Supplementary Material

METHODS

Patient selection

Patients who underwent catheter ablation for VT from January 2012 to January 2018 were prospectively entered into a registry. Patients were referred from University Hospital Coventry and surrounding centres. All adult patients (≥ 18years) were listed having been discussed at an arrhythmia multidisciplinary team meeting. For nhVT referral criteria included symptomatic VT despite medical therapy, intolerance to medication or patient preference against medication, significant (>10%) premature ventricular complex (PVC) burden with symptoms or without symptoms and cardiac dysfunction. For structural heart VT (shVT) indications included symptomatic VT despite medical therapy, three or more episodes of VT within 24 hours, at least 3 episodes of VT requiring anti-tachycardia pacing (ATP) or at least one defibrillator shock. All patients provided written consent prior to the procedure. Approval for the study was provided by our Local Audit and Research Department. The study applied the principles of the declaration of Helsinki.

All patients had transthoracic echocardiography and/or cardiac magnetic resonance imaging prior to the procedure to evaluate ventricular function, scar burden and intracardiac thrombus assessment. nhVT was defined as structurally normal heart (on echocardiogram or cardiac magnetic resonance imaging), or patients with cardiac dysfunction attributed to high PVC burden (defined as >10%). shVT included patients with ICM or non-ischaemic cardiomyopathy (dilated cardiomyopathy, hypertrophic cardiomyopathy or cardiomyopathy due to valvular heart disease).

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Procedure details

All procedures were performed at the University Hospital Coventry. All nhVT ablation procedures were performed under conscious sedation and selective shVT ablation procedures under general anaesthesia where procedural risk was deemed high. When available a 12-lead electrocardiogram (ECG) during VT was used to guide chamber mapping. Clinical VT induction was attempted with programmed electrical stimulation (PES) using up to three extra-stimuli from the right ventricular apex, right ventricular outflow tract (RVOT) and/or left ventricle. Patients were allowed to remain in VT during mapping and ablation if haemodynamically stable; otherwise VT was terminated with ATP or electrical direct current cardioversion.

Anticoagulation strategy

Oral anticoagulation with warfarin was uninterrupted (target international normalised ratio 2.0-3.0). Direct oral anticoagulants were omitted on the day of the procedure. Following successful trans-septal puncture intravenous heparin was administered to maintain an activated clotting time >300s. At the end of the procedure protamine (50mg over 10min) was administered and anticoagulation resumed the same day provided there were no significant bleeding events.

Mapping and ablation

Electro-anatomical substrate and activation mapping was performed using the Ensite NAVX/Velocity/Precision (Abbott Medical, Inc., Minneapolis, MN) systems or CARTO 3 (Biosense-Webster, Inc., Diamond Bar, CA). All nhVT cases underwent pace mapping and if VT was haemodynamically stable, activation

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mapping was performed. A successful pace map was defined as QRS morphology match in at least 11 of 12 leads.[1] In patients with SHD a combination of substrate mapping (bipolar signal amplitude <1.5 mV as scar and <0.5 mV as dense scar), pace mapping (with a stimulation to QRS>45ms) and activation/entrainment mapping were performed, as shown in **Figure 1**. The critical isthmus, late potentials, local abnormal ventricular activities (LAVA) potentials and decrementing early/late potentials were identified.[2, 3] Unstable VT mapping and ablation were performed in sinus or paced rhythm using a substrate modification approach.[4-7] Catheter mapping and ablation was performed using a range of catheters including conventional and saline-irrigated ablation catheters (≤8mm tips) **(Supplementary Table 1)**. Power, force-time integral, lesion size index and ablation index settings were at the operator's discretion. At the end of the procedure standardised PES was performed. Complete acute procedural success was defined as termination of clinical VT with failure to induce clinical VT or VT with a longer tachycardia cycle length (TCL). To minimise follow up bias, post-procedure ICD therapies (ATP and shock) were programmed according to a standardised protocol on the basis of the best evidence available.[8, 9]

Outcomes

Follow up was taken as the last documented clinical contact with the patient after the VT ablation including last clinic consultation and/or ICD interrogation. In the case of re-do procedures follow-up time was calculated from the first procedure performed and comparative outcomes were determined after the first procedure.
The primary outcome for nhVT was a composite endpoint including all cause death, cardiovascular hospitalization and recurrent VT (defined as spontaneous sustained

VT; or Holter evidence of PVC burden >10 %). Secondary outcomes for nhVT included all cause death, cardiovascular hospitalization and recurrent VT. For shVT the primary outcome was a composite endpoint including arrhythmic death, appropriate shock or VT storm (defined as 3 or more documented VT episodes occurring within 24 hours). Secondary outcomes included all cause death, appropriate shock, VT storm and cardiovascular hospitalization. A sub-study analysis was also performed to compare VT ablation outcomes between patients with nhVT and ICM.

