

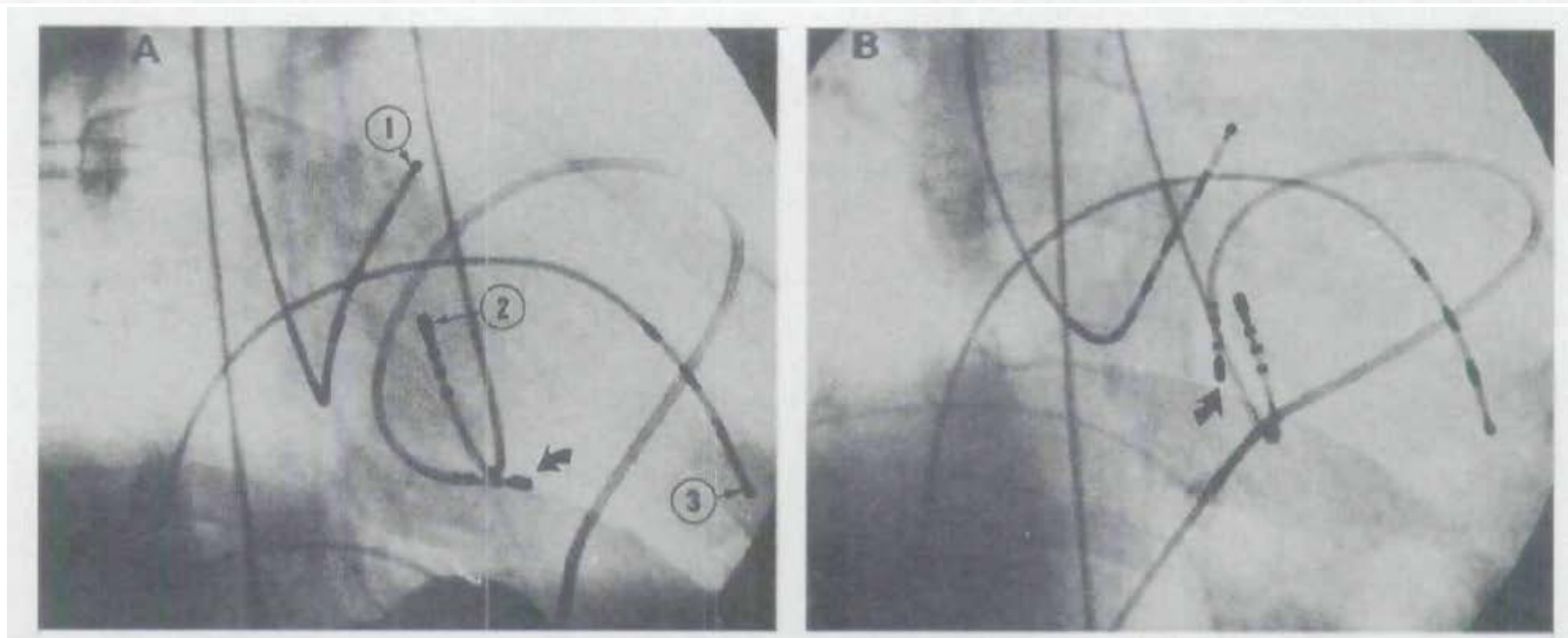
# When to go epicardial

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# A New Technique to Perform Epicardial Mapping in the Electrophysiology Laboratory

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# Questions ?

How much safe in epicardial access ?

How many epicardial origin in VT case ?

# Recommendation for Catheter ablation in VA

## Recommendations for Catheter Ablation

References that support the recommendations are summarized in Online Data Supplement 57.

COR	LOE	Recommendations
I	C-LD	1. In patients with bundle-branch reentrant VT, catheter ablation is useful for reducing the risk of recurrent VT and ICD shocks (1-3).
IIa	B-NR	2. In patients with structural heart disease who have failed endocardial catheter ablation, epicardial catheter ablation can be useful for reducing the risk of recurrent monomorphic VT (4-6).

# **Outcomes in Catheter Ablation of Ventricular Tachycardia in Dilated Nonischemic Cardiomyopathy Compared With Ischemic Cardiomyopathy**

**Results From the Prospective Heart Centre of Leipzig VT  
(HELP-VT) Study**

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Andreas Bollmann, MD, PhD; Sascha Rolf, MD; Christopher Piorkowski, MD;  
Gerhard Hindricks, MD; Arash Arya, MD

# Baseline characteristics

	NIDCM (n=63)	ICM (n=164)	<i>P</i> Value
Age, y	59.2±13.47	67.4±10.09	0.0001
Male sex, n (%)	52 (82.5)	142 (88.4)	0.275
Atrial fibrillation/flutter, n (%)	30 (47.6)	83 (50.6)	0.767
ICD/CRT-D, n (%)	60 (95.2)	149 (90.9)	0.411
Electric storm, n (%)	34 (54)	67 (40.9)	0.1
β-Blocker at admission, n (%)	57 (90.5)	156 (95.1)	0.221
Amiodarone at admission, n (%)	21 (33.3)	64 (39)	0.448
Arterial hypertension, n (%)	30 (47.6)	135 (82.3)	0.0001
Diabetes mellitus, n (%)	18 (28.6)	66 (40.2)	0.125
Heart failure, NYHA class >II, n (%)	34 (55.7)	91 (63.2)	0.349
LVEF, %	33.7±11.09	32.3±11.26	0.414

