QUANTIFICATION OF LV VOLUME BY REAL-TIME 3D ECHOCARDIOGRAPHY WITH SINGLE BEAT CAPTURE

VALIDATION STUDY WITH CARDIAC MRI

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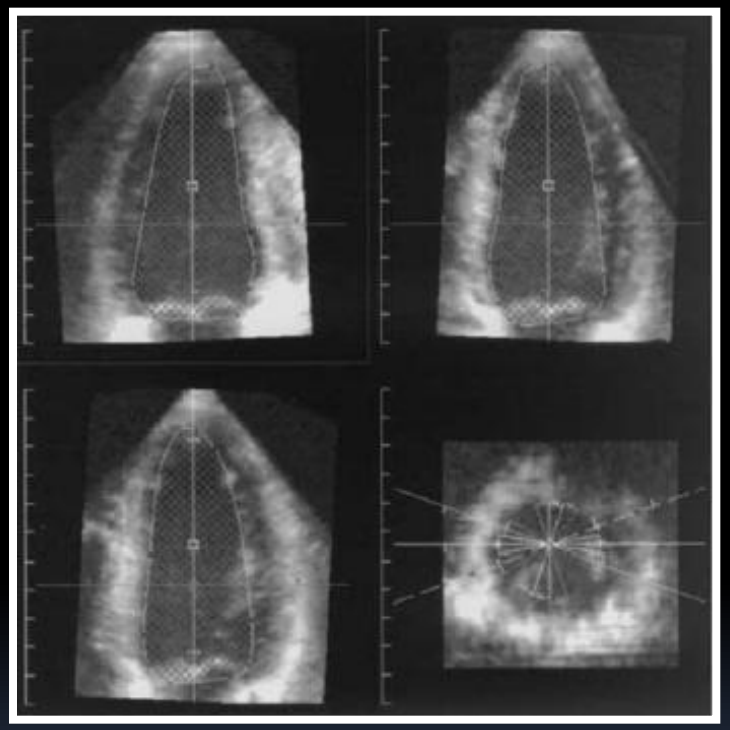
Why 3D in LV Volume Measurement ?

- Real cardiac structure is 3D!
- Measurement of LV volume by 2D echoCG includes

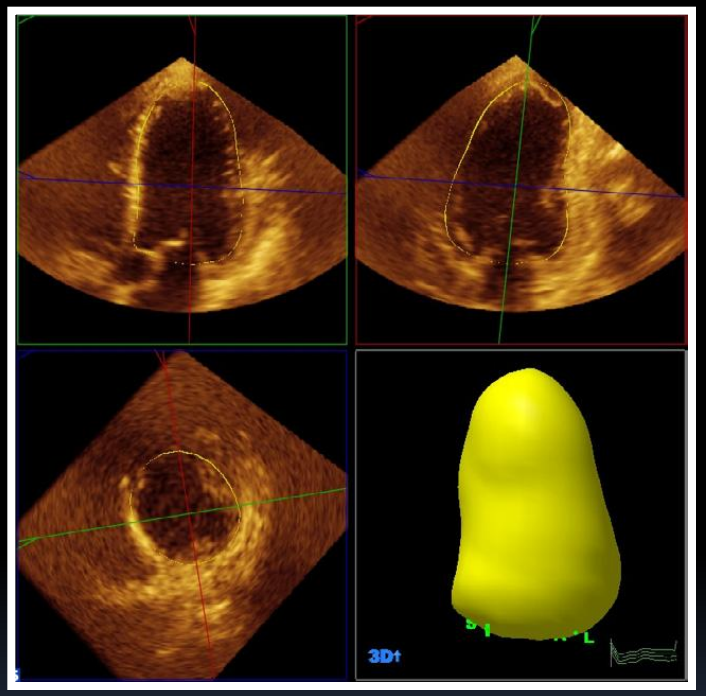
"geometrical assumption"

- Missing true apex or foreshortening by 2D echoCG image

Technical development of 3D Echocardiography



Reconstructed 3D echoCG
12 beats breath hold x 8 series
Mannaerts et al. JASE 2003



Real time 3D echoCG (RT3D)
4 beats breath hold
Mor-Avi V. et al. JACC Imaging 2008

3D echoCG in Real Clinical Practice

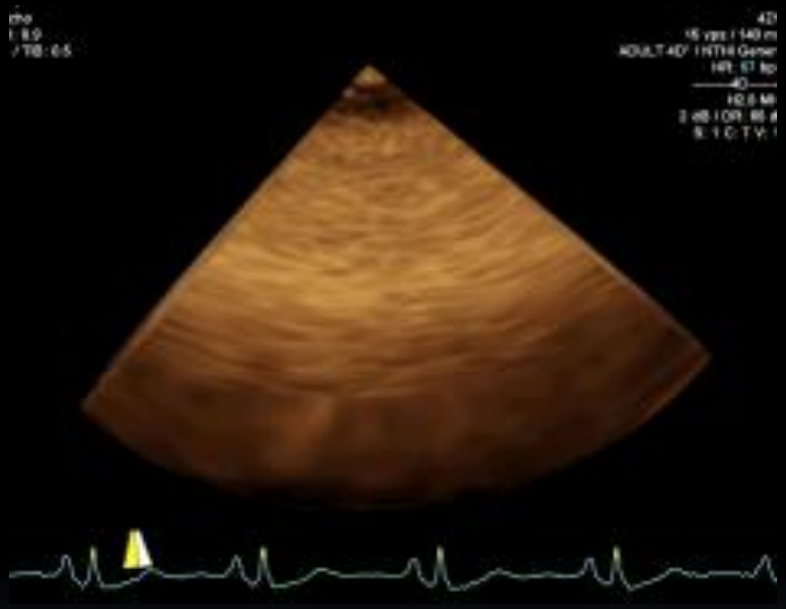
3D echoCG still stands on between bench to bedside, because…

- Longer acquisition and analysis time than 2D echoCG
- Limited image quality
- More training time

