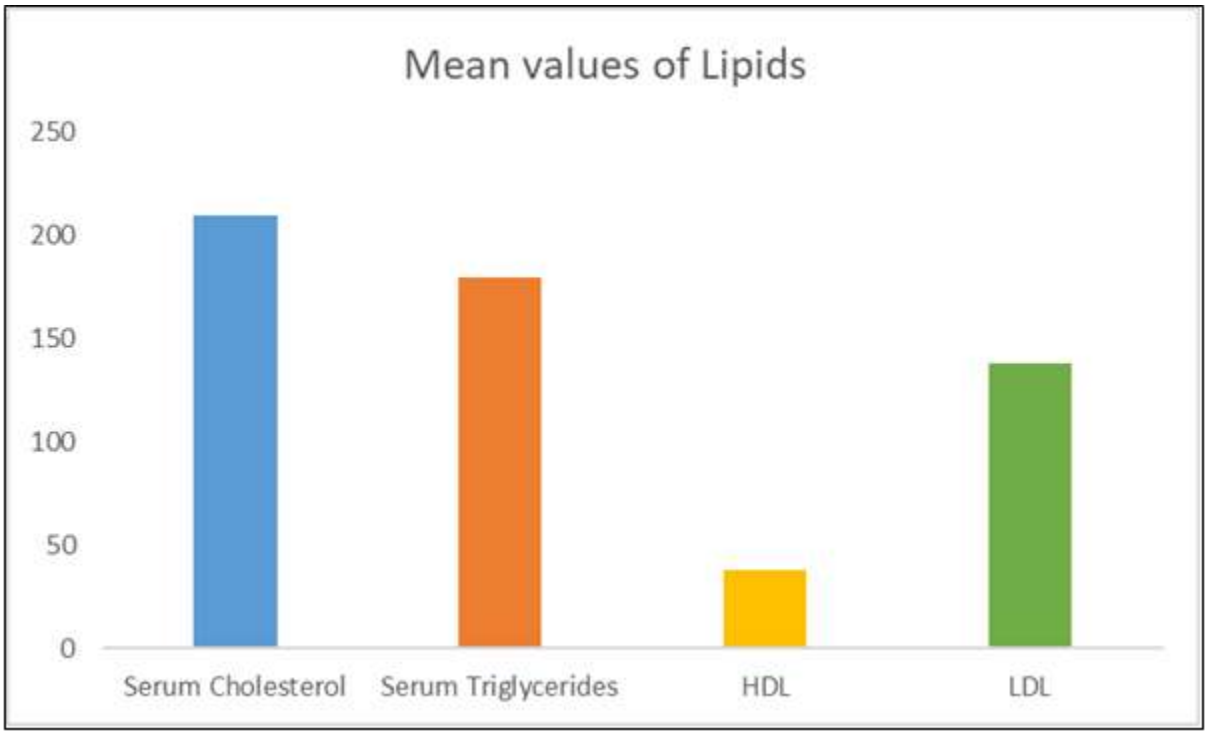


TABLE 10 : ECG DIAGNOSIS OF MI

ECG Diagnosis of MI	N	Percentage
AWMI	46	46.0%
ASMI	7	7.0%
AW IWMI	6	6.0%
PWMI	6	6.0%
IWMI	29	29.0%
ALMI	4	4.0%
ILMI	1	1.0%
PW IWMI	1	1.0%

