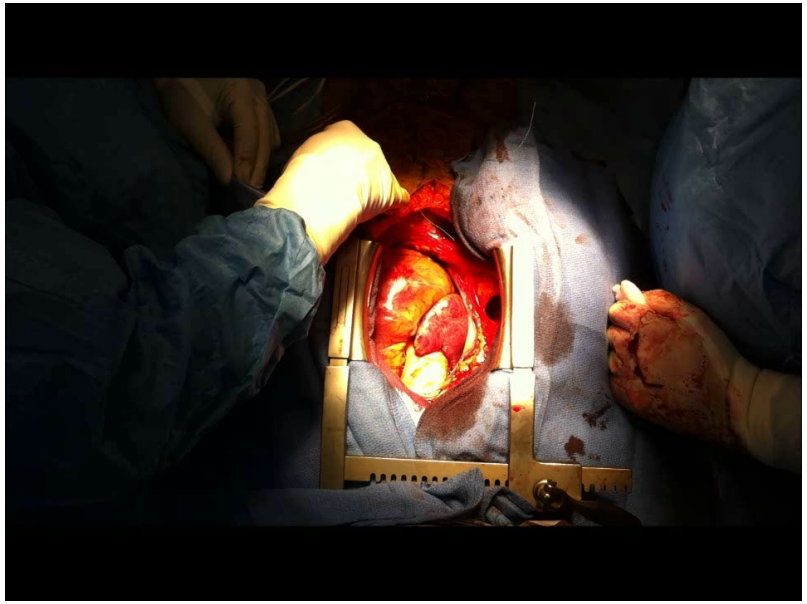
RHYTHM 2019



Ventricular arrhythmias ablation in congenital heart disease

Nicolas Combes
ncombes@clinique-pasteur.com

CLINIQUE Pasteur

Département de rythmologie
et de stimulation cardiaque

Pôle de cardiologie pédiatrique
et congénitale

Marie Lannelongue

Conflict of interest

- Consultant : Meda Pharma, Medtronic, Microport.
- Clinical studies : Biotronik, Boston Scientific, Medtronic, Zoll

CHD associated with ventricular arrhythmias

Relative Risk for Specific Arrhythmias in Common Congenital Heart Defects

	IART	AF	WPW	VT/SCD	SA Node Dysfunction	Spontaneous AV Block	Traumatic AV Block
VSD	+			+			+
ASD	+	+					
TOF	++			++			+
AS		+		++			+
D-TGA (M&S)	+++			++	+++		
CAVC	+					+	++
SING V (F)	+++	+		+	+++		
L-TGA	+		++	+		++	+++
Ebstein's anomaly	++		+++	+			

AF indicates atrial fibrillation; WPW, Wolff-Parkinson-White syndrome; SCD, sudden cardiac death; SA, sinoatrial; VSD, ventricular septal defect; ASD, atrial septal defect; TOF, tetralogy of Fallot; AS, aortic stenosis; M&S, after the Mustard or Senning operation; CAVC, common AV canal defect; SING V (F), single ventricle after the Fontan operation; +++, high risk; ++, moderate risk; and +, slight risk.

Walsh EP *Circulation* 2007;115:3224

Specific ventricular arrhythmias in CHD

Macroreentrant monomorphic VT secondary to developmental and surgical abnormalities within ventricular muscle that create corridors of slow conduction:

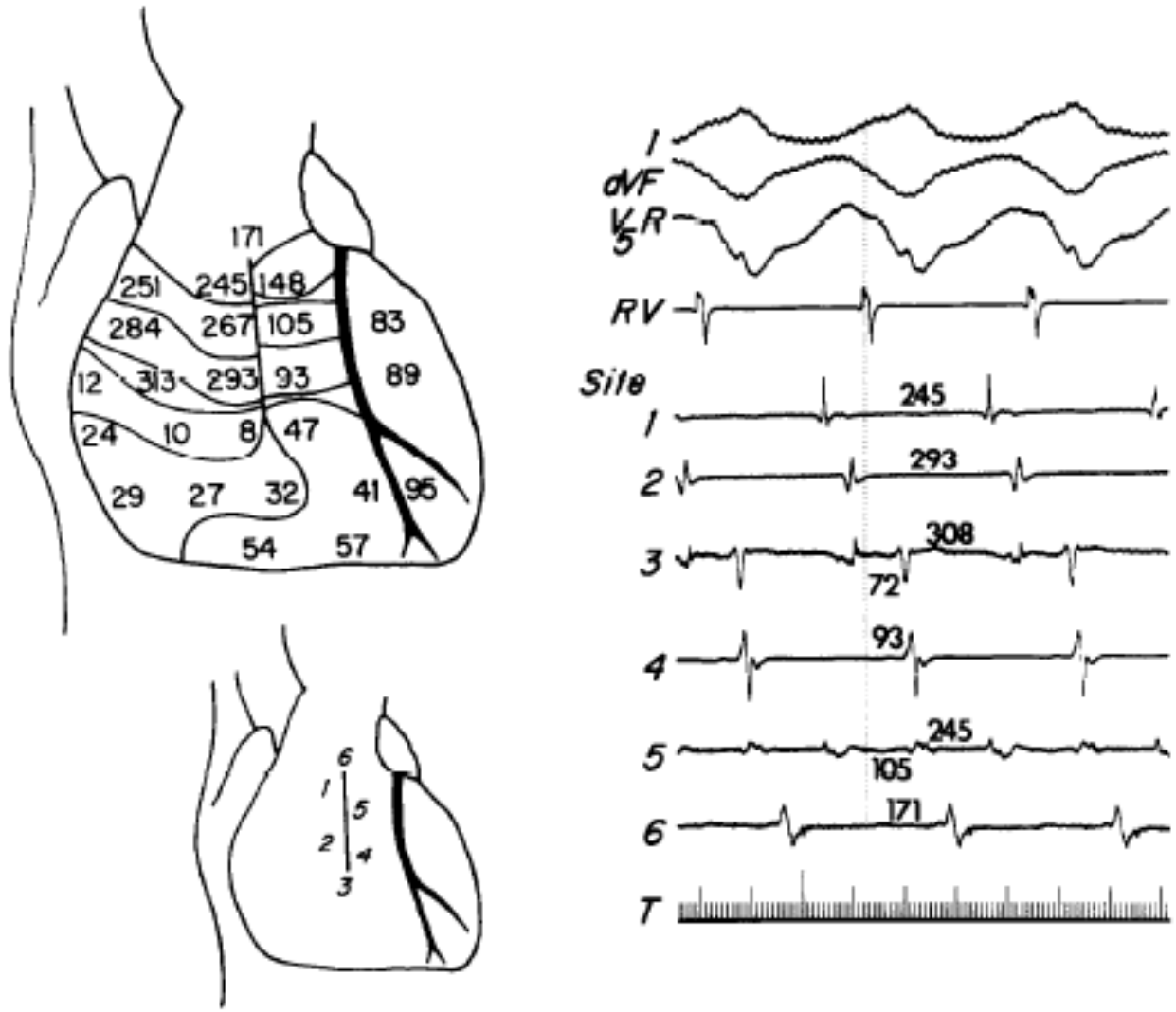
- Tetralogy of Fallot +++
- Ventricular septal defect after surgery
- Ebstein anomaly

Polymorphic VT and VF with diffuse abnormal myocardium (Long-standing Pressure and volume loads, cyanosis):

- Congenital aortic outflow tract obstruction
- Transposition of great arteries with atrial switch
- Tetralogy of Fallot with advanced ventricular dysfunction
- unrepared ventricular septal defect with Eisenmenger physiology
- palliated single ventricle

