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Medicine

To Study the Correlation between ECG and 2D Echocardiography in Locating Acute Myocardial Infarction and Predicting Complications

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Abstract | **Original Research Article**

Background and purpose: Cardiovascular diseases are at present the leading causes of death in the developed and also developing countries. IHD is a great killer accounting for15% of all mortality in India. The purpose of this study is to correlate between ECG & 2D Echocardiography in locating acute myocardial infarction and Predicting complications. ***Methods:*** 86 cases of acute myocardial infarction admitted in ICCU of BLDE (deemed to be university) Shri. B. M. Patil Medical College HOSPITAL and Research Centre, Vijayapura, India between December 2016 to August 2018 were studied. All patients were evaluated for risk factors. 12-leadECG and 2D echocardiography with cardiac enzyme estimation was done. Complication such as Arrhythmias, cardiogenic shock, LVEF status and mortality were noted, result were studied. ***Results:*** On ECG, infarct site were as follows in the order of decreasing frequency. Inferior wall with right ventricle > extensive anterior >anterior septal >antero-lateral. The lesions seen on ECG correlated broadly with those seen on echocardiography with more elaborated detail was noticed. 62% were males and 38% were females of which incidence being more common between 4th to 7th decade of life. Incidence of AMI was more common in patients with smoking/tobacco chewing and hypertension. Incidence of AWMI was equal to IWMI. Out of all arrhythmias, VT was seen in most common preponderance to AWMI. CHB and SB were commonly seen with IWMI. BBB was more common in AWMI than IWMI xiii. ***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. Tachyarrhythmias are more common with AWMI and bradyarrhythmias in IWMI.
Keywords: ECG, echocardiography, AMI.

INTRODUCTION

Cardiovascular diseases are at present the leading cause of death in developed as well as developing countries [1]. Ischemic heart disease is a great killer accounting for 25.1% of total death in urban areas are attributable to disease of circulatory system among which IHD is major entity [2]. Age adjusted death rates for coronary heart disease declined by two-third in the last decade, reflecting the identification and reduction of risk factors as well as improved treatment and intervention. A growing prevalence of obesity type 2diabetes and metabolic syndrome which are important risk factors, now threatens to reverse the progress that has been made in the age adjusted reduction in the mortality rate of coronary heart disease.

For many years cardiovascular disease was considered to be more common in men than in women, but today the numbers has risen in women than men. Exercise ECG has lower diagnostic accuracy in the prediction of epicardial obstruction in women than in men.

ECG & 2D echocardiography helps in the diagnosis and prognostification of myocardial infarction. These investigations are non-invasive and can be done in less advanced centers. Hence this study

is undertaken to correlate the site of infarction by Electrocardiography & 2D Echocardiography.

Myocardial infarction is often depicted as a modern disease; it was recognized before the modern era by Morgagni in 1761 and more clearly by Heberden. It is one of the most common diagnoses in hospitalized patients in industrialized countries& developing countries. Although after admission for myocardial infarction has declined by approx. 30%. Over past two decades approx 1 of every 25 patients who survive the initial hospitalization dies in the first year after acute myocardial infarction [3].

In most patients it results from thrombotic occlusion of the related vessels resulting in infarct myocardial infarction and necrosis set in within about 20 to 40 minutes this occurs as a wave front 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 in fact size should be initiated in this time window of 6 hours. It has been observed that various risk factors such as age male sex smoking obesity tobacco family history, hypertension, hyperlipidemia, Diabetes mellitus, type a personality, sedentary Lifestyle play a role in occurrence of myocardial infarction [4].

Hence, this study is undertaken to correlate the site of infarction and EF by ECG and 2D Echo and also to assess the severity and prognosis of myocardial infarction.

Objectives of study

1. To study the correlation between ECG and 2D echocardiography in locating acute Myocardial Infarction and predicting complications.

METHODOLOGY

Source of data

All patients with history of ischemic type of chest pain attending and admitted in ICCU OF SHRI. B.M. PATIL Medical College Hospital during the study period will be evaluated for the conditions. Period of study will be from December 2016 to August 2018.

Eligibility criteria

- All patients with history of ischemic type of chest pain
- Evolutionary changes of serially obtained ECG
- Rise in serum cardiac biomarkers.
- 2D echocardiography showing wall motion abnormality.

Exclusion criteria

- Patient above the age of 70 years
- Patient presenting with
  - Previous history of Myocardial Infarction
  - Subendocardial Myocardial Infarction, Posterior infarction
  - Cardiomyopathy and previous cardiac surgeries.
  - Valvular heart disease.
  - Congenital heart disease & pericardial disease.

Statistical analysis

All characteristics were summarized descriptively. For continuous variables, the summary statistics of mean± standard deviation (SD) were used. For categorical data, the number and percentage were used in the data summaries and diagrammatic presentation. If the p-value was < 0.05, then the results were considered to be statistically significant otherwise it was considered as not statistically significant. Data were analyzed using SPSS software v.23.0. and Microsoft office 2007.

RESULTS

Table-1: Distribution of cases according to age and sex

Age(yrs)	Male		Female		Total		p value
	N	%	N	%	N	%	
30-40	11	20.37	0	0.00	11	12.79	0.047*
41-50	12	22.22	6	18.75	18	20.93	
51-60	21	38.89	14	43.75	35	40.70	
61-70	7	12.96	9	28.13	16	18.60	
>70	3	5.56	3	9.38	6	6.98	
Total	54	100.00	32	100.00	86	100.00	

Note: * significant at 5% level of significance (p<0.05)

Table 1 shows incidence of AMI in different age groups, number of males and females in each group and their respective percentage in that group. As indicated in the table, the maximum incidence of AMI was in 51-60 years of age. Percentage of females is steadily rising from 41 years of age onwards and is MORE to that of males after 41 years of age group.