FIGURE 11 BAR CHART OF ECG DIAGNOSIS OF MI

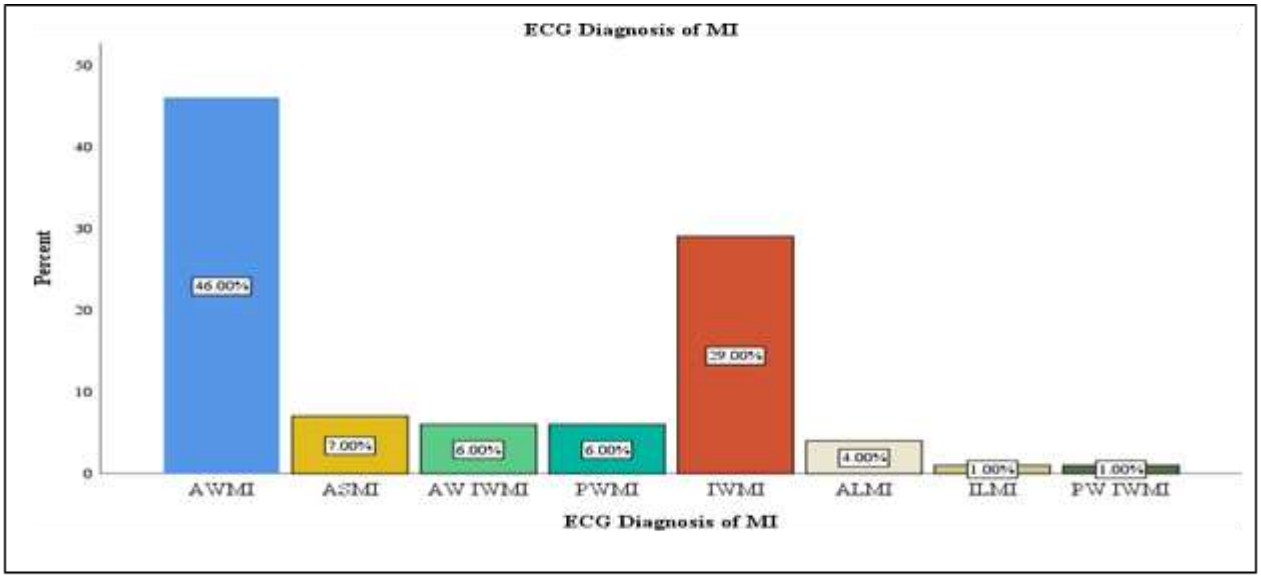


TABLE 11: SITE OF MI BY 2D ECHO

Site of MI by 2D Echo	N	Percentage
AWMI	11	11.0%
Antero-Septal & Apical	37	37.0%
Anterior & Apical	5	5.0%
Anterior & Septal	6	6.0%
IWMI	31	31.0%
LWMI	1	1.0%
Global Akinesia	5	5.0%
No RWMA	4	4.0%