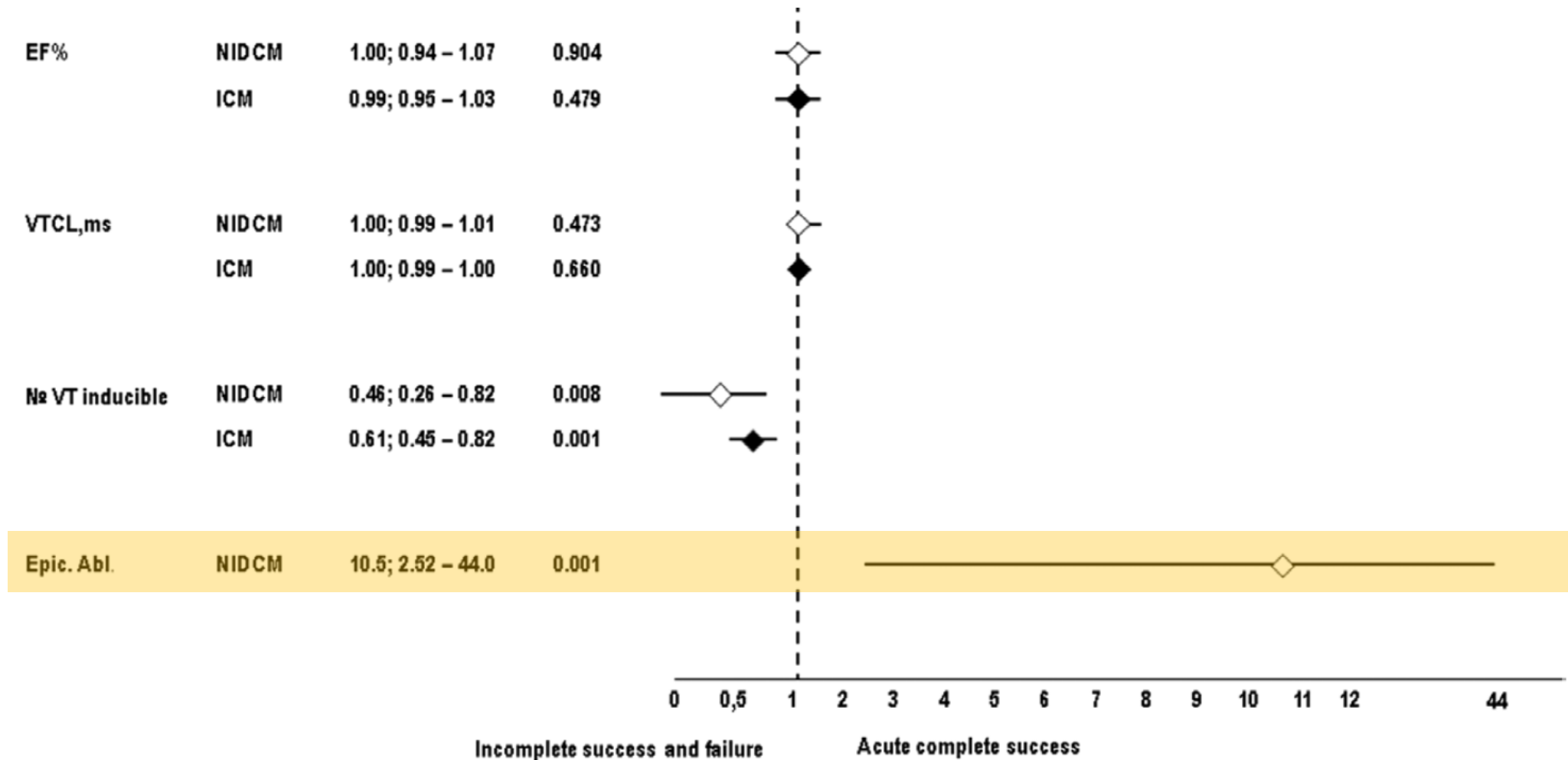
# Procedure characteristics

	NIDCM (n=63)	ICM (n=164)	<i>P</i> Value
RMN, n (%)	5 (7.9)	59 (36)	0.0001
EMF MS, n (%)	60 (95.2)	154 (93.9)	0.699
Epicardial ablation, n (%)	19 (30.2)	2 (1.2)	0.0001
Noninducible with PES, n (%)	9 (15.8)	14 (9.9)	0.360
Ongoing at beginning, n (%)	7 (12.3)	18 (11.5)	0.9
Substrate mapping/LP, n (%)	42 (66.7)	147 (89.6)	<0.0001
Activation mapping, n (%)	31 (63)	79 (48.5)	0.920
Entrainment, n (%)	17 (27)	17 (10.4)	0.002