Substrate for monomorphic VT in CHD: scar related

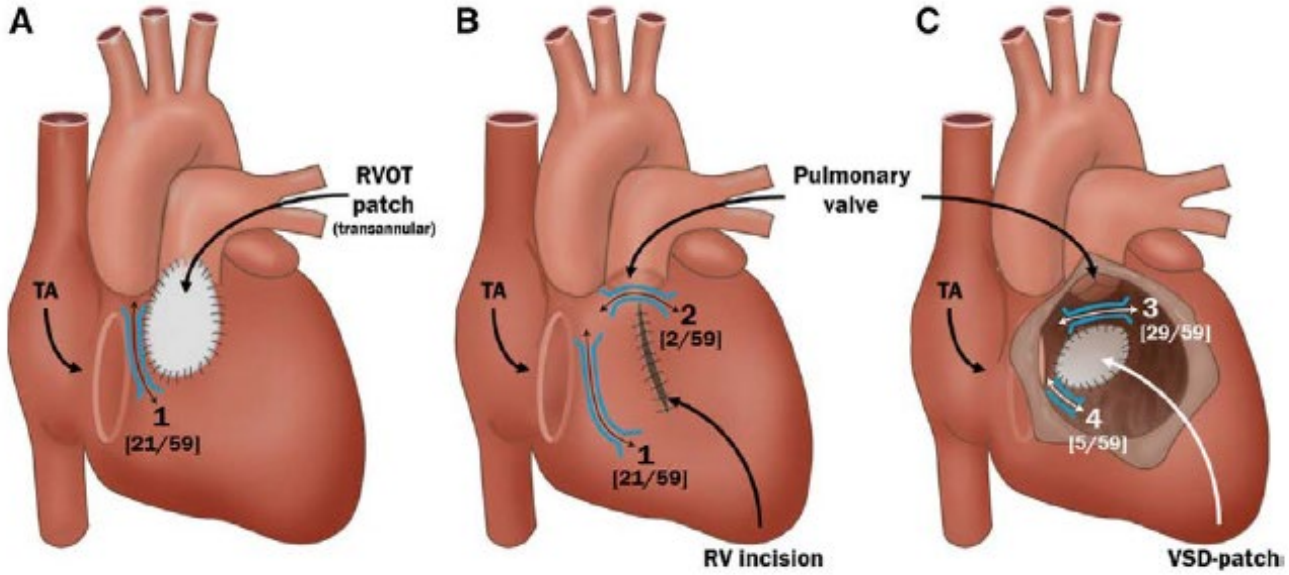
Horowitz L et al. Am J Cardiol 1980;46:446-452

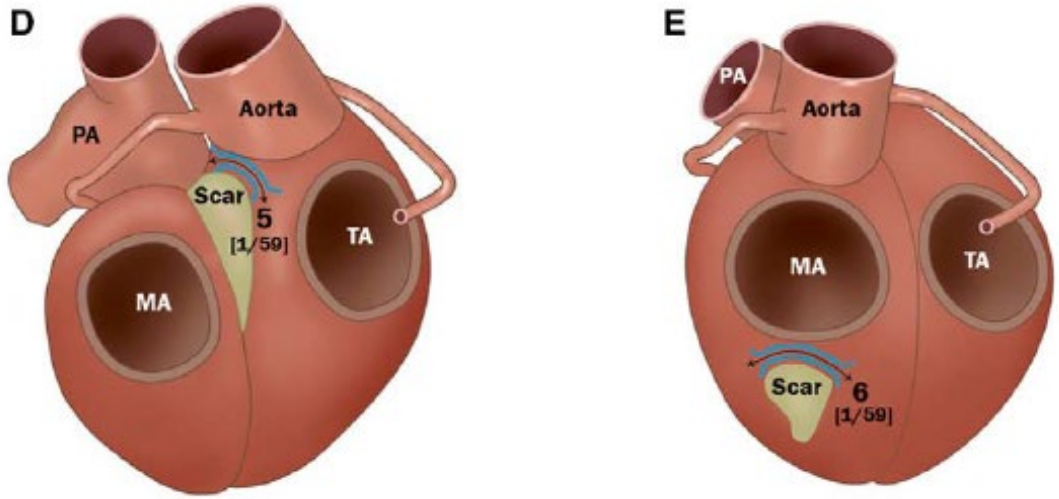


Reentry with right ventricular scar in a TOF patient

Location of critical VT isthmus?

Back to cardiopathy and cardiac surgeries

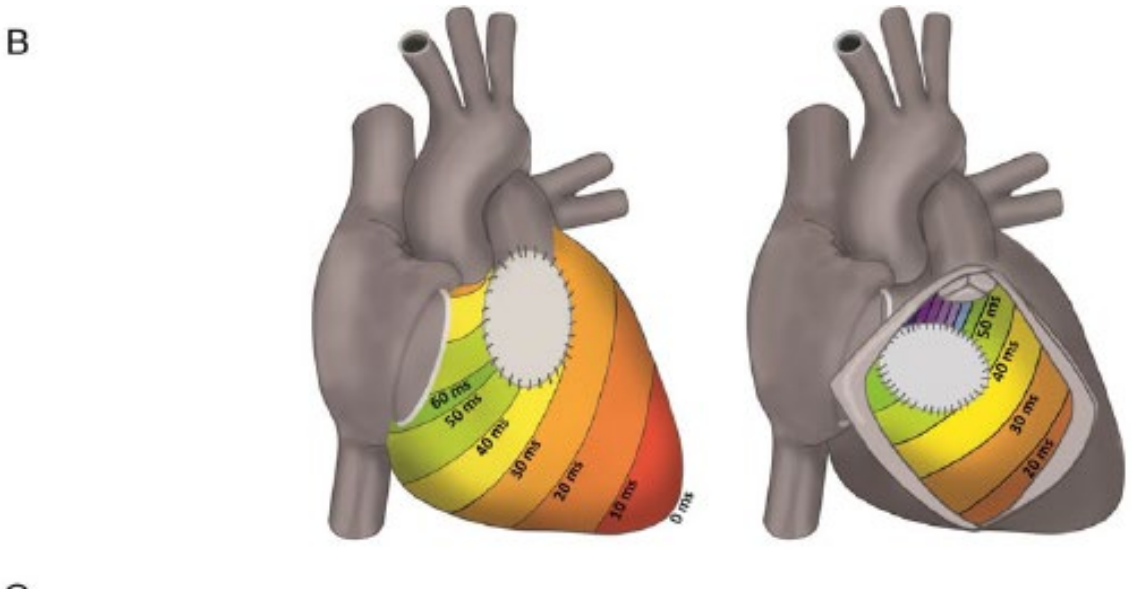




+++ position of the conal septum in TOF

Zappenfeld K et al. Circulation 2007;116:2241-2252
Kapel GF et al. Circ Arrhythm Electrophysiol 2015;8:102-109

Location of critical VT isthmus?



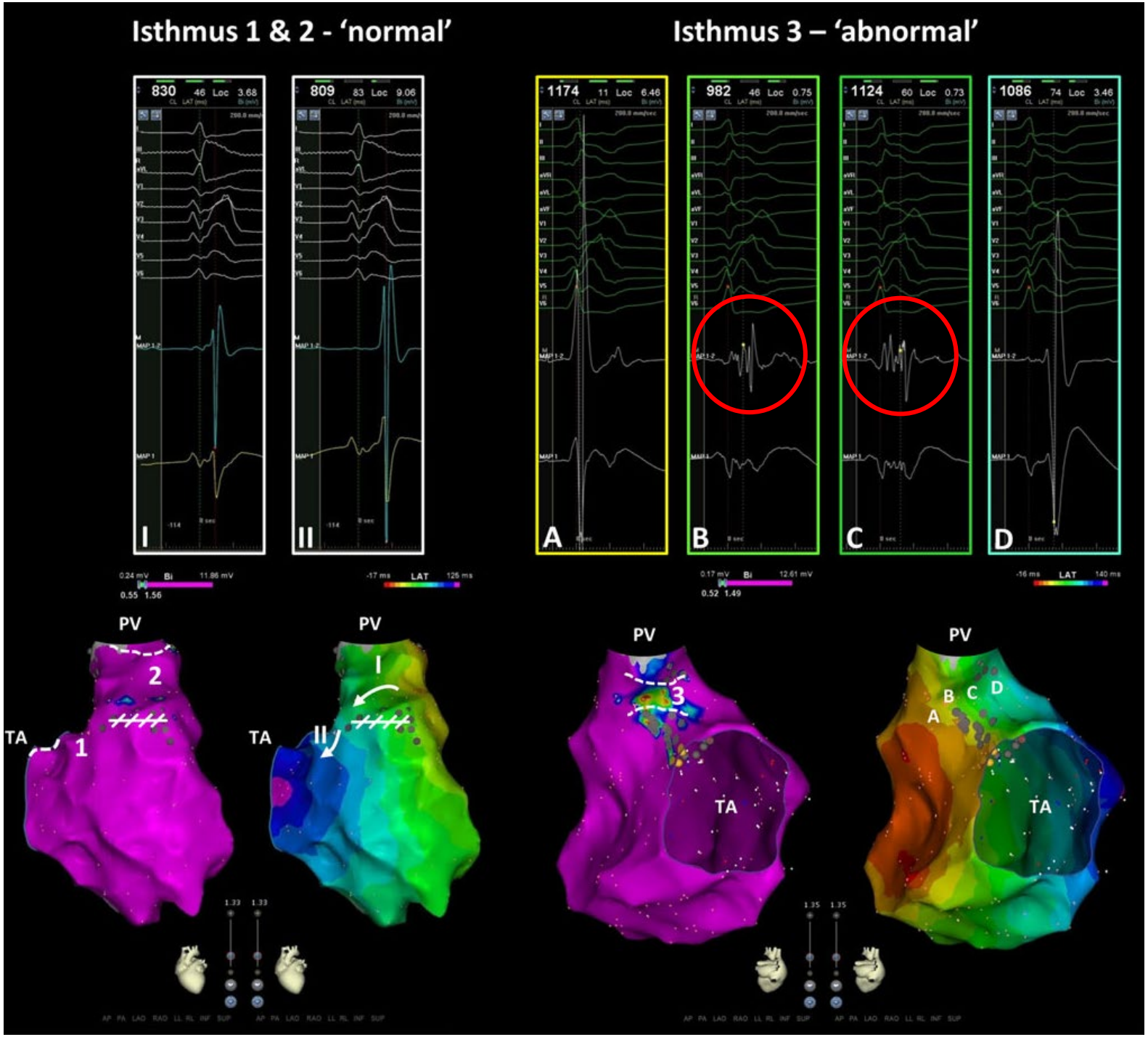
TOF patients isthmuses with monomorphic VT