FIGURE 12 SITE OF MI BY 2D ECHO

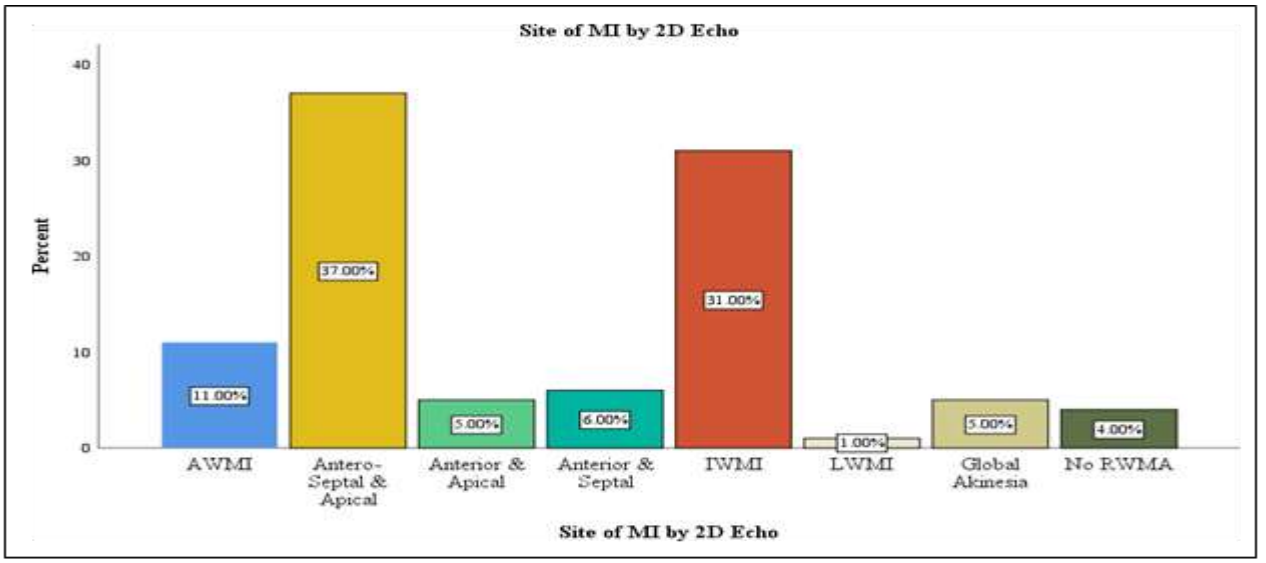


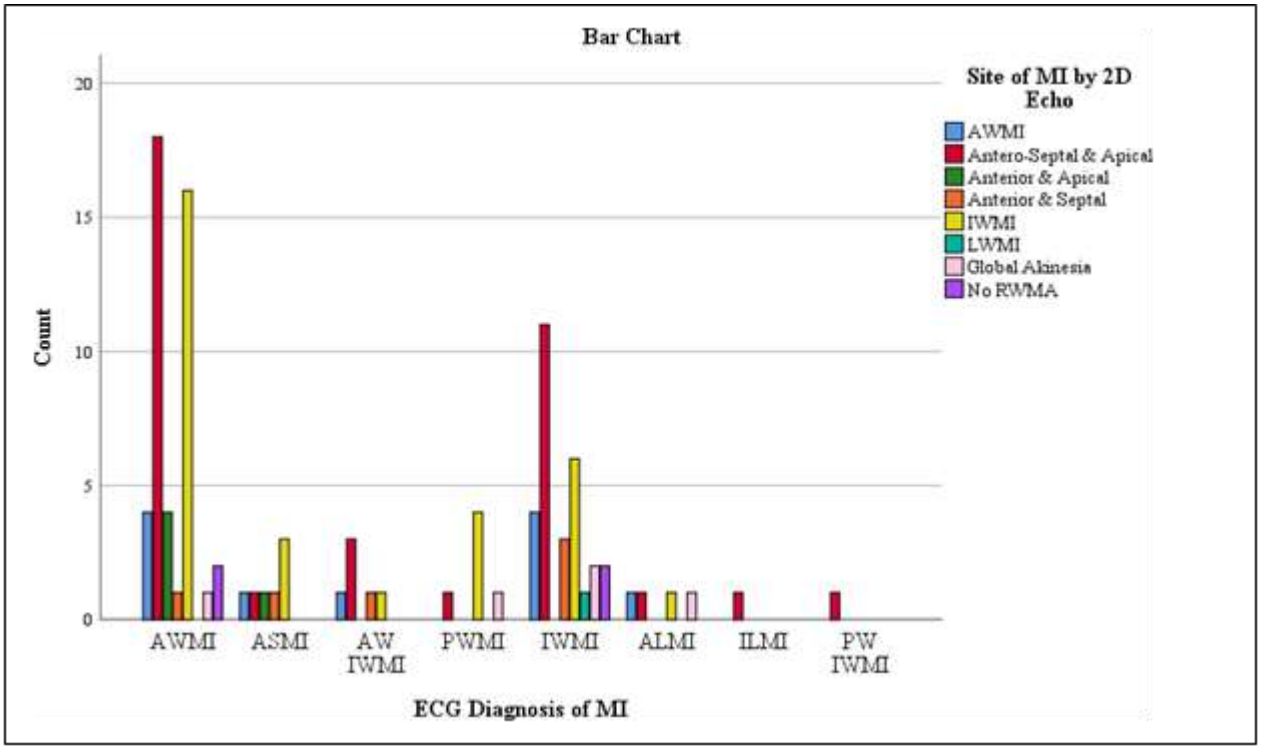
TABLE 12 : CORRELATION OF ECG AND 2D ECHO WITH SITE OF MI

ECG Diagnosis of MI	Site of MI by 2D Echo															
	AWMI		Antero-Septal & Apical		Anterior & Apical		Anterior & Septal		IWMI		LWMI		Global Akinesia		No RWMA	
AWMI	4	36.4%	18	48.6%	4	80.0%	1	16.7%	16	51.6%	0	0.0%	1	20.0%	2	50.0%
ASMI	1	9.1%	1	2.7%	1	20.0%	1	16.7%	3	9.7%	0	0.0%	0	0.0%	0	0.0%
AW IWMI	1	9.1%	3	8.1%	0	0.0%	1	16.7%	1	3.2%	0	0.0%	0	0.0%	0	0.0%
PWMI	0	0.0%	1	2.7%	0	0.0%	0	0.0%	4	12.9%	0	0.0%	1	20.0%	0	0.0%
IWMI	4	36.4%	11	29.7%	0	0.0%	3	50.0%	6	19.4%	1	100.0%	2	40.0%	2	50.0%
ALMI	1	9.1%	1	2.7%	0	0.0%	0	0.0%	1	3.2%	0	0.0%	1	20.0%	0	0.0%
ILMI	0	0.0%	1	2.7%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
PW IWMI	0	0.0%	1	2.7%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%

