

# **Validation of New Fully Automatic Algorithm for Quantification of Gated Blood Pool SPECT: Correlations with Planar Gated Blood Pool and Perfusion SPECT**



**EP Ficaró, RA Quaife, JN Kritzman, JR Corbett**

University of Michigan Health System, Ann Arbor, MI  
University of Colorado Health Sciences Center, Denver, CO

# Conflict of Interest

The University of Michigan receives royalties from the sale of the cardiac quantification software, 4D-MSPECT.

## Objective

- Develop and validate a surface detection algorithm for the quantification of LV function from gated blood pool SPECT (GBPS).
- Compare with the functional results (i.e. LVEF, ED<sub>v</sub>, ES<sub>v</sub>) from planar gated blood imaging and myocardial perfusion SPECT imaging in the same patient population.

## Patient Population

- The study consisted of 56 patients (16F, 40M,  $64 \pm 16$ yo) who had undergone gated myocardial perfusion SPECT, gated blood pool SPECT (GBPS), and gated planar (LAO projection) blood pool imaging.
  - 10 patients had ischemic cardiomyopathy.
- The mean LVEF was  $(64 \pm 19)\%$ .

## Methods – Planar Blood Pool Processing

- 16 frame planar image at LAO projection.
- The LVEFs were measured using standard methods from background subtracted end-diastolic (ED) and end-systolic (ES) regions of interest (Marconi Odyssey software).
- J. Kritzman processed this data set blinded to the results of the other data sets.

## Methods – Myocardial Perfusion SPECT

- 16 frame, uncorrected FBP reconstructions from RAO to LPO with 5mm voxels.
- LVEF, ED<sub>v</sub> and ES<sub>v</sub> values were determined automatically with 4D-MSPECT v2.0.

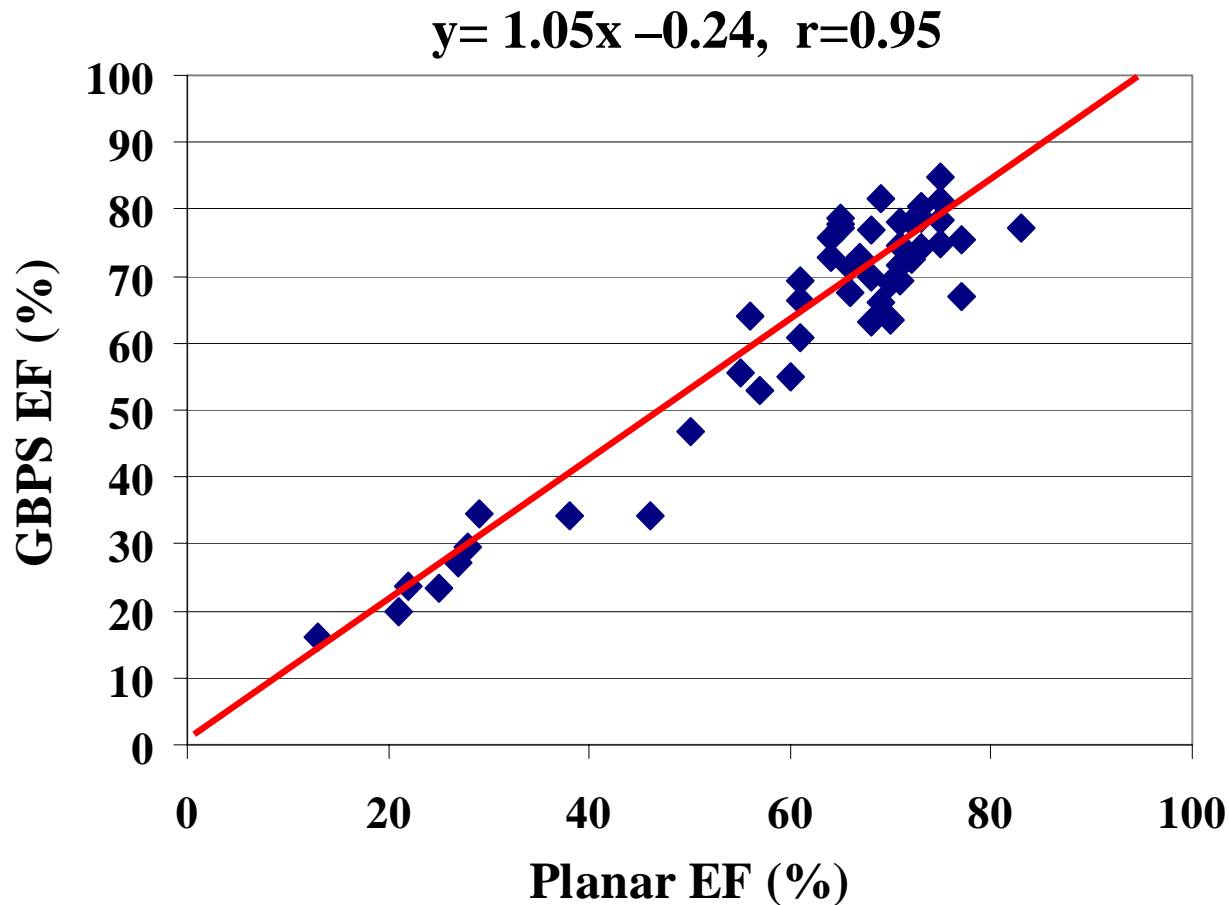
## Methods – GBPS Surface Algorithm

- 16 frame, uncorrected FBP reconstructions from RAO to LPO with 5mm voxels.
- 10 randomly selected patients were used to develop the LV surface detection algorithm.
- The algorithm incorporates standard image processing tools
  - Gradient operators
  - Segmentation and morphologic operators
  - Weighted spline interpolators

