Initial Validation of a Novel ECGI system for Localization of Ventricular Arrhythmias

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Disclosures: Dr. van Dam is the owner of PEACS BV (Anhem, Netherlands) and is a consultant to Catheter Precision Inc. (Ledgewood, NJ) on the development of the VIVO platform. Catheter Precision Inc. loaned the VIVO platform used in this study.

Introduction

- Pre-procedural localization of ventricular arrhythmias using the 12-lead ECG is an important part of procedural planning.
- View into Ventricular Onset (VIVO™) uses the 12-lead ECG, pre-procedural cardiac imaging, and a 3D image of the torso with ECG leads applied to localize the site of earliest ventricular activation.

Objectives

- To describe the accuracy of the VIVO system for localization of premature ventricular contraction (PVC) foci and ventricular tachycardia (VT) exit sites.

Materials and Methods

- **Population**: Patients presenting for catheter ablation of PVC or VT with pre-procedural cardiac CT or MRI.
- **VIVO System:** Using a patient specific model of the heart and torso derived from CT or MRI, a vectorcardiogram (VCG) is reconstructed from the ECG taking into account the electrode positions on the thorax relative to the heart. This VCG is compared to a simulated activation sequences originating from discrete nodes in the heart. The objective is to localize the node that is closest to the PVC or VT origin. The combination of the mid and terminal QRS vectors identify the region from where the PVC or VT originates, while the minimal difference in initial vectors in that region identifies the ventricular node as the PVC/VT origin.
- **Procedure:** Electroanatomical mapping was performed with the CARTO 3 system. A combination of activation and pace mapping were used to localize PVC sites. For VT ablation, a combination of activation, entrainment, and pace mapping were performed to identify with exit sites
- **Comparison of VIVO to EAM:** Sites of interest were localized using a myocardial segmental model adapted from the AHA 16-segment model. For each patient, one observer localized earliest activation in VIVO and another observer localized the PVC foci or VT exit site. A perfect match was defined as identical segment identification using VIVO in comparison to EAM. A near match was defined as an adjacent segment identification using VIVO in comparison to EAM.

Results

Figure 1: Schematic Description of VIVO System

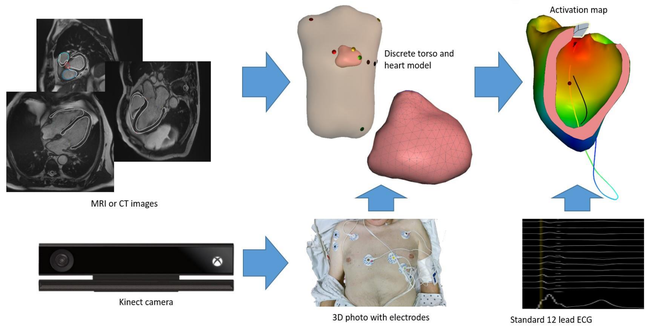


Table 1: Baseline Characteristics

	VT (n = 8)	PVC (n = 12)
Age	51 (24 – 75)	52 (17-77)
VT/PVC Morphologies	9	13
Substrate		
Ischemic	2	1
ARVD	4	0
Non-ischemic	2	2
Other cardiomyopathy	0	0
No structural disease	0	9

Figure 2: Example Cases of VIVO and EAM Localization of PVC/VT

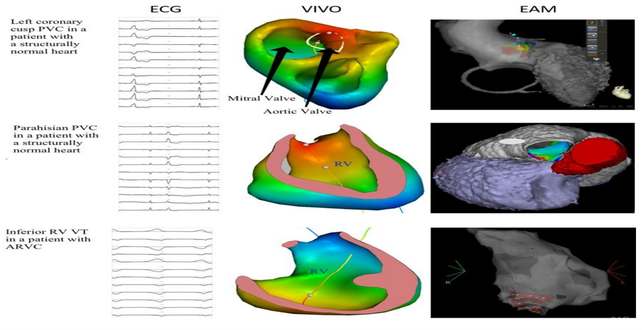
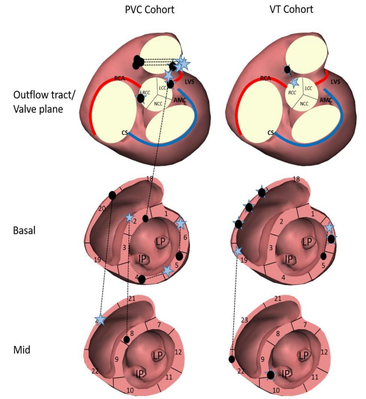


Figure 2: VIVO and EAM Localization of PVC foci and VT exit sites



*Black dots indicate VIVO predicted locations and blue stars indicate EAM-identified PVC foci/VT exit sites.

	VT	PVC
Near Match	2	8
Perfect Match	6	3
No Match	1	2
Side Match	8/9	11/13

Discussion

- VIVO accuracy for PVC localization was fair (85% for near or perfect match; 24% perfect match). Improvements to myocardial model generation, currently done by morphing a reference model which was suboptimal for the outflow tract, could help improve PVC localization accuracy.
- VIVO accuracy for VT exit site localization was good (89% near or perfect match; 67% perfect match) despite modeling assumptions of homogenous propagation. VCG analysis may be less impacted by scar for localization of the exit site, which often reflects break out of activation from a re-entry circuit within scar to the rest of the myocardium.

Conclusion

The View into Ventricular Onset (VIVO) platform for localization for ventricular arrhythmias offers a unique approach to localization of ventricular arrhythmias. In its current iteration, localization accuracy for PVC and VT sites is promising and warrants further development and investigation.