TABLE 13 : PAIRED DIFFERENCES BETWEEN EF BY 2D ECHO AND ECG

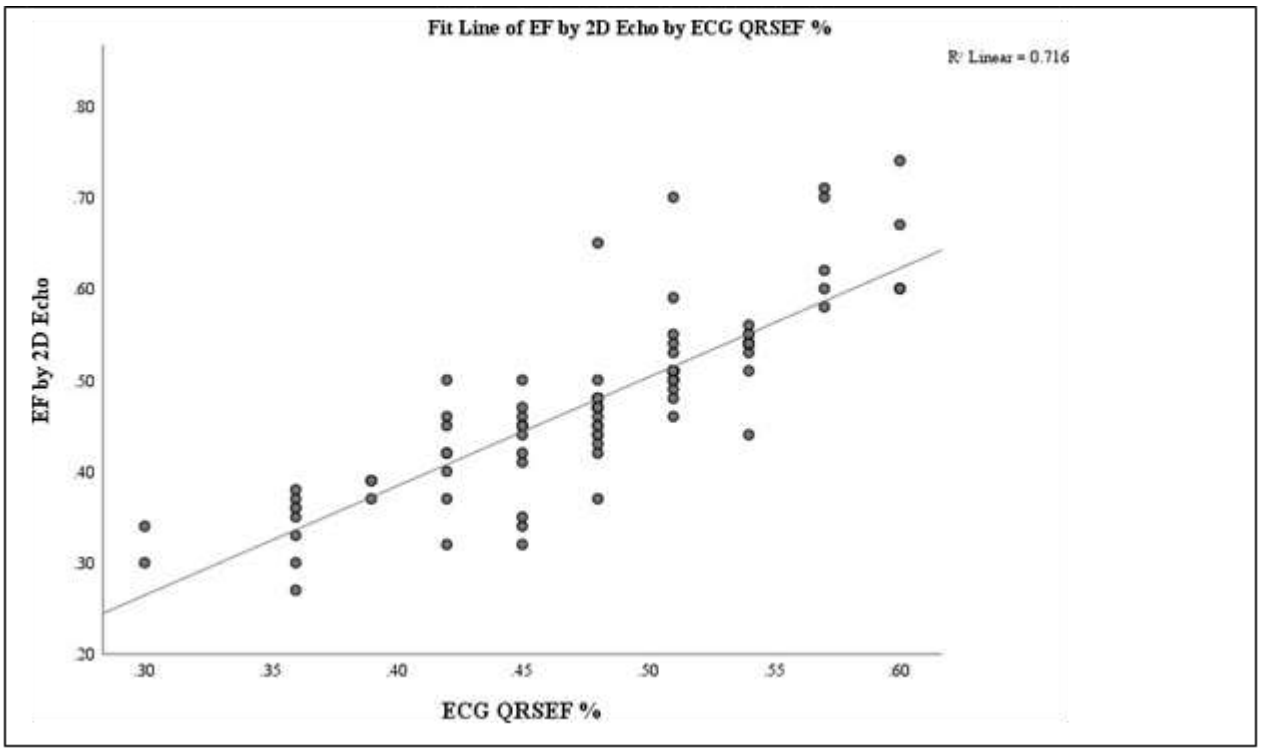
Paired Samples Test								
	Paired Differences					**t**	**df**	**Sig. (2-tailed)**
	Mean	**Std. Deviation**	**Std. Error Mean**	**95% Confidence Interval of the Difference**				
				Lower	**Upper**			
ECG QRSEF % - EF by 2D Echo	.00040	.05130	.00513	-.00978	.01058	.078	99	.938

FIGURE 13 BAR CHART OF SITE OF MI BY 2D ECHO AND ECG



(The p value is not significant depicting that there is no difference between the diagnosis by ECG and 2D echo)

FIGURE 14 FIT LINE REPRESENTATION OF EF BY 2D ECHO AND ECG



(There is positive correlation between EF calculated by ECG and 2D echo as depictedby the linear fit line in the above figure with R^2 of 0.716)

TABLE 14: FURTHER COURSE IN HOSPITAL

Further Course in Hospital	**N**	**Percentage**
Uneventful	71	71.0%
VPC	11	11.0%
VT	7	7.0%
LVF	9	9.0%
Hypotension	2	2.0%

