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ECHOCARDIOGRAPHIC EVALUATION OF LEFT VENTRICULAR FUNCTION, EJECTION FRACTION, STROKE VOLUME AND ESTIMATION OF TROPONIN LEVELS IN PREDISCHARGE PATIENTS WITH ACUTE MYOCARDIAL INFARCTION"

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ABSTRACT
Myocardial infarction is a clinical state occurring as a consequence of imbalance between myocardial oxygen supply versus demand; leading to ischemic necrosis of myocardium.

To know the prognosis and clinical state, left ventricular function assessment is important. Past 3-4 decades has witnessed enormous growth in understanding the pathophysiology as well as recent laboratory facilities, both invasive and noninvasive, which yields, better data regarding mortality and morbidity in acute or long term prognosis.

There are various invasive and noninvasive imaging techniques, out of which echocardiography of the heart is the gold standard in accurate prediction of left ventricular function, both global and regional Doppler is an another invaluable tool to measure flow rate, peak velocity of red blood cells resolution for regurgitation flow.

This study was undertaken to highlight the echocardiographic evaluation of left ventricular function, mainly stroke volume and ejection fraction and estimation of troponin levels in patients with acute MI, studied at the time of discharge.

KEYWORDS : acute MI, Left ventricular function

AIMS AND OBJECTIVES:

1. To study the echocardiographic evaluation of left ventricular functions ejection fraction, stroke volume and estimation of troponin levels in predischarge patients with acute myocardial infarction.
2. To compare the left ventricular function in anterior and inferior myocardial infarction.

MATERIALS AND METHODS

All the 40 patients studied are admitted to Sri Venkata Sai Medical College and Hospital, Mahabubnagar, between November 2006 to September 2008. Among 40 patients 34 were males and 6 were females.

Inclusion criteria:

1. Patients with severe congestive cardiac failure
2. Those older than 80 years
3. Associated with significant ventricular premature complexes were excluded from this study so as to prevent wrong interpretation of echocardiography values.

The criteria for selection of patient were as follows according to the Epidemological reports from WHO and American College of Cardiology and European Society of Cardiology.

1. Clinical onset of chest pain which lasted for more than 30 minutes.
2. Rise of relevant serum enzymes, within 36 hours of onset of chest pain.
3. Appearance of ECG changes diagnostic of infarction.

Detailed history, clinical examination, and investigations as in proforma were collected. Around 6-8 days after the onset of myocardial infarction, all the 40 patients underwent resting 2-D echocardiography for left ventricular volume study. Volume study consisted of evaluation of left ventricular end diastolic volume, end systolic volume, ejection fraction and stroke volume. Stroke volume is calculated by end diastolic volume minus end systolic volume. Ejection fraction was calculated by dividing stroke volume by end diastolic volume. The values were expressed in fractions and in percentages.

Echocardiography was done, by single observer, was recorded in Hewlet and Packard diagnostic systems with single mechanical transducer of 3MH frequency.

Procedure

All patients were studied around 1-3 PM, patients were put in left lateral recumbent position with normal respiration. Heart rate and ECG were recorded simultaneously. Final reading were taken after averaging 5 beats, each during end of systole, and end of diastole. End systole and end diastole were correlated well with closure and full opening and mitral valves.

Methods

Left ventricular function assessed by two different methods. One was "Area-length method" and another was by "Cube method".

a. Area length method

In this method transducer was placed at the cardiac apex, two chamber apical views are obtained. End systole and end diastole were freezed, the area 'A' of left ventricular wall was measured by tracing the fine endocardial echo. Then longest length (L) was measured from the tip of mitral valve to left ventricular apex. Total volume (V) was obtained by using the following formula.

$$V = \frac{6}{\pi} LD^2 = \frac{8A^2}{3\pi L} \text{ (ml)}$$

Where D is dimension of short axis obtained by

$$D = \frac{4A}{\pi L} \text{ (cms)}$$

b. Cube method

In this method transducer was placed over 3rd and 4th intercostal space on the left sternal border. M-mode echocardiography was obtained at the level of chordae of anterior mitral leaflet. The distance between interventricular septum and posterior wall was measured at end systole and end diastole.