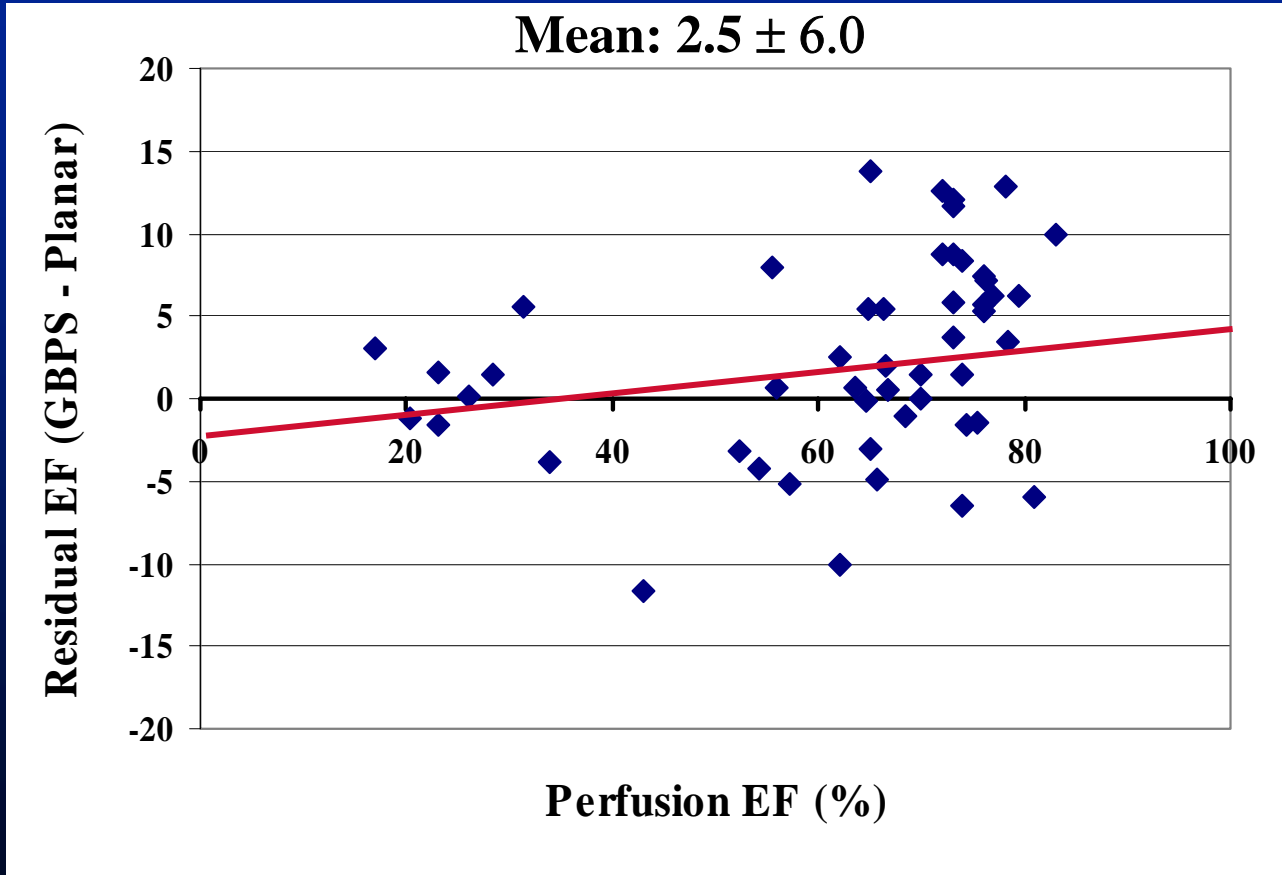
## Methods – GBPS Surface Algorithm

- Cylindrical/Spherical Sampling System
- Line profile analysis from mid-HLA is used to delineate RV from LV.
- Region growing algorithm with gradient constraints is used to delineate the LV from LA. Phase analysis may be incorporated as the RV surface estimates are further developed.
- Surfaces are iteratively determined from 2D gradient LA images.
- Weighted spline interpolators (LA, SA and temporal) are employed for smooth contours throughout the cardiac cycle.