FIGURE 15 PIE REPRESENTATION OF FURTHER COURSE

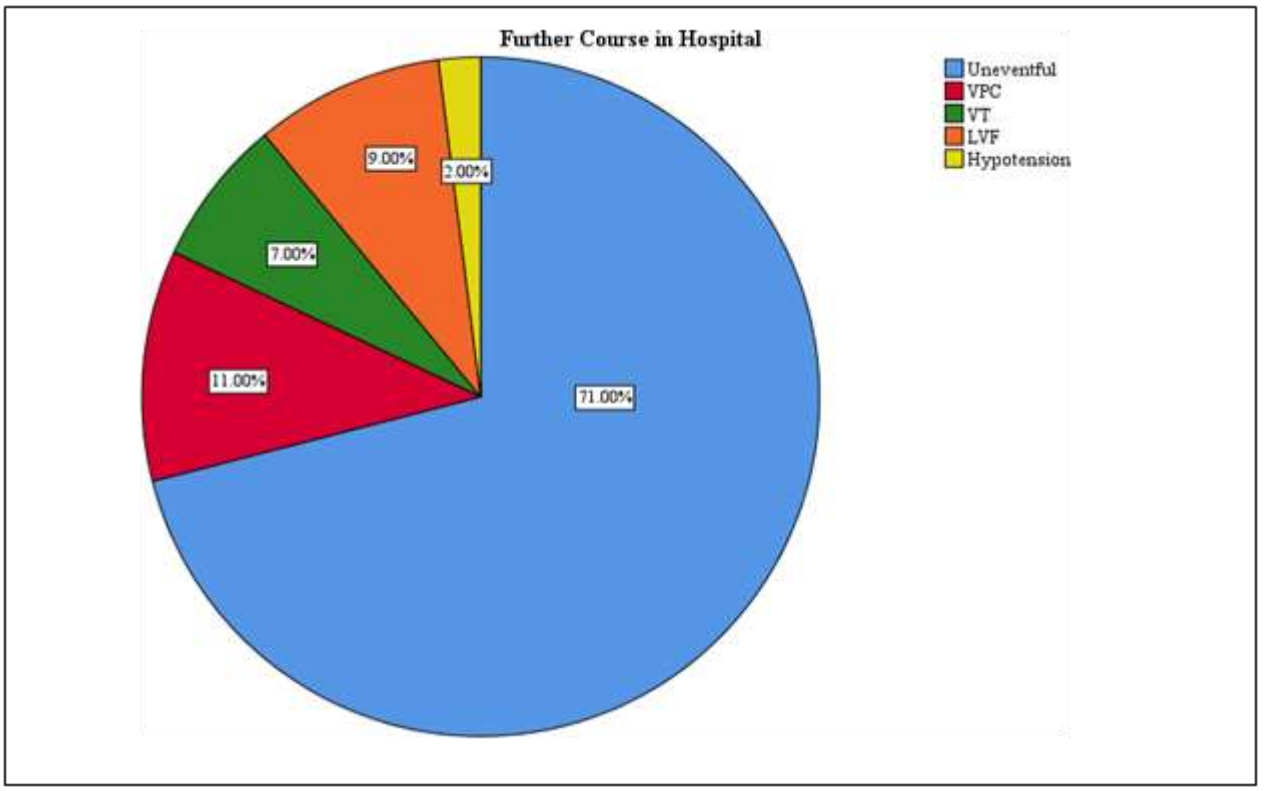


TABLE 15: COMPLICATIONS DURING HOSPITAL STAY

Complications during Hospital stay	N	Percentage
Improved/None	91	91.0%
Cardiac Arrest	6	6.0%
Cardiac Shock	2	2.0%
Ventilated	1	1.0%