RMS : remote magnetic navigation

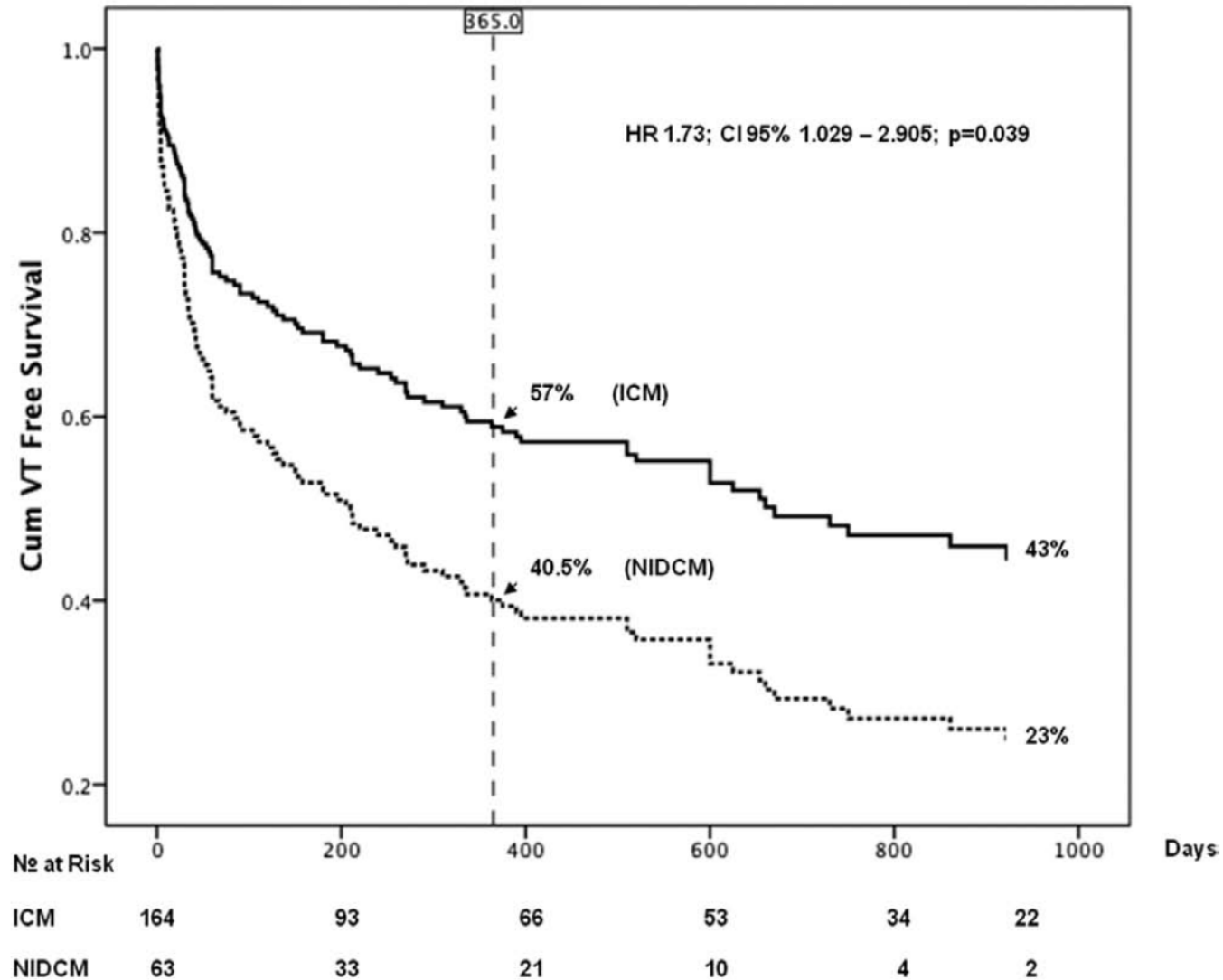
# Predictors of acute success

Complete success : Complete elimination of any clinical and nonclinical stable monomorphic VT





# VT-free survival



# Predictors of VT Recurrence

	NIDCM, HR; 95% CI	<i>P</i> Value	ICM, HR; 95% CI	<i>P</i> Value
Age	0.98; 0.95–1.015	0.278	0.97; 0.95–0.99	0.038
Diabetes mellitus			1.3; 0.77–2.24	0.313
Heart failure, NYHA class I–IV	1.02; 0.63–1.66	0.929	1.36; 1.02–1.81	0.034
EF, %	1.003; 0.97–1.03	0.853	0.98; 0.96–1.007	0.172
Failure vs complete success	4.12; 1.56–10.89	0.004	4.48; 1.2–16.65	0.025
Partial vs complete success	3.28; 1.25–8.65	0.016	1.9; 1.004–3.58	0.048
No. of VTs	1.13; 0.83–1.53	0.443	1.2; 0.98–1.47	0.076
Epicardial ablation	1.86; 0.76–4.53	0.172		
β-Blocker	2.04; 0.63–6.62	0.236	1.02; 0.24–4.3	0.975
AAM	0.48; 0.22–1.07	0.072	1.71; 0.94–3.1	0.079

Experience for safety  
of epicardial ablation

# Epicardial Ablation for Ventricular Tachycardia

## A European Multicenter Study

### Ix of Epicardial ablation

Heart Disease	Study Sample	Indication		Approach	
		First Choice	Failure of Previous Endocardial Ablation	Endo-Epicardial	Epicardial Only
None	48 (22.0)	15 (31.3)	33 (68.8)	43 (89.6)	5 (10.4)
CAD	85 (39.0)	28 (32.9)	57 (67.1)	74 (87.1)	11 (12.9)
IDCM	67 (30.7)	30 (44.8)	37 (55.2)	57 (85.1)	10 (14.9)
ARVD/C	13 (6.0)	2 (15.4)	11 (84.6)	13 (100)	0 (0.0)
HCM	5 (2.3)	3 (60.0)	2 (40.0)	4 (80.0)	1 (20.0)
Total	218	78 (35.8)	140 (64.2)	191 (87.6)	27 (12.4)

IDCM : idiopathic DCM

# Cx of Epicardial ablation

Major : 9 (4.1 %)

8 – Cardiac tamponade

→ 6 : fully recovery within 24 hr

2 : surgical intervention

Minor : 17 (7.8 %)

2 – acute HF

1 – transient AV block

1 – permanent LBBB

46 (21%) –precordial pain

Complete prevention of VT

156 (71.6%)

IDCM 45 (67.2%)

Recurrence rate

60/191 (31.4%)

IDCM 22 (20.2%)

## Conclusions

In experienced centers, epicardial ablation of VT has an acceptable risk and favorable outcome.

In selected patients, it is reasonable to consider as a first-line ablation approach.

