

# Assessment of LV functions and volumes, are conventional methods still beneficial?

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## What do we mean by conventional methods?

- We mean widely available and used method as assessment by 2D transthoracic echocardiography:
- Assessment is recommended to be done by biplane Simpson's disc summation method.

## What are the non conventional methods available?

### **A) Refinement of the widely available 2D echo:**

- Through using newer techniques and modalities as strain and speckle tracking techniques.

Or

- Through enhancing image by contrast echo.

### **B) Use of new modalities:**

- 3D echocardiography.
- Cardiac MR.

- CMR is the gold standard for assessment of cardiac chamber volume and function.

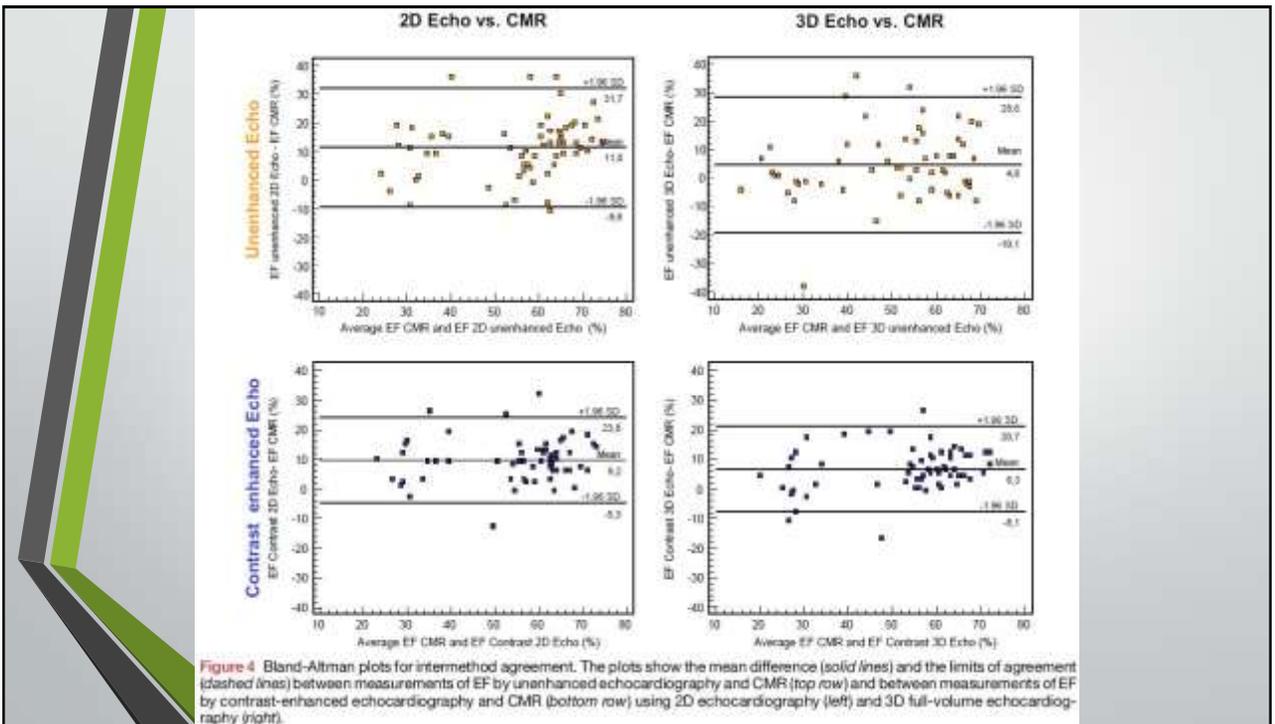
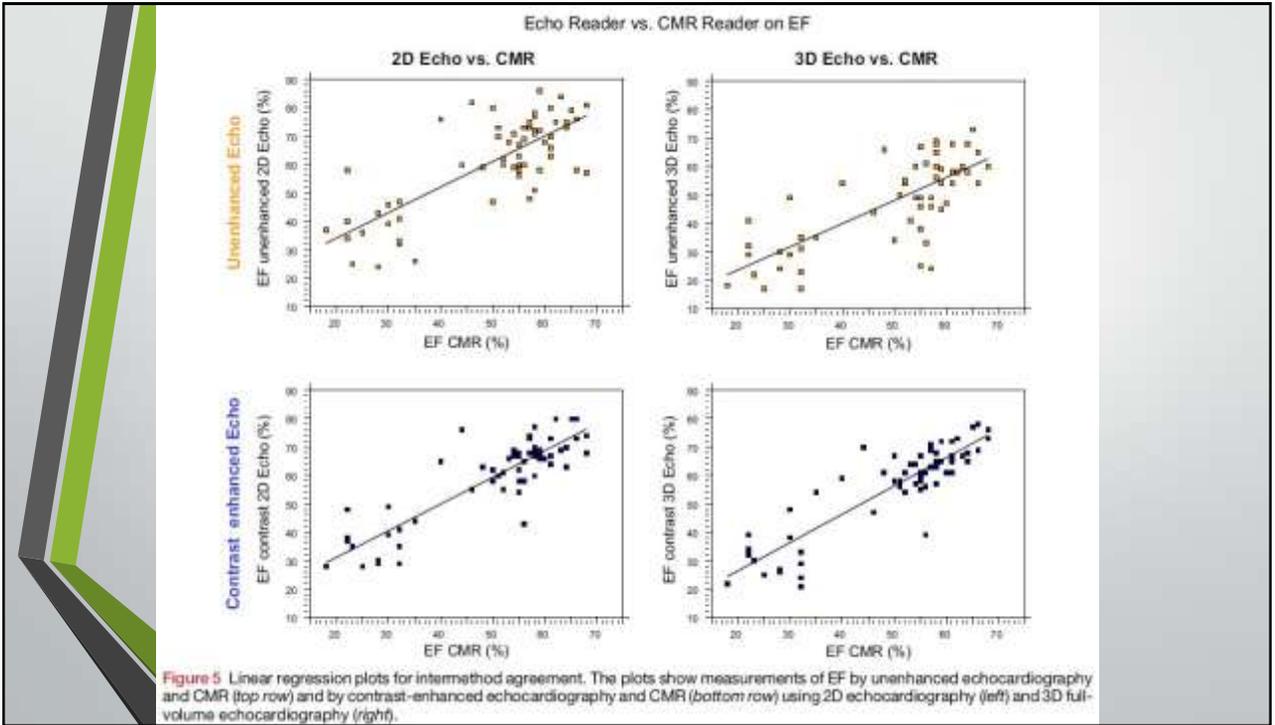
## Analysis of Left Ventricular Volumes and Function: A Multicenter Comparison of Cardiac Magnetic Resonance Imaging, Cine Ventriculography, and Unenhanced and Contrast-Enhanced Two-Dimensional and Three-Dimensional Echocardiography