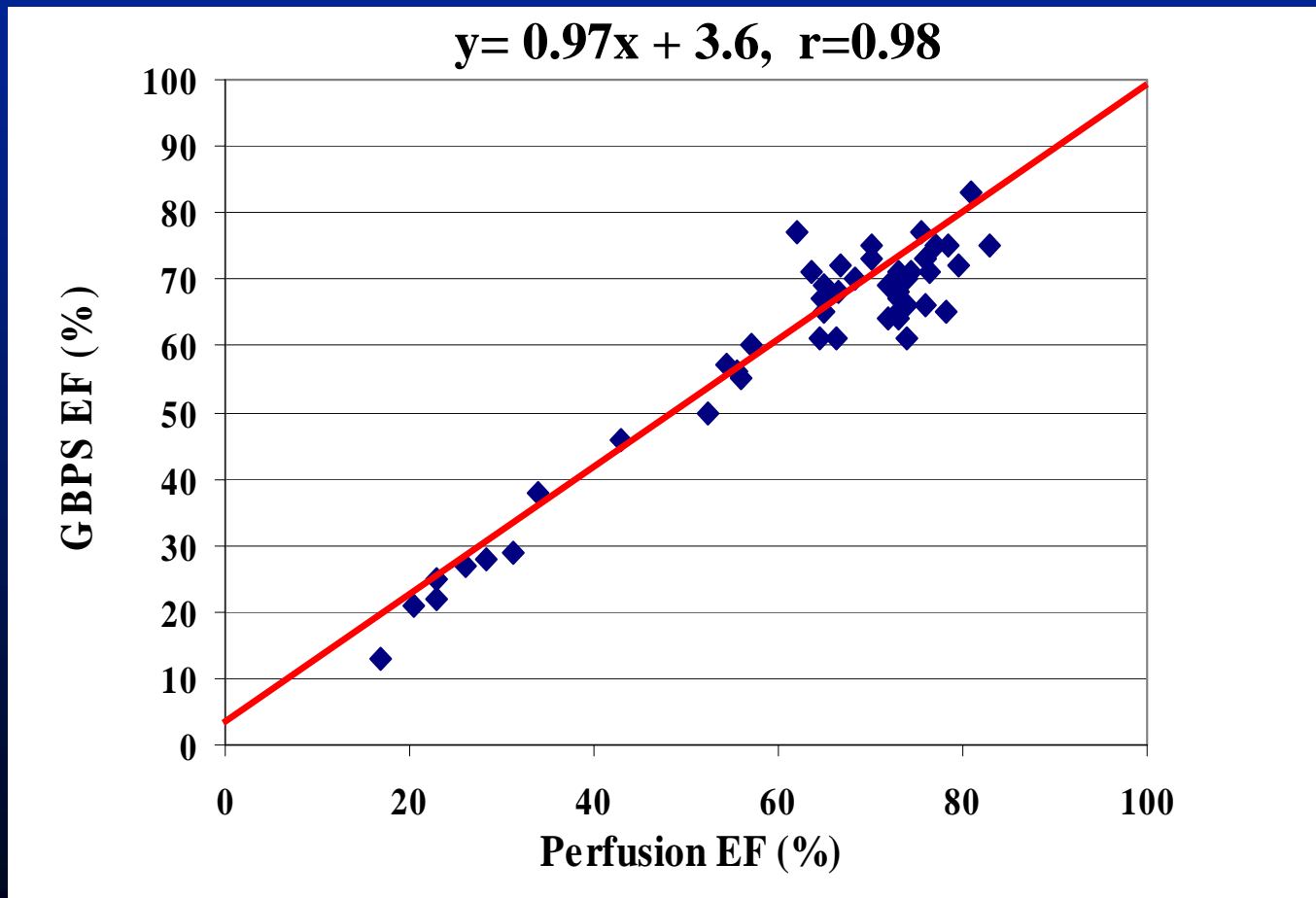
# EF Correlation: GBPS vs Planar BP



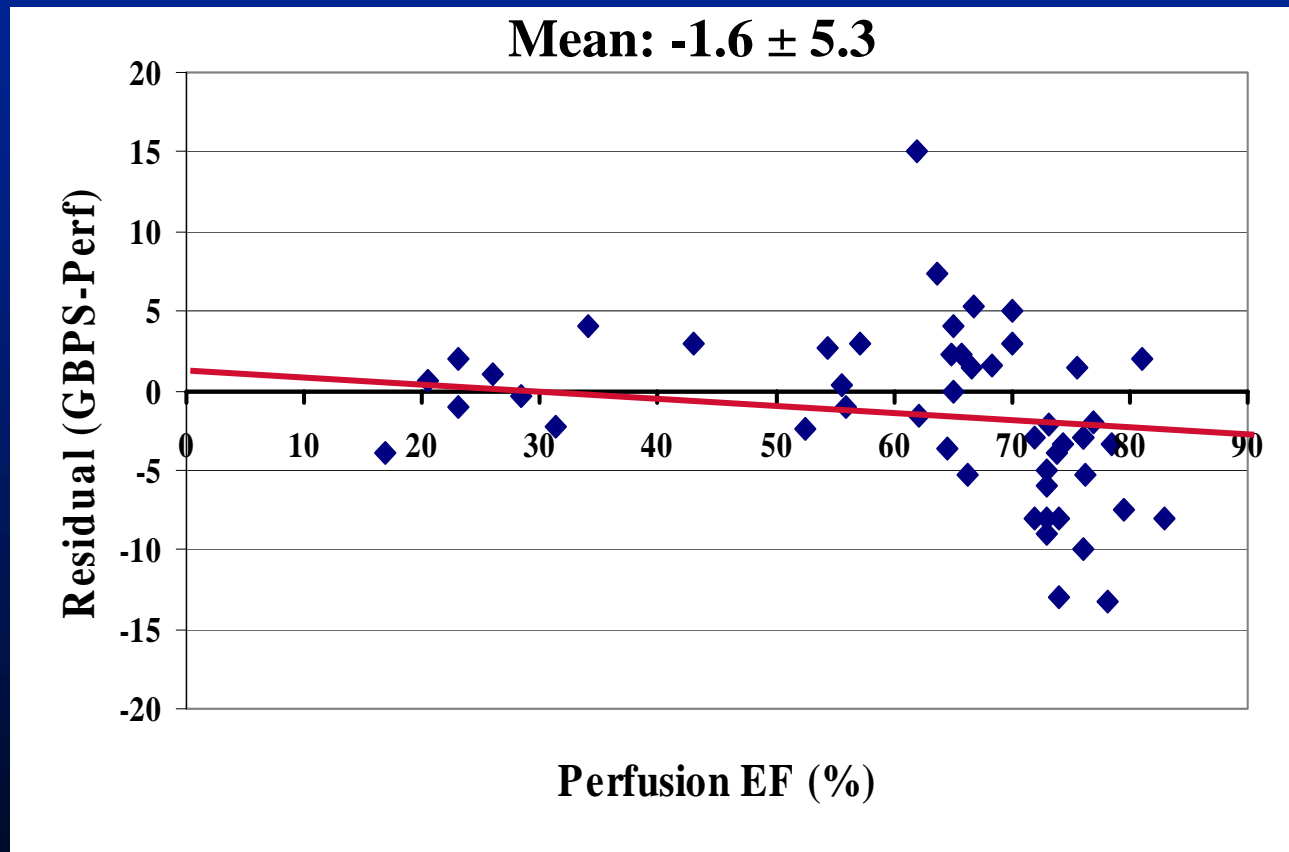
# EF Bland-Altman: GBPS vs Planar BP



# EF Correlation: GBPS vs Perfusion SPECT



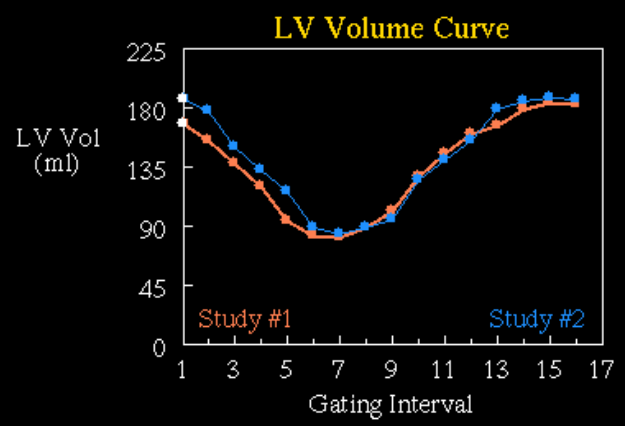
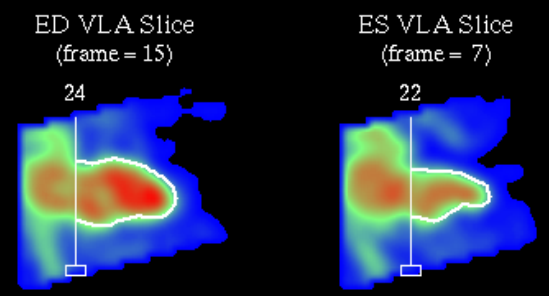
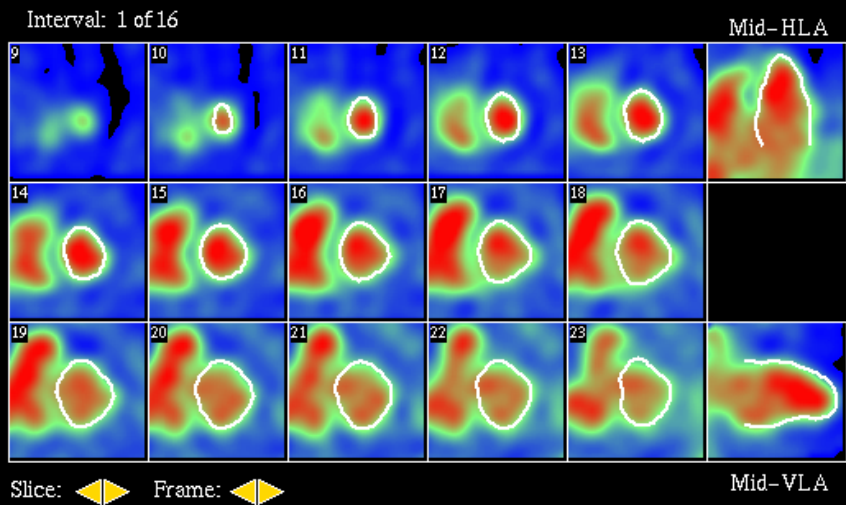