FIGURE 16 PIE REPRESENTATION OF COMPLICATIONS

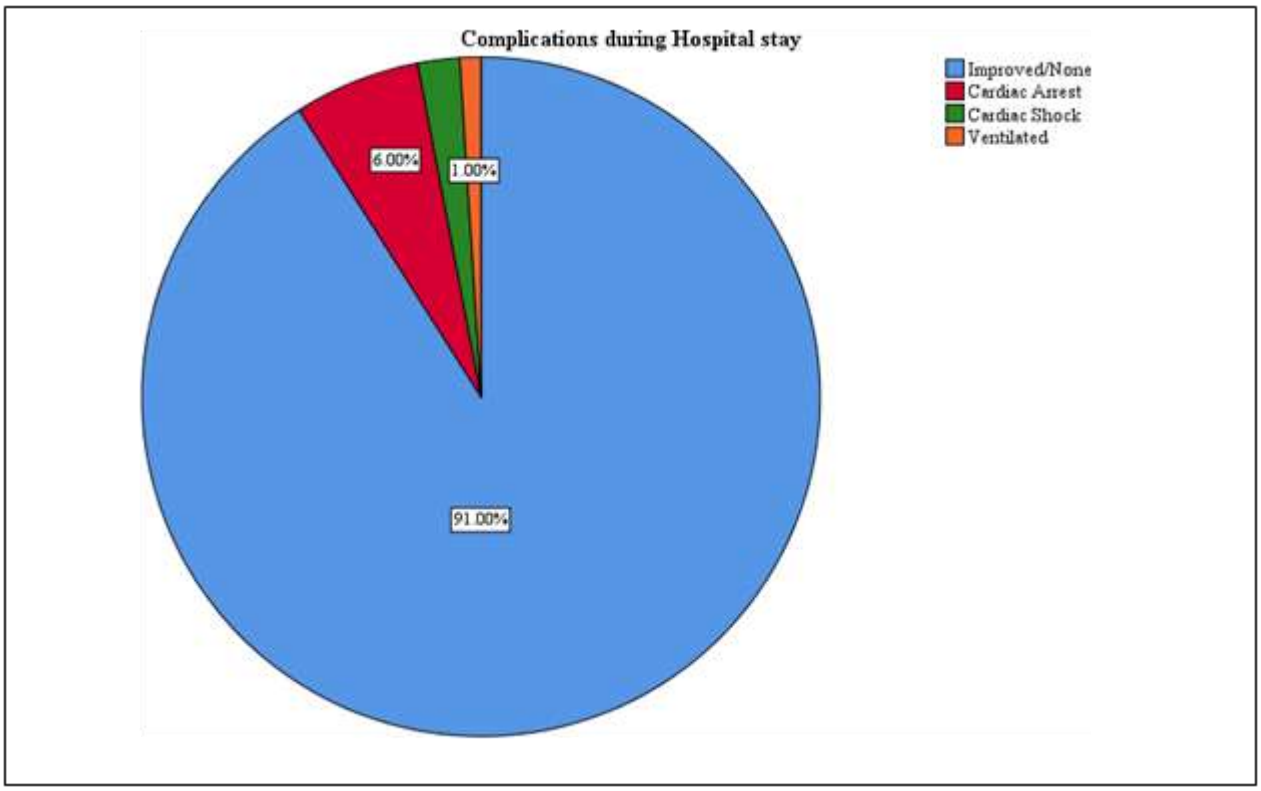
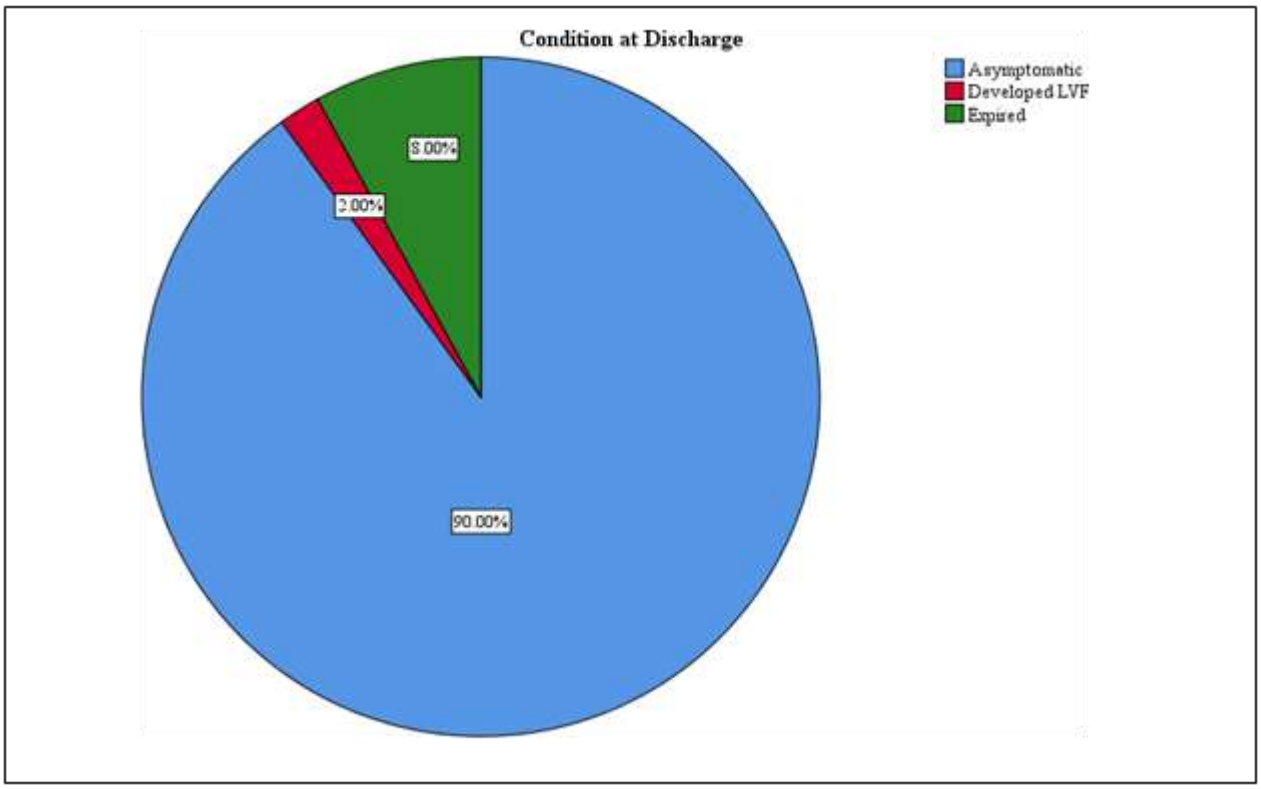