Longer: 22+/-7 vs 16+/7 mm p=0.001

Narrower: 20+/-8 vs 28+/-11 mm p<0.001

Lower Conduction Velocity Index:
0.36+/-0.34 vs 0.78+/-0.24 m/s

Kappel GF et al. Eur Heart J 2016

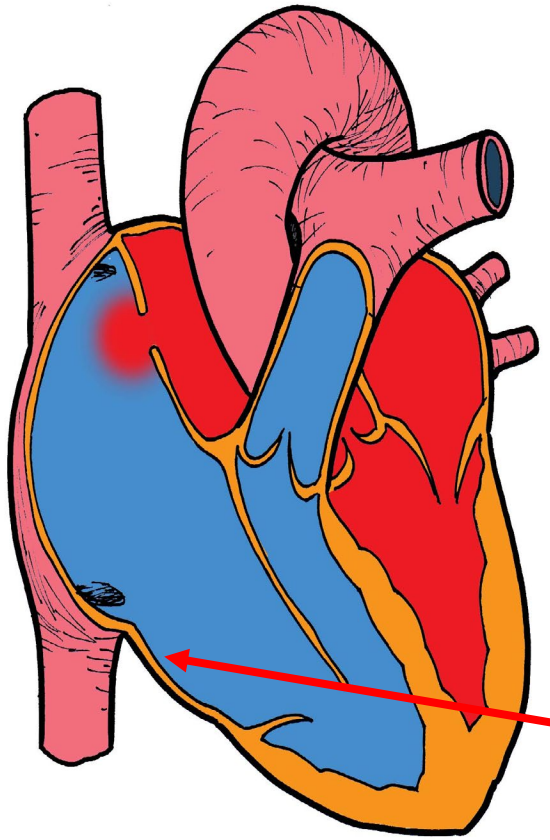


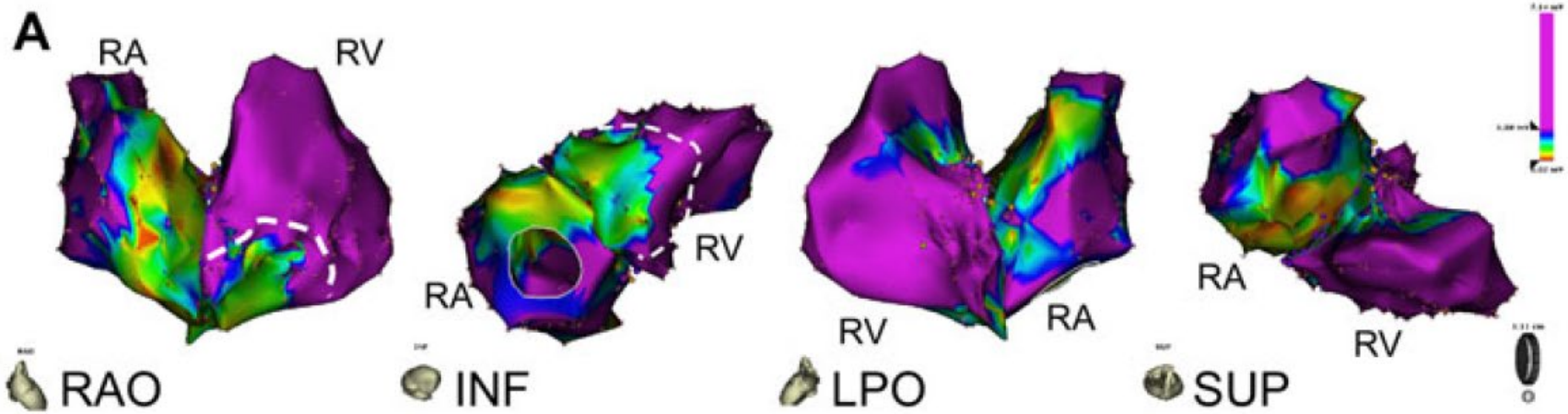
Slow conducting isthmus with abnormal local electrogram in sinus rhythm

Kappel GF et al. Eur Heart J 2016

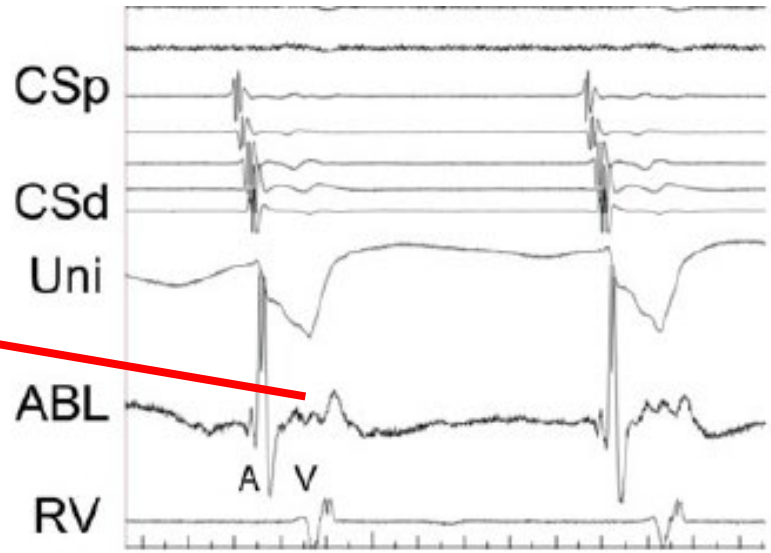
Monomorphic VT substrate in Ebstein's anomaly

Abnormal ventricular voltage in atrialized right ventricle





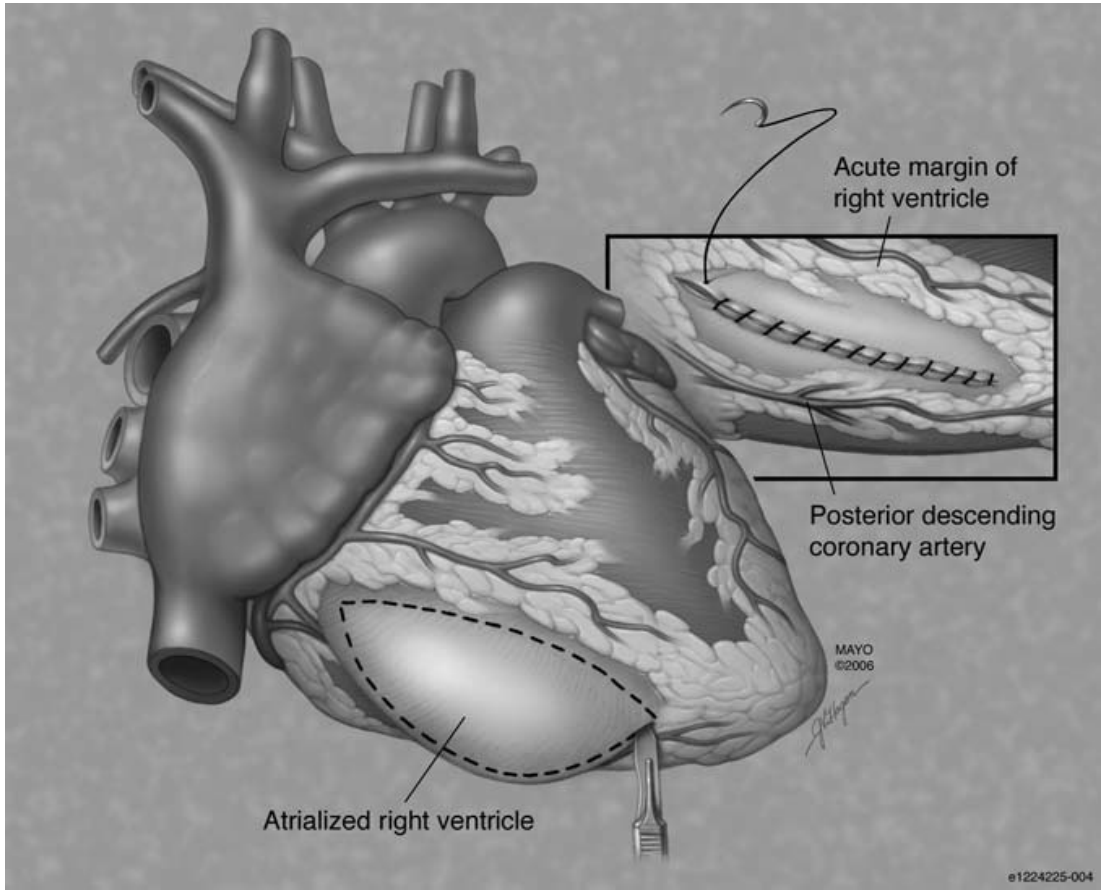
Guo XJ et al. J Cardiovasc Electrophysiol 2015;26:404