# EF Bland-Altman: GBPS vs Perfusion SPECT



**SA**

20-Sep-2001 16:56:46  
Intervals: 16  
Pharma: Tc99m-RBC  
EDv,ESv: 182 ml, 80 ml  
EF : 56 %  
Myo Mass: 0 g  
UngVol: 124 ml  
TID: N/A  
Visual Score: N/A  
Database:

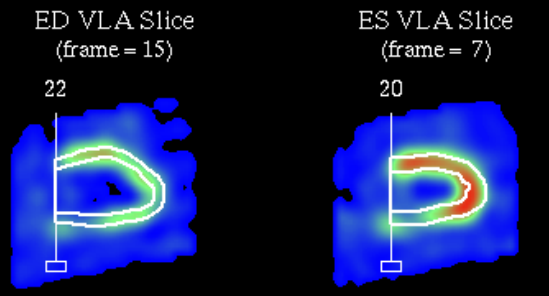
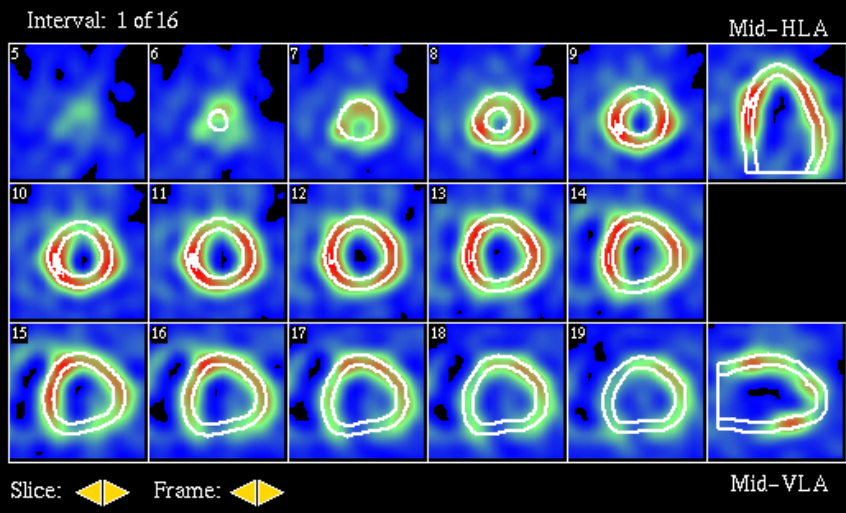
None