# Epicardial Ventricular Tachycardia Ablation

## A Multicenter Safety Study

2001-2007, 3 tertiary care center,  
913 VT ablation → 121 (13%) Epicardial ablation

## Baseline characteristics

	Ischemic CMP (n = 51)	Idiopathic Dilated CMP (n = 39)	ARVC (n = 14)	No CMP (n = 17)	Other CMP (n = 13)	All Patients (n = 134)
Percentage of epicardial access compared with the global population of VT ablation (n = 722)	16%	35%	41%	6%	18%	19%
Age (yrs)	63 ± 11	59 ± 15	42 ± 13	48 ± 14	53 ± 13	56 ± 15
Men	48 (94%)	32 (82%)	9 (64%)	10 (59%)	10 (77%)	109 (81%)
Left ventricular ejection fraction (%)	31 ± 11	33 ± 12	59 ± 9	61 ± 9	44 ± 11	40 ± 17
Patients with previous endocardial VT ablation	46 (90%)	33 (85%)	9 (64%)	15 (88%)	12 (92%)	115 (86%)
Patients with epicardial mapping and ablation	42 (82%)	36 (92%)	14 (100%)	12 (71%)	9 (69%)	113 (84%)

# Complications related to epicardial VT ablation

Complications Related to Epicardial Approach			Other Complications	
<b>Major complications</b>				
Acute	Intrapericardial bleeding (>80 cm <sup>3</sup> )	7 (4.5%)	Pulmonary embolism	2 (1.3%)
	Coronary artery stenosis	1 (0.6%)	Endocardial pop with pericardial effusion	1 (0.6%)
			Cardiogenic shock	1 (0.6%)
			Infranodal AV block	1 (0.6%)
			Bilateral groin hematoma requiring blood transfusion	1 (0.6%)
Delayed (>48 h)	Major pericardial reaction	1 (0.6%)		
	Delayed tamponade	1 (0.6%)		
	Myocardial infarction	1 (0.6%)		
<b>Total</b>		<b>11 (7%)</b>		<b>6 (4%)</b>
<b>Minor complications</b>				
	RV puncture without consequence	23/136 percutaneous approach (17%)	Femoral dissection	1 (0.6%)
	Pleural catheterization with guidewire	2 /136 (1.5%)		
	Chest pain	Almost all patients		



Efficacy of epicardial ablation  
in each cardiomyopathy

# Epicardial ablation of ventricular tachycardia: An institutional experience of safety and efficacy

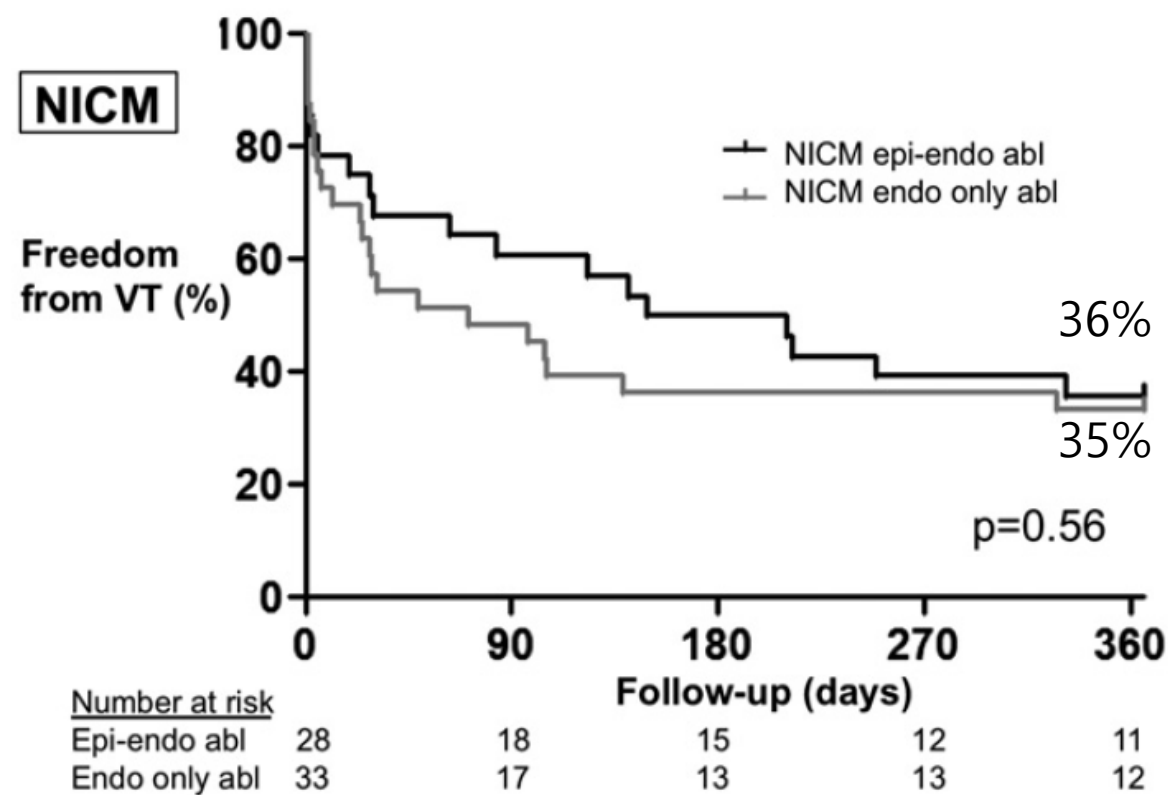
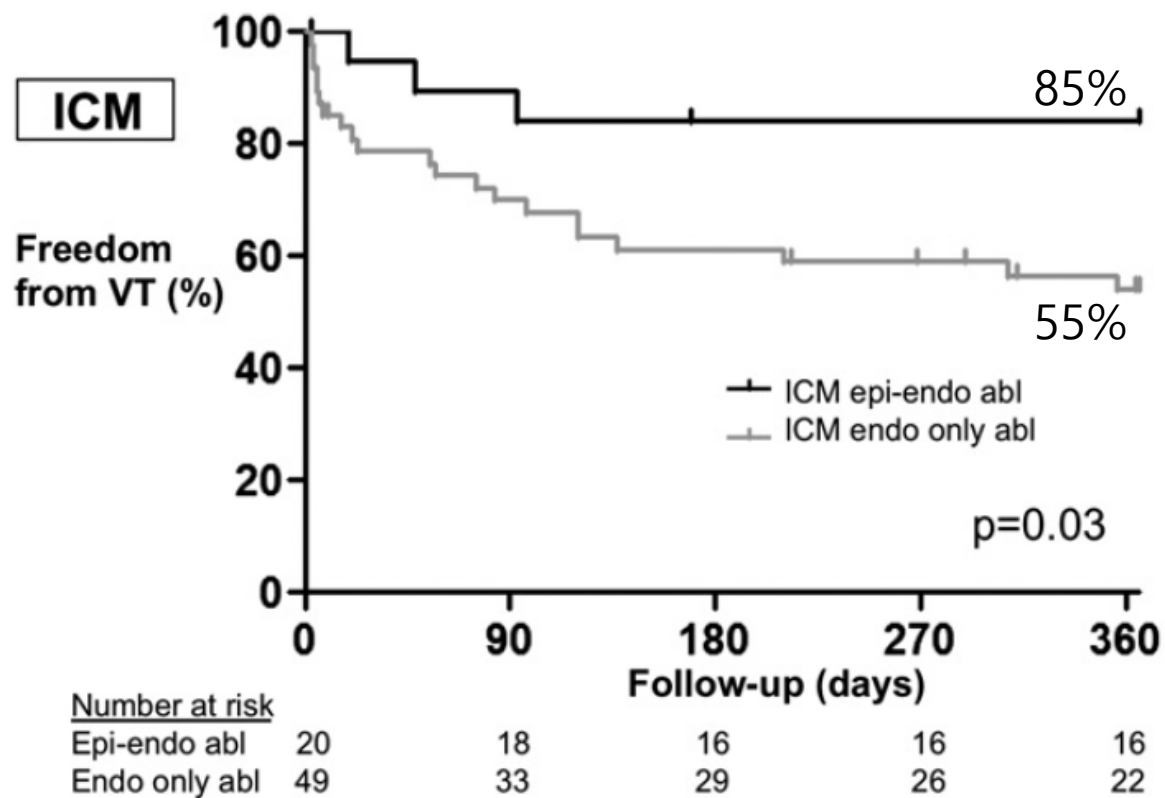
2004-2011, single center, UCLA,