New Technique in RT-3DE

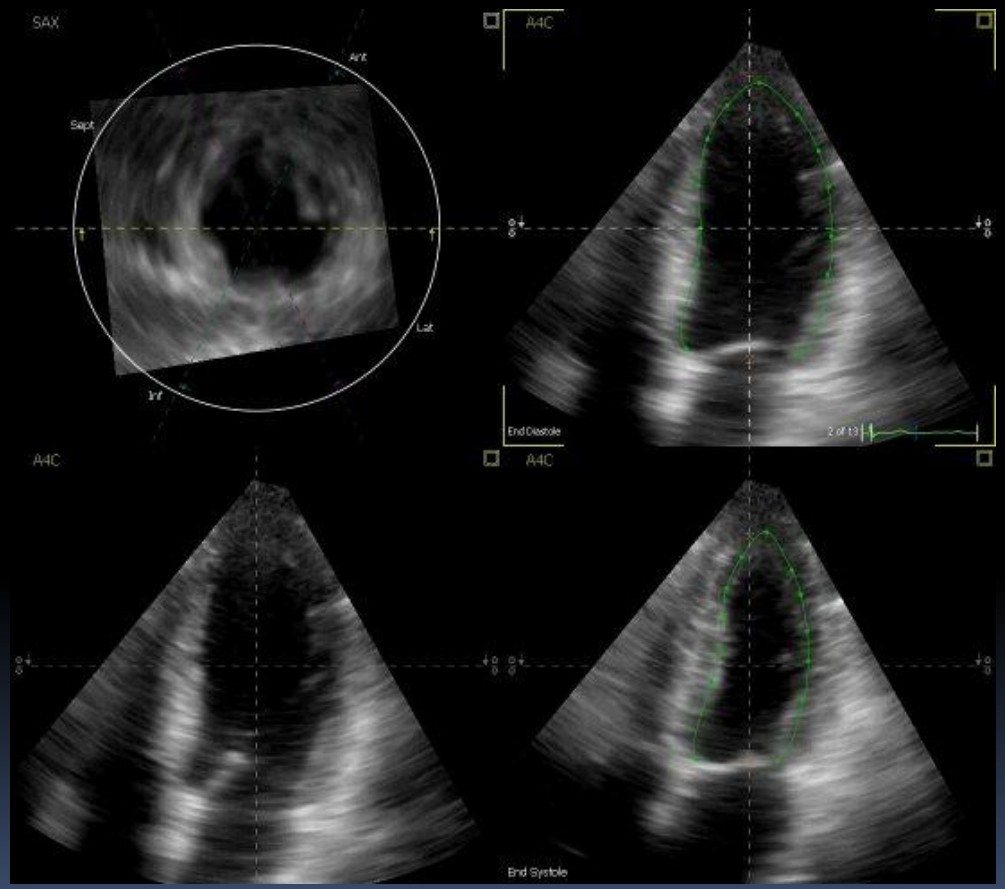
- Acouson SC 2000 system (Siemens Medical Solutions USA)
- New 3D probe : 4Z1c

- No stitching artifacts
- Reduced impact of respiration
- Reduced impact of arrhythmia



- Volume acquisition, 90x90 degree @ 20 vol/sec minimum
- Entire heart in one cardiac cycle rather than four cycles

Auto Volume Contouring



- Auto traces the volume and displays the contours on multiple planes
- Eliminates manual tracing
- Enhances reproducibility
- Accelerates workflow

Aim of the Study

Feasibility and Validation Study for the Measurement of LV Volume by Single Beat RT3DE in Real Clinical Practice

- compared with volume measurement by CMR

Study Population

Inclusion Criteria

- Patients who are successfully finished the CMR and scheduled for echocardiography at the same day

Exclusion Criteria

- Uncontrolled arrhythmia
- Poor echo window in 2D echoCG

Cardiac MRI

Cine MRI :
1.5-T scanner (Siemens Medical Solution USA)
6mm thickness with gap of 4mm
Temporal resolution 25-30 frames /sec

LV volume analysis by a single investigator

Image Acquisition : Echocardiography

Acouson SC2000 machine with 4Z1c probe

Single experienced sonographer

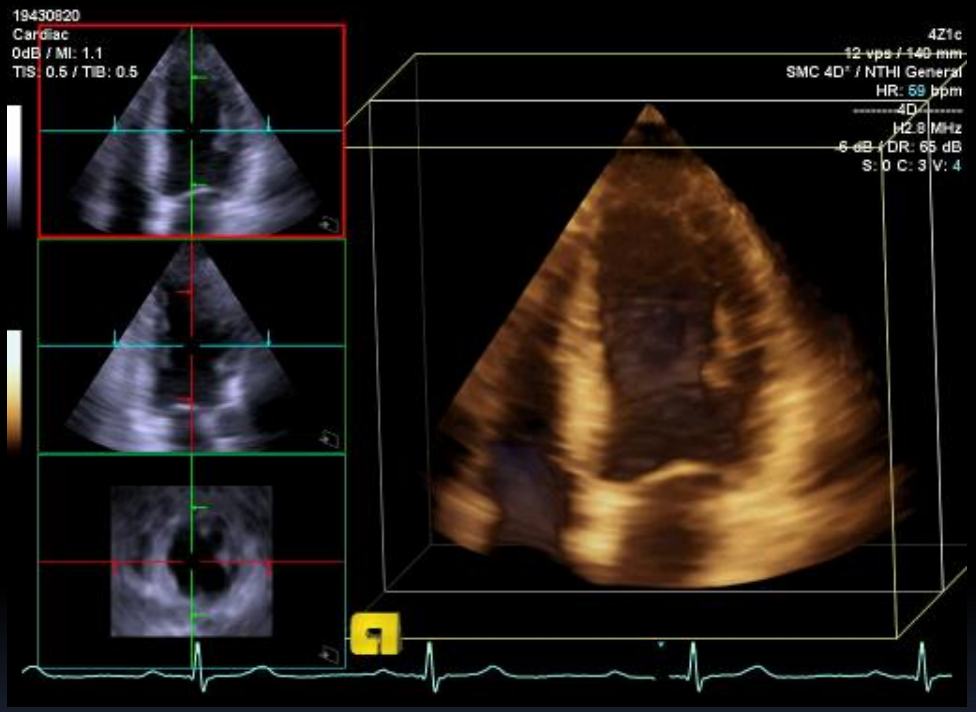
Optimization of volume angle with frame rate 12-15/sec

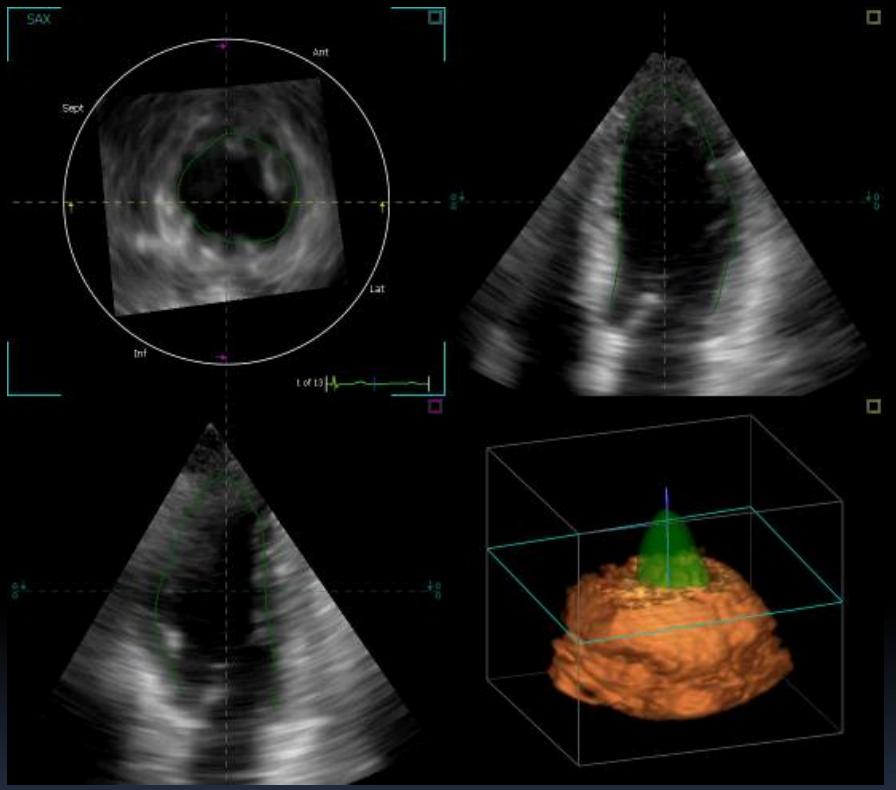
Acquisition of RT3DE using single beat capture