**SA-GStr**

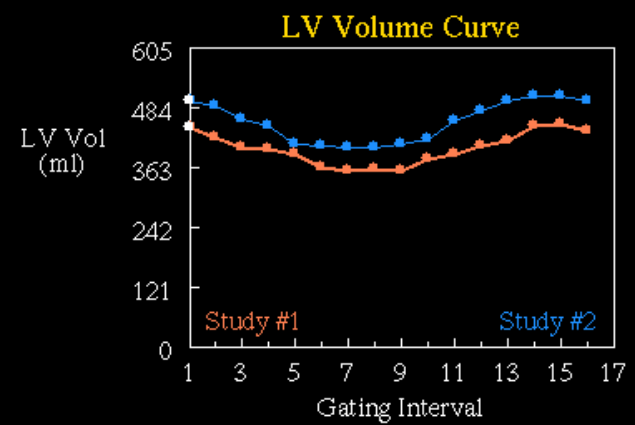
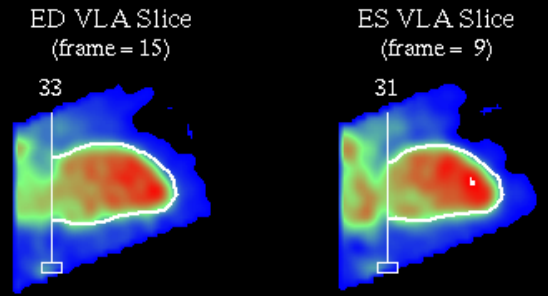
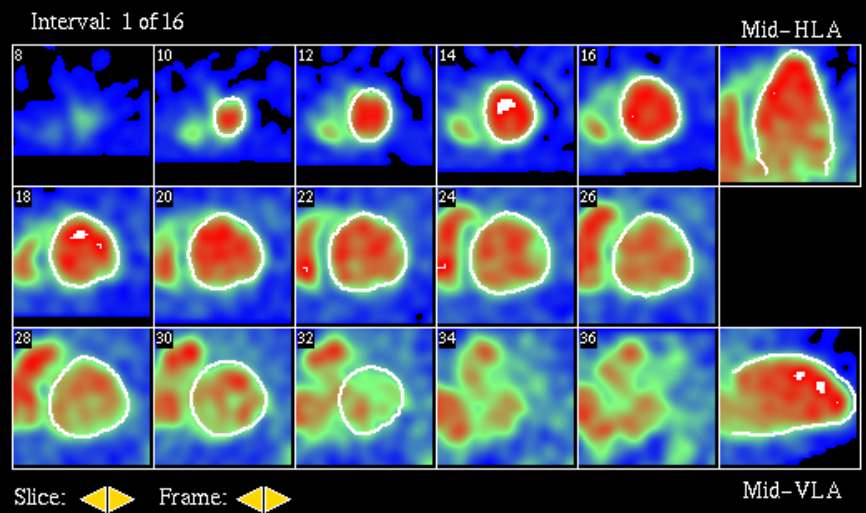
19-Sep-2001 14:37:58  
Intervals: 16  
Pharma: Cardiolite  
EDv,ESv: 187 ml, 84 ml  
EF : 55 %  
Myo Mass: 192 g  
UngVol: 105 ml  
TID: N/A  
Visual Score: N/A  
Database:

None



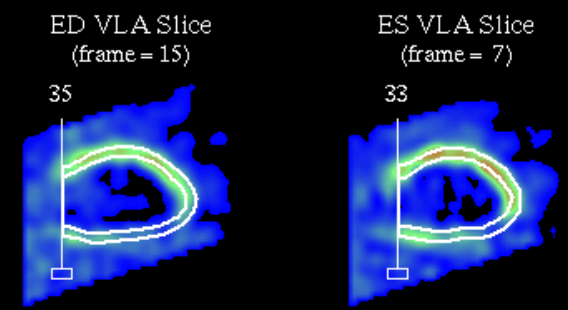
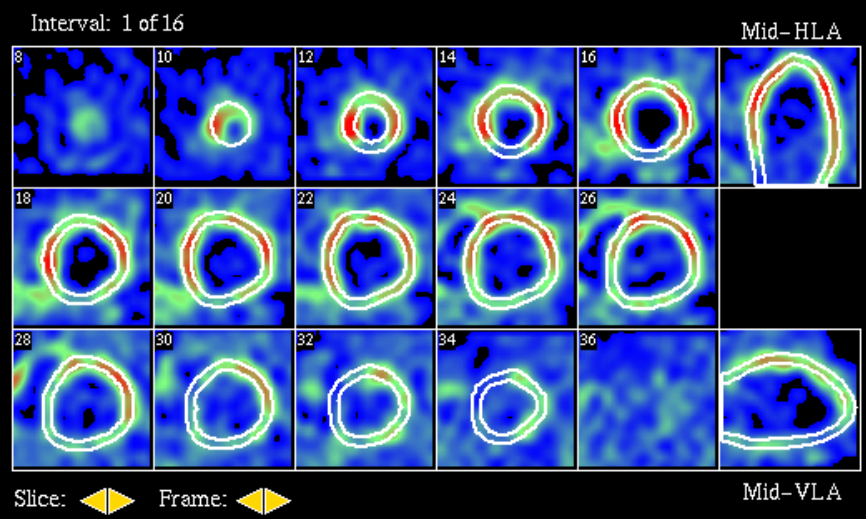
**SA**  
 05-Oct-1999 14:45:44  
 Intervals: 16  
 Pharma: Tc99m-RBC  
 EDv,ESv: 449 ml, 355 ml  
 EF : 21 %  
 Myo Mass: 0 g  
 UngVol: 422 ml  
 TID: N/A  
 Visual Score: N/A  
 Database:

