

Title: Diagnostic accuracy of a non-invasive mapping system for scar dependent VT exit site localisation: relationship to myocardial scar and successful ablation lesions.

CCCC Heart Rhythm

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Background

View into ventricular onset (VIVO) is a non-invasive mapping system used for localising the site of earliest activation in ventricular arrhythmia by utilising a mathematical algorithm, patient specific cardiac model (constructed using cross-sectional imaging data), 3D images of the patient's torso (for localising surface electrodes), and a 12-lead electrocardiogram (ECG). The system has been validated for normal heart PVCs however diagnostic accuracy data for scar-dependant VT is lacking.

Objective(s)

The main objectives of this study were:

- I. Assess the accuracy of VIVO in localising the scar-dependant VT exit site (VT-ES).
- II. Assess the relationship of VIVO VT-ES and scar on cross-sectional imaging.
- III. Assess the location of successful ablation lesions to VIVO VT-ES.

Method

Maps from 45 patients with structural heart disease (34 ICM) (Male n=41, 64±14 years) and cross-sectional imaging (CTCA n=36, cMRI n=9), were analysed over 31-months (table 1). Invasive electro-anatomical mapping (EAM) was performed with the Advisor HD Grid multipolar catheter and Ensite X mapping system. The VT-ES was identified using activation-and/or pace-maps and location defined using the AHA 17 segment model of the LV and 15 segment model of the RV. VIVO maps were reviewed by an operator blinded to the EAM and segments allocated. Cross-sectional imaging scar segments and successful ablation sites were also identified. A "complete match" was defined as exact segment concordance, "partial match" as adjacent segments, and "no match" if neither.

Results

A total of sixty-one VTs from 45 patients were mapped, with the VT-ES identified in all cases (21 VT activation map; 40 pacemap). A complete VT-ES match was seen in 66% and partial match was seen in a further 23% of cases (table 2). The VIVO VT-ES was located within or adjacent to cross-sectional imaging defined scar in 89% of VTs. The successful ablation sites were within or adjacent to the VIVO VT-ES in 86% of VTs. At median follow-up of 350 days, 86% of patients were free from any device therapies.

Table 1: Baseline characteristics and procedural outcomes. *values presented as mean and standard deviation.

Baseline characteristics		
Age at ablation, years	63.6 ± 13.7*	
Aetiology		
Ischaemic cardiomyopathy, n (%)	34(75.6)	
ARVC, n (%)	2 (4.4)	
Dilated cardiomyopathy, n (%)	4 (8.9)	
Hypertrophic cardiomyopathy, n (%)	2 (4.4)	
Sarcoidosis, n (%)	2 (4.4)	
Post myocarditis, n (%)	1 (2.2)	
Past medical history		
AF/flutter, n (%)	18 (40.0)	
Hypertension, n (%)	12 (26.7)	
Diabetes, n (%)	8 (17.8)	
COPD, n (%)	3 (6.7)	
Cerebrovascular disease, n (%)	0 (0)	
CABG, n (%)	9 (20.0)	
CKD, n (%)	15 (33.3)	
Cardiac imaging		
Cardiac CT, n (%)	36 (80.0)	
Cardiac MRI, n (%)	9 (20.0)	
LVEF, %	34.5 ± 13.3*	
Amiodarone, n (%)	29 (64.4)	
B-blocker, n (%)	45 (100)	
Ivabradine, n (%)	1 (2.2)	
Mexiletine, n (%)	0 (0)	
ACEi/ARB, n (%)	12 (26.7)	
Sacubitril/Valsartan, n (%)	28 (62.2)	
MRA, n (%)	30 (66.7)	
SGLT2i, n (%)	27 (60.0)	
Procedural data Procedural data	264.9 ± 82.3*	
Radiofrequency ablation time, minutes	26.6 ± 19.3*	
Fluoroscopy time, minutes	41.7 ± 17.3*	
Epicardial access, n (%)	8 (17.8)	
VTs successfully mapped during procedure, n	61	
Post procedural outc	-	
Clinical VT inducible, n (%)	0 (0)	
Non- clinical VT inducible, n (%)	12(26.7)	
No VT inducible, n (%)	32(71.1)	
VT induction not attempted, n (%)	1 (2.2)	
Free from ICD shocks at 12 months, n (%)	38(88.4)	
Free from ATP therapy at 12 months, n (%)	39(90.7)	
Free from any device therapy at 12 months, n (%)	37(86.0)	
Complications, n (%)	6 (13.3)	

Table 2: Results of view into ventricular onset (VIVO), Electro-anatomical mapping (EAM), scar and ablation site segment concordance..

	Complete match	Partial match	No match
VIVO VT-ES and invasive EAM (n=61)	40	14	7
VIVO VT-ES and scar on cross-sectional imaging (n=53)	29	18	6
VIVO VT-ES and successful ablation site (n = 51)	23	21	7
VIVO VT-ES and VT critical isthmus (17)	5	9	3

Figure 1: two examples of VTs mapped with VIVO map, activation map, substrate map and successful ablation sites shown. A) VT with epicardial exit site. B) VT with endocardial exit site.