The volume (V) was obtained by using the following formula.

$$V = \frac{\pi}{6} LD^2 = D^2 \text{ (ml)}$$

When L = 2D cm

OBSERVATION AND ANALYSIS

Total number of patients admitted to Sri Venkata Sai Medical College and Hospital, Mahabubnagar between November 2006 to September 2008 to medicine department were 7744 and the number and percentage of patients with myocardial infarction were 180.

Total number of male and female patients admitted with myocardial infarction with their percentage and ratio was 156& 24, 86.6&13.4 and 6.5&1 respectively.

Pattern of infarction out of 40 patients taken up for study is anterior wall MI -24 patients and inferior wall MI – 16 patients.

Total number of patients classified according to Killip's classification, with their percentage are as shown in Table below.

Killips Classification

Kilips classification	Total No. of Patients	Anterior wall infarction	Percentage	Inferior wall infarction	Percentage
I	8	0	0	8	50
II	18	10	41.6	8	50
III	8	8	33.3	0	0
IV	6	6	25.1	0	0

Mean Ejection fraction depending on the pattern of infarction, both area length and cube method are as follows. In the present study 24 patients with anterior wall infarction had a mean Ejection fraction of 46% and 49% by area length and cube method respectively. 16 patients with inferior wall infarction had mean Ejection fraction of 52.50% and 54.5% by area length and cube method respectively.

All the 40 patients in this study are classified according to Killip's classification and their mean Ejection fraction in area length and cube method are as follows. Patients with class I had a mean Ejection fraction of 48% by area length and 50% by cube method respectively. Patients in Killip's class IV had a mean ejection fraction of 30% by area length and 32% by cube method.

Total number of patients are classified depending on pattern of infarction and their mean stroke volume in both area length and cube methods. Mean stroke volume in ml of patients with anterior wall MI and Inferior wall MI by Mean area length method and Mean cube method are 48,50.75 and 52.75, 56 respectively.

Wall motion study done in 40 patients are grouped as 0-Hyperkinesia, 1-Normokinesia, 2-Hypokinesia, 3-Akinesia, 4-Dyskinesia, 5-Aneurysm and the number of patients in each group are 0,0,16,8,10and 2 respectively .

Total number of patients with associated complications and their percentage and pattern of infarction are as shown in Table below.

Complications

Complications	Total No. of patients	Percentage	Anterior	Inferior
Pericardial effusion	8	20	6	2
Aneurysm	4	10	4	0
Thrombus	4	10	4	0
Mitral regurgitation	2	5	2	0
Calcification	0	0	0	0

34 (85%) patients out of 40 patients studied, survived after infarction had mean Ejection fraction 46 and stroke volume 53 ml by area length and ejection fraction 48 and stroke volume-56 ml by cube method respectively. 6(15%) cases died were having ejection fraction-28; and stroke volume-17.66ml by area length and ejection fraction 30 and stroke volume 20 ml by cube method respectively. This shows patients who survived had better ejection fraction than the patients who died.

DISCUSSION

In this study 40 patients of acute myocardial infarction were selected, all were having transmural infarction and were having myocardial infarction for the first time.

1. Total number of admission with myocardial infarction
According to medical statistical details obtained from Sri Venkata Sai Medical College and Hospital, Mahabubnagar between November 2006 to September 2008 is as shown in Table-1. Out of 7744 medical admissions 180 were admitted for acute myocardial infarction. Which accounts for 2.3% of total medical cases.

The incidence according to various statistics are as follows :
According to Singh et al., study (1995) incidence of coronary artery disease is 3% in North Indian Rural population, 9% in North Indian Urban population and in South India it is 13.9%(1).

Coronary artery disease was accounted for <10% of all deaths in 1910 in United States by 1965, mortality due to coronary artery disease rose to 55% of all deaths. Last 3 decades saw an annual decline of coronary artery disease in United States (0.6% for prevalence, 1-2% for incidence, 2-4% for mortality).