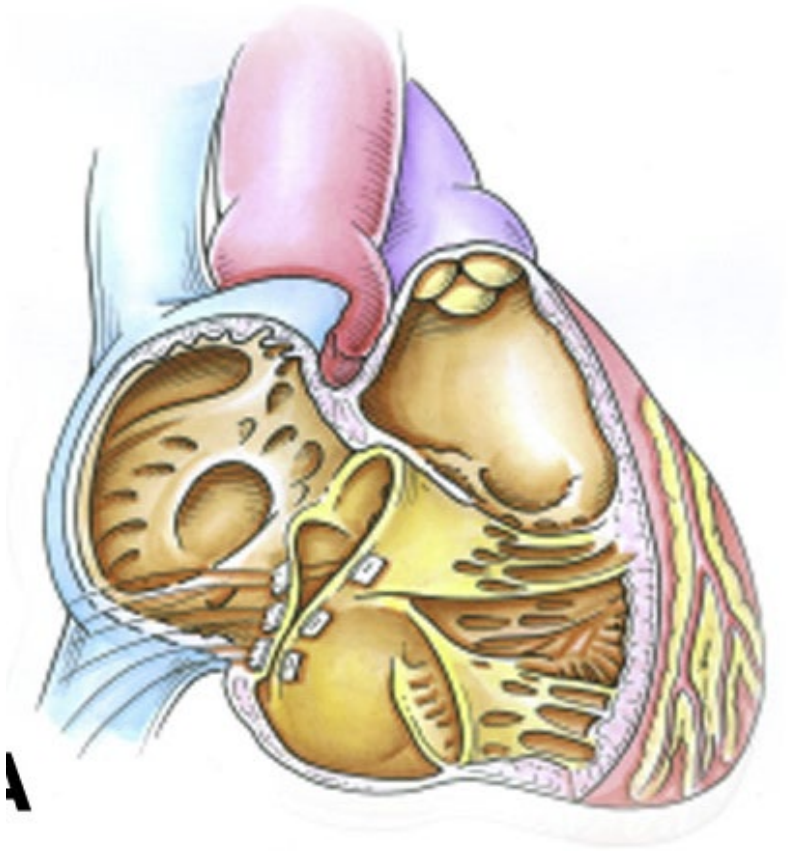


Monomorphic VT substrate in Ebstein's anomaly

After surgery: right ventricle plasty with excision or plicature of the atrialized chamber

Important difficulties to reach the substrate with percutaneous access.



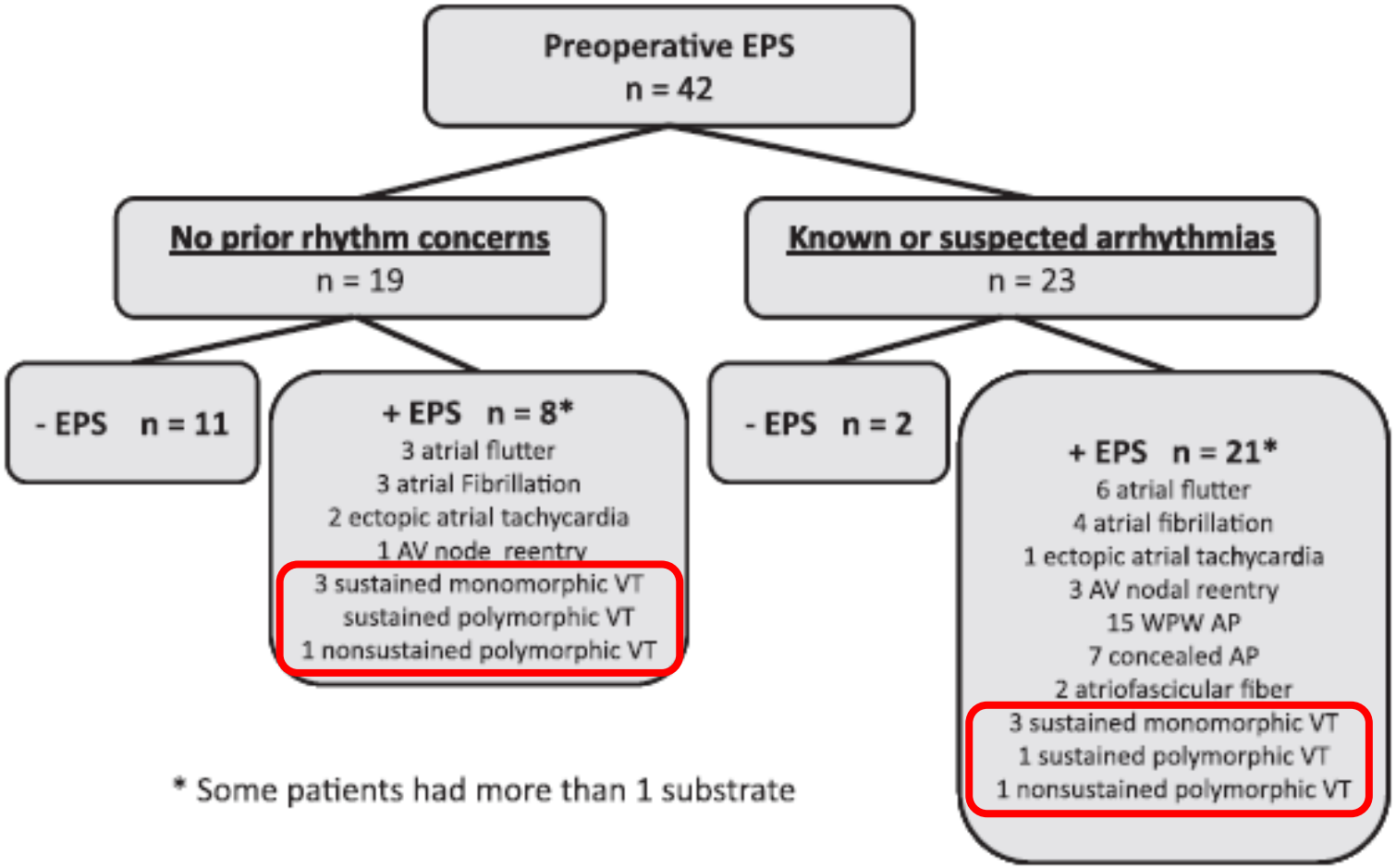


Dearani J et al. Cardol Young 2006;16:12-20

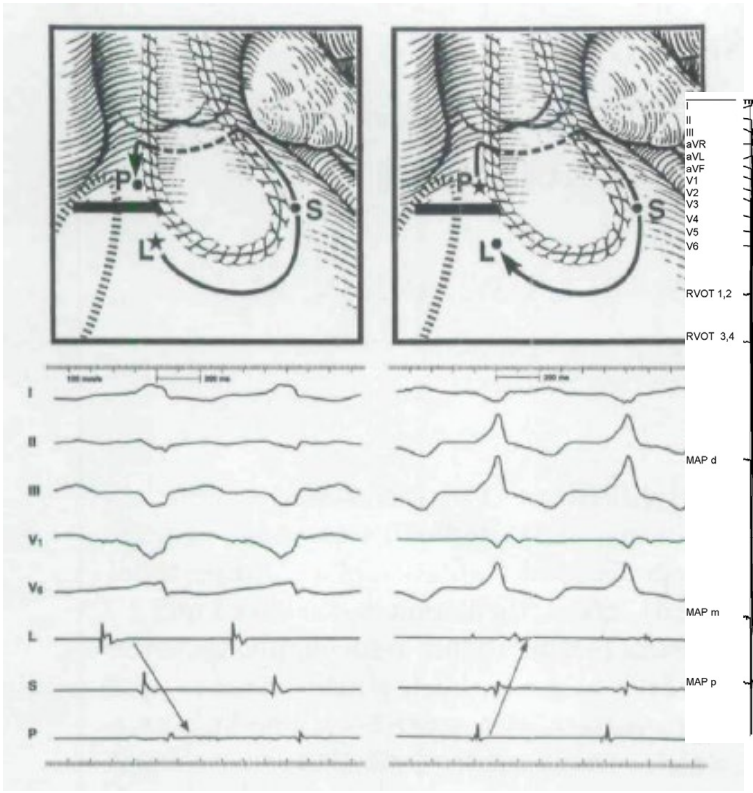
Monomorphic VT substrate in Ebstein's anomaly