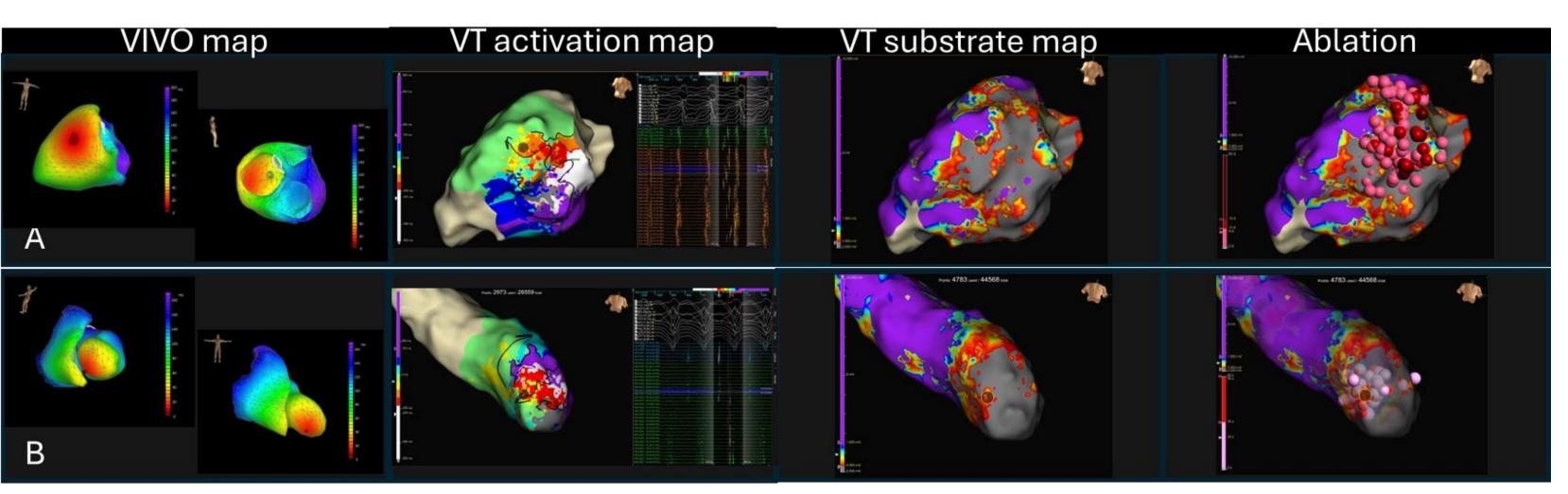
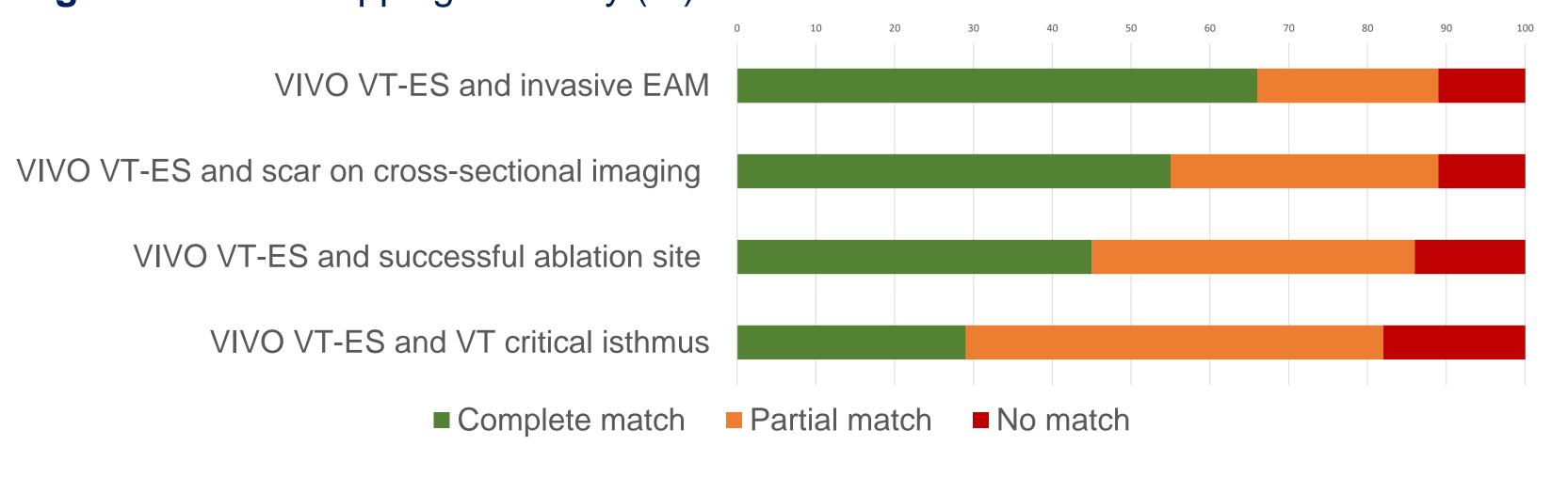


Figure 2: VIVO mapping accuracy (%)



Conclusion

VIVO non-invasive mapping system was able to accurately map the VT-ES in scar dependent VT and identify the relevant myocardial scar as seen on cross-sectional imaging, with good correlation to successful ablation sites.

Further research is required to determine the feasibility of a VIVO guided VT ablation workflow.