Proposal for Contrast-enhanced 2D Echocardiography Reference Values in Females

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BACKGROUND AND OBJECTIVE

- The determination of left ventricular (LV) size is one of the most important measures in a general echocardiographic report.
- LV size is preferably assessed as volumetric data by Simpson's rule or 3D assay, when appropriate [1].
- The latest American Society of Echocardiogrpahy (ASE) and European Society of Cardiovascuar Imaging (EACVI) published the latest Recommendation for normal values in 2015 [1].
- Endocardial definition is inadequate for Simpson's or 3D volumetric assay in approximately 10-15 (%) of patients [2].
- Contrast-derived LV volumes are larger than those obtained without contrast (**Figure 1**) [1].
- However, there are no publications suggesting normal reference values for contrast-enhanced LV volumes.

The Objectives of this study were

1**) to test the performance of noncontrast normal values on contrast volumes.**

2) to propose normal reference values for LV volume in contrast echocardiography

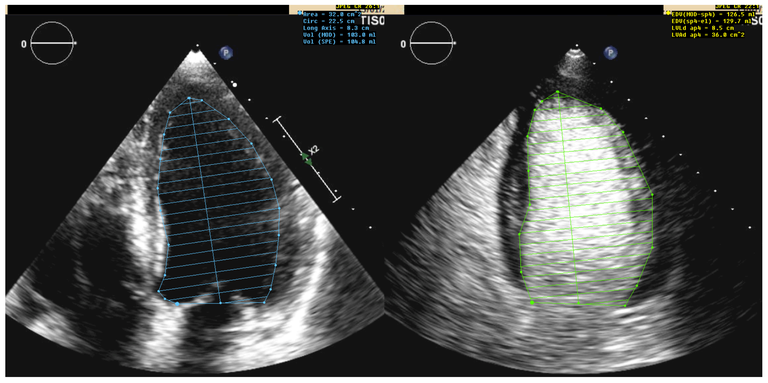

Figure 1. Differences in LV volumes in contrast and noncontrast measurements. LV volume by nonontrast is 103 ml and with contrast 126 ml.

PATIENTS

82 female patients were selected from an ongoing study screening for chemotherapy cardiotoxicity (He, submitted). Inclusion criteria were

- Female sex
- Normal LV size (4chamber and 2chamber BSA-indexed EDV [1])
- Normal valves (no more than mild abnormality)
- Normal EF (≥53 %)
- Normal wall motion
- Good native imaging quality (≥10/12 segments visualized)
- Baseline study.
- Informed consent.

All patients except for 2 had normal GLS (global longitudinal strain ≥18.0 %).

Mean age 57 (±9), Systolic BP 125 (±17), diastolic BP (75 ±10), BSA 1.8 (±0.2), heart rate 69 (Systolic BP 125 (±17), diastolic BP (75 ±10)11), GLS 21.3 (±1.8) and EF 63 (±5.3).

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METHODS

- All echocardiographic recordings were performed according to the standards [3].
- LV size was calculated by Simpon's rule in a blinded fashion by independent readers for native and contrast images [1].
- GLS was assessed by 2-, 3-, and 4-chamber views with semiautomated fashion (Qlab, Siemens).
- All statistics were performed with SPSS (IBM).

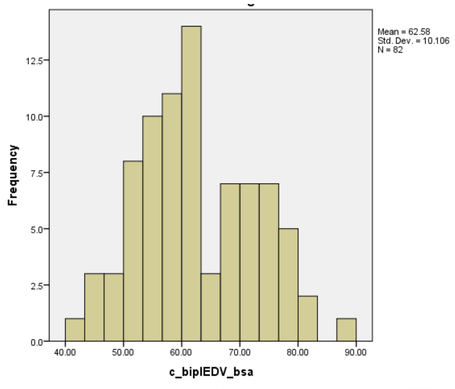

Figure 2. Histogram of contrast-derived biplane EDV volumes/BSA.
Kolomogorov-Smirnow p=0.192

RESULTS

NONCONTRAST REFERENCE VALUES

- The noncontrast reference values [1] performed surprisingly poorly when categorizing the contrast-derived LV volumes as normal or dilated (**Table 1**).
- As much as 50% were categorized as dilated, even after BSA-indexing.
- 25–30% were classified moderately or severely dilated.
- One-plane measurements performed better.

Table 1. Classification of the contrast-derived volumes by non-contrast guideline values [1].

	Females (n=82)			
	Normal	Dilated		
		All	Mildly	Moderately or severely
	n (%)	n (%)	n (%)	n (%)
Biplane				
EDV	42 (51.2)	**40 (48.8)**	13 (15.9)	**27 (33.0)**
EDV/BSA	41 (50.0)	**41 (50.0)**	22 (26.8)	**20 (24.4)**
2-chamber				
EDV	67 (81.7)	15 (18.3)	.	.
EDV/BSA	68 (82.9)	14 (17.1)	.	.
4-chamber				
EDV	73 (89.0)	9 (11.0)	.	.
EDV/BSA	79 (96.3)	3 (3.7)	.	.

CONTRAST REFERENCE VALUES

The obtained contrast- and noncontrast values are presented in **Table 2** in parallel with the published normal values.

- The noncontrast values correspond well to the published normal values.
- EF was comparable, otherwise contrast values **were larger by 30 ml (EDV), 18 ml/m² (EDV/BSA) or 28% (±13 %).**
- BSA-indexed values were normally distributed (**Figure 2**).

Table 2. LV size with and without contrast of 82 female subjects in parallel with the published reference values [1].

	Published reference		Native values		Contrast values	
	Mean (SD)	2SD	Mean (SD)	2SD	Mean (SD)	2SD
Biplane						
EF	64 (5)	*54-74*	63 (5)	*52-74*	63 (5)	*53-73*
EDV	76 (15)	*46-106*	79 (18)	*44-115*	111 (21)	***69-154***
EDV/BSA	45 (8)	*29-61*	45 (8)	*28-61*	63 (10)	***42-83***
4-chamber						
EDV	94(23)	*48-140*	77 (17)	*43-112*	108 (22)	*65-152*
EDV/BSA	56 (13)	*30-82*	43 (8)	*27-60*	61 (10)	*40-82*
2-chamber						
EDV	87 (23)	*41-133*	79 (20)	*40-119*	111 (23)	*65-157*
EDV/BSA	50 (12)	*26-74*	45 (10)	*25-64*	63 (12)	*39-86*

CONCLUSION

NEED FOR CONTRAST-SPECIFIC NORMAL VALUES

- As indicated by our results, the contrast-derived LV volumes cannot be classified by noncontrast reference values, as the contrast values are significantly larger.
- The mean end-diastolic volume difference was 30 ml (18 ml/m² or 28%), corresponding to the previous multicenter data [4].

THE PROPOSED NORMAL VALUES

- Although our population was not selected based on the same characteristics as the published reference values |1], our material presents a real-life situation of middle-aged women with healthy hearts as defined by several echoardiographic parameters.

REFERENCES

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DISCLOSURES

JC has received a Speaker's Bureau from Phillips Healthcare and HB has received Speaker's Bureau and worked as a Consultant for Braco.
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