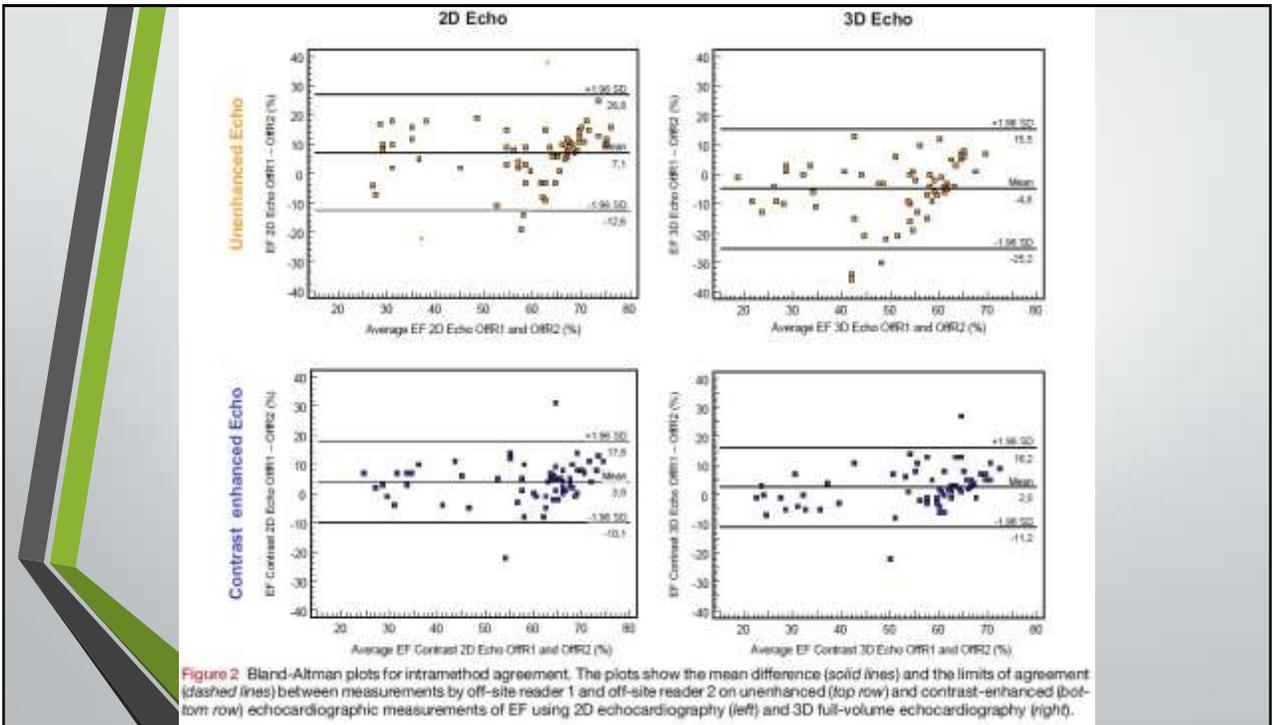
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Journal of the American Society of Echocardiography  
Volume 27 Number 3

**Methods:** A multicenter, open-label study was conducted including 63 patients, using intrasubject comparisons to assess the agreement of unenhanced and contrast-enhanced 2D and 3D echocardiography as well as calibrated biplane cine ventriculography with cardiac magnetic resonance for the determination of LV volumes and EF. Each of the imaging techniques used to define LV function was assessed by two independent, off-site readers unaware of the results of the other imaging techniques.