Statistical analyses

Statistical analyses were performed using SPSS Version 22 (IBM, New York, USA). Continuous variables were tested for normality using the Kolmogorov-Smirnov test. Continuous variables are reported as mean+/-standard deviation (SD) for normally distributed variables and median (interquartile range [IQR]) for non-normally distributed variables. Categorical variables are reported as frequency (percentage). Group differences were tested using Pearson Chi-Square test for categorical variables, and independent t-tests for continuous variables. For non-normally distributed data the Wilcoxon test was used. $P<0.05$ was statistically significant.

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Supplementary Table 1

Procedural data

	All	Normal heart	Ischaemic cardiomyopathy	P Value
	53	26	19	
Number of clinical VTs	1.2±0.7	1.2±0.7	1.1±0.6	0.863
1	2 (4)	24 (92)	13 (68)	0.034
2	43 (81)	0	4 (22)	
3	1 (2)	1 (4)	0	
4	2 (4)	1 (4)	0	
Rhythm at start of procedure				
Sinus rhythm or paced rhythm	49 (93)	25 (96)	18 (95)	0.820
Pre-op intracardiac thrombus assessment	16 (30)	4 (15)	8 (42)	0.045
General anaesthesia	6 (11)	0	4 (22)	0.014
VT stimulation study performed	16 (30)	2 (8)	9 (47)	0.002
Clinical VT induced	26 (49)	9 (35)	11 (58)	0.121
Haemodynamically stable VT	37 (70)	26 (100)	7 (37)	<0.001
Technology				
Mapping system				
CARTO 3	21 (40)	4 (15)	13 (68)	<0.001
Velocity	18 (34)	16 (62)	1 (5)	
Precision	13 (25)	5 (19)	5 (26)	
Conventional	1 (2)	1 (4)	0	
Agilis sheath	28 (53)	6 (23)	17 (89)	<0.001
Mapping catheters				
Pentarray	17 (32)	3 (12)	10 (53)	<0.001
HD linear Duodeca	11 (21)	3 (12)	5 (26)	
Array	10 (19)	10 (38)	0	
RF catheter	15 (28)	10 (38)	5 (26)	
Unspecified	9 (17)	6 (23)	2 (8)	
Tacticath	3 (6)	3 (12)	0	
Smart Touch	2 (4)	1 (4)	1 (5)	
DF Navistar	1 (2)	0	1 (5)	
RF catheters				
Smart Touch	16 (30)	7 (27)	5 (26)	<0.001
Tacticath	15 (28)	1 (4)	10 (53)	
M Therapy	13 (25)	13 (50)	0	

Thermocool DF	2 (4)	0	2 (8)	
L Therapy	1 (2)	1 (4)	0	
DF Navistar	1 (2)	1 (4)	0	
DF FlexAbility	1 (2)	0	1 (5)	
Conventional	1 (2)	1 (4)	0	
Trans septal				
Trans septal puncture	26 (49)	2 (8)	18 (95)	<0.001
Patent foramen ovale	1 (2)	1 (4)	0	
None	26 (49)	23 (88)	1 (5)	
Mapping				
Left ventricle	34 (64)	7 (27)	19 (100)	<0001
Right ventricle	27 (51)	24 (92)	1 (5)	<0.001
Endocardial	52 (98)	26 (100)	18 (95)	0.237
Epicardial	3 (6)	2 (8)	1 (5)	0.747
Epicardial access	1 (2)	0	1 (5)	0.237
Substrate mapping	30 (57)	4 (15)	19 (100)	<0.001
Pace mapping	36 (68)	16 (62)	13 (68)	0.634
Successful pace map	34 (94)	16 (62)	12 (63)	0.259
Entrainment mapping	6 (11)	0	4 (22)	0.014
Activation mapping	36 (68)	21 (81)	9 (47)	0.019
Number of VTs mapped				
0	8 (15)	1 (4)	6 (32)	<0.001
1	35 (66)	23 (88)	6 (32)	
2	8 (15)	0	7 (37)	
3	1 (2)	1 (4)	0	
4	1 (2)	1 (4)	0	
Ablation				
Number of VTs ablated				
0	7 (13)	1 (4)	5 (26)	
1	36 (68)	23 (88)	7 (37)	
2	8 (15)	0	7 (37)	
3	1 (2)	1 (4)	0	
4	1 (2)	1 (4)	0	
RF total, median (IQR) min	22 (11-48)	N=21 14 (10-20)	N=15 56 (41-79)	<0.001
Procedure time, min	200 (141-241)	N=25 142 (123-190)	N=19 240 (220-290)	<0.001
Fluoroscopy time, min	N=49 27 (19-34)	21 (12-34)	28 (25-38)	0.028

Values expressed as mean±SD for continuous variables and frequency (%) for discrete variables unless otherwise specified. Group differences were tested using Chi-squared test and Independent t test for discrete and continuous variables respectively. For non-normally distributed data the Mann Whitney U Test was used to test group differences. [a] n=18
IQR = interquartile range, RF = radiofrequency, VT = ventricular tachycardia.

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