TABLE 16 : OUTCOMES

Condition at Discharge	N	Percentage
Asymptomatic	90	90.0%
Developed LVF	2	2.0%
Expired	8	8.0%

FIGURE 17 PIE REPRESENTATION AT DISCHARGE



Discussion

The present study was conducted in 100 patients who were selected from the cases admitted in ICCU, Osmania General Hospital, Hyderabad.

Age & Sex: Out of hundred patients studied,age ranging from 30 to 70 years,males were 69(69%) and females were31(31%). The maximum number of cases were noted in 51 – 60 years (37 cases). Less number of cases were noted in less than or equal to 30 years (2cases). The male to female ratio was 2.2:1.

Study conducted by Khanna et al, the mean age was 40 yrs ranging from 30 – 68 yrs. The male to female ratio was 11:2.In another study conducted by Shah et al, the mean age was 54. 4 yrs, male to female ratio was 11.3:1. The maximum number of cases noted in this study were between 51 – 60 yrs.

In Cole & Katz series 83% of cases came within the age group of 40 – 69 yrs.

They reported 25% incidence of infarction in females. The reported finding of male to female ratios was varied from 3.6:1 (Vakil, 1962) to 24:1 (Singh et al. 1977) (185). Our results correlate to these studies.

Symptoms: Malliani study shown that chest pain was the most common symptom and the associated symptom was excessive sweating. In the present study, chest pain is the commonest symptom (89%) & sweating is the most common associated symptom (82%). So there is no much difference between these studies.

Risk Factors: Among risk factors, the present study shows that smoking is the commonest risk factor (66%), followed by type A personality (55%), obesity (42%), family H/o IHD, DM, HTN (10%), hypertension 11%,DM and HTN (11%), hyperlipidemia (46%) and 8% for tobacco chewing.

In Kanitz et al study (186), (1996) showed that the major risk factors were tobacco use (81%), family history of IHD (40%), hypertension (26%), hyperlipidemia (20%) and diabetes was not a risk factor in his study. The study done by Sameer Thanavaro et al (187), found diabetes in 18 % of patients & hypertension 39%.

In another study Chinniah et al., 1979 smoking was seen in 76%, obesity in 25%,family history of IHD in 22%, hyperlipidemia in 32%. So there is no much significant difference noted when all the above studies were compared.

ECG & Echocardiography correlation for site of MI:According to Hegar et al. (188) (1979) echocardiography could evaluate regional asynergy associated with acute myocardial infarction. The location of segmental asynergy corresponded to ECG location of Q waves and pathological location of infarction but the echocardiogram also detected the segmental asynergy in the regions where the ECG showed no evidence of infarction

In our data, as shown in observation in TABLE 12 and TABLE 13, 46 patients out of 100 patients had extensive anterior wall myocardial infarction on ECG. Echocardiography in these patients further elaborated that 1 patients had extensive anterior wall infarction,37 patients had antero-septal and apical wall myocardial infarction, 5 had anterior & apical, 6 had anterior & septal infarction & 4 patient

showed no regional wall motion abnormality, thus elaboratingthe extensive anterior infarction seen on echocardiography in great details.

29 patients, out of 100 patients had inferior wall myocardial infarction and inferior wall with right ventricle infarction on ECG. When echo was done in these patients, 31 patients had inferior wall myocardial infarction, 1 patients had inferior wall and left ventricle infarction,2 patients had global hypokinesia, 3 patients had inferior wall and anterior-septal myocardial infarction and 2 patient showed no regional wall motion abnormality, again giving a more lucid interpretation.

7 patients out of 100 patients had antero-septal infarction on ECG. On echocardiographic examination inthese patients,6 patients had antero-septal myocardial infarction, 1 patient had anteroseptal apical infarction, 1patient had antero- septal and interventricular septum infarction & none showed no regional wall motion abnormality, thereby lending credence to the fact that echocardiography delineates ischemic changes more extensively.