None

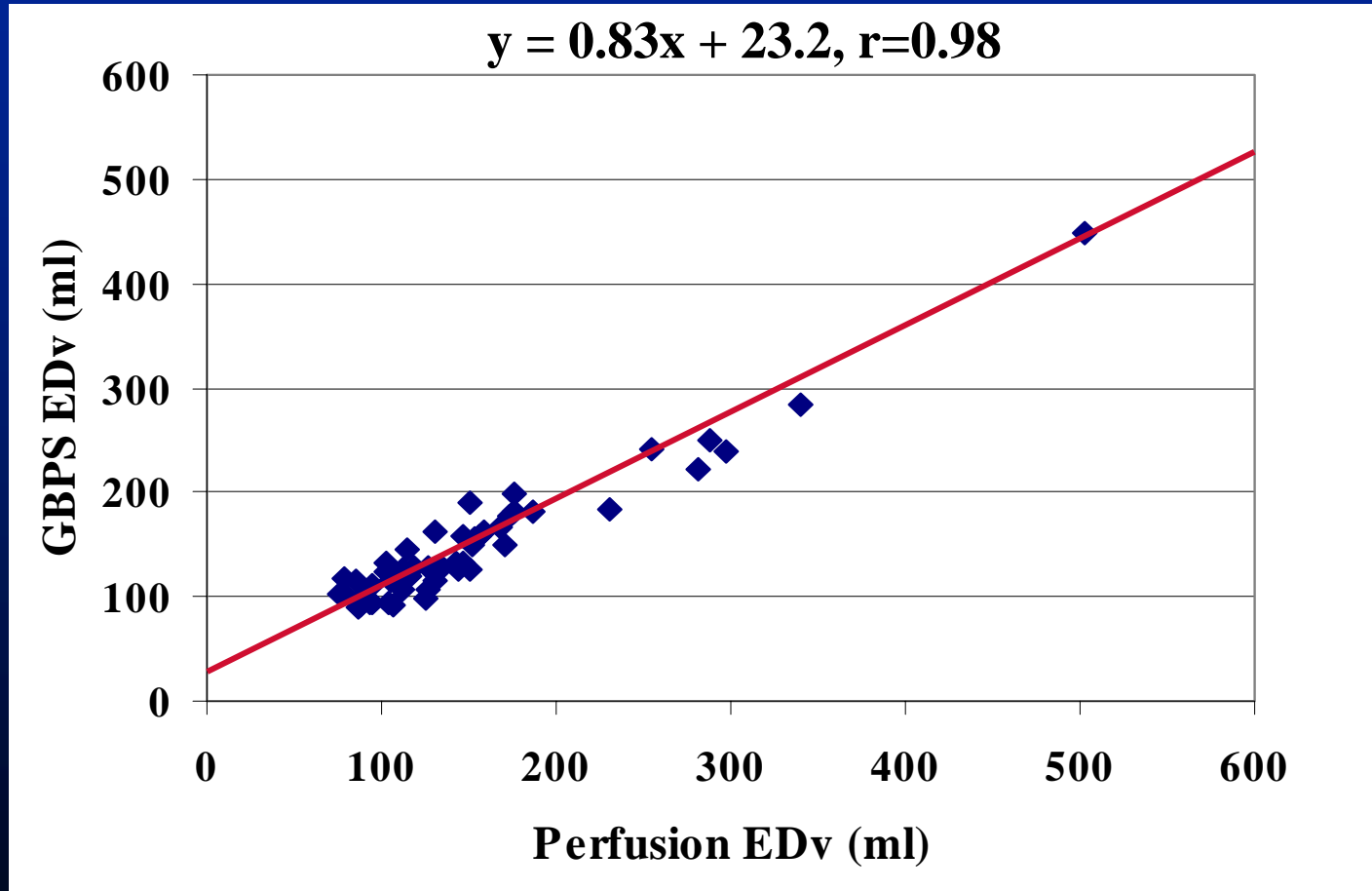


**SA-Gstr**  
 27-Sep-1999 12:45:32  
 Intervals: 16  
 Pharma: Cardiolite  
 EDv,ESv: 504 ml, 401 ml  
 EF : 20 %  
 Myo Mass: 358 g  
 UngVol: 413 ml  
 TID: N/A  
 Visual Score: N/A  
 Database:

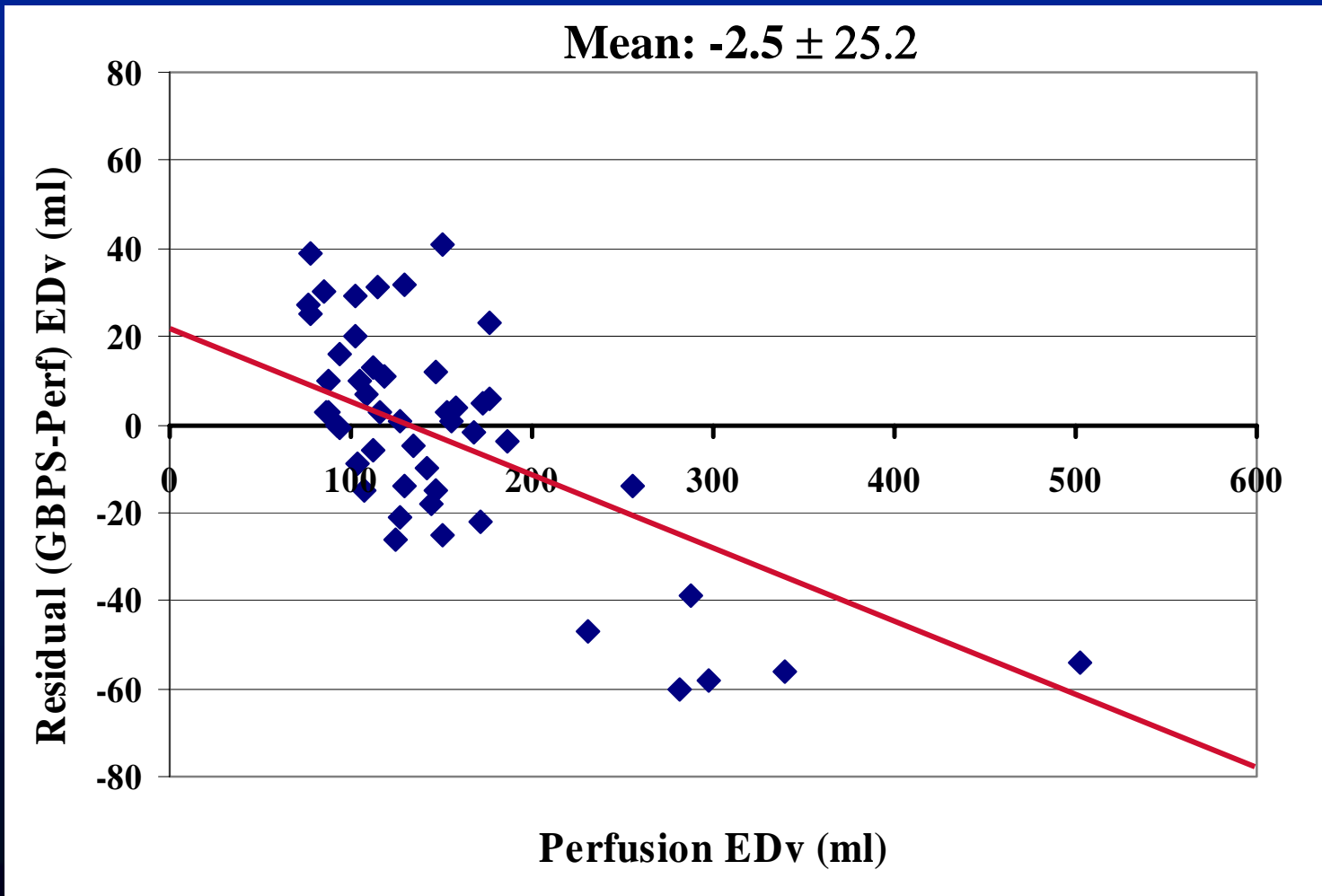
None



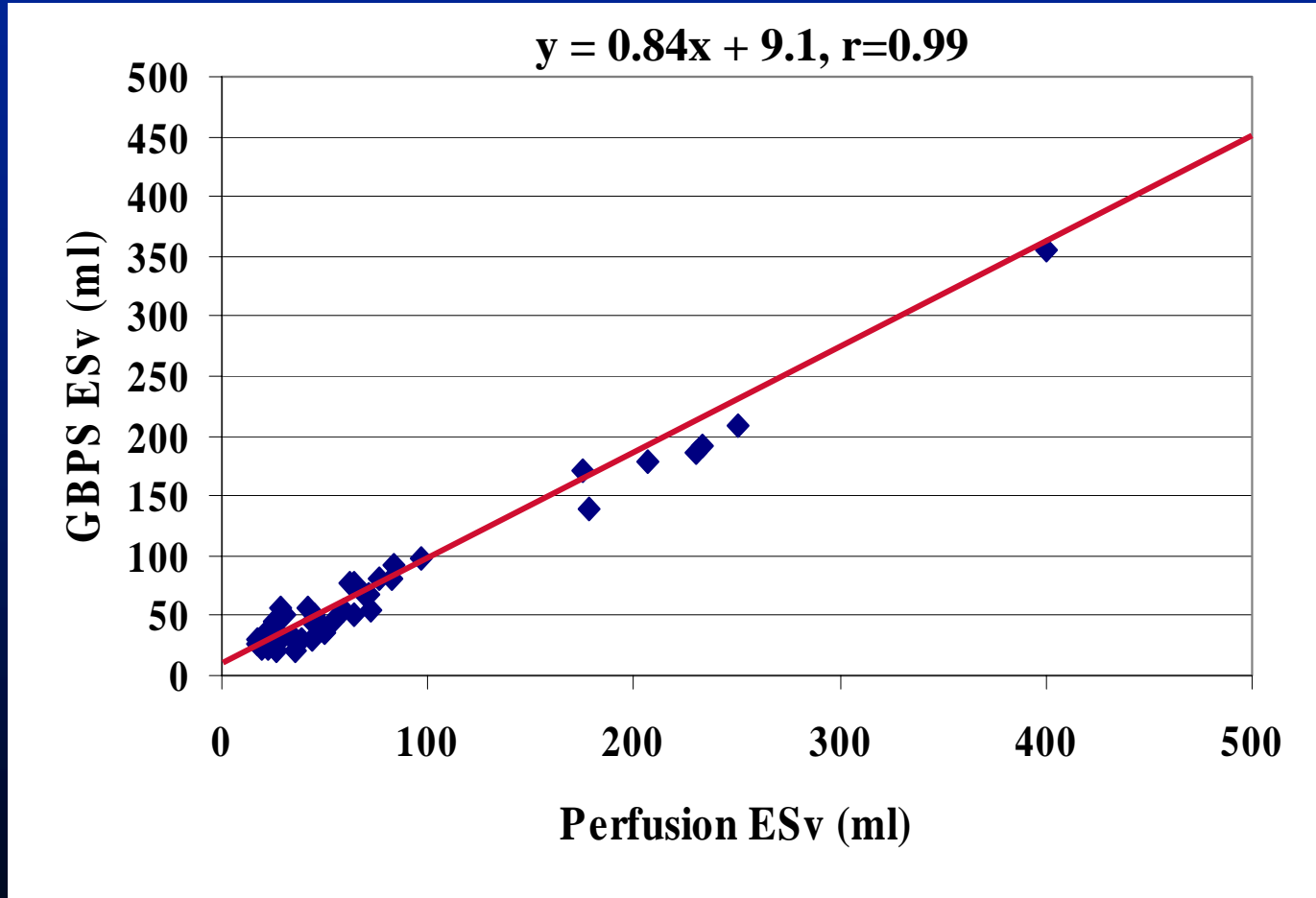
# EDv Correlation: GBPS vs Perfusion SPECT