Analysis of RT3DE image

By 2 experienced investigators

Software was offered on the SC2000 machine


19430820
Cardiac
0dB / MI: 1.1
TIS: 0.5 / TIB: 0.5
4Z1c
12 vps / 140 mm
SMC 4D* / NTHI General
HR: 59 bpm
4D
H2.8 MHz
5 dB / DR: 65 dB
S: 0 C: 3 V: 4


SAX
Ant
Sept
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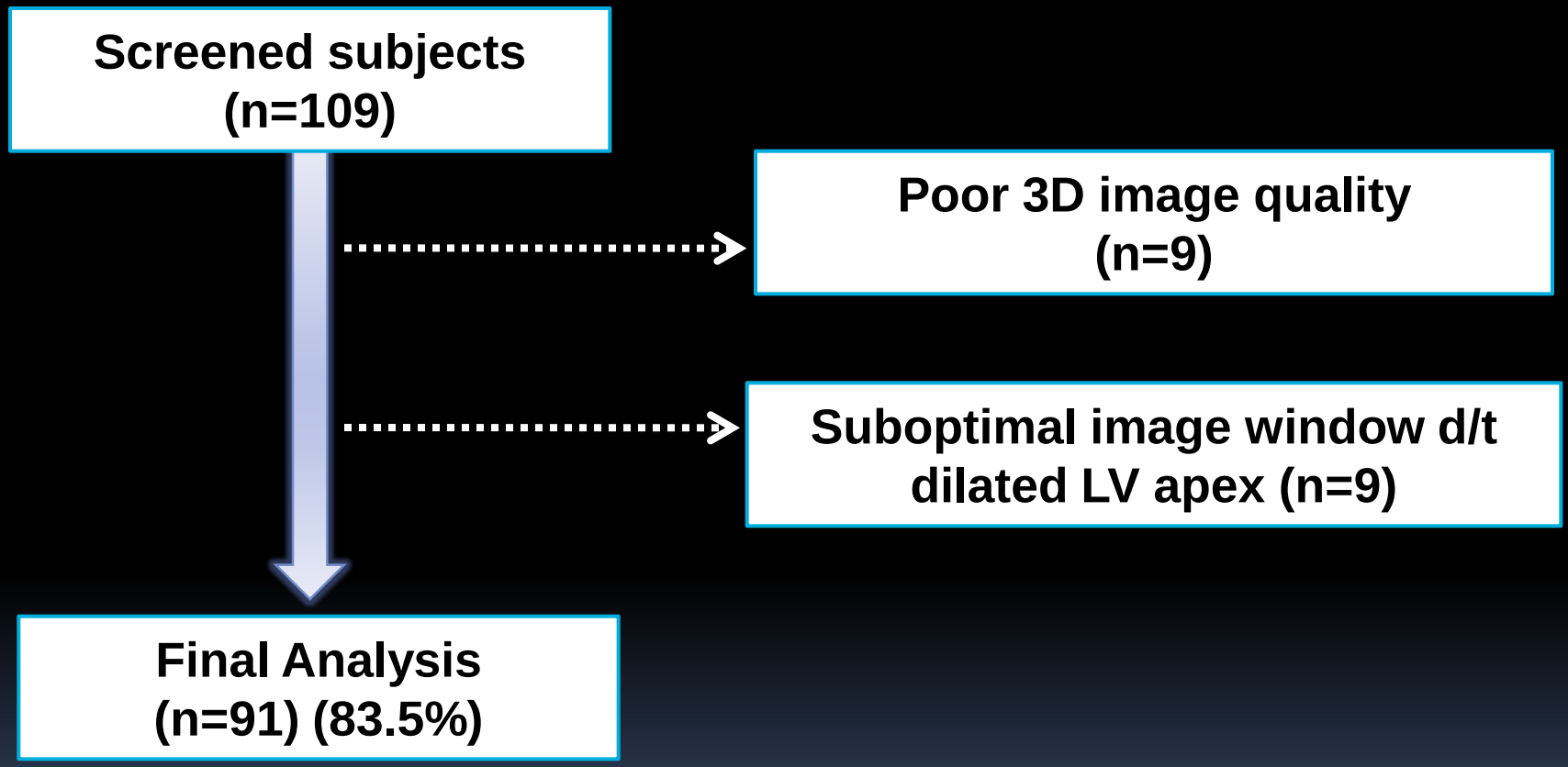
1 of 13