There are only 20.37% cases below the age group of 40 years those too only males. Overall the number of female cases is highly significant as compared to males.

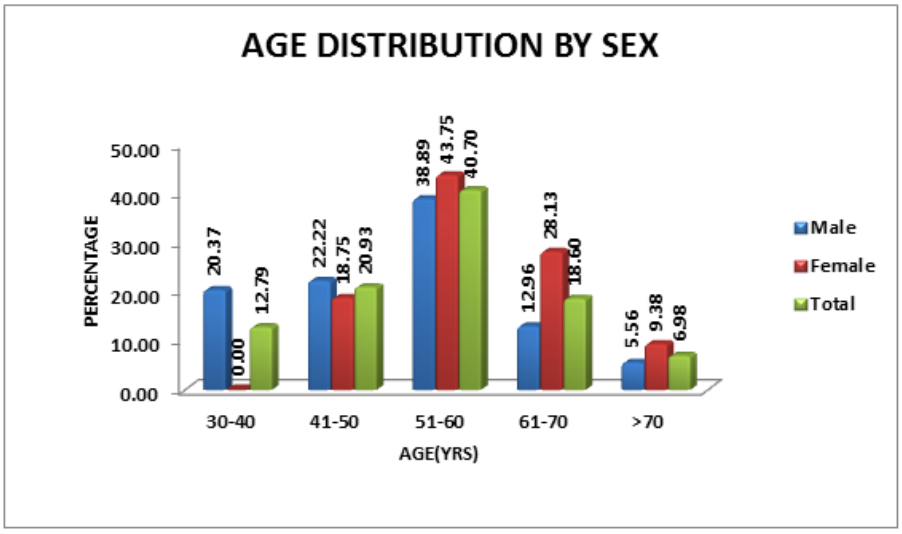

Fig-1: Distribution of cases according to age and sex

Table-2: Mean age according to sex

	Male		Female		p value
	Mean	SD	Mean	SD	
Age(yrs)	52.9	12.1	59.9	9.5	0.007*

Note: * significant at 5% level of significance (p<0.05)

Mean age for Male was 52.9(SD 12.1) and Female was higher 59.9(SD 9.5)

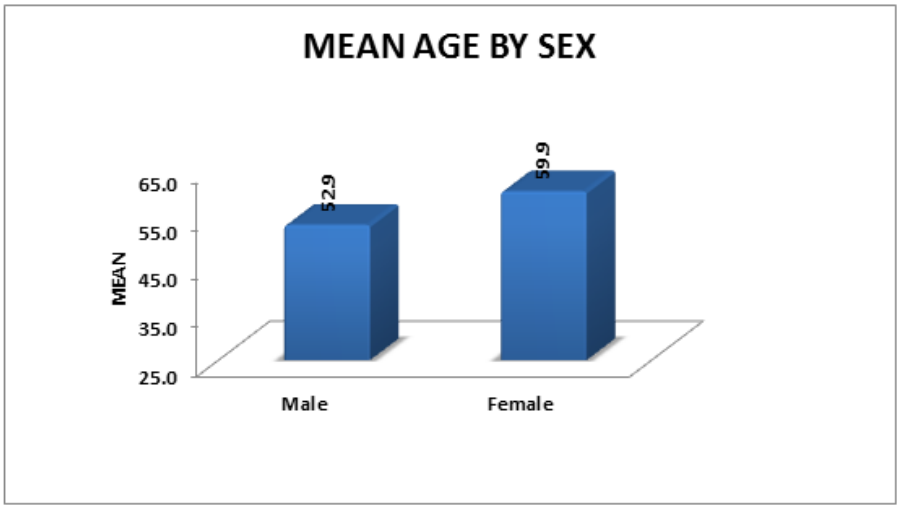

Fig-2: Mean age according to sex

Table-3: Distribution of cases according to symptoms

Symptoms	N	%
Chest pain	83	96.5
Breathlessness	30	34.9
Sweating	32	37.2
Vomiting	13	15.1
Pain abdomen	10	11.6

Table 3 shows the pattern and incidence of various symptoms of AMI. Chestpain was the most common presenting symptom which was present in 96.5% of patients and another 10% had all together epigastrium pain and pain in left arm alone.

Sweating was 2nd most common symptom (37%) followed by dyspnoea (34.9%). Vomiting was present in 15% and palpitation in 11%. Another 8% of patientspresented with giddiness / syncope

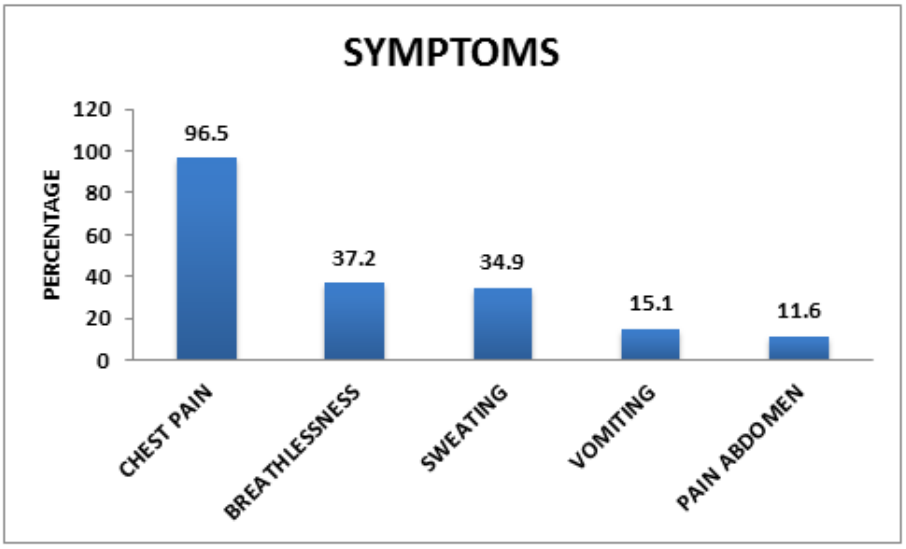

Fig-3: Distribution of cases according to symptoms

Table-4: Distribution of cases according to risk factors

Risk factors	N	%
Hypertenson	22	25.6
Diabetis mellitus	15	17.4
Smoking/tobacco chewing	38	44.2
Alcohol	20	23.3
Obesity	5	5.8
Family history	2	2.3

Table 4 shows major risk factors for AMI was smoking or tobacco chewing (44.2%) followed by hypertension (25.9%), alcohol intake (23.3%), and diabetes mellitus (17%), obesity (5.8%) positive family history for CHD (2.3%).