From 1960 to 1990's the coronary artery disease prevalence increased two fold in rural India from 2% to 4%, and 3 fold 3.45% to 9.45% in urban India.

2. Sex Distribution
In the present study out of 180 patients with acute myocardial infarction 156 were males (86.6%) and 24 were females (13.4%) which forms the ratio of 6.5%.

According to Jens Berning study in 1992(2) the sex ratio was 2.6:1. According to Agarwal et al., study in 1978 (3) the sex ratio was 15:1. According to Meher et al., (1991) the sex ratio was 25:1 in young patients and 14.2:1 in elderly.

The disease is more common in men compared with premenopausal women in a ratio of 25:1. However, in postmenopausal women a rapid rise in atherosclerotic coronary artery disease occurs (4). After age of 60 years the ratio is 3:2 against 25:1 in premenopausal women.

3. Pattern of infarction
As per Table-3 out of 40 patients 24(60%) had anterior wall-infarction and 16 (40%) had of inferior wall-infarction.

According to Agarwal et al., (1978) study showed 58% anterior wall myocardial infarction and 42% were inferior wall myocardial infarction (3).

E.Kjoller, L. Kober et al., (2002) showed anterior wall myocardial infarction in 64% of patients and inferior wall myocardial infarction in 36% of patient (5).

4. Killip's classification
All the 40 patients in the present study were classified according to Killip's classification class I to IV. Out of the 16 patients with inferior wall infarction 8 were in class I and 8 were in class II. Out of 24 with anterior wall infarction 10 were in class II and 8 were in class III and 6 were in class IV. Majority of anterior wall infarction come under class III and IV. This is because of larger size of infarction.

5. Mean Ejection fraction
In the present study 24 patients with anterior wall infarction had a mean Ejection fraction of 46% and 49% by area length and cube method respectively. 16 patients with inferior wall infarction had mean Ejection fraction of 52.50% and 54.5% by area length and cube method respectively.

Ejection fraction in anterior wall infarction is less than inferior wall because the size and extent of infarction is usually more in anterior wall infarction. The study conducted by Gerard Kan and Visser et al., (1994) mean Ejection fraction of anterior wall myocardial infarction was 46.7±9.5(6).

6. Ejection fraction depending on Killips classification
Patients with class I had a mean Ejection fraction of 48% by area length and 50% by cube method respectively. Patients in Killip's class IV had a mean ejection fraction of 30% by area length and 32% by cube method.

This observation shows that the patients with higher Killip's classification had lower ejection fraction and patients with lower

Killip's classification had higher ejection fraction.

The study conducted by Kan, G, Visser, Durrer the ejection fraction was calculated by area length method and modified Simpson's rule (7). In their study Ejection fraction was low in higher Killip's classification, i.e., 28±7.8 when compared to low Killip's classification, i.e., 46.0±14.9 in area-length method and 28.1±6.2 Vs. 48.1±10.2 in modified Simpson rule.

Another study conducted by Bhatnagar, S.K., Yusuf ,Et al were 79 consecutive survivors (mean age 48 years) of a first acute myocardial infarction were prospectively studied and followed up for a mean 18 months (8). Out of which 47 has an uncomplicated myocardial infarction, 17 had post infarction angina and 15 had left ventricular failure. Left ventricular function of these patients prior to discharge were assessed by 2-D Echocardiography and Radionucleide angiography. Ejection fraction was 51.9±2.7 in uncomplicated infarction, 45.3±4.0 in patients with post infarction angina and 35.1±3.3 in patients with left ventricular failure. The values of ejection fraction in present study are in concordance with Bhatnagar et al., study. One year mortality increases as ejection fraction falls below 40.

7. Stroke volume depending on pattern of infarction
The mean stroke volume of 24 patients with anterior wall infraction were 48 ml in area length method and 50 ml by cube method respectively. And mean stroke volume of 16 patients with inferior walls infarction were 52 ml in area length and 56 ml in cube method respectively.