173 VT ablation in 144 Pt → 109 epicardial procedure in 95 Pts

## Baseline characteristics and acute success

	ICM			NICM		
	epi-endo	endo only	<i>P</i>	epi-endo	endo only	<i>P</i>
N	21 (29%)	51		29 (45%)	35	
Age (y)	68 ± 10	69 ± 8	.69	58 ± 12	57 ± 13	.85
Sex: Male	19 (90%)	47 (92%)	.81	26 (90%)	25 (71%)	.07
Ejection fraction (%)	33 ± 10	27 ± 11	.06	32 ± 16	32 ± 14	.91
Hypertension	13 (62%)	30 (59%)	.81	12 (41%)	19 (54%)	.3
Renal failure (Cr > /= 1.5)	7 (33%)	17 (33%)	1	7 (24%)	8 (23%)	.9
Previous ablation	17 (81%)	12 (24%)	<.001	18 (62%)	14 (40%)	.08
Previous epicardial access attempt	1 (5%)	0 (0%)		1 (3%)	6 (17%)	.08
Previous cardiac surgery	8 (38%)	33 (65%)	.04	2 (7%)	8 (23%)	.08
Acute procedural success (and inducible from the start)	10 (48%)	29 (57%)	.6	13 (45%)	14 (40%)	.8
Acute or partial procedural success	20 (95%)	48 (94%)	1	24 (83%)	28 (80%)	1