Preoperative evaluation +++ / ablation

Shivapour JK et al. Heart rhythm 2004;11:182-86

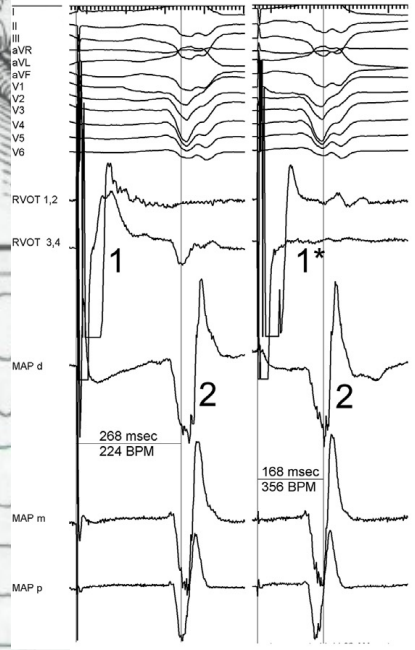


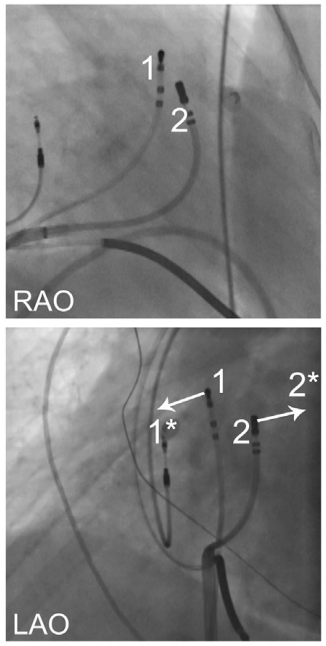
After interruption of VT during ablation, validation of isthmus block is needed