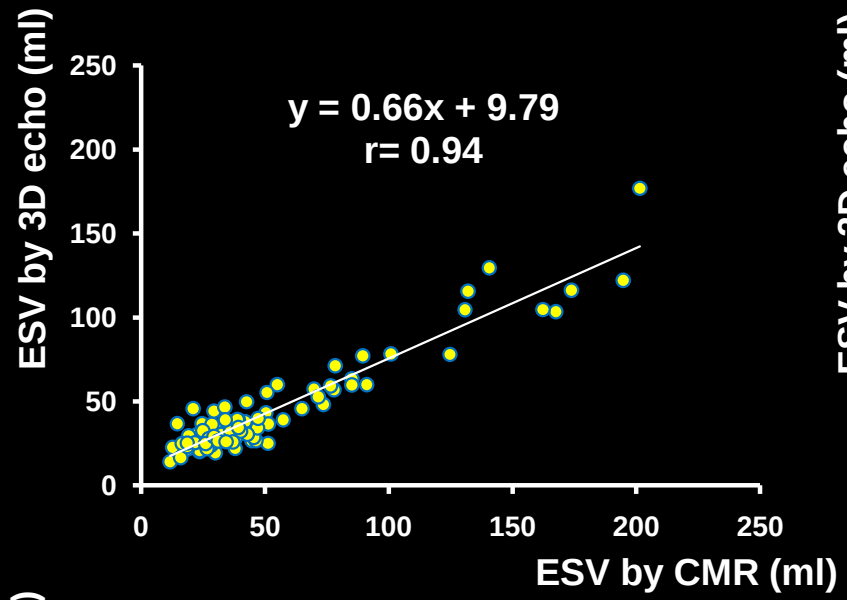
Characteristics of Patients

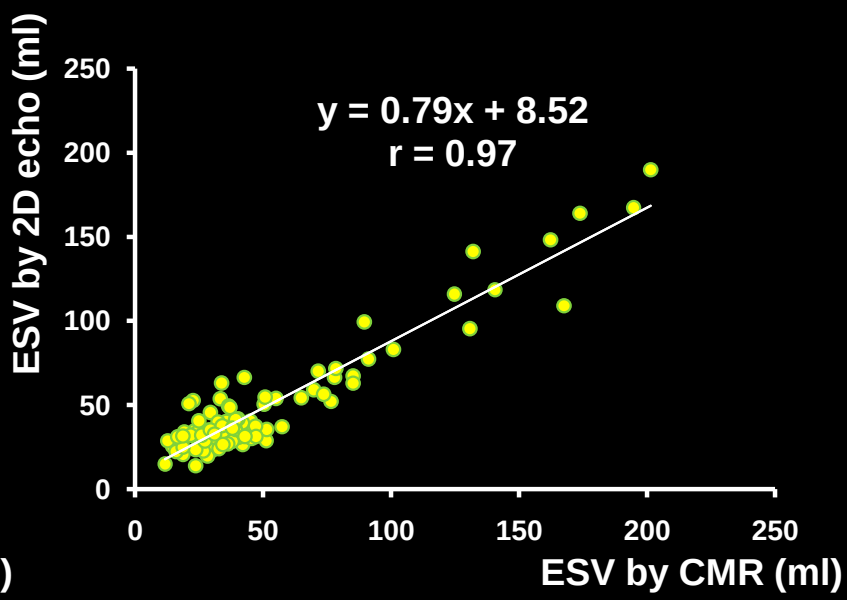
	N=109
Age	53.4 ± 13.9
Male	78 (71.6)
Presumptive diagnosis	
No significant heart disease	42 (38.5%)
Ischemic cardiomyopathy	32 (29.4%)
Non-ischemic cardiomyopathy	21 (19.3%)
Hypertrophic cardiomyopathy	8 (7.3%)
Others	6 (5.5%)
LV ESV (ml) by CMR	62.4 ± 58.1
LV EDV (ml) by CMR	150.8 ± 58.6
LV EF (%) by CMR	63.9 ± 17.3

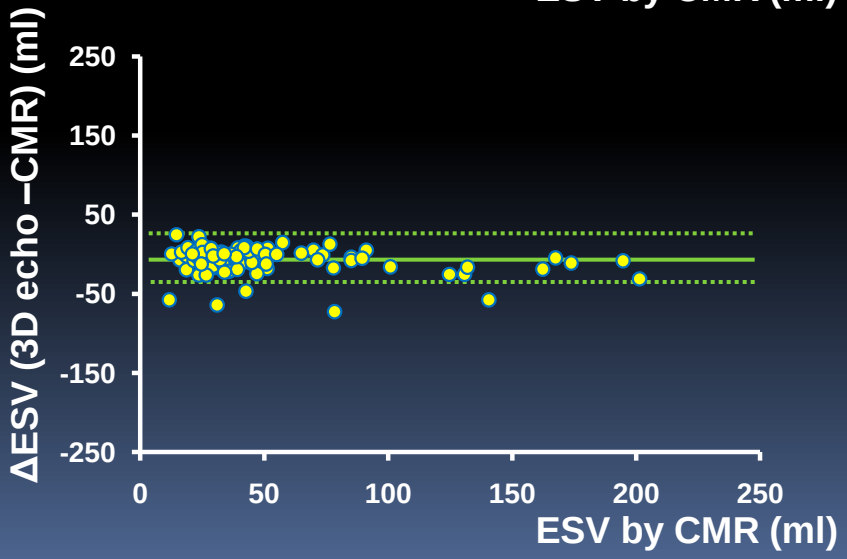
Feasibility of single beat capture RT3DE