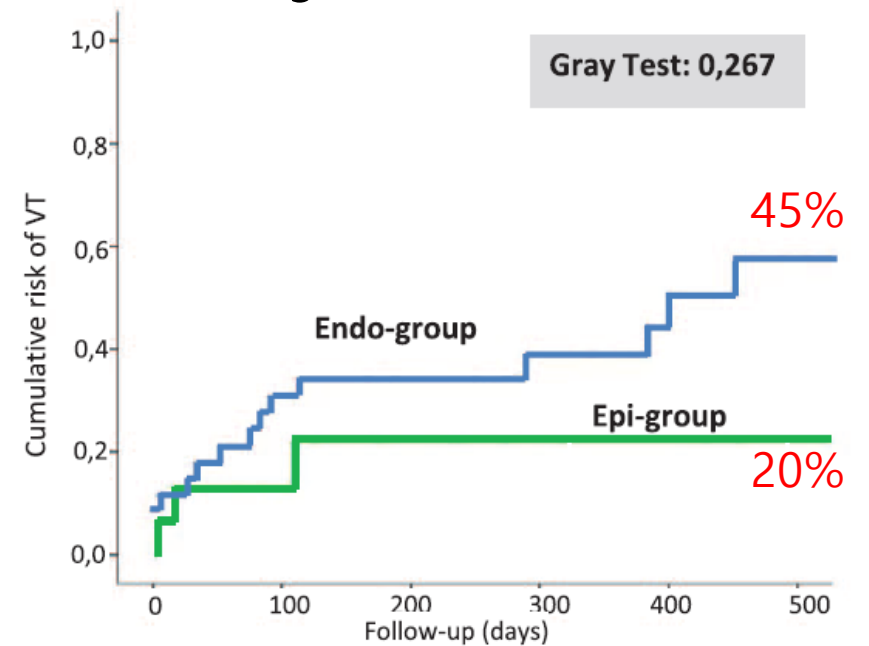
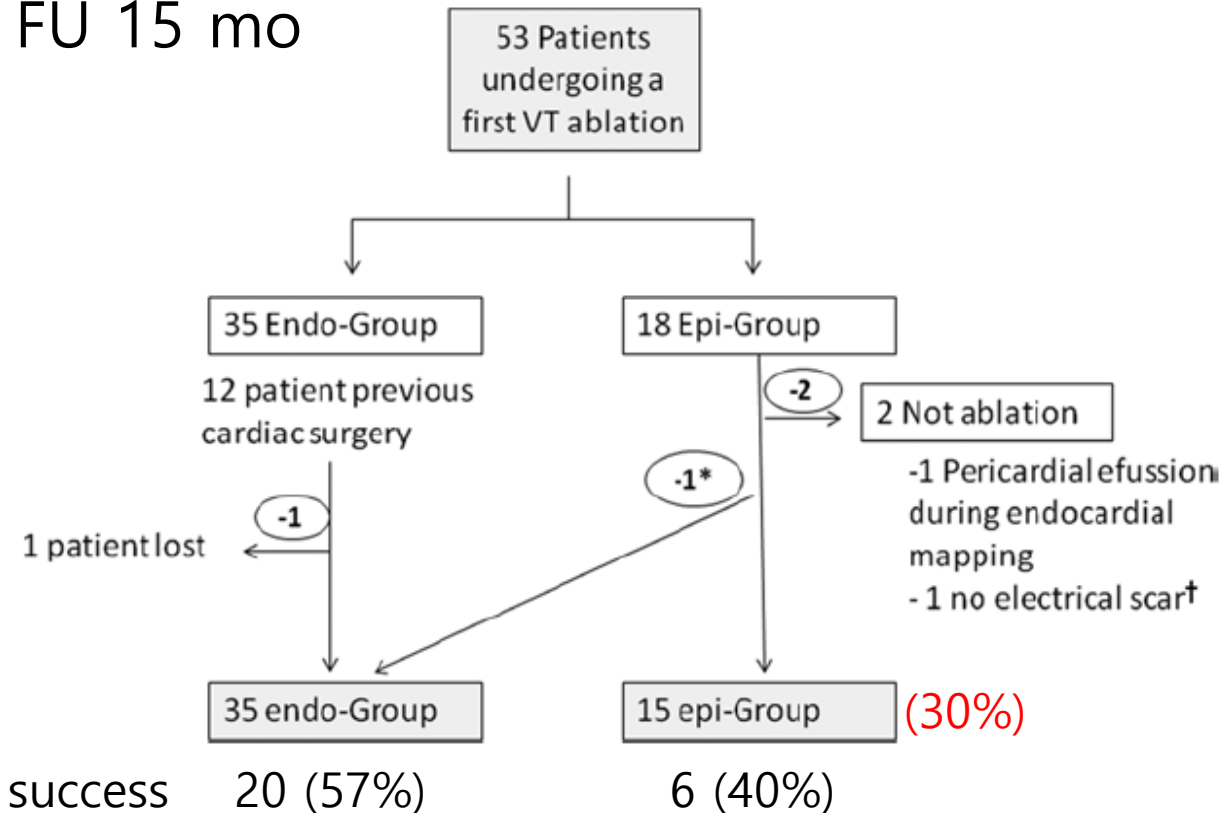
# Freedom from VT



# Endo-Epicardial Versus Only-Endocardial Ablation as a First Line Strategy for the Treatment of Ventricular Tachycardia in Patients With Ischemic Heart Disease

