

How to Measure Left Atrial Volume

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(*ECHOCARDIOGRAPHY, Volume 21, August 2004*)

left atrial volume, echocardiography

Left atrial (LA) size may be evaluated both qualitatively and quantitatively with echocardiography. Parasternal LA dimension (LAD) is normally about the same dimension as the

aortic root. The anteroposterior LAD is used to measure LA size by M-mode and two-dimensional (2D) studies.¹ This measurement is relatively insensitive to LA enlargement, but when it is increased, it is specific for such (Fig. 1).

The LA is normally a slightly tapered, pillow-shaped three-dimensional structure, without a natural long or short axis. LA dimensions can

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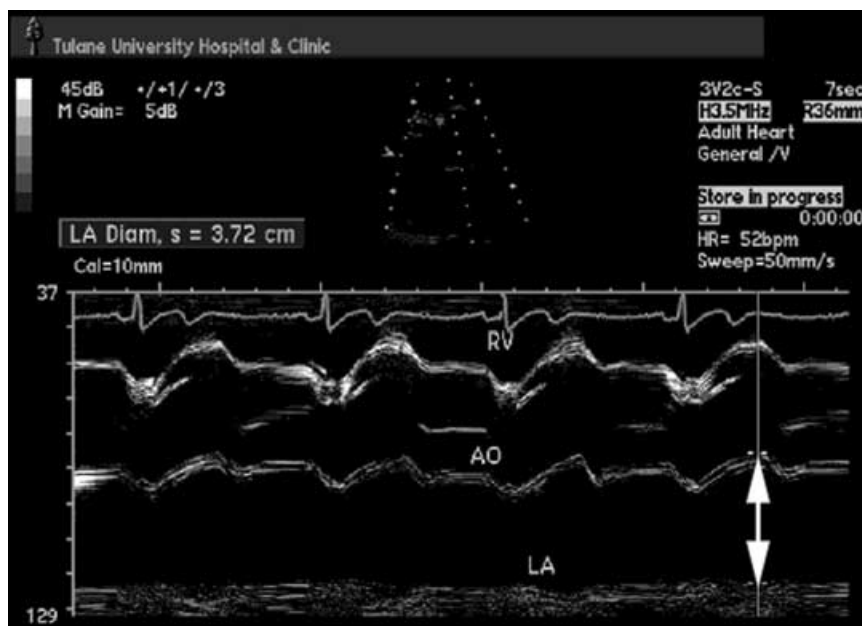


Figure 1. M-mode measurement of LA size from a parasternal window. According to ASE guidelines, the measurement (leading-edge to leading-edge method) is performed at end-systole, measured at the maximum dimension from the leading edge of the posterior wall of the aorta, to the dominant line of the posterior wall of the LA (arrows).

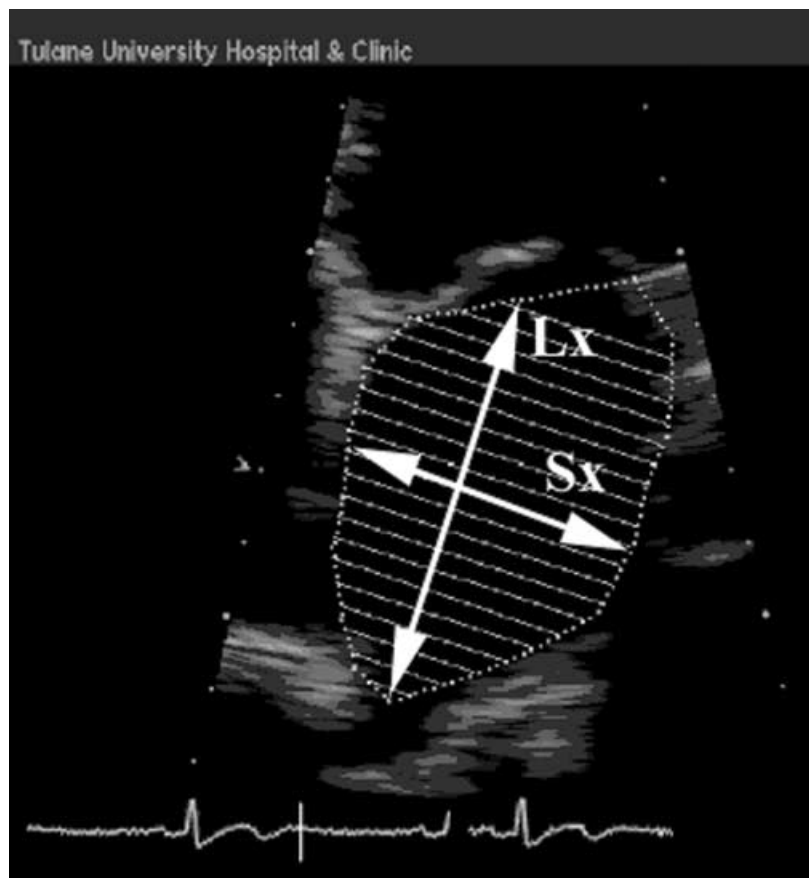


Figure 2. Apical four-chamber view highlighting the LA. The endocardial border has been traced and the area generated, for use by Simpson's Method. One may also use an elliptical model to calculate LAV, in which the LA long-axis (Lx) and short-axis (Sx) are only needed in this view. Tracing an accurate endocardial border may be difficult at times.