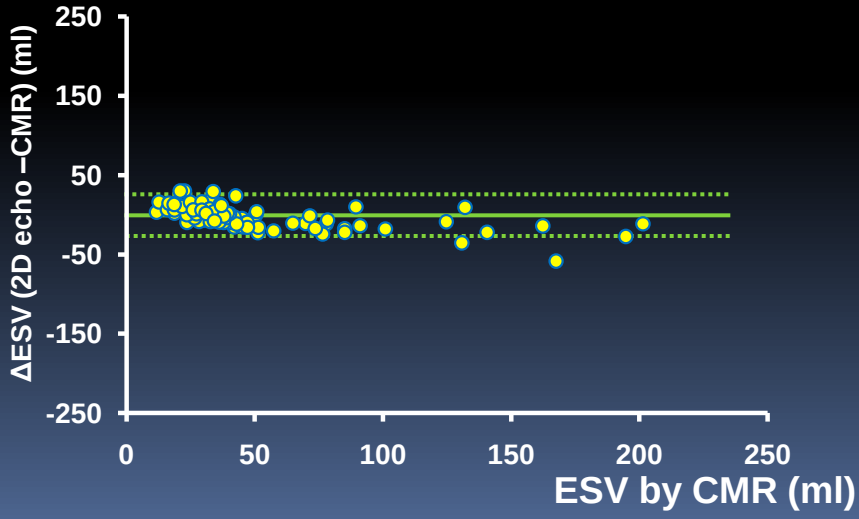


Measurement of LV ESV by RT3DE and CMR

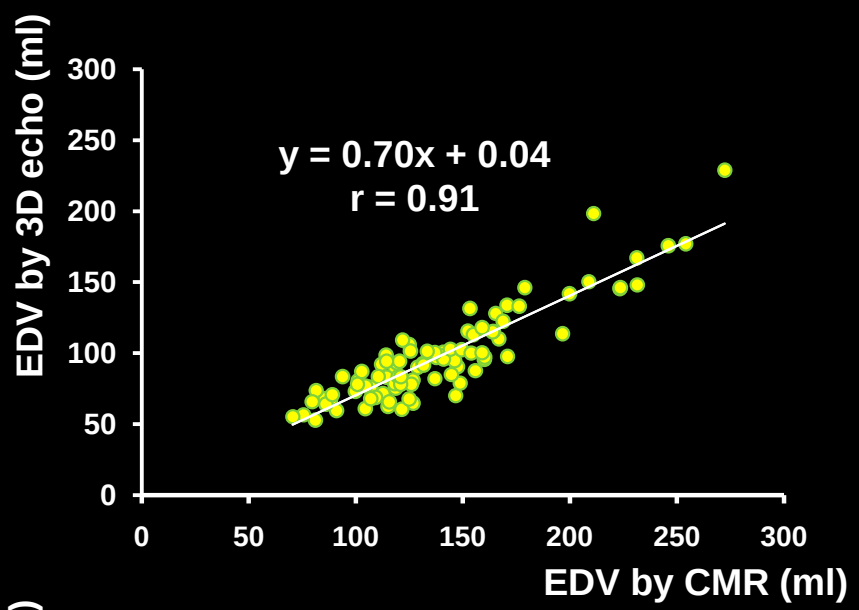


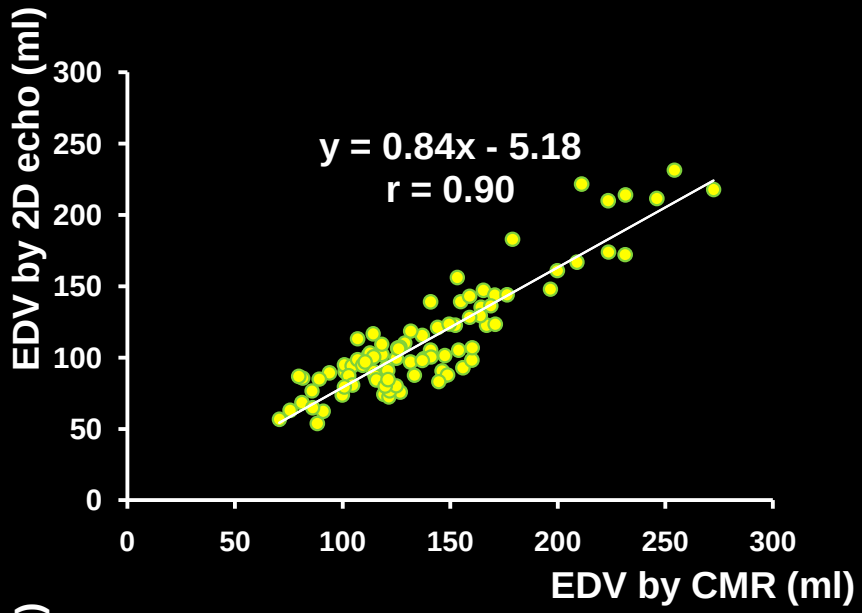


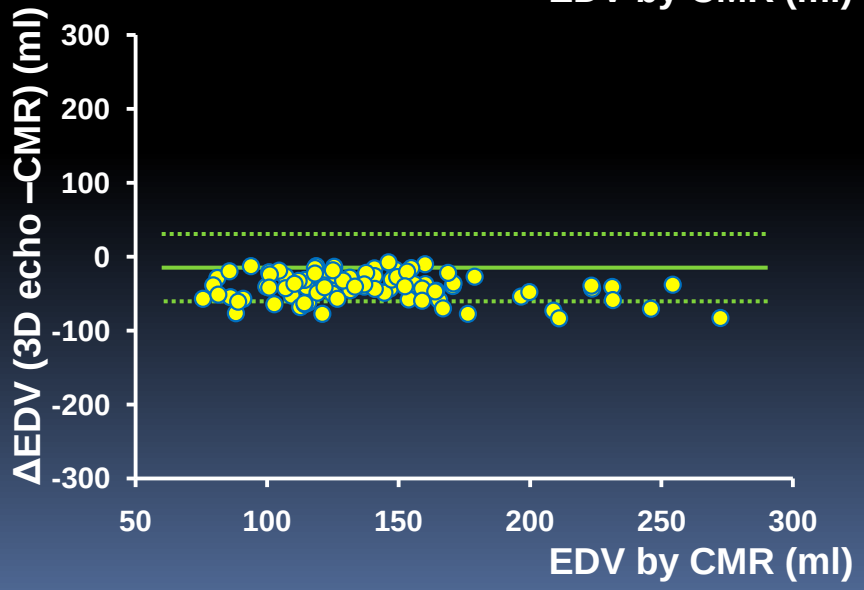


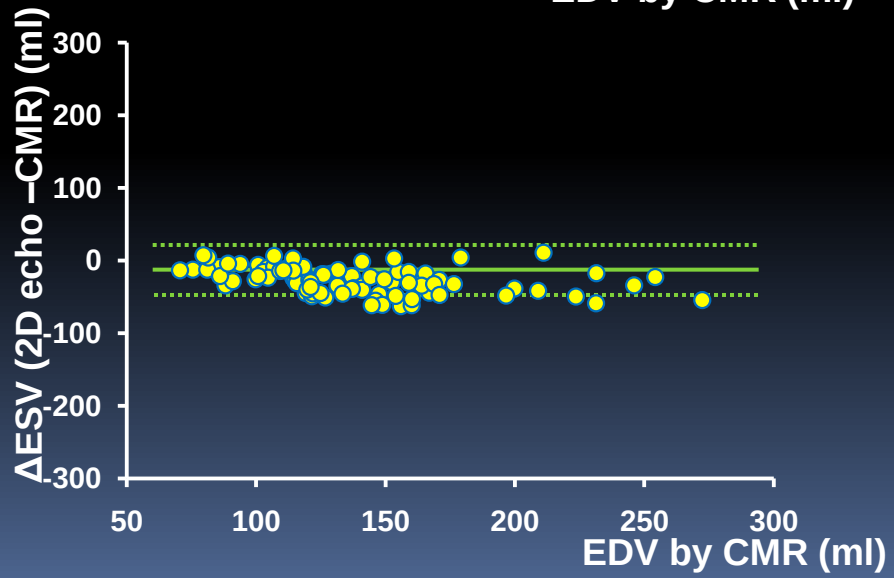


Measurement of LV EDV by RT3DE and CMR

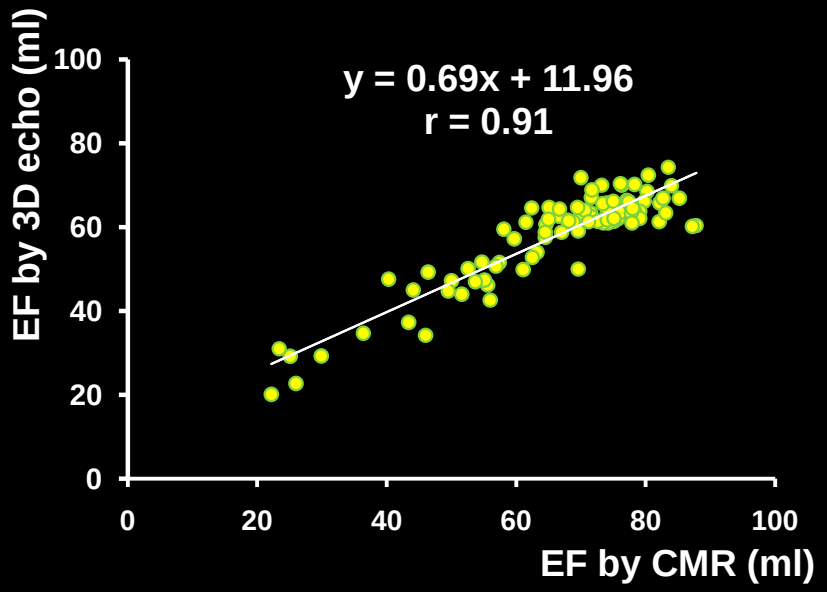