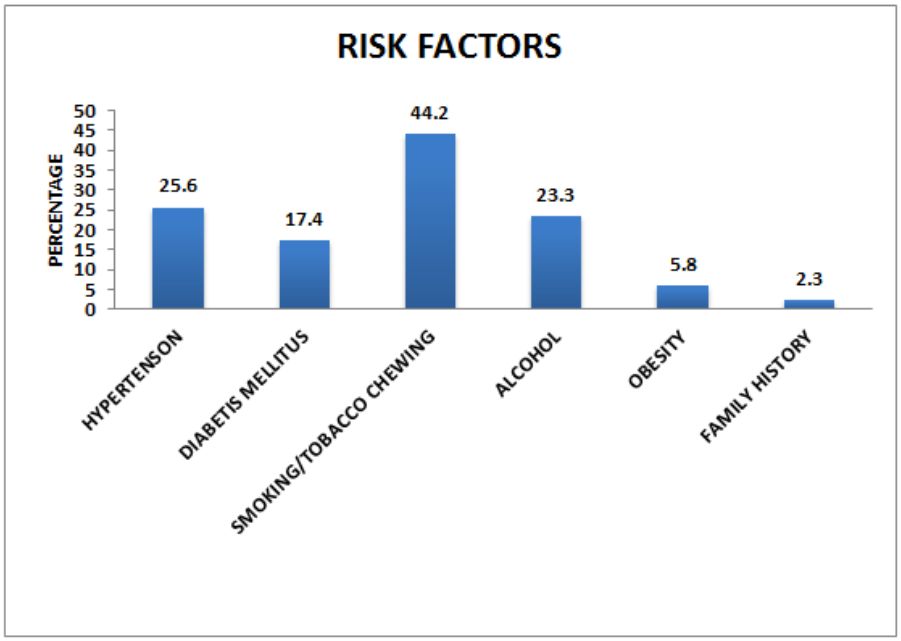

Fig-4: Distribution of cases according to risk factors

Table-5: Distribution of cases according to vital parameters

Parameters	Mean	Sd
Pulse rate/min	87.6	17.1
SBP	133.8	29.7
DBP	83.8	16.9
Respiratory rate (cpm)	19.7	3.4

Table-6: Distribution of cases according to lipid profile

Parameters	Mean	SD
Total cholestrol(mg/dl)	171.1	38.4
TG(mg/dl)	157.3	93.7
LDL(mg/dl)	102.8	33.9
HDL(mg/dl)	38.4	13.3

Table-7: Descriptive statistics of cpk-mb, trop-t and trop-i

CPK-MB(U/L)	N	%
≤27	10	11.6
>27	72	83.7
TROP-T (ng/ml)		
Negative	7	8.1
Positive	44	51.2
TROP-I (ng/ml)		
≤0.12	1	1.2
>0.12	34	39.5
Mean±SD	13.03±24.08	

Table shows details regarding rose in cardiac enzymes in AMI. CPK-MB rose in 72(83%) of subjects. Troponin-I or Troponin T (either one was done) was raised in 78(90%) of subjects.