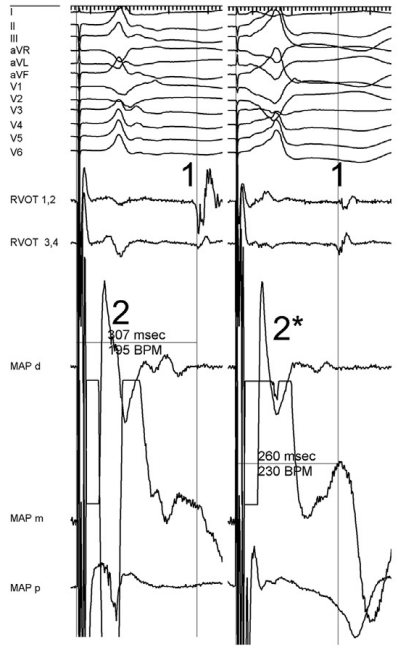


Horton RP et al.
J Cardiovasc Electrophysiol
1997;8:432-435

By pacing

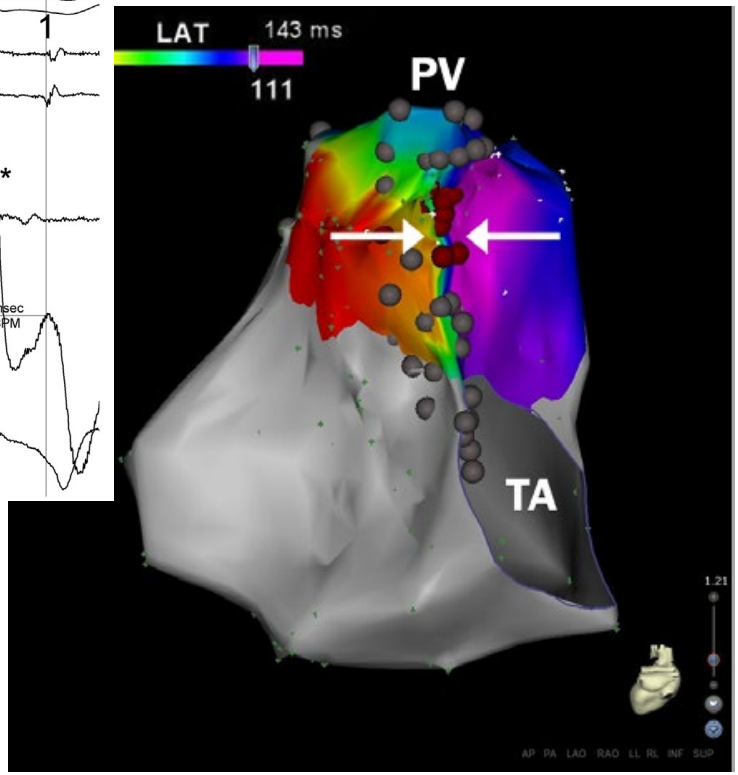






Zeppenfeld K et al.
Card Electrophysiol Clin 2018

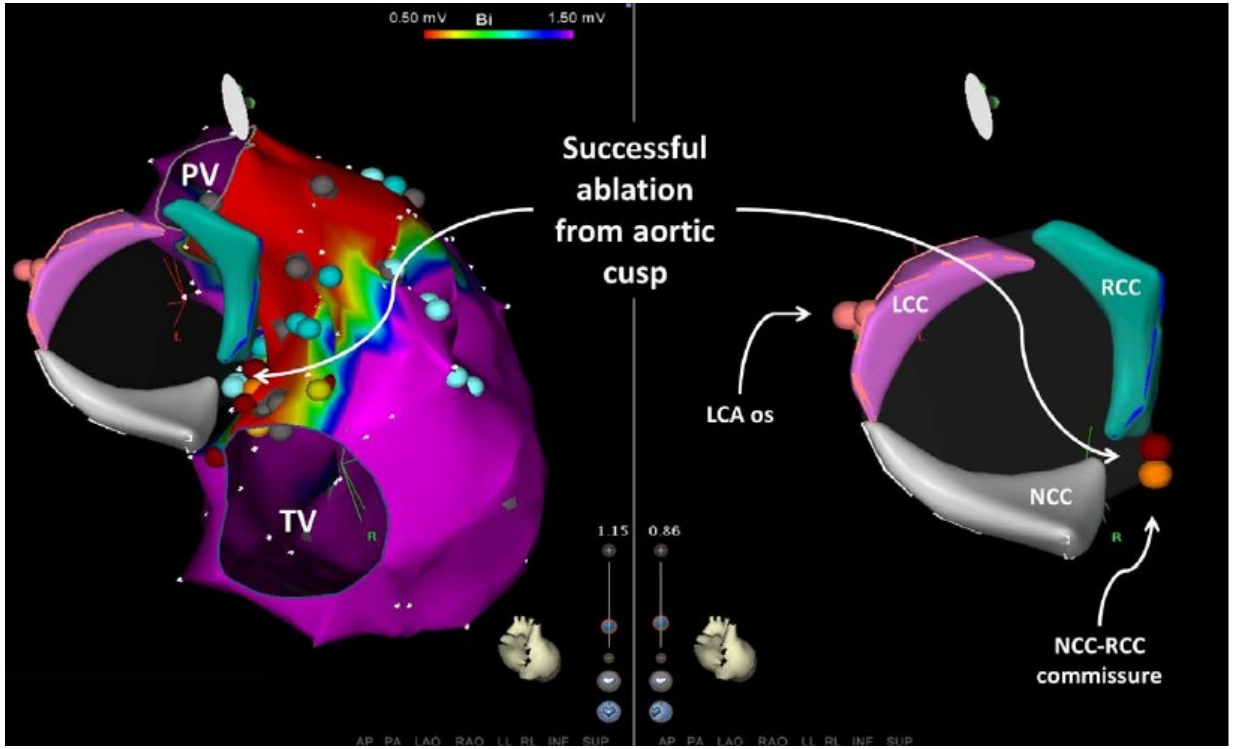
By 3D activation mapping



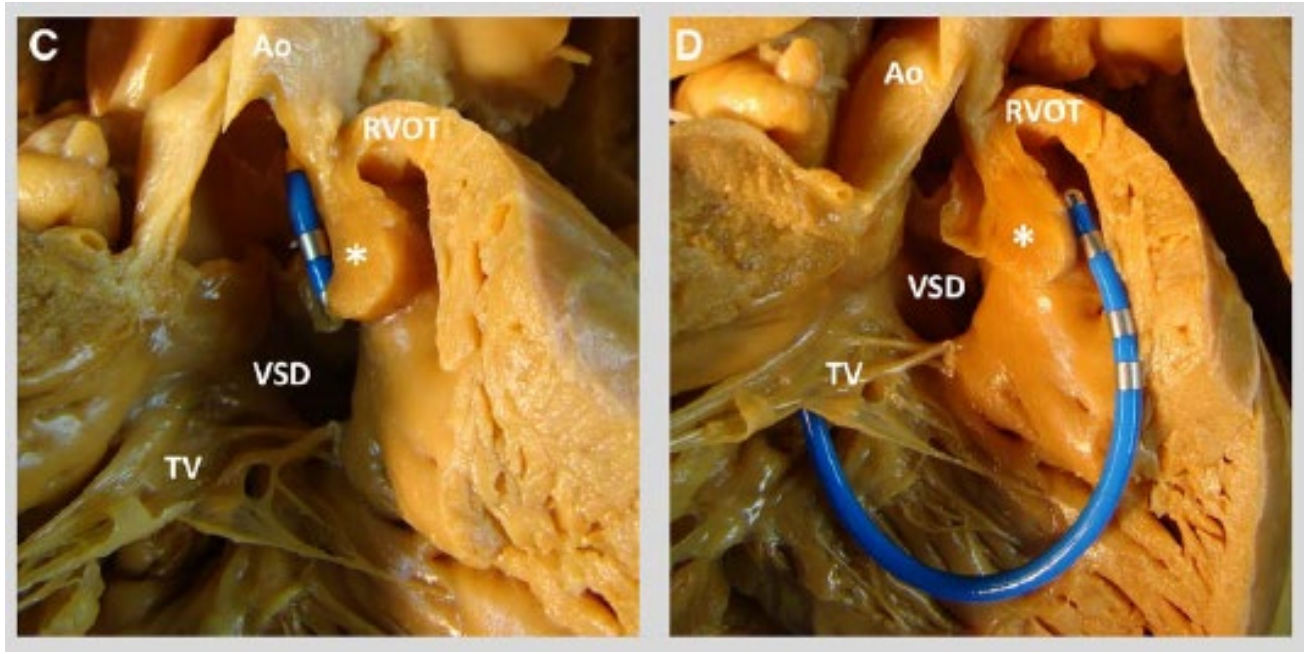
Kapel GF et al.
Circ Arrhythm Electrophysiol
2015;8:102-109

Causes of percutaneous ablation failure

Think about left side in right ventricular tachycardias

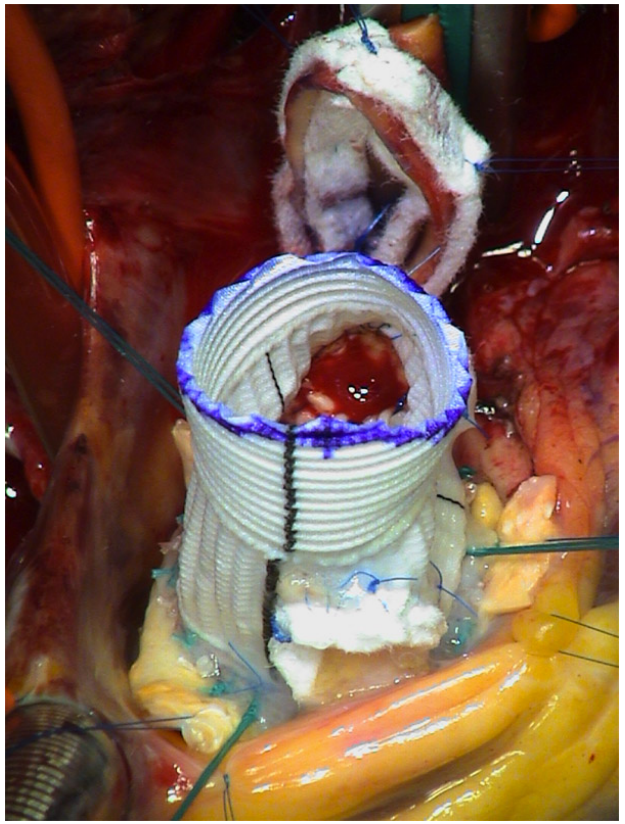


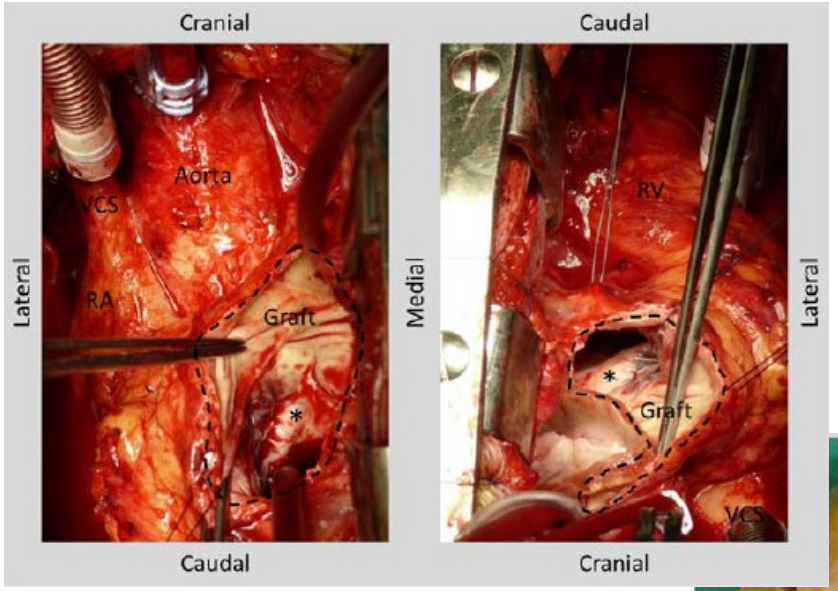
Kapel GF et al. *Circ Arrhythm Electrophysiol* 2014;7:889