2012-2014, single center,  
End point : noninducibility of VT  
FU 15 mo

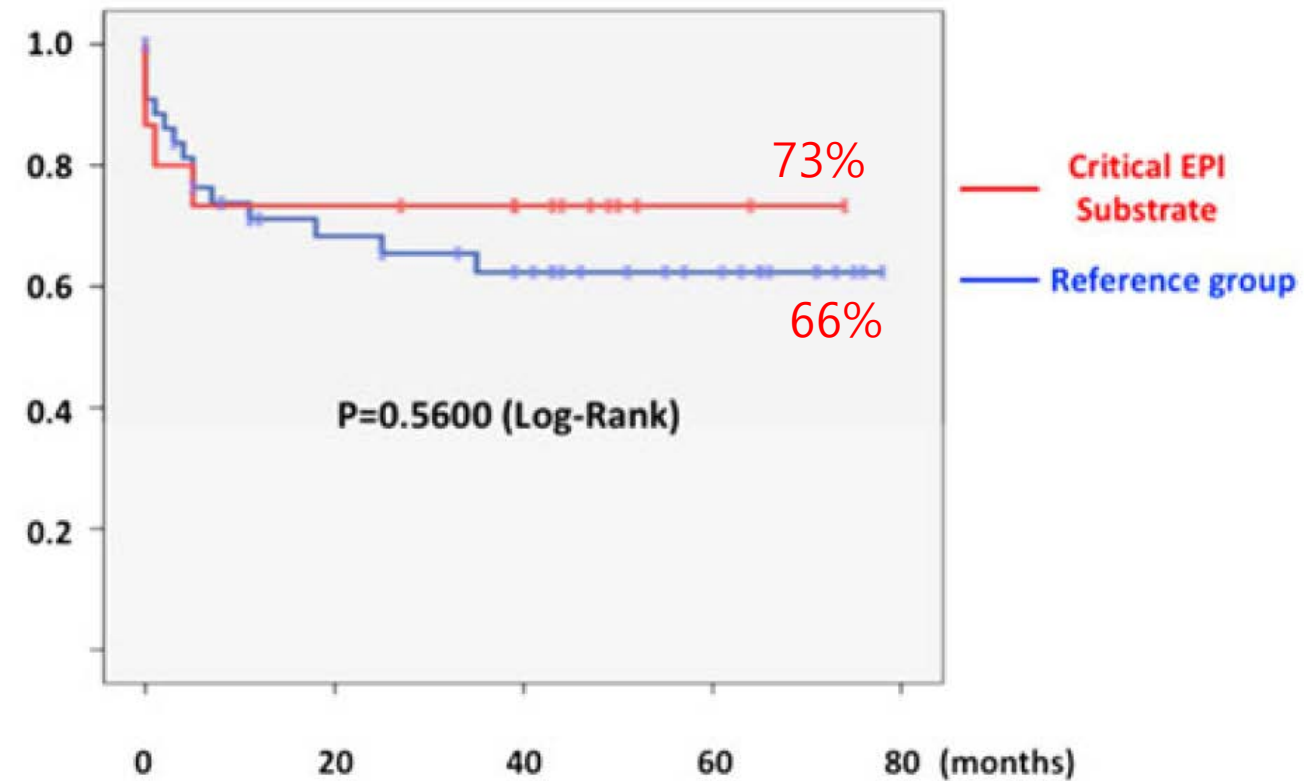
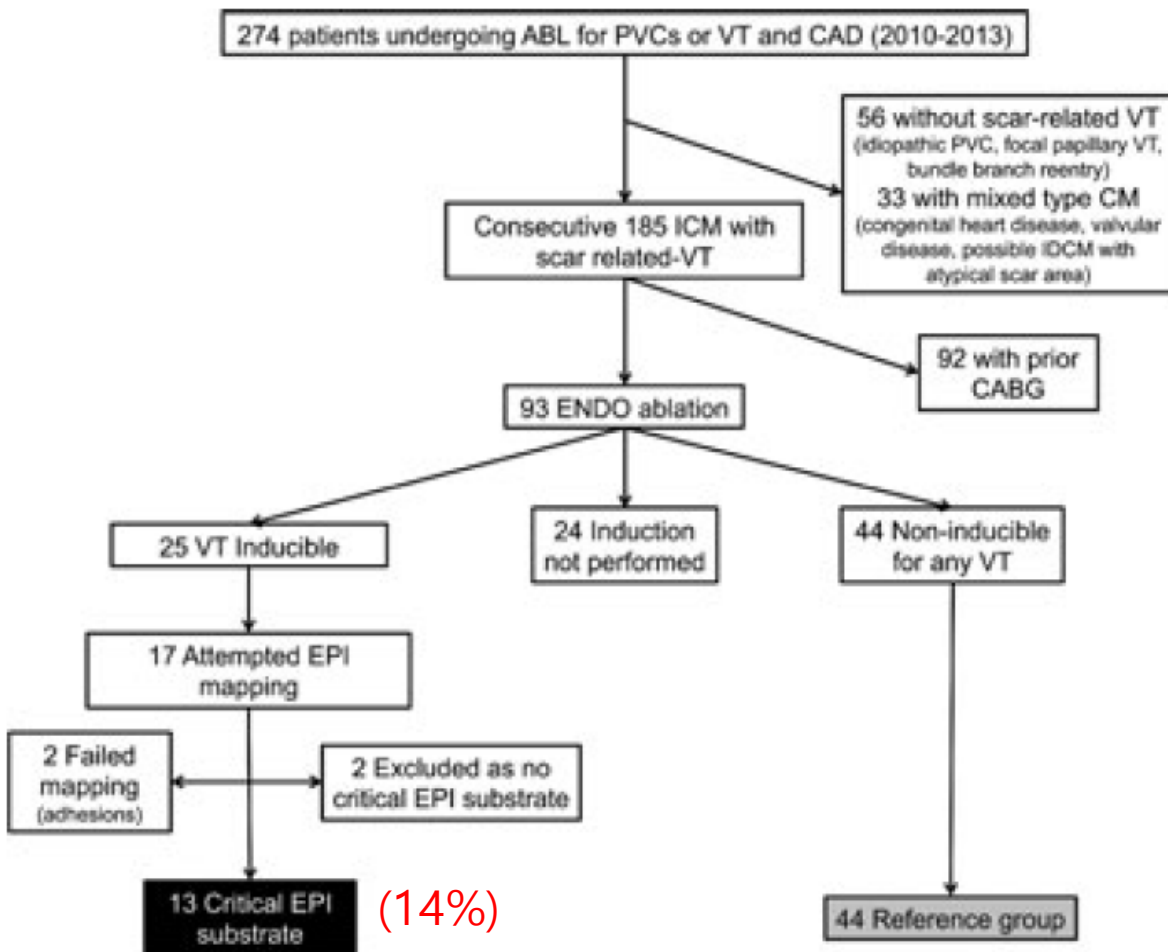
## Cum probability of VT recurrence



Epi-group	15	(2)	10	(1)	7	(0)	4	(0)	3
Endo-group	35	(10)	21	(1)	17	(1)	14	(2)	8

# Epicardial ventricular tachycardia in ischemic cardiomyopathy: Prevalence, electrophysiological characteristics, and long-term ablation outcomes