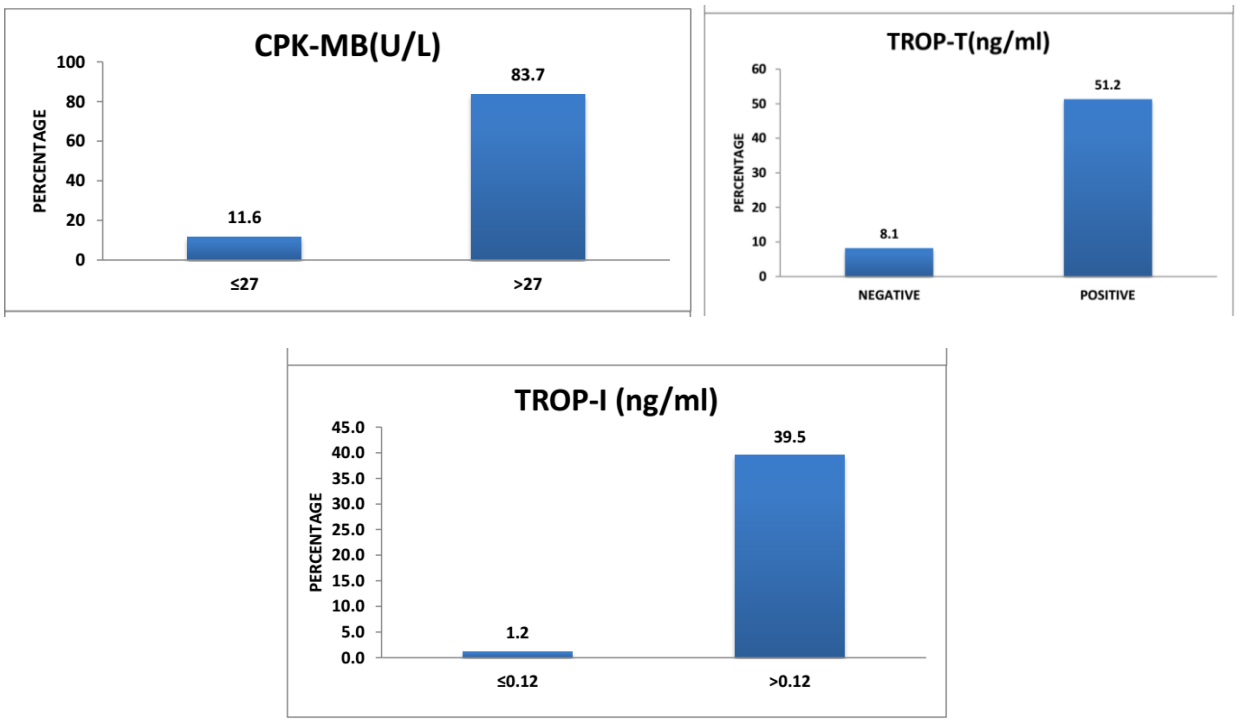

Fig-5: Descriptive statistics of cpk-mb, trop-t and trop-i

Table-8: Distribution of cases according to lvef %

LVEF %	N	%
Normal	25	29.1
Mild dysfunction	37	43
Moderate dysfunction	22	25.6
Severe dysfunction	2	2.3
Total	86	100

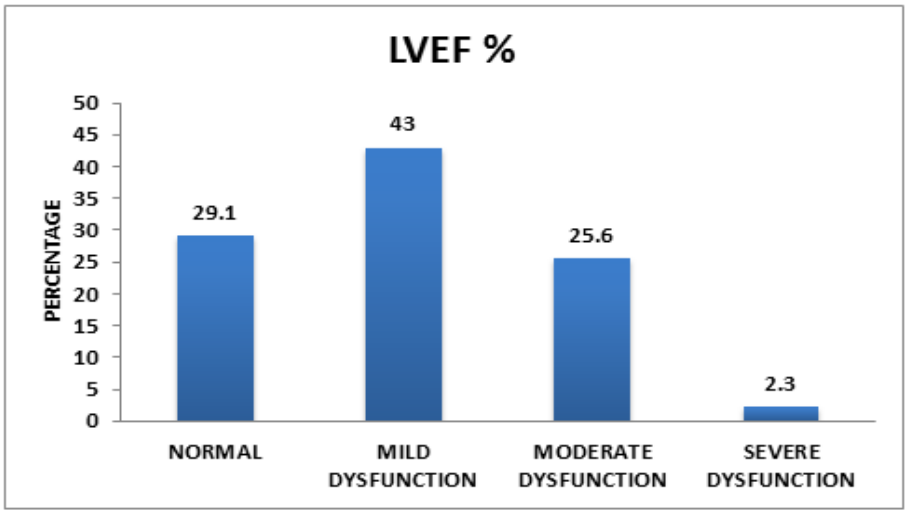

Fig-6: Distribution of cases according to LVEF %

Table-9: Distribution of cases according to site of infraction by ecg

Site of infraction by ECG	N	%
Inferior wall & inferior wall +RVMI	43	59.3
Extensive anterior	20	23.3
Anterior septal wall	15	17.4
Anterior lateral wall	8	9.3
Lateral wall	1	1.2

Table 9 shows the pattern and incidence of various AMI, according to the site overall all together anterior wall (i..e anterior + anterolateral + anteroseptal)almost equal which was in 51% of patients followed by inferior wall (i.e. inferior +infero-lateral + inferior and right ventricular + inferior and posterior wall) occurred in49% of patients.

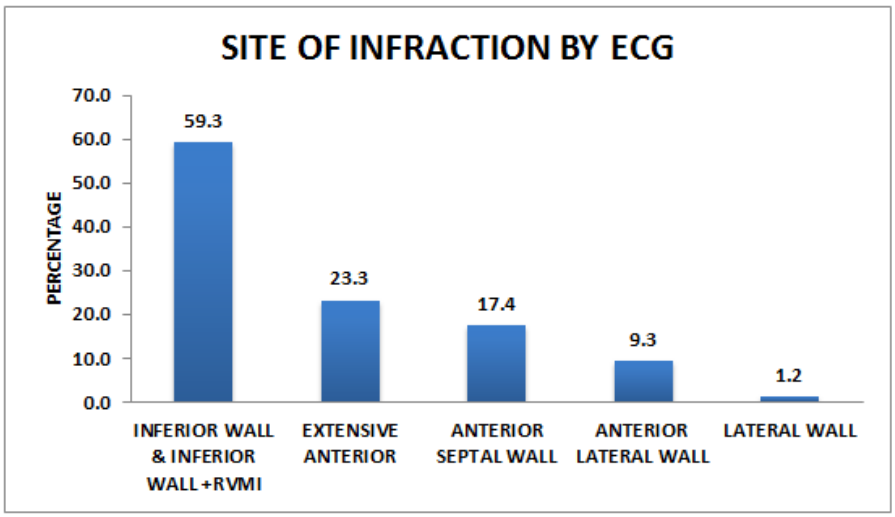

Fig-7: Distribution of cases according to site of infraction by ECG

Table-10: Distribution of cases according to site of mi by 2d echo

Site of mi by 2D echo	N	%
Anterior lateral wall	9	10.5
Anterior septal wall	36	41.9
Anterior wall	31	36.0
Apex wall	26	30.2
Global wall	1	1.2
Inferior lateral wall	27	31.4
Inferior septal wall	15	17.4
Inferior wall	45	52.3
Lateral wall	9	10.5
Posterior wall	6	7.0
Septum wall	1	1.2

Table 10 shows overall distribution of cases according to site of infarction based on 2D echocardiography.