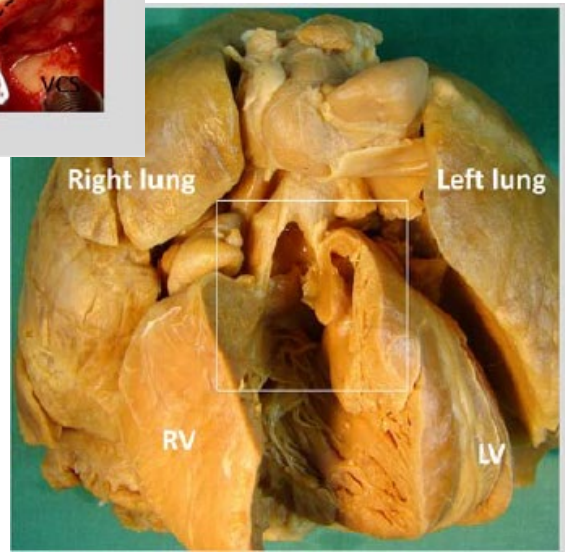
Causes of percutaneous ablation failure

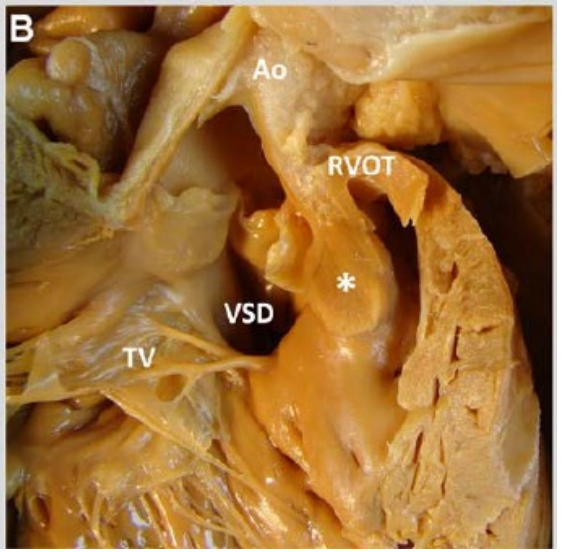
Valvular prosthesis / homografts





Kapel GF et al. *Circ Arrhythm elctrophysiol* 2014;7:889

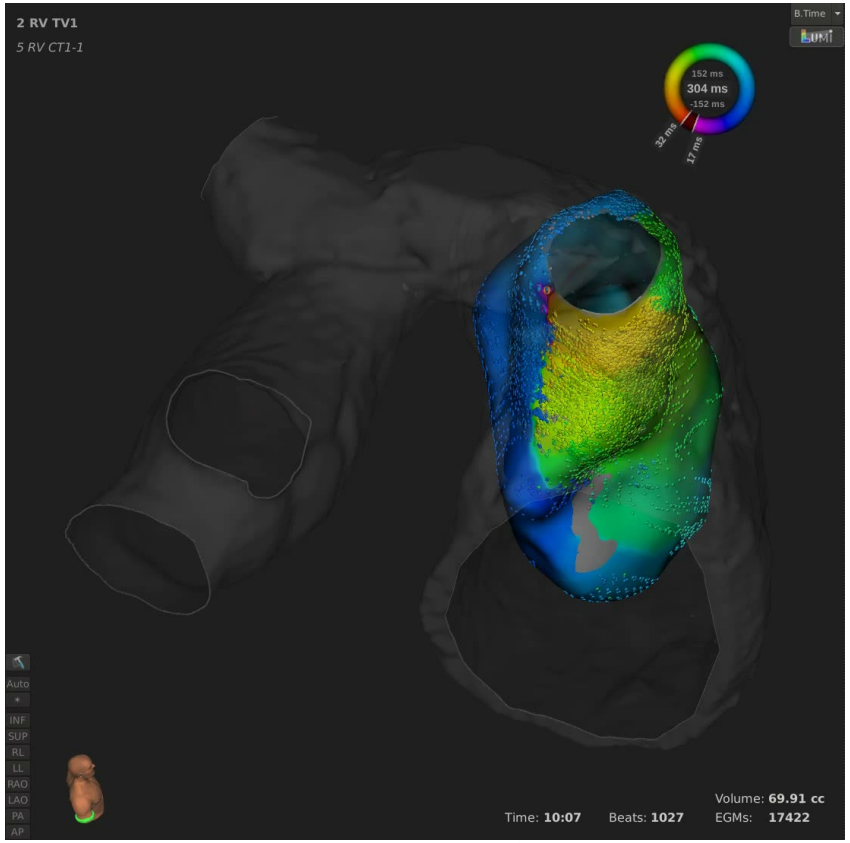


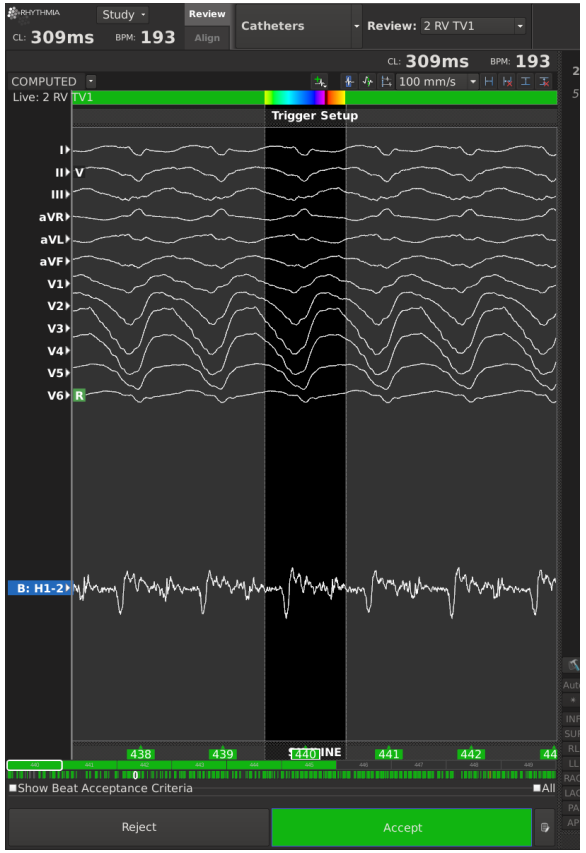


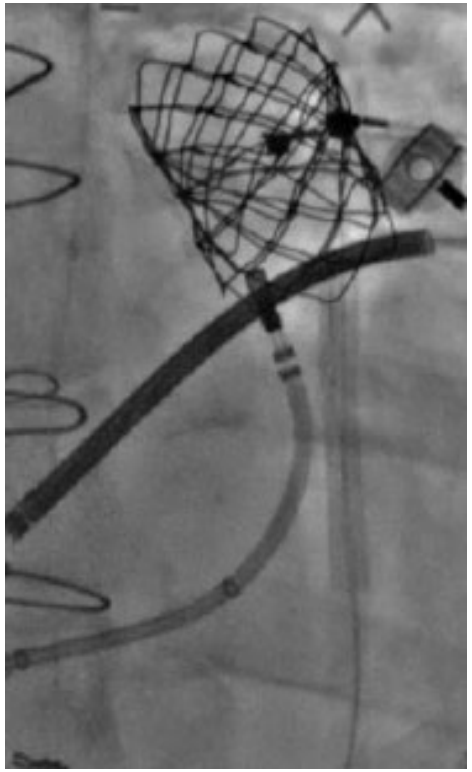
Conduction tissu proximity
Local Hypertrophy, calcifications / epicardial source
Access to cardiac chamber of interest

Causes of percutaneous ablation failure

Caution with percutaneous pulmonary valves with possible arrhythmia « protected isthmus »