Survival free from VT recurrence



# VT ablation in ARVD/C

Author	Number of patients	Mapping strategies	Sites of targets	Acute results	Follow-up duration	Short-term freedom from VA recurrences ( $\leq 1$ years)	Long-term freedom from VA recurrences
Dalal et al. <sup>87)</sup>	24	Conventional or 3D mapping	Endocardial	46% for all inducible VT; 31% for clinical VT; 23% procedural failure	32 $\pm$ 36 months	50% (5 months)	25%
Verma et al. <sup>88)</sup>	22	3D mapping	Endocardial	82%	37 months (median)	77% (1 years)	53%
Garcia et al. <sup>12)</sup>	13	3D mapping	Endocardial+epicardial	92% (for all targeted VT)	18 $\pm$ 13 months	-	77%
Philips et al. <sup>13)</sup>	87	Conventional or 3D mapping	Endocardial+epicardial	Complete success 47%; partial success 38%; procedural failure 15%	88.3 $\pm$ 66.1 months	1 years: 47% (endocardial: 45%; epicardial 64%)	5 years: 21%; 10 years: 15% (5 years-endocardial 19%; 5 years-epicardial 45%)
Bai et al. <sup>32)</sup>	49	Conventional or 3D mapping	Group 1: endocardium alone, (n=23); group 2: endo+epicardium (n=26)	Polymorphic VT/VF: 1 in group 1 and 2 in group 2	At least 3 years group 1: 1,224 $\pm$ 310 days; group 2: 1,175 $\pm$ 112 days	300 days follow-up group 1: 88.5%; group 2: 100%	3-years follow-up group 1: 52.2%; group 2: 84.6%
Santangeli et al. <sup>17)</sup>	62	3D mapping	Endocardial $\pm$ epicardial	VT non-inducibility: 71%	56 $\pm$ 44 months	-	71%
Wei et al. <sup>89)</sup>	48	3D mapping	Endocardial $\pm$ epicardial	81.3%	71.4 $\pm$ 45.7 months	-	56.3%
Lin et al. <sup>15)</sup>	80	3D mapping	Endocardial $\pm$ epicardial	100%	38 $\pm$ 11 months	95% (1 year)	51.2%
total	316		Endo $\pm$ Epi	71-100%		64-100%	45-85%

# Endocardial only ablation in Brugada syndrome

Study	N	Ablation site	Epicardial mapping	Endocardial substrate present	F/u (months)	VT/VF inducibility pre-ablation	VT/VF inducibility post-ablation	Post-ablation Electrogram elimination	Type I Brugada Pattern free	VT/VF free	Procedural adverse events
Endocardial-only mapping and ablation with substrate modification											
Hayashi 2016 <sup>21</sup>	1	Endo circumferential RVOT and endo anterior RVOT	No	Yes	6	-	-	1 (100%)	0	0	-
Tauber 2016 <sup>4</sup>	1	Endo RVOT	No	Yes	-	1 (100%)	0	-	1 (100%)	1 (100%)	-
Notarstefano 2015 <sup>22</sup>	1	Endo anterior RVOT	No	Yes	18	-	-	-	-	1 (100%)	-
Sunsaneewitayakul 2012 <sup>23</sup>	4	Endo RVOT	No	Yes	12-30	3 (75%)	-	2 (50%)	4 (100%)	1 (25%)	1 RBBB
Shah 2011 <sup>24</sup>	1	Endo septal and anterolateral RVOT	No	Yes	78	-	-	-	1 (100%)	1 (100%)	-
Yao 2010 <sup>25</sup>	9	Endo RVOT	No	Yes	24	-	-	-	-	8 (89%)	None
Summary	17	-	-	17/17 100%	-	4/5 80.0%	0/1 0%	3/5 60.0%	6/7 85.7%	12/17 70.6%	-

# Epicardial ± Endo ablation in Brugada syndrome

Study	N	Ablation site	Epicardial mapping	Endocardial substrate present	F/u (months)	VT/VF inducibility pre-ablation	VT/VF inducibility post-ablation	Post-ablation Electrogram elimination	Type I Brugada Pattern free	VT/VF free	Procedural adverse events
Epicardial ± endocardial mapping and catheter ablation with substrate modification											
Pappone 2017 <sup>12</sup>	135	Epi RV and RVOT	Yes	-	10 (8-12)	135 (100%)	0	135 (100%)	133 (98.5%)	133 (98.5%)	5 pericardial effusion
Hocini 2016 <sup>13</sup>	3	Endo RVOT	Yes	-	24	-	-	3 (100%)	3 (100%)	3 (100%)	-
Saha 2016 <sup>14</sup>	1	Endo and epi RVOT	Yes	Yes	41	0	-	-	-	1 (100%)	1 pericarditis
Zhang 2016 <sup>15</sup>	11	Epi anterior RVOT	Yes	1 (9.1%)	25 ± 11	9 (100%)*	0*	-	11 (100%)	8 (73%)	2 pericarditis
Brugada 2015 <sup>11</sup>	14	Epi anterior RV and RVOT	Yes	-	3-6	14 (100%)	0	14 (100%)	14 (100%)	14 (100%)	1 pericarditis
Forkmann 2015 <sup>16</sup>	1	Epi anterior RVOT and epi lateral tricuspid annulus	Yes	No	9	1 (100%)	0	1 (100%)	-	1 (100%)	-
Maeda 2015 <sup>17</sup>	1	Epi anterior RVOT and epi inferior RV	Yes	Yes	20	-	-	-	-	1 (100%)	-
Sacher 2015 <sup>18</sup>	3	Endo RVOT (n=2); Endo and epi RVOT (n=1)	Yes	No	9 ± 3	-	-	3 (100%)	3 (100%)	3 (100%)	-
Szeplaki 2014 <sup>19</sup>	1	Epi anterior RVOT	Yes	No	18	0	-	1 (100%)	1 (100%)	1 (100%)	-
Cortez-Diaz 2013 <sup>20</sup>	1	Epi anterior RVOT	Yes	No	6	1 (100%)	1 (100%)	1 (100%)	1 (100%)	1 (100%)	-
Nademanee 2011 <sup>6</sup>	9	Epi anterior RVOT	Yes	No	20 ± 6	9 (100%)	2 (22.2%)	-	8 (89%)	8 (89%)	2 pericarditis
Summary	180	-	-	3/41 7.3%	-	169/171 98.8%	3/169 1.8%	158/158 100%	174/177 98.3%	174/180 96.7%	-



# Summary

Epicardial origin account for about 20-35% in VT

Epicardial ablation might be safe and feasible technique as second or first line.

In ARVD/C, and Brugada syndrome, epicardial substrate modification appears to be more effective than endocardial-only approach.

Thank you very much