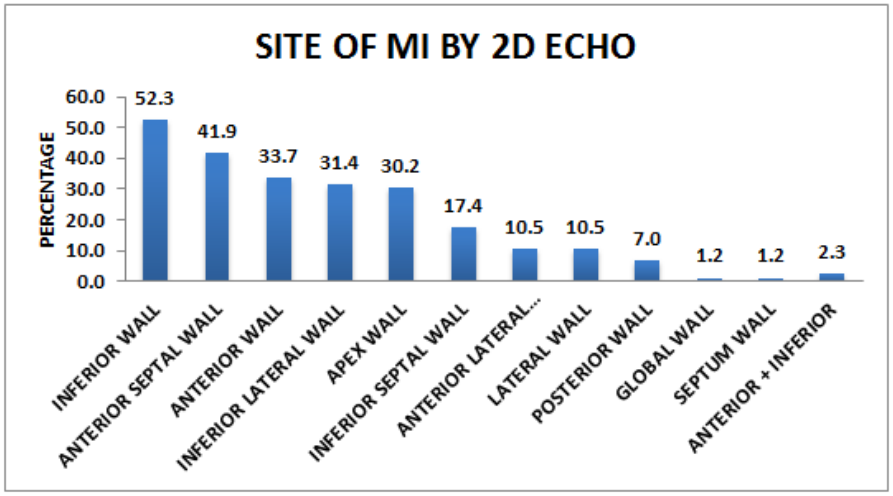

Fig-8: Distribution of cases according to site of mi by 2d echo

Table-11: Site of mi by 2d echo among 43 cases of inferior wall & inferior wall +rvmi

Site of infraction by 2D echo	N	%
Inferior wall	35	40.7
Inferior lateral wall	26	30.2
Apex wall	1	1.2
Inferior septal wall	15	17.4
Anterior lateral wall	2	2.3
Lateral wall	6	7.0
Posterior wall	5	5.8

Table 11 shows among 43 cases with IWMI & IWMI +RVMI the distribution according to 2D echocardiography. Predominantly inferior wall (40.7%), followed by infero-lateral wall (30.3%), infero-septal(17.4%), lateral wall(7%), posterior wall(5.8%).

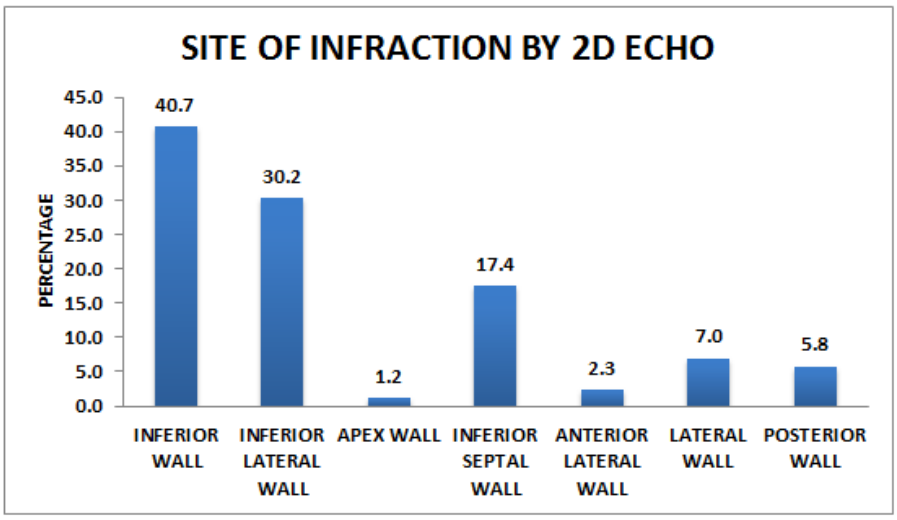

Fig-9: Site of mi by 2d echo among 43 cases of inferior wall & inferior wall +rvmi

Table-12: Site of mi by 2d echo among 20 cases of extensive anterior

Site of infraction by 2D echo	N	%
Anterior septal wall	13	15.1
Anterior wall	11	12.8
Apex wall	11	12.8
Inferior wall	2	2.3
Anterior lateral wall	2	2.3
Inferior lateral wall	1	1.2
Inferior septal wall	1	1.2
Lateral wall	1	1.2
Global wall	1	1.2
Septum wall	1	1.2

Table 12 shows distribution of cases with extensive anterior wall involvement in ECG, with anterior sptal(15%), anterior wall(12%), apex(12.8%), inferior wall(2.3%), inferior septal, inferior lateral, global, septum wall (1.2% each).

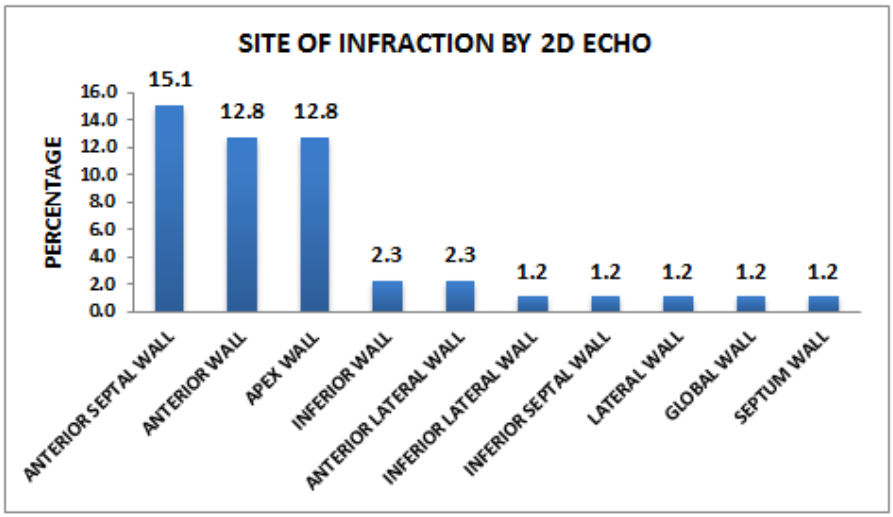

Fig-10: site of mi by 2d echo among 20 cases of extensive anterior

Table-13: Site of mi by 2d echo among 15 cases of anterior septal wall

Site of infraction by 2D echo	N	%
Anterior septal wall	15	17.4
Anterior wall	12	14.0
Apical wall	10	11.6
Anterior lateral wall	3	3.5
Lateral wall	1	1.2

Table 13 shows 2D echo elaboration of 15 cases showing anterior septal wall, anterior septal wall (17.4%), anterior wall (14%) apical wall(11.6%) antero-lateral wall(3.5%).