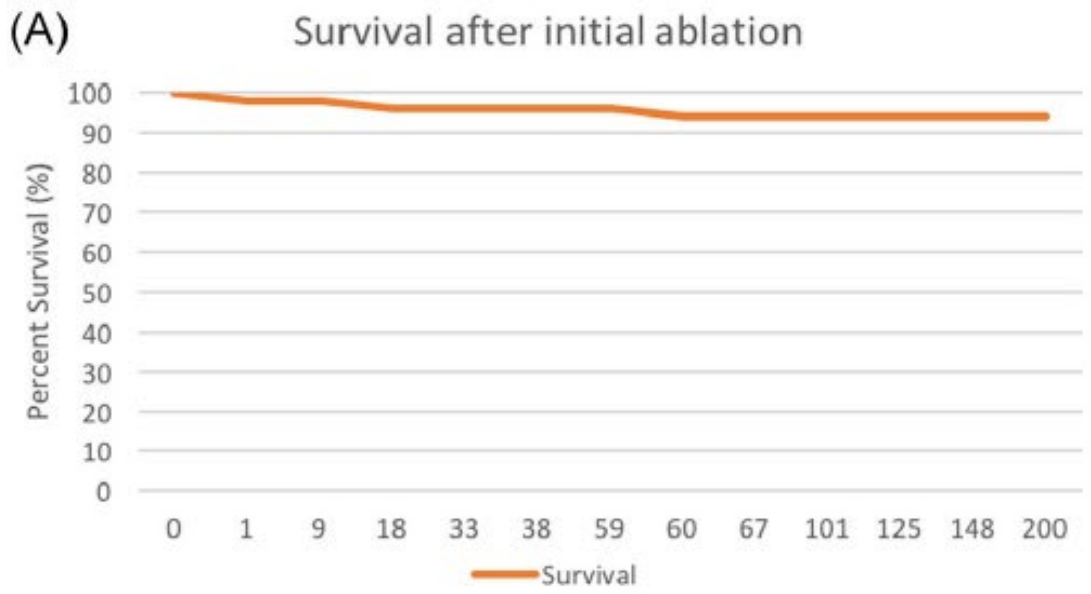


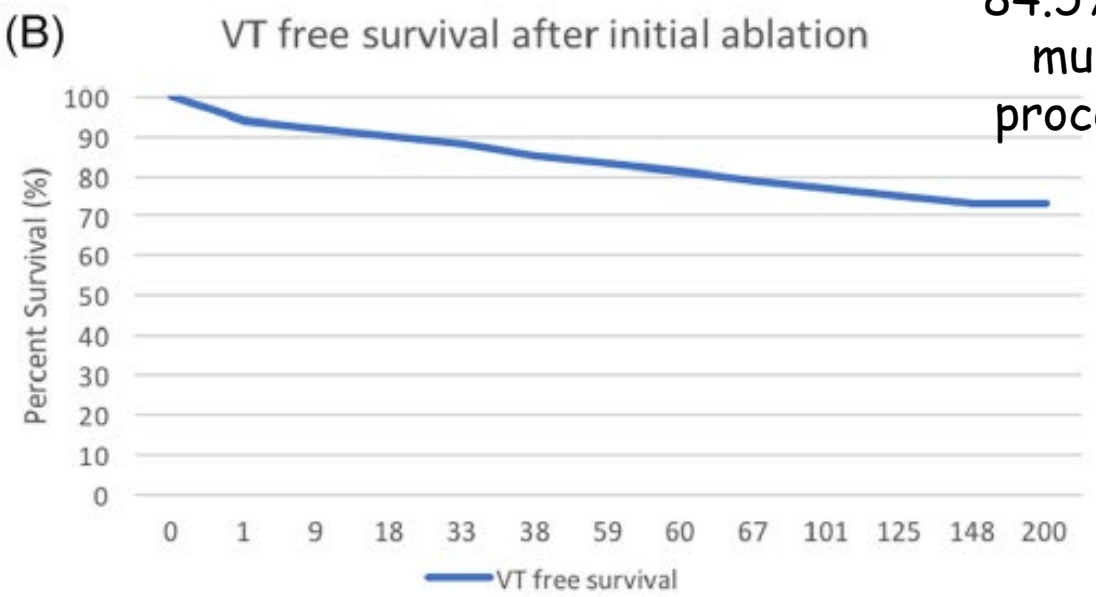


Combes N. et al. Eur Heart J 2019;epub

Discussion of arrhythmia evaluation before surgery in adults ++

Good results in long term follow up in tertiary centers





84.5% after multiple procedures

Yang J et al. *J Cardiovasc Electrophysiol* 2019;30:1560

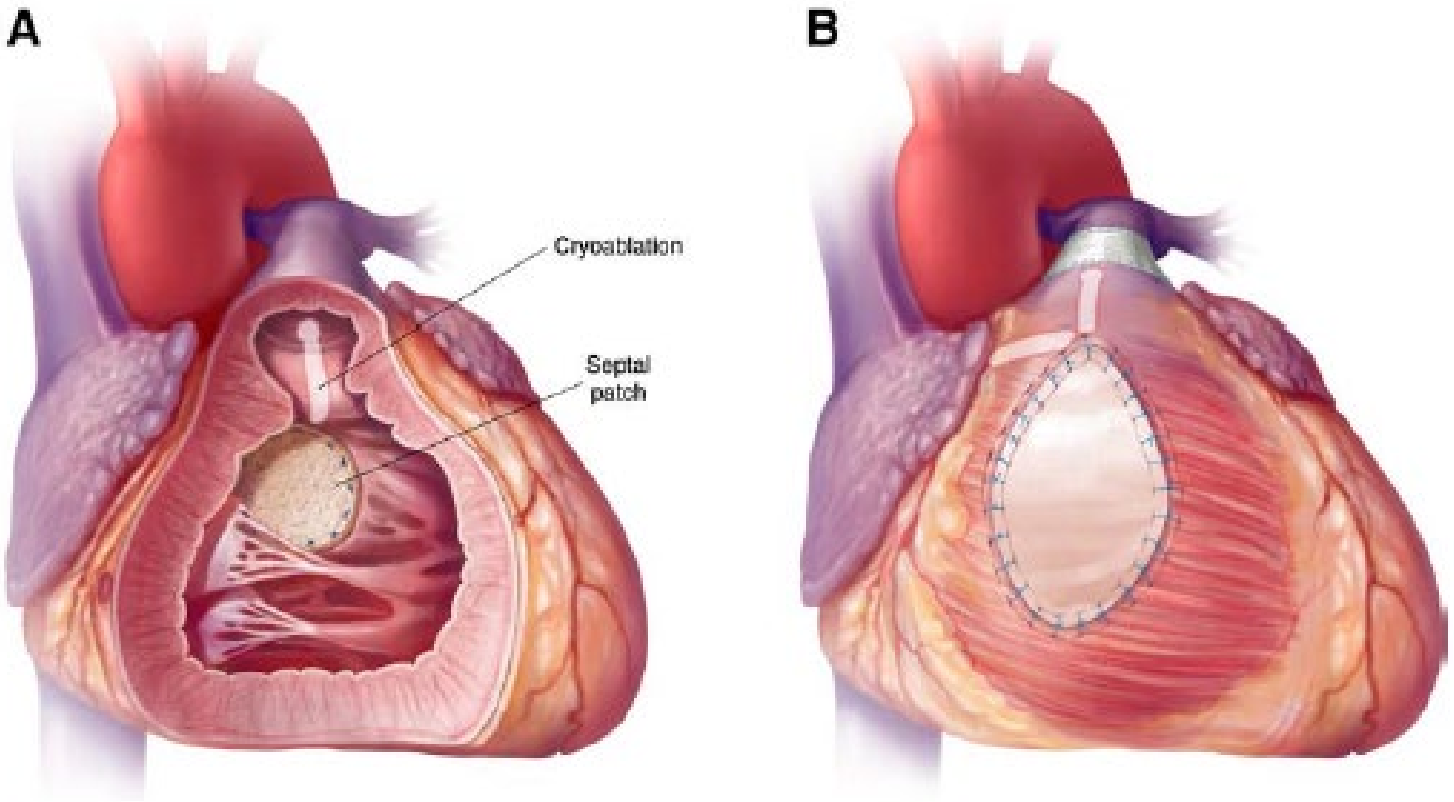
Global acute success rate 90% with 10 to 20% of recurrences at 2 years, complication rate 2%

Gonska BD et al. Circulation 1996;94:1902-8
Morwood JG et al. Heart Rhythm 2004;1:301-8
Zeppenfeld K et al. Circulation 2007;116:2241-52
Kriebel T et al. Am Coll Cardiol 2007;50:2162-68
Schneider HE et al. J Cardiovasc Electrophysiol 2012;23:930-37
Kappel GF et al. Circ Arrhythm Electrophysiol 2015;8:102-9
Van Zyl M et al. Heart Rhythm 2016;13:1449
Larredo M et al. Arch Cardiovasc Dis 2017;110:292

Indications for surgical ablations

Few datas

In case of pulmonary valve replacement +++ but no systematic
(possibly pro arrhythmic if isthmus block is incomplete)
+++ EPS guided in selected patients with selected isthmus



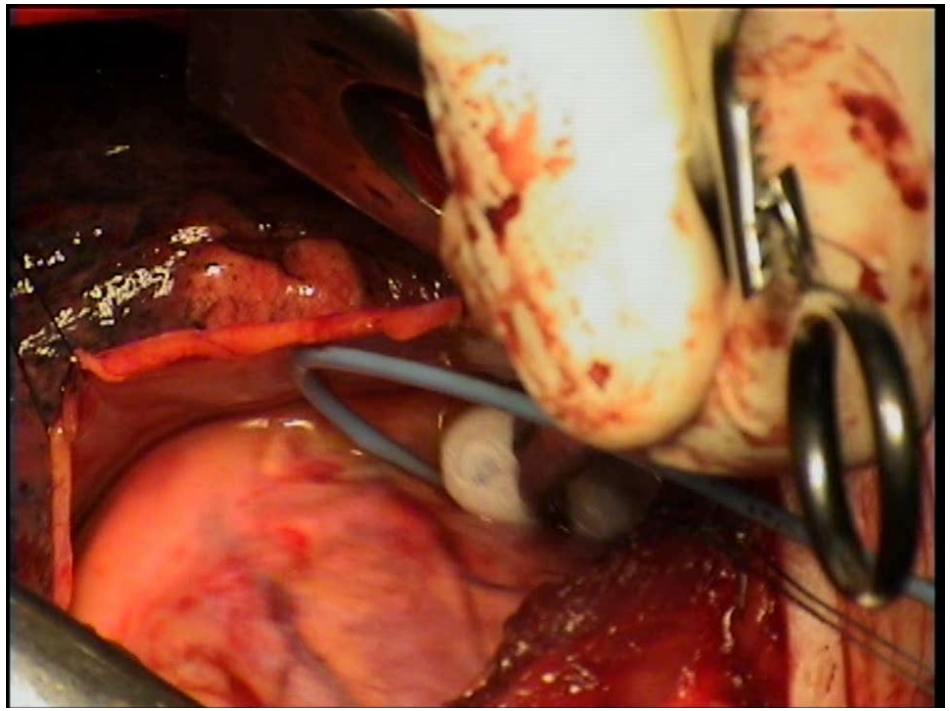
Cryoablation lines +++

Rotes AS et al. Circ Arrhythm Electrophysiol 2015;8:110-16

Indications for surgical ablations

In cases of percutaneous failure and refractory symptomatic VTs

- Resections of anevrysms/patches (infundibular ++)
- Surgical lesions guided by EPS
- Focal/linear epicardial ablation with intraoperative mapping during VT



Indication for VT ablation in CHD

Khairy P et al. HeartRhythm 2014;11(10):e102-65

Classe I	Level C	Catheter ablation is indicated as adjunctive ther… ICD in adults with CHD, recurrent monomorphic ventricular … ltiple appropriated shocks that are not manage… r drug therapy
Classe IIa	Level B	… d monomorphic … native to drug
Classe IIa	Level C	…asonable in adults with CHD and frequent …associated with detoriating ventricular function
Classe III	Level C	Catheter ablation alone is not considered appropriate prophylactic therapy in adults with CHD deemed to be at increase risk for sudden cardiac death

Guidelines too restrictives for VT ablation with recent datas. A neeed for more agressive treatment in dedicated multidisciplinary teams

In patients with monomorphic reentrant VT with good right and left function and criteria for complete isthmus ablation, first line therapy without ICD ?

Conclusion

Most ventricular arrhythmias in CHD patients are reentrant.

Ablation in CHD is feasible with a good success rate and a low complication rate.

Ablation planning is crucial for good result with evaluation of haemodynamic status, review of surgical datas, check for substrate access, check for adapted tools (sheaths, guidewires, large ablation catheter curve, 3D mapping…).

Muldisciplinary team involved in CHD is mandatory for optimal management.