

Non-invasive artificial intelligence pre-imaging and decrement evoked potentials mapping guided ischemic ventricular tachycardia ablation

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Background and Aim: Catheter-based ablations utilizing advanced methods for arrhythmia focus localization represent an innovative and rapidly evolving field. Presenting the first AI-enabled imaging-based ventricular tachycardia (VT) ablation procedures in Baltic countries. We hypothesize that non-invasive artificial intelligence and decrement evoked potentials mapping (DEEP) guided procedures provide cumulative results for freedom from documented VTs and prevention of potential de novo VTs developing via high-risk identified isthmuses.

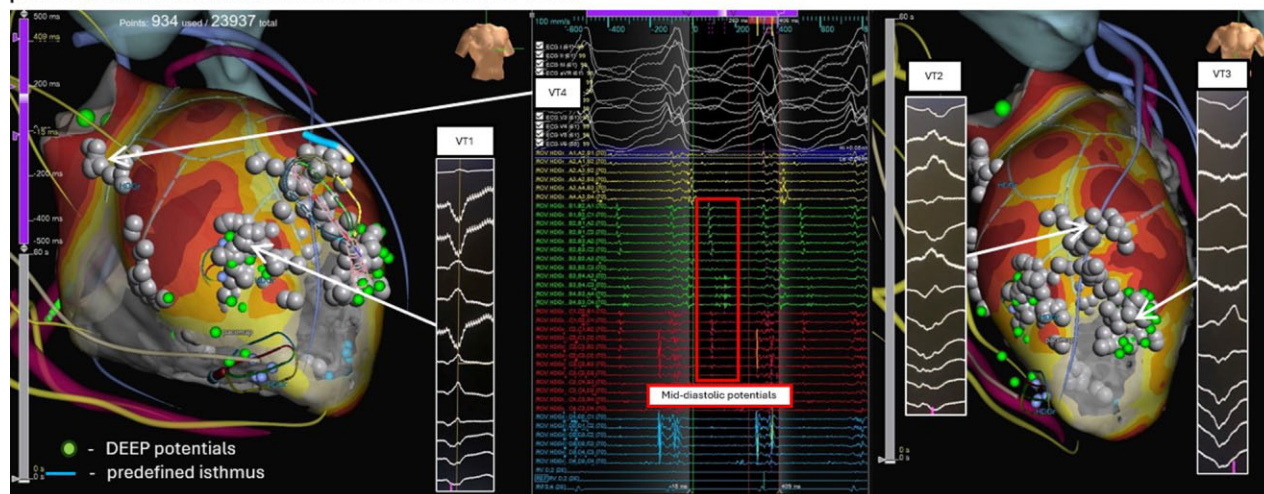
Methods: Anonymised medical data of four patients with a history of myocardial infarction, symptomatic ventricular tachycardia and computed tomography (CT) evaluation was used. Electrophysiological studies and treatment performed in EP lab using the electroanatomic 3D mapping integrated with the CT scans during the late contrast phase, processed by AI-enabled system. Pro-arrhythmic critical isthmuses defined as viable tissue thinning from 3 to 1 millimetre indicating borderline scar zones. During the procedure scarred areas were matched with the presence of functional substrate identified as DEEP potentials with the use of 1 extra-stimulus pacing. In addition, imaging and DEEP potentials were matched with mid- or end-diastolic potentials during high-density activation mapping if arrhythmia was hemodynamically tolerable for at least 30 seconds (fig 1). Patients invited for interrogation of intracardiac defibrillators (ICD) in the postoperative period of 1-year. The primary endpoint of the study was freedom from recurrent ventricular arrhythmia or appropriate ICD discharge.

Results: All patients are males (100%) with a mean age of 69.2 ± 5.7 years and a mean left ventricular ejection fraction of $32.2 \pm 13.2\%$. Arrhythmic substrate averaged 10.5 ± 5.72 identified isthmuses, 26.59 ± 7.35 ml scar volume and 2 ± 1.41 number of VT morphologies (fig 2). In all the patients non-inducibility reached with aggressive stimulation using 400/S2/S3/S4 protocol. In post-operative period all four patients were discharged to outpatient care without complications 5,5 days after the ablation procedure. During follow-up of 1-year after procedure, ICD interrogation in 4 patients revealed no episodes of discharges. In one patient, five self-terminating, non-sustained, asymptomatic, hemodynamically stable VT episodes were recorded. One patient developed anticipated left bundle branch block due to left septal ablation. One patient died due to head injury presumably without arrhythmia-related causes (no cardiac syncope prior to ablation, LVEF 35%, documented transient ischemic attacks and stroke).

Conclusion: Combining AI-enabled imaging-guided predicted isthmuses with DEEP high-density mapping synthesizes complementary anatomical and electrophysiological approach. This may improve both acute procedural and long-term outcomes by reducing the incidence of new VT morphologies, especially in complex cases. Further prospective comparative studies are needed.

Substrate map with AI-enabled imaging

Figure 1. Substrate map with AI-enabled pre-imaging based on viable tissue wall thinning in CT scans during the late contrast phase. Locations of likely VT exits of different ECG morphologies are indicated on map by arrows. EGM presents mid-diastolic potentials in LVOT during VT4. DEEP potentials match isthmuses of induced VTs.



Arrhythmias and Device Therapy – Arrhythmias, General, Treatment, Catheter Ablation of Arrhythmias

Procedural details and ICD interrogation

	Parameter	Mean value or %	Standard Deviation
Pre-Ablation Clinical Events & ICD Interrogation	VT/VF Frequency (6 months pre)	2.67	2.87
	ICD Discharges (6 months pre)	13.67	18.93
	ICD ATP Episodes (6 months pre)	7	10.82
	Clinical Tachycardia Cycle Length (TCL) - Pre (ms)	372.5	58.69
	Patients with Electrical storm (≤ 1 week pre- ablation) (%)	25	-
	Patients with Intolerable VT (%)	50	-
Procedural Details & Mapping	Procedures involving Septal Ablation (%)	75	-
	Substrate Mapping Time (min)	50	9.54
	Ablation Time (min)	45.85	7.78
	Whole procedure duration (min)	277.7	6.4
	Fluoroscopy Time (min)	43.7	25.3
	Fluoroscopy Dose ($\mu\text{Gy}\cdot\text{m}^2$)	693.25	485.6
	VT morphologies	2	1.41
	Number of isthmuses identified	10.5	5.72
	Scar volume (ml)	26.59	7.35
	PAINESD score	14.75	4.44