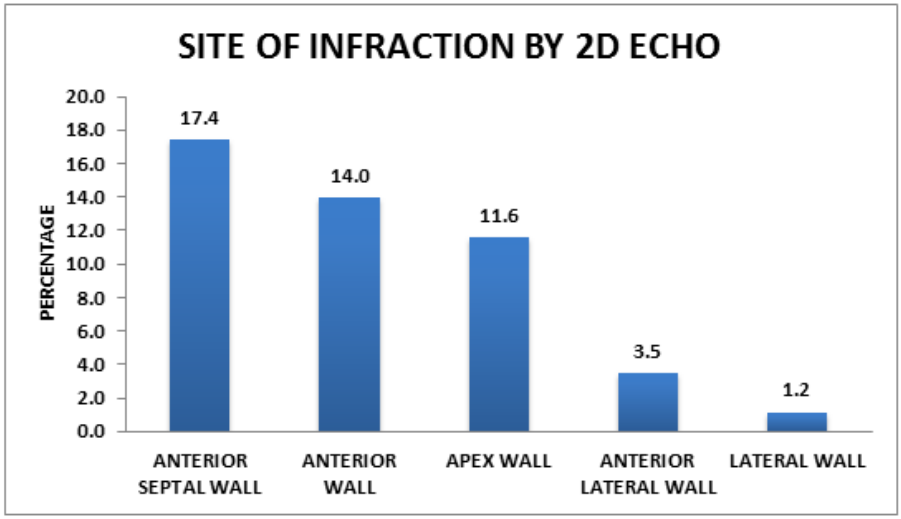

Fig-11: Site of mi by 2d echo among 15 cases of anterior septal wall

Table-14: Hypotension according to site of infraction by ecg

Site of infraction by ECG	Hypotension
Inferior wall & inferior wall +RVMI	19
Extensive anterior	5
Anterior septal wall	6
Anterior lateral wall	1
Lateral wall	0

Table 14 shows hypotension as complication of AMI is seen majorly in IWMI+RVMI followed by AWMI

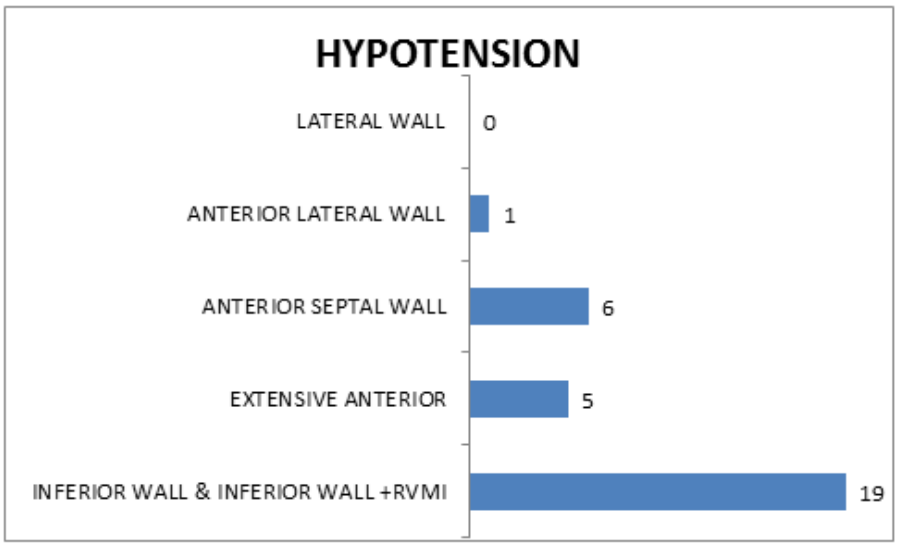

Fig-12: Hypotension according to site of infraction by ECG

Table-15: Distribution of cases according to arrhythymias/conduction block

Arthymias/conduction block	N	%
No	58	67.4
Yes	28	32.6
Total	86	100

Total of 28 cases encountered arrhythmias or conduction block

Table-16: Arthymias/conduction block according to site of infraction by ECG

Site of infraction by ECG	VT	CHB	SB	ST	RBBB	LBBB	AV I°	AV II°	VPB
Inferior wall & inferior wall +rvmi	3	5	5	0	0	1	2	1	0
Extensive anterior	3	0	0	1	2	0	0	0	1
Anterior septal wall	2	0	0	2	1	1	1	0	0
Anterior lateral wall	0	0	0	2	1	1	0	0	1
Lateral wall	0	0	0	0	0	0	0	0	0

Table 16 shows varies arrhythmia and conduction block with distribution among site of infarction involved most common was ventricular tachycardia 8 cases, CHB & SB 5 cases each. Sinus tachycardia 5 , RBBB 5, LBBB 3, Av 1st degree block 3, 2nd degree 1 VPB 2 cases.