6 patients out of 100 patients had antero-inferior wall myocardial infarction on ECG. When echo was done in these patients, 3 patients anteroseptal and apical, 1 each anterior wall and anteroseptal and inferior wall abnormality.

Ejection fraction by ECG & Echocardiographic Correlation: In our correlative study of EF with ECG & echocardiography we found that there was a good correlation in anterior wall MI & in inferior wall MI.

IN GENERAL

ECG showed EF of 47.95% (mean ± 6.59) when compared to EF by echo study which showed 48.23%(mean ± 9.33)

Inferior MI:

Our study has also shown that the index of ejection fraction in inferior wall infarction was better than anterior wall MI. EF by ECG was 54.55 ± 3.82. The EF by echocardiography was 56.25 ± 6.65 in

inferior wall myocardial infarction. This correlates well with the study of Khanna et al., who found that left ventricular ejection fraction was better in inferior wall infarction than anterior wall infarction.

In our study out of 68 patients of anterior wall MI 3 patients expired of which 2 patients had low EF & out of 4 cases of global MI 3 cases had low EF in which 2 cases expired due to cardiogenic shock. This correlates well with the study of Nelson et al. In their analysis of mortality of 14 patients who died of shock subsequent to AMI, all patients had low ejection fraction.

Rudwan AW et al. showed that both techniques reflect the magnitude of damage sustained by the myocardium as reflected by the presence of Q wave in case of QRS score or regional wall motion abnormality in case of echo score.

In a study by Tateishi S et al. (1997) the QRS scoring system can be used as a simple & economical method for estimation of infarct size soon after reperfusion.

Barbagelata A. (189) (2004) concluded that in the reperfusion era, a 12-lead ECG provides a simple, economical means of risk stratification at discharge.

In the 45 patients out of 100 whose EF was repeated by QRS scoring system (7-20 days after the 1st ECG) showed a slightly improved EF after the 1st week.

The statistical analysis done on the basis of linear regression curve reveals a fair degree of correlation between ejection fraction as obtained by echocardiography with $R2 – 0.716$ and $p>0.05$.

However, better correlative values could not be obtained possibly because of certain limitations.

1) Equipment and techniques used in estimation of ejection fraction.

2) Standardization of ECG.

3) Ideally the ECG used for scoring should have been performed on the same day or nearest possible day as ejection fractions obtain the best correlation.

Summary

1) In the present study males outnumbered females (2.22 :1).

2) Majority of cases was seen in 51 – 60 years.

3) Smoking emerged as the main risk factor in acute myocardial infarction patients.

4) The most common type of myocardial infarction is anterior wall MI.

5) The lesions seen on ECG correlated broadly with those seen on echocardiography. Echo was able to elaborate regional wall motion abnormalities in detail than ECG.

6) LVEF (pump function) can be calculated from ECG at bedside in Q-wave infarction.

7) Can give a fair idea about pump function during the course in ICCU and at discharge.

8) LVEF in anterior wall MI was less compared to inferior wall MI.

9) Anterior & Global MI had lower LVEF.

10) ICCU mortality was 8%.

11) Correlative study of LVEF (pump function) by linear regression scale showed $r = 0.84$ $p > 0.05$. This indicates a fair correlation between EF as estimated by ECG & 2D- Echocardiography in MI as well as subgroups of AMI.

12) Hence the, QRS scoring system can be used as a simple and economical method for estimation of infarct size soon after reperfusion.

However, ejection fraction by QRS scoring system cannot be superior to LVEF obtained by echocardiography or even used as a substitute because of following limitation:

a) Cannot estimate infract size directly.

b)Cannot be used in –

- Non Q – wave infract

-Acute MI with conduction disturbance.

c)Scoring system cannot be used to exclude diagnosis of a prior or acute myocardial infarction.

d)Different equipment and techniques used in different institutions may have limitations on the scoring system.

Though the relative inadequacies of this study, relative fair correlation was obtained between ECG QRS scoring and echocardiographic LV pump function. Hence this can be used as an additional method of evaluating left ventricular function in 'Q' wave infarction.

Conclusion

•The location of MI seen on ECG correlated broadly with those seen on echocardiography. Echo was able to elaborate regional wall motion abnormalities in detail than ECG.

•LVEF (pump function) can be calculated from ECG at bedside in Q wave infarction, which correlated fairly to 2D-Echo findings.

•Anterior wall MI and Global MI had lower EF when compared to inferior wall MI.

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