Even though anterior infarction will have low stroke volume than inferior wall because of larger size of infarction. In present study there is not much difference when pattern of infarction is considered.

8. Stroke volume depending on Killip's classification
In this present study, patients with class I had mean stroke volume of 56 ml by area length method and 58 ml by cube method respectively and patients with class IV have mean stroke volume of 28 ml by area length and 30 ml by cube method respectively.

This shows that with higher Killip's classification stroke volume decreases.

9. Wall motion study
The scoring for wall motion study was graded as per the study conducted by Rick A. Nishimura, Guy S. Reader., in "Prognostic value of prediscarge 2-D echocardiography after acute myocardial infarction", were as follows :

Grade 0-Hyperkinesia; grade1-Normokinesia; grade 2-hypokinesia; grade 3-akinesia; grade 4-dyskinesia; grade 5-aneurysm (9).

Some patients had wall motion abnormalities at different sites had of different grade. In the present study 36 (90%) showed all motion abnormality; 16 (40%) had - hypokinesia; 8 (20%) akinesia; 10(25%) dyskinesia; 2(5%) had aneurysm.

Since echocardiography done between 6-10 days after the infarction. Hyperkinesia which is seen in early phases, is not seen.

In the study conducted by Richard S. Horowitz., (1982) wall motion abnormality was noticed in 94% of cases with acute myocardial infarction. The value in present study correlates well with above mentioned study.

10. Complications
Eight -8 patients (20%) showed evidence of pericardial effusion. Out of which 6 were anterior wall and 2 were of inferior wall. In most of these cases effusion was minimal and there were no evidence of cardiac tamponade.

In study conducted by Tetsuro Sugiura et al., (1990) incidence of pericardial effusion was 25% (10). The value in present study correlate well with the above mentioned study.

Aneurysm was noticed in 2 (5%) of patients and all were of anterior wall infarction. According to the study of Abrams, D.L. (1963), a study conducted out of 65 consecutive autopsied patients with myocardial infarction incidence of aneurysm was 8-15%.(11)

According to David Faxon et al., (1982) study incidence of aneurysm was 7.6%.(12) True aneurysm is develop in less than 5-10% of all patients with transmural myocardial infarction mainly anterior wall. Value in the present study correlates well with the above mentioned study.

THROMBUS
This was noticed in 4 patients out of 40 patients (10%) and all were anterior wall myocardial infarction. Thrombus was situated in left ventricular apex.

According to Keeley et al., (1996) mural thrombi occur in approximately 20% of patients with acute myocardial infarction who do not receive anticoagulant therapy (13). Paolo Spirito et al., study (1985) incidence of thrombus was 41% (no anticoagulant and antiplatelet drugs were used).

The Stefano Deomenicucci, (1987) study showed thrombus in 10% of patients at the time of hospital discharge.

In present study anticoagulant and antiplatelet drug were used.

Mitral regurgitation
Mitral regurgitation was noticed in 2 patients (5%) of anterior infarction there were no evidence of papillary muscle dysfunction and there were no evidence of VSD, rupture of free wall or pseudo aneurysm.

11. L.V. function and prognosis
34 (85%) patients out of 40 patients studied, survived after infarction had mean Ejection fraction 46 and stroke volume 53 ml by area length and ejection fraction 48 and stroke volume-56 ml by cube method respectively. 6(15%) cases died were having ejection fraction-28; and stroke volume-17.66ml by area length and ejection fraction 30 and stroke volume 20 ml by cube method respectively. This shows patients who survived had better ejection fraction than the patients who died.

In study of Kan, G., Visser, E.A., (1984) ejection fraction measured in 90 patients after infraction. There were statistically significant trends towards low ejection fraction with higher Killip's class. The ejection fraction was lower in six patients dying from cardiogenic shock was 28.0±7.8, when compared with survivors, which was 46.6±10.1 by area length method.

According to study conducted by Jens Berning, Jeppe Launbjerg et al., (1992) mean ejection fraction was 41 in survivors and 28 in non survivor.