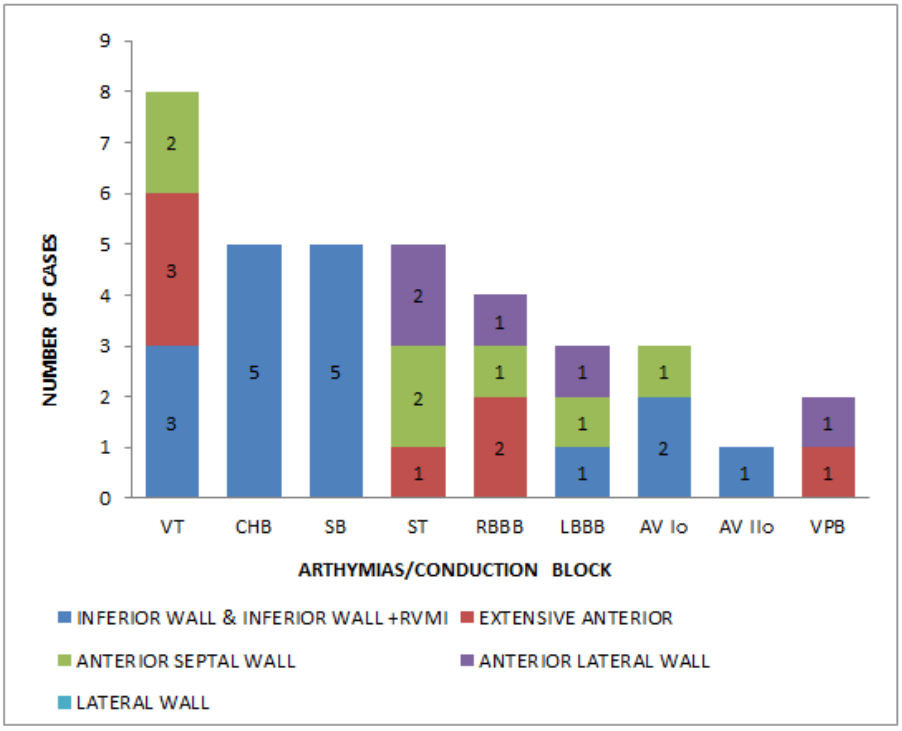

Fig-13: Arthymias/conduction block according to site of infraction by ECG

Table-17: Deaths according to site of infraction by ecg

Site of infraction by ECG	Deaths
Inferior wall & inferior wall +RVMI	3
Extensive anterior	3
Anterior septal wall	1
Anterior lateral wall	0
Lateral wall	0

Total of 7 cases expired during hospital stay, a total 4 cases had AWMI and 3 had IWMI.

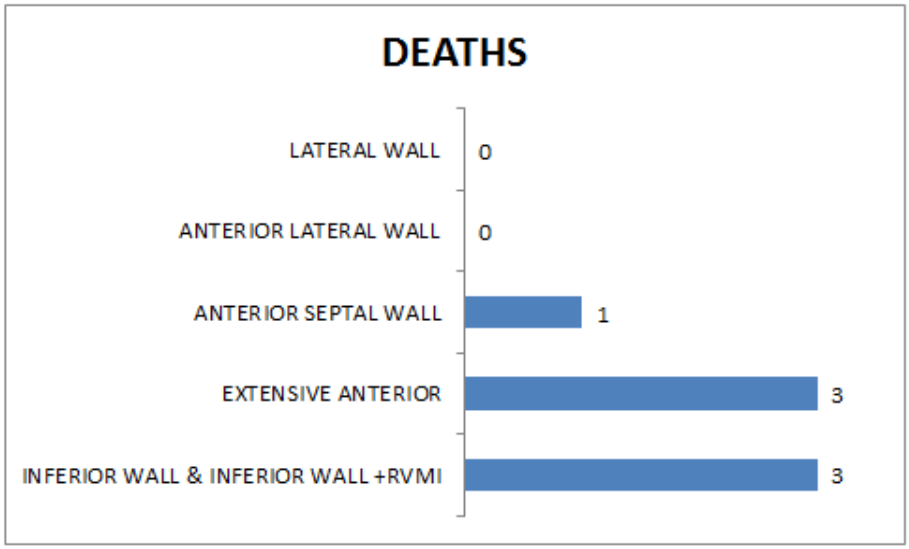

Fig-14: Deaths according to site of infraction by ECG

DISCUSSION

Age & Sex

IN his study 86 patients were studied in the present study. The age ranged from 30-80yrs. 54 patients were males (62%) & 32 patients were females (37%). The maximumnumber of cases were noted in 51 – 60 years (35 cases). Less number of cases was notedin 30 – 40 years & above 70(6 cases). The male to female ratio was 3:2mean age in male was 52.9 and in female 59.9. Study conducted by Khanna *et al*. the mean age was 40 yrs ranging from30 – 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. They reported 25% incidence of infarction in females. The reported finding of male to female ratios was varied from 3.6:1. 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 (96%) & sweating is the most common associated symptom (35%).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 (44%), followed byhypertension 25.6%, diabetes mellitus (17.4%),alcholic (23.3%) &obesity (5.8%).

In Tanajura *et al*. [5] study, smoking was the commonest risk factor (88%) followed byhypertension (22%), hyperlipidemia 16% diabetes (4%) & no risk factors (9%). Smokinghas been observed as a significant risk factor among patients of coronary artery disease in (70%) by Oscar roth [16], in (75%) by Chandurkar [17].

The study done by Sameer Thanavaro *et al*. [6], found diabetes in 18 % of patients & hypertension 39%So there is no much significant difference noted when all the above studies werecompared

ECG and 2D echocardioggraphy correlation

ECG helps to localize the site of infarction. The changes of infarctionare seen in lead II, III and avf in inferior wall infarction, in lead I, avl and V5-6 in anterolateral infarction, in lead V1-3 anteroseptal infarction, lead V5-6 apical infarction and lead V1-6 in extensive anterior infarction.