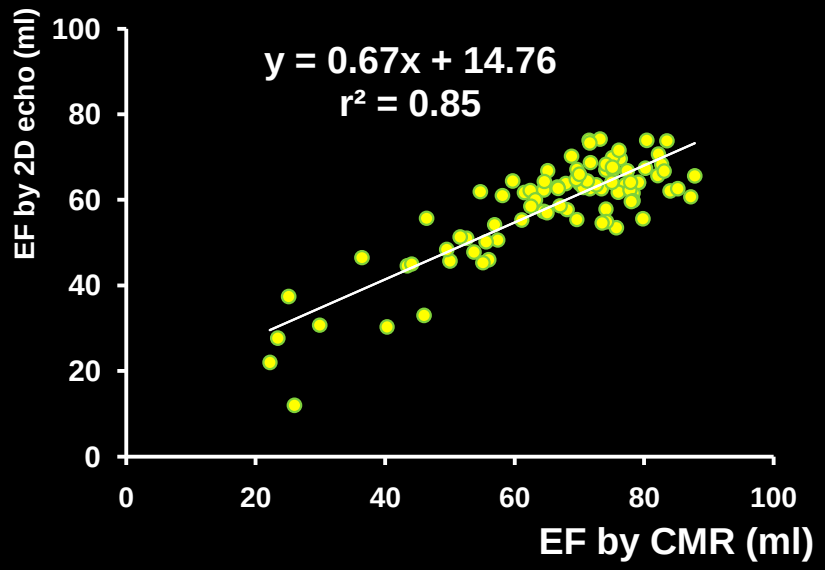


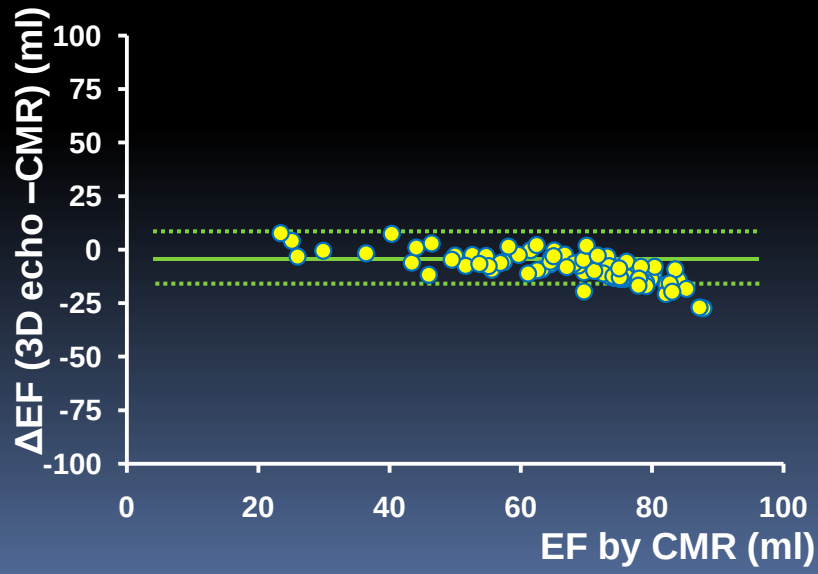


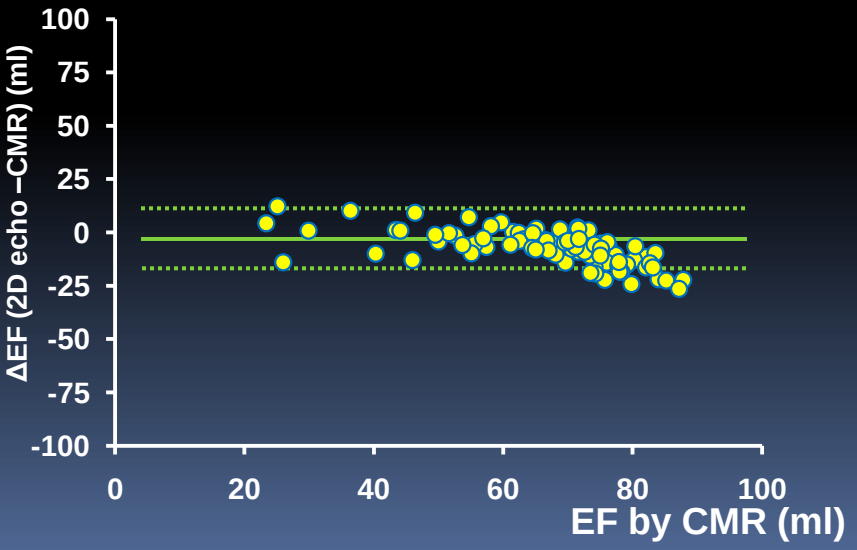


Measurement of LV EF by RT3DE and CMR



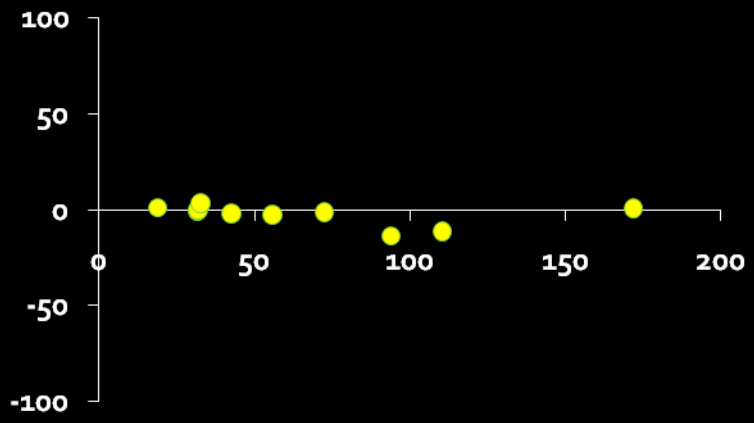


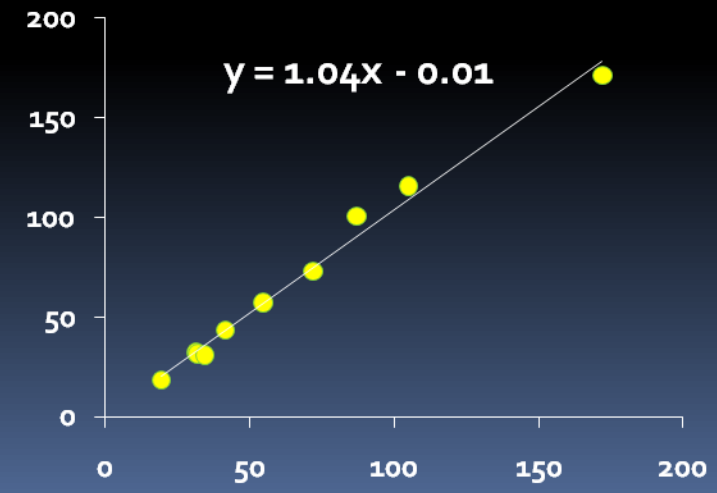




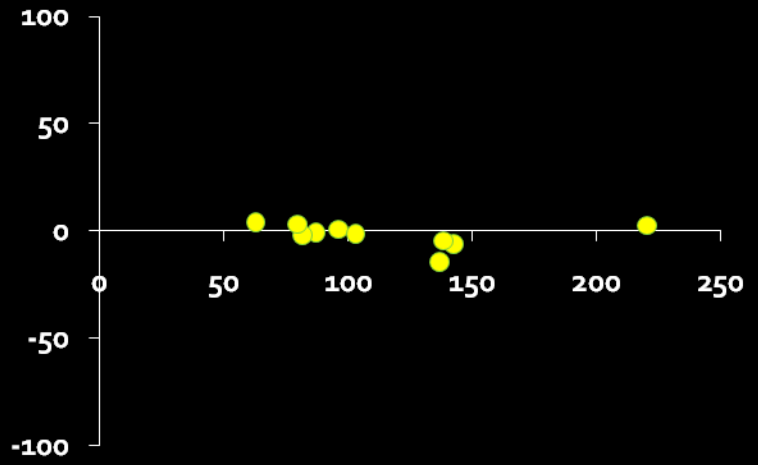
Intra-observer variability

