
Estimation of Left Ventricular Aneurysm Utilizing Cineangiographic Film

Noori Y. Kattami PhD* & Sabah M. Yacoub FRCP**

Abstract:

Background: LVA is any large area of LV dyskinesia or akinesia that reduces LV ejection fraction. Left ventricular aneurysm therapy (medically or surgically) depends on the estimation of normal and abnormal left ventricular wall motion by determination the perimeter of left ventricular aneurysm, left ventricular volume and shape indices, and ejection fraction.

Objectives: To estimate left ventricular aneurysm from left ventricular cineangiogram films, in patients with coronary artery disease who underwent cardiac catheterization.

Methods: Left ventricular cineangiograms of ten patients with left ventricular aneurysm, who underwent cardiac catheterization in 2002 at Al-Rasheed teaching Hospital/ Cardiac Catheterization Laboratory, were analyzed to determine LV volume indices, LV shape indices, and to measure the size of LVA (the percentage of the diastolic akinetic and/or dyskinetic perimeter), and compared to a computerized LV model (previously established at the Department of Physiology/ Al-Mustansiriya Medical College).

Results: There was decreasing in ejection fraction with respect to increasing of LV wall motion abnormality (inverse correlation, $r = -0.95$, $P < 0.001$). The results obtained were utilized to establish a prognostic fitting diagram for therapeutic management of the patients with left ventricular aneurysm.

Conclusion: In the present study LV wall motion and ejection fraction of the patients studied were utilized for the quantification of the global and segmental LV dysfunction as an effort to decide the way of therapy.

Introduction

Myocardial Infarction results in a spectrum left ventricular (LV) shape abnormalities (true left ventricular aneurysm (LVA), intermediate Cardiomyopathy, and ischemic dilated Cardiomyopathy) [1].

LVA is defined as any large area of LV dyskinesia or akinesia that reduces LV ejection fraction (EF %) [2-3].

The pathophysiology and treatment may be the same for ventricular akinesia and dyskinesia [4]. Many methods were used to estimate LVA utilizing different technique such as cardiac catheterization [5], echocardiography [6-7], and magnetic resonance imaging (MRI) [8]. Global LV shape was assessed by the index of LV sphericity, which measured the ratio between the long axis and short axis, or the ratio between the end diastolic volume and the volume of the sphere having a diameter equal to the same length of long axis [9]. Different surgical techniques were used to repair dyskinetic LVA (linear and patch remodeling) [10].

In the present study computerized estimation of LVA is done by determining the indices of LV volumes, LV shape indices at (end systole and end diastole), and segmental LV wall motion abnormalities, from the analysis of the LV cineangiograms (LVCG) of the patients studied.

Materials and Methods:

LVCG films in right anterior oblique (RAO) were analyzed of ten patients with coronary artery disease and LVA, who underwent cardiac catheterization procedure in 2002 at Al-Rasheed Teaching Hospital/ Cardiac Catheterization Laboratory.

The results obtained were compared with LV model (previously established at the Department of Physiology/ Al-Mustansiriya Medical College) [11]. All patients were males, their age range between (30-60) years, mean of $(41 \pm 9, M \pm SD)$. The analyses of the LVCG's of these ten patients were performed utilizing personal computer and appropriate computer algorithms for the image processing to determine:

1. LV segmental length change (cm) during end systole and end diastole (ES and ED), and LV wall motion abnormality (%LVW) based on the percentage of the diastolic perimeter that was akinetic or dyskinetic (LVW%: mild= 1% to 14%, moderate= 15% to 29%, and $\geq 30\%$) [12].
2. End systolic and end diastolic LV volume indices (ESVI and EDVI) to determine EF%.
3. LV shape indices at end systole and end diastole (SHESI and SHEDI) utilizing the following equation: **LV shape index** = $4 \times \pi \times \text{LV (area)} / \text{LV (perimeter)}^2$ [13].

Where:

LV (area) = the area within LV contour (cm²)

LV (perimeter) = circumference of LV contour (cm)

$\pi = 3.14$

Statistical Analysis:

1. Mean (M) $\pm$ standard deviation ($\pm SD$) of LV volumes and shape indices of the subjects studied were compared with the normal readings of the LV model using unpaired student's t-test (P-value < 0.05 was considered significant difference between means).
2. Correlation factor (r) between LVW% and EF% was determined with the plotting of the regression line to find the equation that

correlates between LVW% and EF% (the value of (r) is between +1 and -1 , and (r) is represented as weak correlation when the value of (r) is near zero).

Results:

The results listed in Table 1, were compared with the normal readings of LV model previously established. In patients with LVA, the mean ESVI, EDVI and SHESI were significantly different from normal ($P<0.001$). Also LVW% and EF% were significantly different from normal ($P<0.001$). The SHEDI was not significantly different from normal ($P>0.05$).