In patients with acute chest pain syndrome without diagnostic ECG findings of acute myocardial infarction, echocardiography may provide a rapid, sensitive and specific tool to aid in establishment of correct diagnosis. In patients with non-transmural myocardial infarction, severe hypokinesia appears to be the best discriminator of myocardial infarction.

In our data, as shown in results, 20 patients out of 86 patients had extensive anterior wall myocardial infarction on ECG. Echocardiography in these patients further elaborated that 11 patients had extensive anterior wall infarction, 13 patients had antero-septal and apical wall myocardial infarction 11 had anterior & apical.

2 had anterior & inferior infarction & 2 antero-lateral, 1 lateral wall, 1 global infarction, thus

elaborating the extensive anterior infarction seen on echocardiography in great details.

43 patients, out of 86 patients had inferior wall myocardial infarction andinferior wall with right ventricle infarction on ECG. When echo was done in these patients, 35 patients had inferior wall myocardial infarction, 5 patients had inferior walland right ventricle infarction, 26 Infero lateral& 15 infero septal 2 patients had inferior wall and anterior-lateral myocardial.

15 patients out of 86 patients had antero-septal infarction on ECG. Onechocardiographic examination in these patients, 15 patients had antero-septal myocardial infarction, 10 patients had anteroseptal apical infarction, 3 patients had antero-lateral, and thereby lending credence to the fact that echocardiography delineates ischemic changes more extensively.

According to Izumi *et al*. [8,4] electrocardiography has limitations in Diagnosing infero-posterior myocardial infarction especially during the acute phase, but 2D echocardiography is an additional useful diagnostic procedure.

Mahajan Devinder Singh [8] concluded that localization of the site of myocardial infarction on ECG correlated broadly with that seen on ECHO, ECHO was able to elaborate regional wall motion abnormalities in detail i.e., ECHO could detect abnormalities in those areas, which could not be shown by ECG.

Arrhythmias

Sinus bradycardia (SB)

Bradyarrhythmias[9] and hypotension are common in proximal occlusion of right coronary artery commonly leading to inferior myocardial infarction, because of reflexes arising from the ischemic right ventricle.

In the present study 5 had SB, out of which all 3 were purely in inferior and 2 in inferior wall with right ventricular extension and inferior + posterior wall MI. In all these patients, SB was transient and majority of the patients had normal sinus rhythm (NSR) by the end of 1st day. All the patients had NSR at discharge. Similar observations were made by Swart G *et al*. [10]

Sinus tachycardia (ST)

In my study, ST was observed in 5 patients and it was most commonlyassociated with anterior and antero-lateral wall than inferior and inferolateral wall MI. Same observation of anterior wall being commonlyinvolved was made by Crimm A *et al*.[11].

AV blocks (Atreioventricular blocks): Complete (III0) AV block in present study was 5,all of which together in inferior MI (inferior, inferolateral and inferior with right ventricular extension.

Other studies done by Rathore SS *et al.* [12] and Garcia Garcia C *et al*. [13] alsoshowed increased incidence of CHB in inferior wall MI, the incidence being 7.3% and 12% respectively. Though incidence is less as compared to present study but still more than any other site of AMI.

In the present study, the combined incidence of I^0 and II^0. AV block was 4. inferior wall (inferior and inferoposterior) having 75% and anterior wall (anterior and antero-septal) having 25% incidence.

In the study done by Majumder AA *et al*. [14] the combined incidence of I0 and II0A-V block was 15%, with inferior wall showing 30.3% incidence and anterior wall showing 4.45% incidence. Though the incidence of both studies differs, both show an affinity of AV blocks for inferior wall.

Bundle branch blocks (BBB)

In the present study, the incidence of BBB was 7 with more affinity for anterior wall MI than inferior wall. In present study mortality was high in RBBB associated with anterior.

Ventricular arrhythmias

In the present study, overall ventricular arrhythmias were seen in 10 patients of which VT were 8, VPB 2. The frequency of VT was seen more in anterolateral MI than anteroseptal MI which compares well with study done by Horvat D *et al*. [15] in 2008.

Summary

- In the present study males outnumbered females (3:2).
- Majority of cases was seen in 51 – 60 years.
- Smoking emerged as the main risk factor in acute myocardial infarction patients.
- both anterior wall MI & inferior wall MI were equal in incidence
- The lesions seen on ECG correlated broadly with those seen onechocardiography. Echo was able to elaborate regional wall motionabnormalities in detail than ECG.
- LVEF in anterior wall MI was less compared to inferior wall MI Anterior & Global MI had lower LVEF.
- ICCU mortality was 8%.
- Sinus tachycardia (ST) was observed in 5 patients with higher incidence inanterior and antero-lateral
- Sinus bradycardia (SB) was observed in 5 patients predominantly seen ininferior wall MI. However, no death was observed in patients with SB and inferior wall MI.
- Overall incidence of complete (III0) AV block in present study was 5 cases predominantly seen in inferior wall MI .mortality was higher in anterior wall.
- Bundle Branch Blocks have high affinity for anterior wall (Anterior + anteroseptal +

anterolateralits 10%. Among this mortality was higher in patients associated with RBBB.

- Overall incidence of ventricular arrhythmas was 10 of which VT's were 8

CONCLUSIONS

- 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.
- Cardiac arrhythmias routinely manifest during or following ACS. Early recognition and management of post myocardial infarction arrhythmias can significantly modify the morbidity and mortality in myocardial infarction.
- AMI is one of the major causes for hospital admission in elderly with male preponderance between 4th to 7th decade and incidence being equal in both sexes beyond 7th decade.
- AMI is commonly seen in anterior wall with high incidence of tachyarrhythmias and higher mortality whereas inferior wall MI was less common and was commonly associated with bradyarrhythmias with lesser mortality.
- Sinus Bradycardia, if transient, has protective role in AMI whereas persistence of sinus tachycardia has high mortality in AMI

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