**Results:** LV end-systolic and end-diastolic volumes were underestimated by 2D and 3D unenhanced echocardiography compared with cardiac magnetic resonance. Contrast enhancement resulted in similar significant increases in LV volumes on 2D and 3D echocardiography. The mean percentage of interreader variability for LV EF was reduced from 14.3% (95% confidence interval [CI], 11.7%–16.8%) for unenhanced 2D echocardiography and 14.3% (95% CI, 9.7%–18.9%) for unenhanced 3D echocardiography to 8.0% (95% CI, 6.3%–9.7%;  $P < .001$ ) for contrast-enhanced 2D echocardiography and 7.4% (95% CI, 5.7%–9.1%;  $P < .01$ ) for contrast-enhanced 3D echocardiography and thus to a similar level as for cardiac magnetic resonance (7.9%; 95% CI, 5.4%–10.5%). A similar effect was observed for interreader variability for LV volumes.





**Conclusions:** Contrast administration on 3D echocardiography results in improved determination of LV volumes and reduced interreader variability. The use of 3D echocardiography requires contrast application as much as 2D echocardiography to reduce interreader variability for volumes and EF. (J Am Soc Echocardiogr 2014;27:292-301.)

Echocardiography. 2014 Jan; 31(1): 87-100.

Published online 2013 Nov 26. doi: [10.1111/echo.12331](https://doi.org/10.1111/echo.12331)

PMCID: PMC4231568

## Left Ventricular Ejection Fraction and Volumes: It Depends on the Imaging Method

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- Performed a PubMed on studies that reported reference values in normal populations for 2D ECHO and 3D ECHO, and CMR.
- In addition all studies (2 multicenter, 16 single center) were reviewed, and the results compared for non-contrast and contrast 2D ECHO, and 3D ECHO with those of CMR.

They concluded that:

- Contrast 2D ECHO and noncontrast 3D ECHO show good reproducibility and good agreement with CMR measurements of LVEF.
- The agreement of volumes is worse.

## Current guidelines say:

- LV size should be routinely assessed on 2DE by calculating volumes using the biplane method of disks summation technique.
- In laboratories with experience in 3DE, 3D measurement and reporting of LV volumes is recommended when feasible depending on image quality.

- LV systolic function should be routinely assessed using 2DE or 3DE by calculating EF from EDV and ESV.
- Two-dimensional STE-derived GLS appears to be reproducible and feasible for clinical use and offers incremental prognostic data over LV EF in a variety of cardiac conditions, **although measurements vary among vendors and software versions.**

- Contrast agents should be used when needed to improve endocardial delineation when two or more contiguous LV endocardial segments are poorly visualized in apical views.
- Contrast-enhanced images may provide larger volumes than unenhanced images that are closer to those obtained with CMR in head-to-head comparison.
- Normal reference values for LV volumes with contrast enhancement are not well established.

## APPROPRIATENESS

- From the 2006 consensus document of appropriate use criteria<sup>7</sup>:

**Table 16.** Structure and Function

Indication	Appropriateness Criteria (Median Score)
<b>Evaluation of Ventricular and Valvular Function</b> Procedures may include LV/RV mass and volumes, MR angiography, quantification of valvular disease, and delayed contrast enhancement	
18.	A (9)
19.	U (6)
20.	A (8)
21.	A (8)
22.	A (8)
23.	A (8)
24.	A (9)
25.	A (8)

## Conclusion

- CMR is the gold standard for assessment of LV systolic function and volumes and it offers the most reliable and reproducible technique.
- 2D echo is less reproducible and underestimates both LV function and volumes
- yet with a good technique and contrast enhancement in selected patients it offers a comparable widespread affordable portable technique.

- Values for normal LV volumes are not entirely agreed upon and validated for contrast echo and 3D echo.
- It is recommended to follow up a patient using the same technique due to inter-technique variations in measurements.

- Cardiac MR feature tracking is a new less tedious technique that shows much promise as compared to the manual technique.

## Final statement

- Till CMR becomes a portable affordable technique, 2D echo is the mainstay for assessment of LV volumes and systolic function.
- Care should be directed towards a more proper technique and use of contrast agents when appropriate.