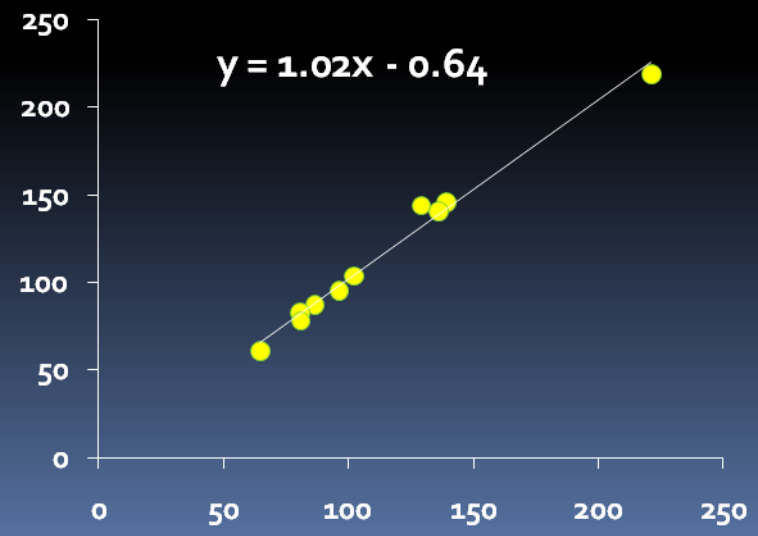
ESV



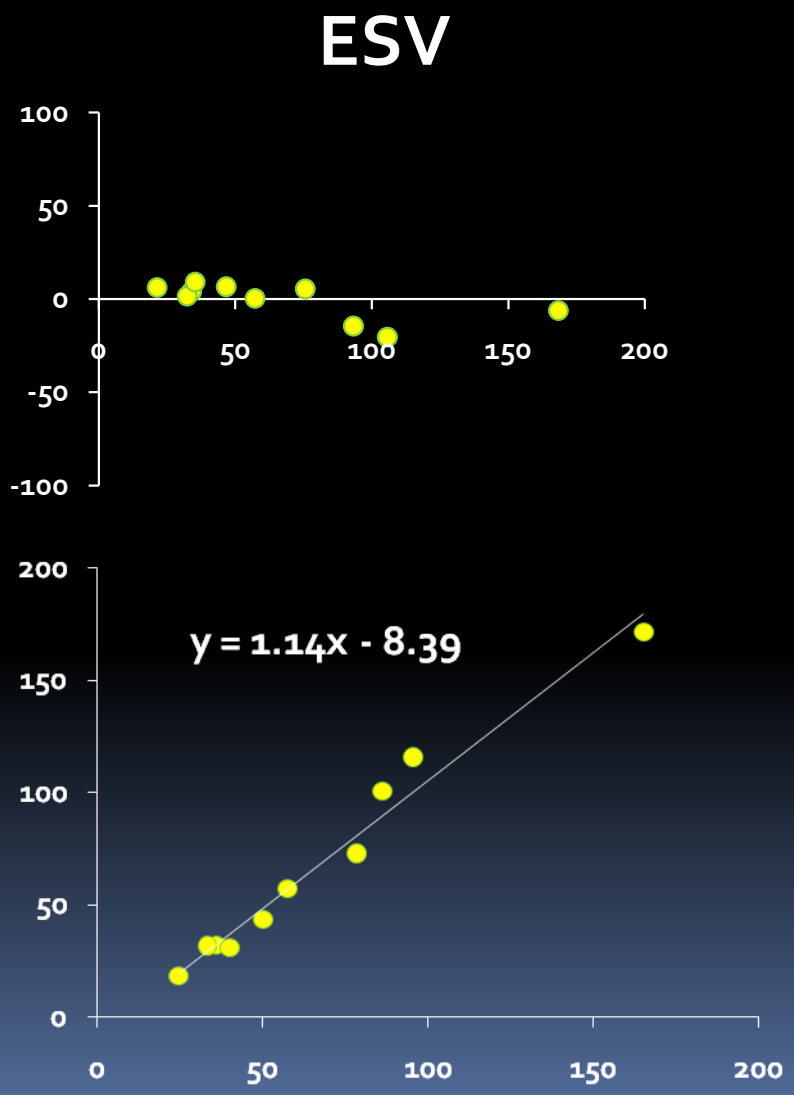


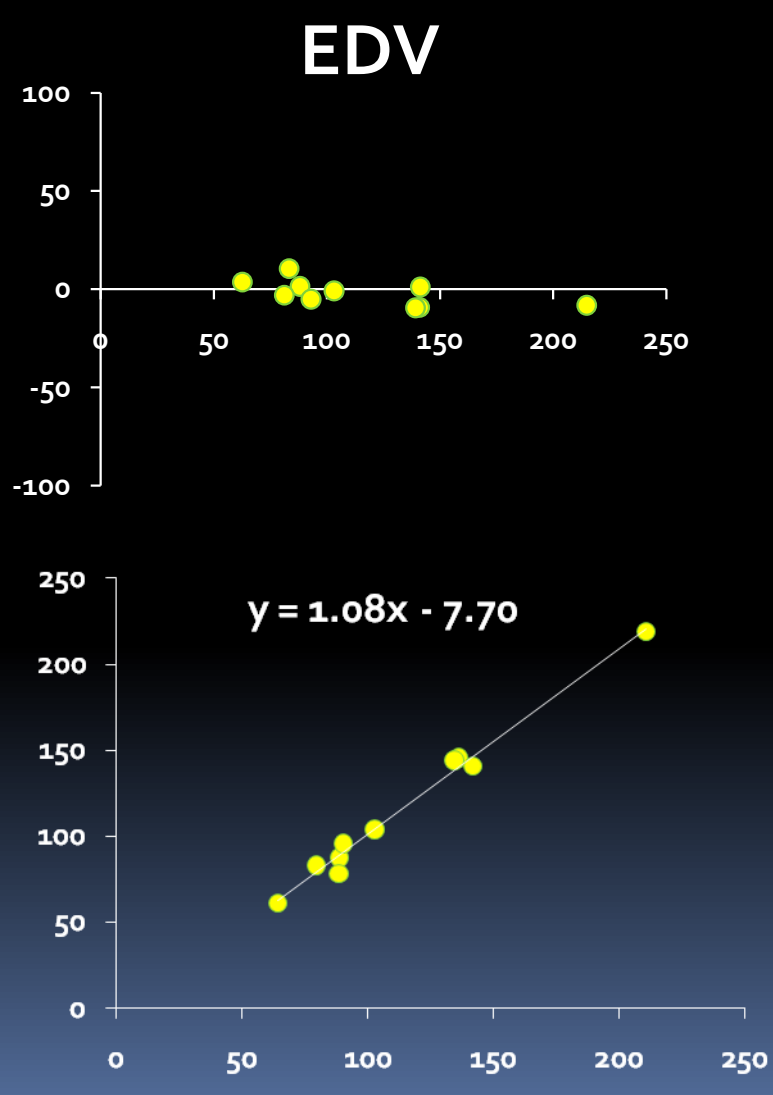
EDV



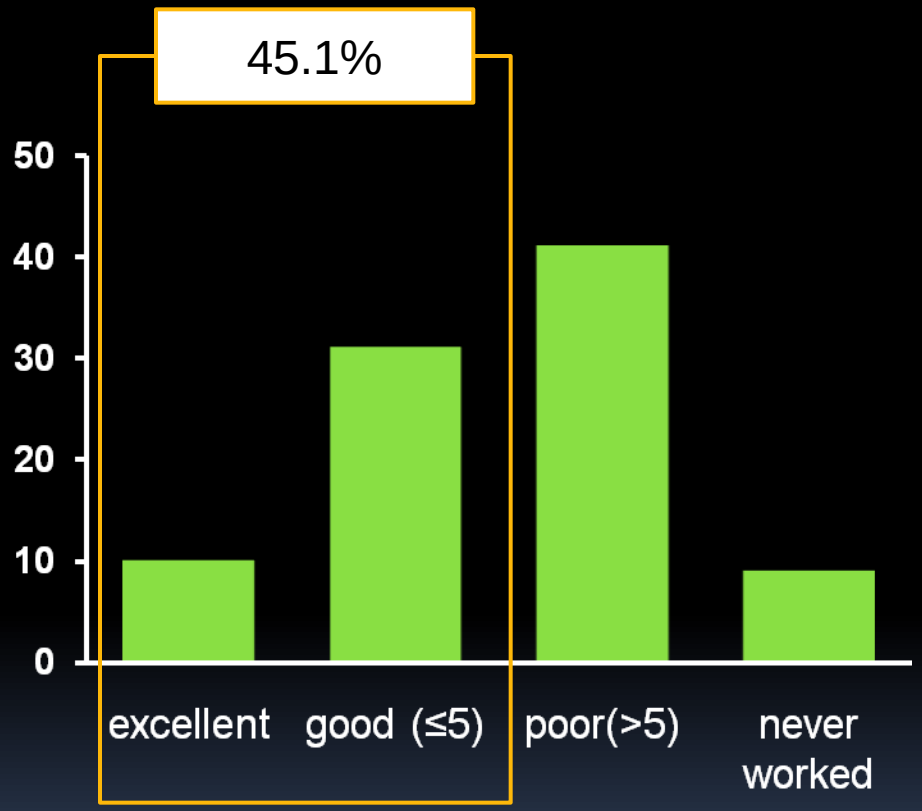


Inter-observer variability

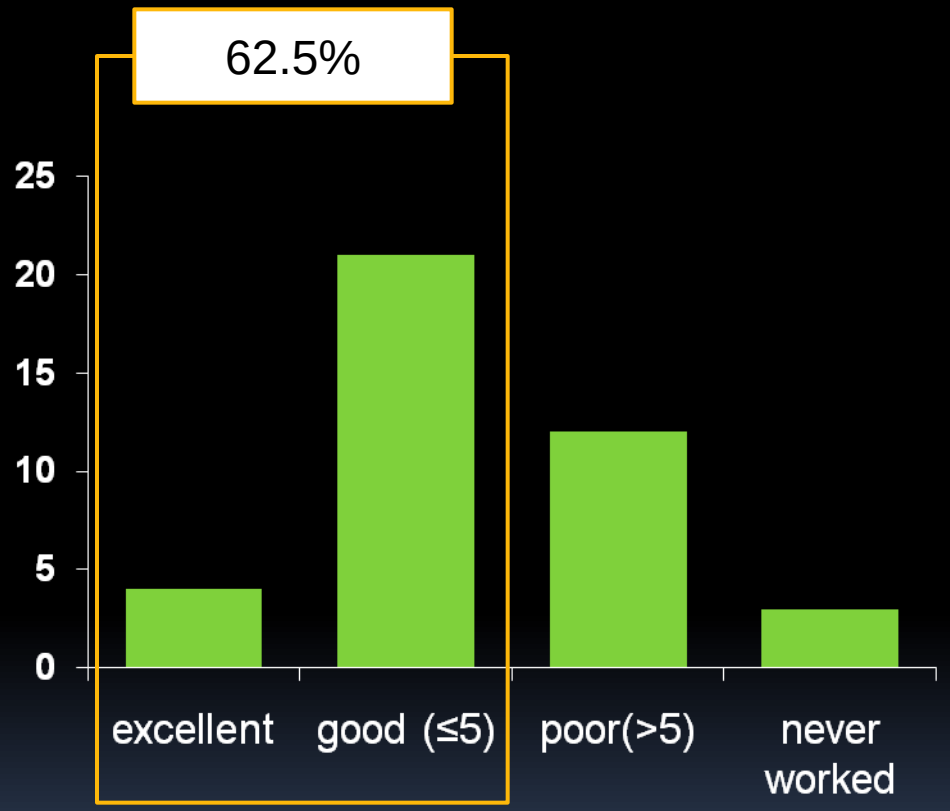




Application of Auto-contouring Algorithm



Overall study subjects (n=91)



Apparently normal heart (n=40)

SUMMARY

- RT3DE with single beat capture is feasible and correct method in patients with good echocardiographic window

- RT3DE with single beat capture was limited in some cases with dilated LV

- Automated border detection is easy and quick method but still limited in half of the cases

Thank You for Your Attention