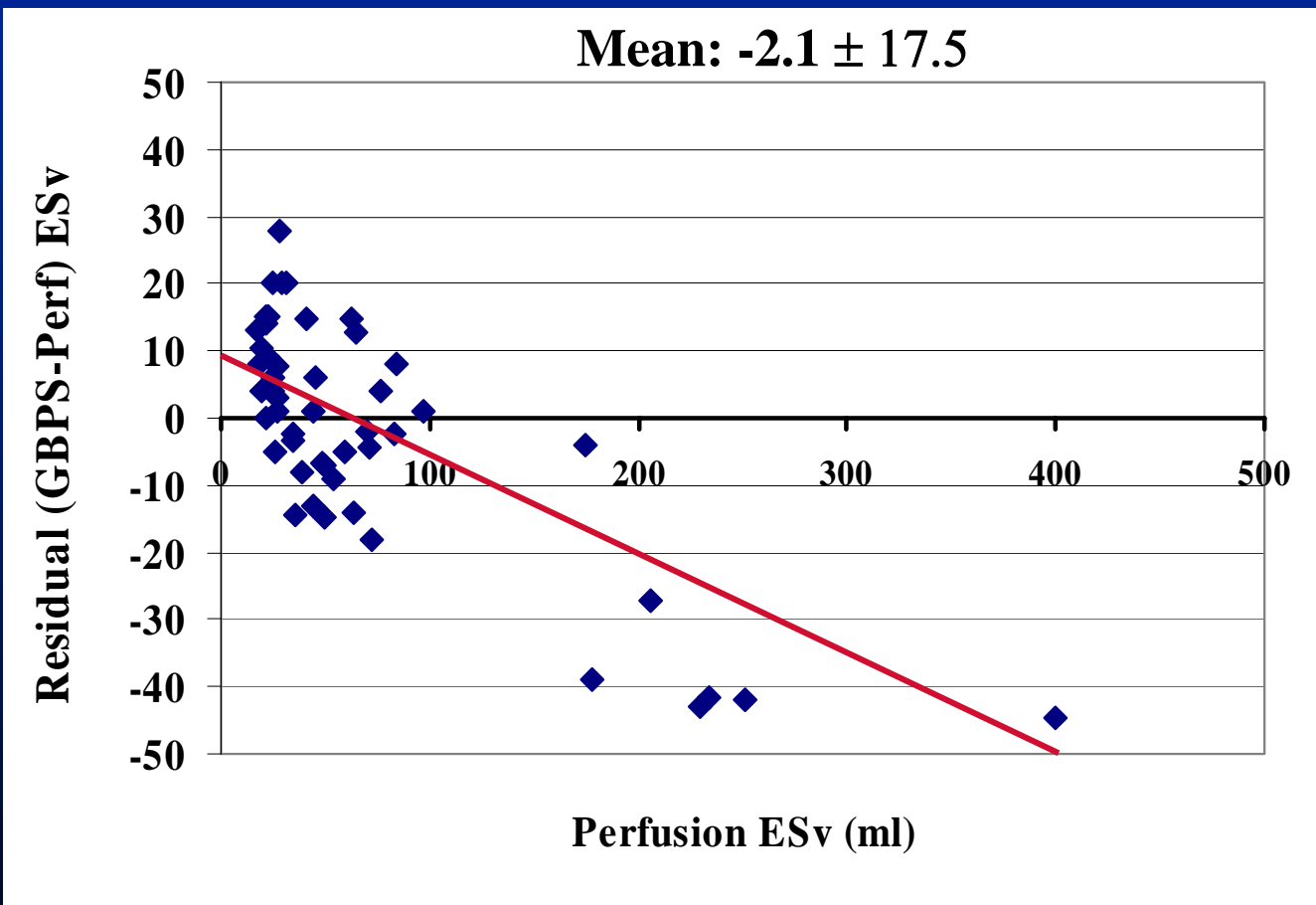
# EDv Bland-Altman: GBPS vs Perfusion SPECT



# ESv Correlation: GBPS vs Perfusion SPECT



# ESv Bland-Altman: GBPS vs Perfusion SPECT



## Summary

- Preliminary results from this population demonstrated good accuracy for LVEF, ED<sub>v</sub> and ES<sub>v</sub> for GBPS compared to myocardial perfusion SPECT and planar blood pool imaging.
- With the integration of both GBPS and perfusion surface algorithms in the same quantitative environment, a more detailed analysis of regional wall motion and the correlation of function and perfusion information for clinical diagnoses should be achieved.

## To be done.....

- Validation with a larger, more functionally diverse patient population is warranted.
- Automation for determining LV/LA junction can be improved.
- Extension of surface detection to the RV.