be distorted by gross dilatation of the ascending aorta and dilatation or tortuosity of the descending aorta, which is not uncommon in older patients. Hence, LA volume (LAV) measurements may be a better indicator of true LA size.² Compared to M-mode LAD measurements, LAV using measurements from several two-dimensional echocardiographic planes, may be a better predictor for the development of atrial fibrillation,³ survival after myocardial infarction,⁴ predictor of first cardiovascular event in the elderly,⁵ and marker of left ventricular (LV) diastolic dysfunction and "cardiovascular risk burden."⁶ Although three-dimensional echocardiography may be promising for accurate measurements of LAV, we are unaware of any longitudinal studies using this method to evaluate LAV as a predictor of cardiovascular risk.

Methods have been described for the measurement of LAV,^{2,7-11} but no standardized method has been adopted. Algorithms used for LV volume measurements (area length and Simpson's biplane) may be used for LAV cal-

culatation.¹² An elliptical model that does not require tracing the LA endocardium and reduces mathematical calculations has been validated⁸ in a population study. Results correlate closely with other methods of LAV calculations (Fig. 2). LAV is calculated using the elliptical model as

$$\text{LAV} = (\pi/6)(\text{LAD})(\text{Lx})(\text{Sx})$$

where LAD is a parasternal M-mode measurement (Fig. 1), Lx is an apical four-chamber LA long-axis dimension, and Sx is an apical four-chamber LA short-axis dimension (Fig. 2).

Left atrial volume is reported in units of milliliters (ml). Left atrial volume is often indexed to the body surface area (BSA) (m²) or body mass index (BMI) (kg/m²), but the best way to report LAV and account for body size has not been established.¹³ BSA may be found for an individual in "lookup tables" or calculated from the following formula:

$$\text{BSA} = \text{Weight}^{0.425} \times \text{Height}^{0.725} \times 0.007184$$

TABLE I

Reference Ranges for LAD and LAV from a Population Study in Patients ≥ 45 Years of Age.

Measurement	Gender	Percentile		
		5%	50%	95%
LAD, cm	Female	2.80	3.50	4.20
LAD, cm	Male	3.00	3.90	4.60
LAD/BSA, cm/m ²	Female	1.58	2.00	2.52
LAD/BSA, cm/m ²	Male	1.49	1.88	2.30
LAD/BMI, cm/kg per m ²	Female	0.100	0.131	0.176
LAD/BMI, cm/kg per m ²	Male	0.101	0.137	0.172
LAD/height, cm/cm	Female	0.017	0.022	0.026
LAD/height, cm/cm	Male	0.017	0.022	0.027
LAV, ml	Female	23	36	54
LAV, ml	Male	29	45	69
LAV/BSA, ml/m ²	Female	14	21	30
LAV/BSA, ml/m ²	Male	14	22	33
LAV/BMI, ml/kg per m ²	Female	0.94	1.37	2.07
LAV/BMI, ml/kg per m ²	Male	1.02	1.61	2.47
LAV/height, ml/cm	Female	0.144	0.226	0.333
LAV/height, ml/cm	Male	0.164	0.257	0.390

Values are for the 5th, 50th, and 95th percentiles of the population. LAD and LAV have also been normalized to BSA and BMI. (Reproduced with Permission from Pritchett et al.⁸).

BMI = body mass index; BSA = body surface area; LAD = left atrial dimension; LAV = left atrial volume.

where BSA is in square meters, weight in kilograms, and height is in centimeters. The BSA of the average 70-kg adult is 1.73 m². Reference ranges of LAD and LAV using the elliptical model are provided in Table I.⁸

Several suggestions to help make accurate measurements include:

1. Utilize the "Zoom/Res" feature on the echocardiographic machine.
2. Correct for a foreshortened image by moving down one intercostal space.
3. Use the 2D frame just prior to initiation of mitral valve opening.
4. A common mistake of measuring the LA by tracing is to including the mitral leaflets and pulmonary veins (especially when they are dilated). When using Simpson's Method of Discs

start/end tracing at the mitral annulus and omit pulmonary veins in the tracing.

5. Repeat LAV measurements for accuracy.

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