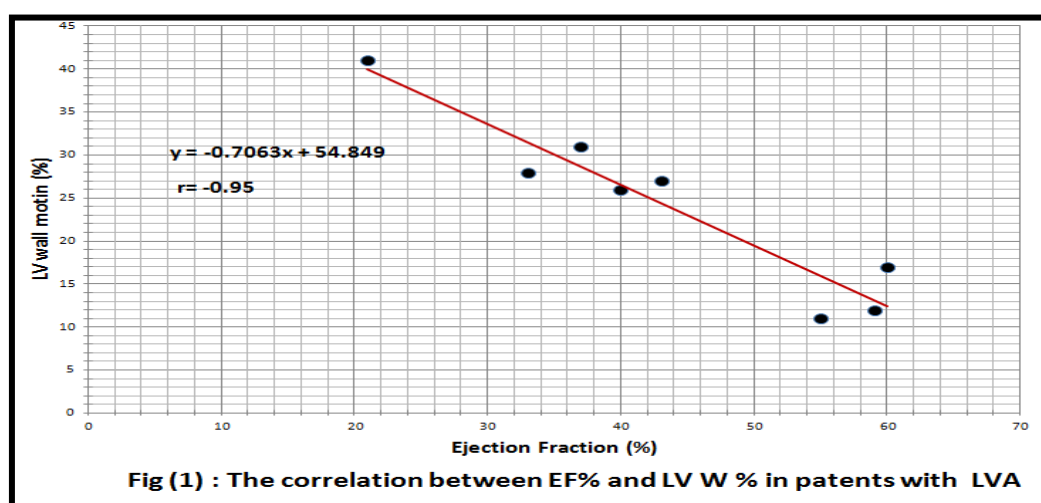
There was decreasing in EF% with respect to increasing in degrees of LVW% (inverse correlation, $r = -0.95$, ($P<0.001$) as demonstrated in Fig.1. Segmental length change curves (fig. 2) were utilized to determine the site and the perimeter of (LVA), and to demonstrate the segmental length at Es more than segmental length at ED for a patient with LVA in the antero-lateral and apical regions (the crossing points of the two curves at ES and ED in front the antero – lateral and apical regions). From the results obtained (EF% and LVW %), new prognostic fitting diagram was established (Fig.3) to correlate between the management of therapy, EF% and LVW% in patients with LVA.

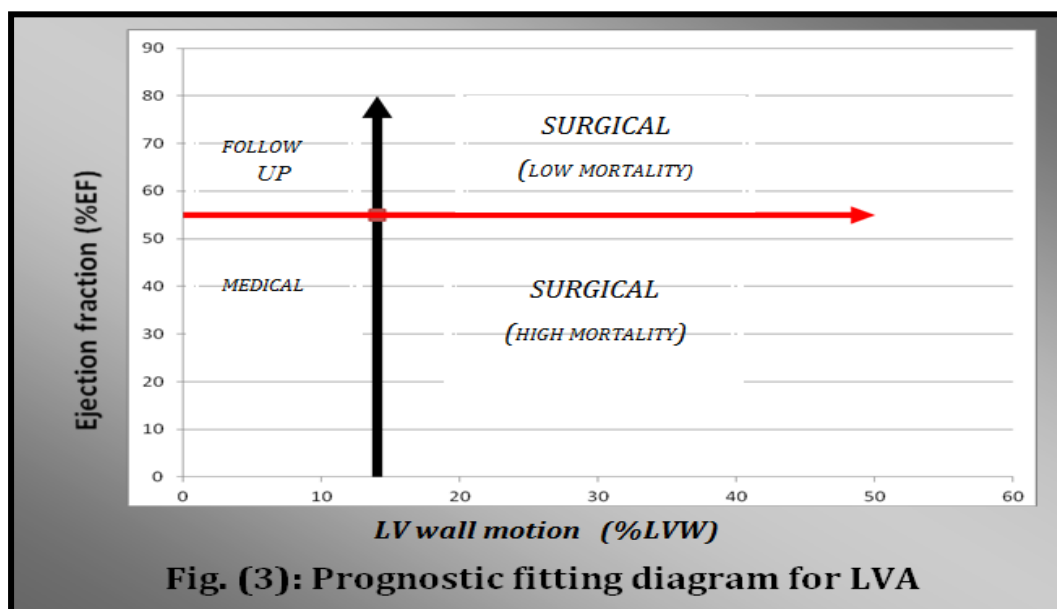
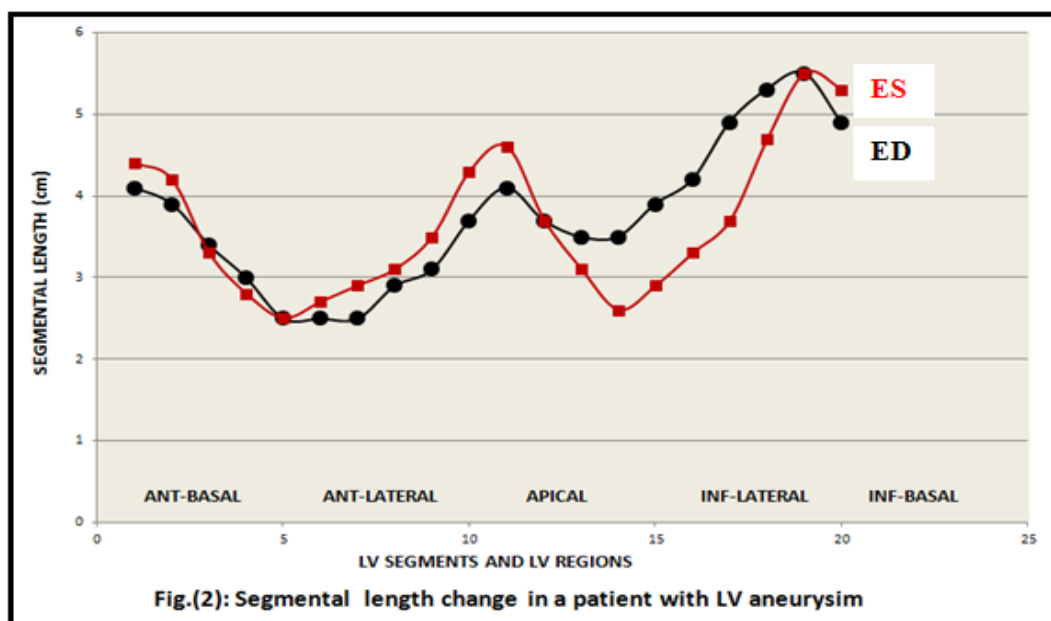
Table 1: Comparison between the means of LV Volumes, EF%, LVW%, and LV shape indices of the studied patients and LV model.

