EMORY UNIVERSITY SCHOOL OF MEDICINE

New Automatic Left Ventricular Base-Detection Algorithm Improves Overall Accuracy of Quantitative PET Myocardial Perfusion Imaging

C. David Cooke[1], MSEE, Russell D. Folks[1], CNMT, Fabio Esteves[1], MD, Richard Eppes[2] and Ernest V. Garcia[1], PhD

[1]Emory University School of Medicine and [2]Syntermed, Inc, Atlanta, GA

Objective

The purpose of this study was to evaluate the accuracy of a new left ventricular automatic base-detection algorithm in ECTb4 coupled with our previously described image decision support system (LVX) and compare to our previous base detection algorithm using expert's visual interpretation of PET MPI as a reference standard.

Methods

We retrospectively studied 100 clinical ^{82}Rb stress/rest patients, all read by the same expert reader. The original processed studies were analyzed by an experienced technologist who adjusted the location of the basal plane of the heart as needed. These same 100 studies were re-processed in the Emory Cardiac Toolbox™ v4 (ECTB4) from raw data with the original base-detection algorithm and then re-processed a second time from raw data with the new base-detection algorithm. The new algorithm starts the search at the previous single %count threshold-based base location. It then continues searching for the LV base moving towards the apex until multiple thresholds are fulfilled for each myocardial wall and for the valve plane. The quantitative results from all 3 processings were then passed through LVX which automatically analyzed and localized disease; final localized results were compared to the expert's visual readings. Figure 1 shows an example study with results from the original base algorithm and the new base algorithm.

Results

One study failed to process with both the original base-detection algorithm and the new base-detection algorithm and an additional study failed to process with the original base-detection algorithm; both studies were excluded from this analysis. Accuracy for each processing compared to expert visual readings is shown in table 1. Cochran's Q test was used to determine if the results were significantly different from the expert's visual readings.

Vascular Territory	ECTb4 Processing by Experienced Technologist	ECTb4 Auto Processing with Original Base Algorithm	ECTb4 Auto Processing with New Base Algorithm
CAD Accuracy	0.70*	0.65*	0.80
LAD Accuracy	0.72*	0.70*	0.79*
LCX Accuracy	0.81*	0.71*	0.84
RCA Accuracy	0.85	0.72*	0.83

Table 1. Accuracy for each processing compared to expert visual readings. *$p < 0.05$ vs. expert visual readings (Cochran's Q test).

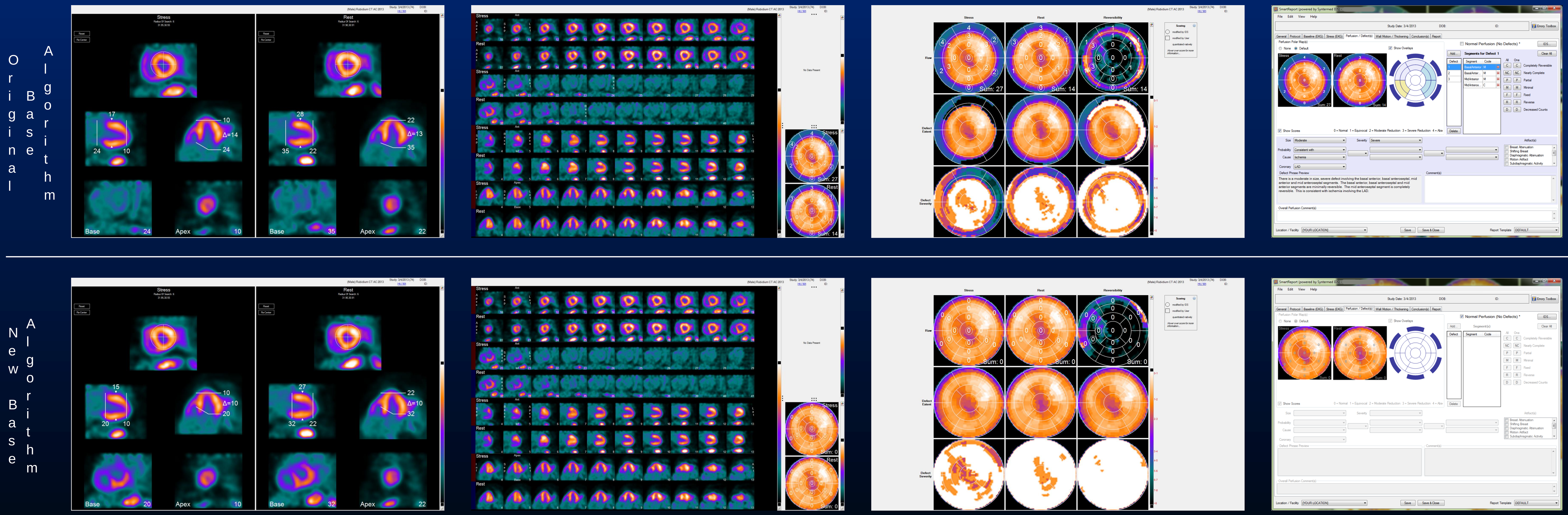

Figure 1. An example male study processed using the original base algorithm (top row) and the new base algorithm (bottom row); this study was read as normal by our expert reader.