Value of ejection fraction in the present study correlates well with the above mentioned studies.

SUMMARY
- 90%(34 cases) of Patients with clinically diagnosed myocardial infarction had elevated troponin levels
- Mean ejection fraction is less in anterior wall myocardial infraction in comparision with inferior wall.
- Patients with higher Killip's had low ejection fraction and stroke volume than with lower Killips class.
- Out of 40 patients studied 18 showed complications. 8 (20%) showed pericardial effusion, 4 (10%) showed left ventricular aneurysm, 4 (10%) showed thrombus and 2(5%) showed a mitral regurgitation.
- In present study 36 (90%) had wall motion abnormality, 16 (40%) had hypokinesia, 8(20%) had akinesia, 10 (25%) had dyskinesia, 2 (5%) had aneurysm.
- Patients who survived had better ejection fraction compared to patient died.

CONCLUSION
In acute myocardial infarction two dimensional echocardiography at rest has proved useful in the assessment of left ventricular function and risk stratification.

Predischarge 2-D echocardiography at rest can identify patients at higher risk of death, recurrent infarction or development of congestive heart failure in late follow up. More importantly, a normal wall motion index early in infarction identifies a low risk sub group that remains free of complications with a negative predictive accuracy of 95%. Two

dimensional echocardiography can readily detect the rupture of ventricular septum, free wall, ventricular aneurysm, pseudoaneurysm, mural thrombus, infarction extension following myocardial infraction.

The advantage of 2-D echocardiography includes its portability and ease of performance. It can be used in coronary care unit, on very sick patients and can be repeated when necessary. It is painless and relatively inexpensive. Limitations include difficulties in obtaining interpretable studies in some patients with unusual body features like empysema, obesity, overlying lung tissue obscuring the echocardio graphic window.

Values obtained in the present study match favourably with others studies conducted elsewhere.

REFERENCES:
1. Singh RB, Ninz MA et al : Coronary risk factors in Indians. Lancet 1995 ; 778-779.
2. Jens Berning, Jeppe Launbjerg et al : Echocardiographic Algorithms for admission and predischarge prediction of mortality in acute myocardial infarction. Am. J. Cardiol 1992 ; 69 : 1538-1544.
3. Agarwal BL, Agarwal RK et al : Prognostic factors in Acute Myocardial infarction. Indian Heart Journal 1978 ; volume 30, No. 4 : 195-198.
4. Pahlajani DB. Ischemic Heart disease. API text book of medicine. 5th edition 1992. Chapter 19, pp. 460.
5. Kjoller E, Kober L, Jorgensen S et al : Short and long term prognostic importance of regional dyskinesia versus akinesia in acute myocardial infarction. Heart 2002 ; 87 : 410-414.
6. Gramic R Shah PM, Echocardiography of aortic root. Invest Radiol 1968 ; 3 : 356-366.
7. Kong Ing Lie, Visser, Durrer, Eur. Heart J. 1984 ; 3 : 210-217.
8. Antman EM, Grudzein C, Sacks DB, Evaluation of a rapid bedside assay for detection of cardiac troponin T. JAMA 1995 ; 243 : 1279-1282
9. Rick A. Nishimura, Guyas Reeder et al : prognostic value of predischarge 2-D. Echocardiography after acute myocardial infarction. Am. J Cardiol 1984 ; 53 : 429-432.
10. Tetsuro Sugiura, Toshiji Iwasaka et al : Factors associated with pericardial effusion in acute Q wave myocardial infarction. Circulation 1990 ; 81 : 477-481.
11. Abrams DL et al : Ventricular aneurysm : A reappraisal based on a study of 65 consecutive autopsied cases. Circulation 1963 ; 27 : 164.
12. David P. Faxon. Prognostic significance of Angiographically documented left ventricular amerysm from coronary artery surgery study. (CASS) Am. Journal cardiol 1982 ; 50 : 157.
13. Keeley EC, Hillis LD : Left ventricular mural thrombus after acute myocardial infarction. Clin Cardiol 1996 ; 19 : 83.