No.	ESVI	EDVI	SHESI	SHEDI	*LVW (%)	EF (%)
1	47	116	66	91	12	59
2	80	105	87	87	16	23
3	70	105	78	82	28	33
4	47	119	69	88	17	60
5	103	174	85	90	26	40
6	71	89	80	90	19	20
7	69	123	75	89	27	43
8	108	138	84	87	41	21
9	70	112	82	92	31	37
10	69	154	74	92	11	55
Mean± SD	73.4±19.9	123.5±25.3	78± 6.9	88.8± 3.01	23± 9	39.1± 15.25
LV Model M± SD	17±4.5	67± 17	65± 4.5	86± 4	-	74±5
P-value	0.00003E-10	0.00008E-02	0.00003E-02	0.118	-	0.00002E-7

*%LVW: Mild = 1 – 14(%), Moderate= 15-29(%), and Severe ≥ 30 (%)

* P-value: $P>0.05$ (not significant difference); $P<0.05$ (significant difference)





Discussion:

LVA most frequently develop after myocardial infarction^[14]. Number of authors defining LVA as any large area of LV akinesia or dyskinesia that reduces EF%^[2]. Also, LVA was used to describe systolic-diastolic deformation^[15]. Surgical techniques (linear and patch remodeling) were used for post infarction LVA, and both surgical techniques achieved satisfactory results with respect to mortality, late function, and survival^[10].

LVA, the most advanced form of segmental dysfunction, is often associated with global LV dysfunction depends on the analysis of the contrast ventriculography, which remains the single most useful test in LVA^[16].

The prognostic fitting diagram (Fig.3) demonstrates that small LVA should be treated

medically when EF% is still normal, or when %EF is reduced (with high mortality). LVW% and EF% were significantly different from normal ($P < 0.001$). But the SHEDI was not significantly different from normal ($P > 0.05$). So the results of eight patients were utilized to plot the relationship between EF% and LVW% (fig. 1), and two patients with congestive Cardiomyopathy and diffuse hypokinesia, were excluded. Generally the evaluation of the perimeter of LVA are represented as the following (LVW%: Mild = 1 – 14%, Moderate= 15-29%, and Severe > 30%)^[12].

The estimation of LV shape as "sphericity index" using echocardiographic technique, failed to detect apical shape abnormalities (global LV dilatation), and apical concity index was used^[9]. Also most of the recent quantitative techniques require

sophisticated computer facilities. MRI-SPAMM Technique based on magnetic tagging (spatial modulation of magnetization) provides temporal correspondence of material points within the heart wall. But there is some initial experience in the use of tagged MRI^[6]. 3D echocardiography (volumetric curvature method) is proved to be of low interobserver and intraobserver variability, but the using of this method needs to analyze data from a large enough sample size to specify the relationship between LV shape and cardiac diseases^[17].

In conclusion the estimation of the LVA was performed as an effort to decide the way of therapy whether medically or surgically. The method chosen is relatively simple and therefore suitable for routine clinical use.

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* Dept. of Physiology Al-Mustansiriya Medical College.

** Dept. of Medicine, Baghdad Medical College.