Discussion

We have previously described a novel decision support system, LVX, for cardiac image interpretation[1], as well as it's diagnostic performance on Stress/Rest ^{82}Rb PET perfusion studies[2]. In this study we report on how the accuracy of LVX is affected by proper base selection. Because PET is, in general, a high-resolution imaging technique, we often see atria and other background features in PET myocardial perfusion studies. Because of this background, our original single-threshold base detection algorithm would sometimes locate the base too far out. This new algorithm now employs multiple thresholds that are confined to specific myocardial walls as well as the valve-plane. As can be seen in Figure 1, the new algorithm is finding the base further in (by 3 – 4 slices in this example), which has a significant impact on the quantitation and interpretation of this study. Using the original algorithm, there were large quantitative defects involving all 3 vascular territories, which LVX interpreted as triple-vessel disease. Using the new algorithm, there were no defects identified, and the study was correctly interpreted as normal. In all 294 vascular territories (98 patients x 3 territories), 30 false-positives (10%) were converted to true-negatives by way of proper automatic base selection (7 LAD, 13 LCX and 10 RCA). Figure 2 shows an additional example.

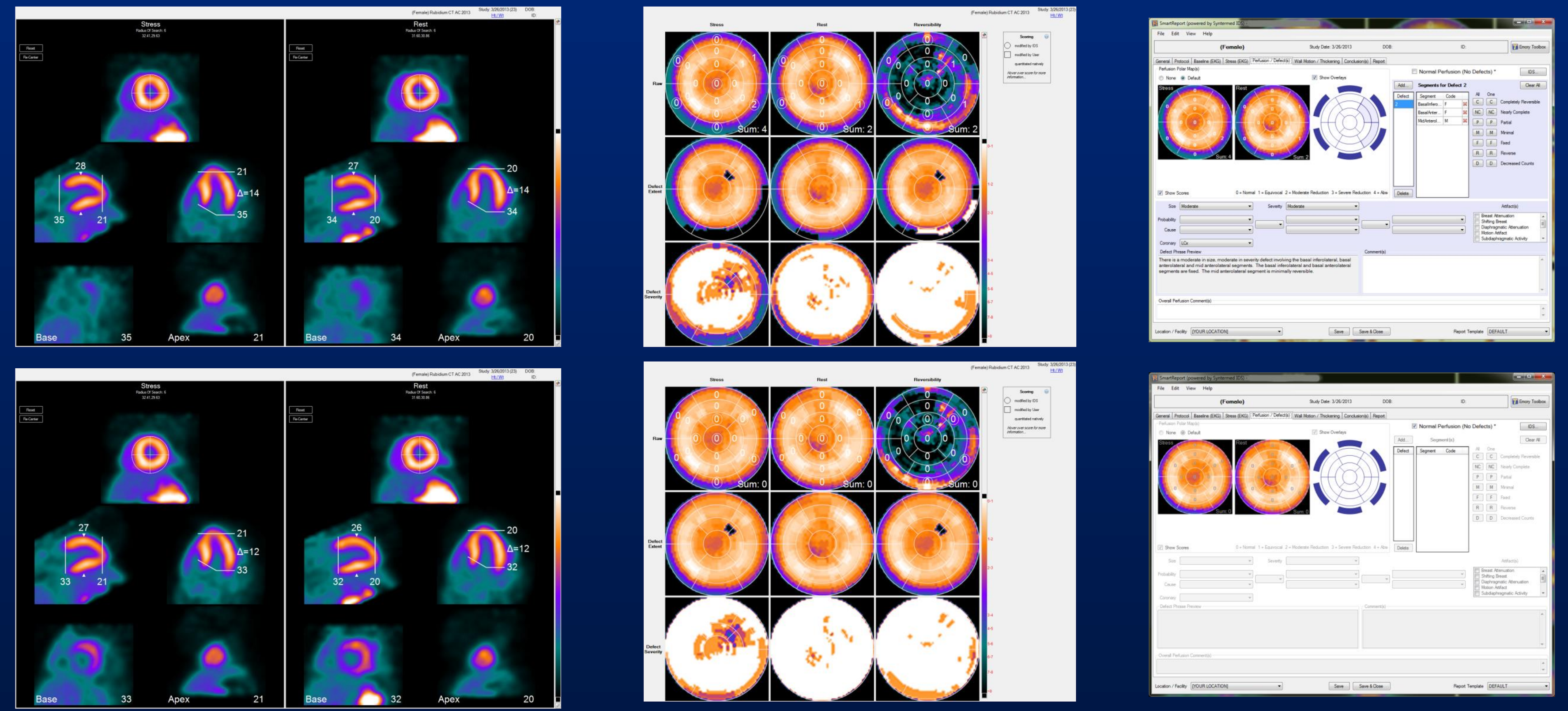

Figure 2. An example female study processed using the original base algorithm (top row) and the new base algorithm (bottom row); this study was read as normal by our expert reader.

Conclusion

Our new automatic base-detection algorithm coupled with LVX improves accuracy and provides diagnostic results consistent with those from an expert processing.

References

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2. Esteves FP, Sultana R, Cooke CD, Folks RD, Garcia EV. Diagnostic Accuracy Comparison of LVX Versus ECTb4 on Rest/Stress Rb-82 Myocardial Perfusion 3D PET. J Nucl Cardiol Suppl 20(4):689, 2013.

DISCLOSURE

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