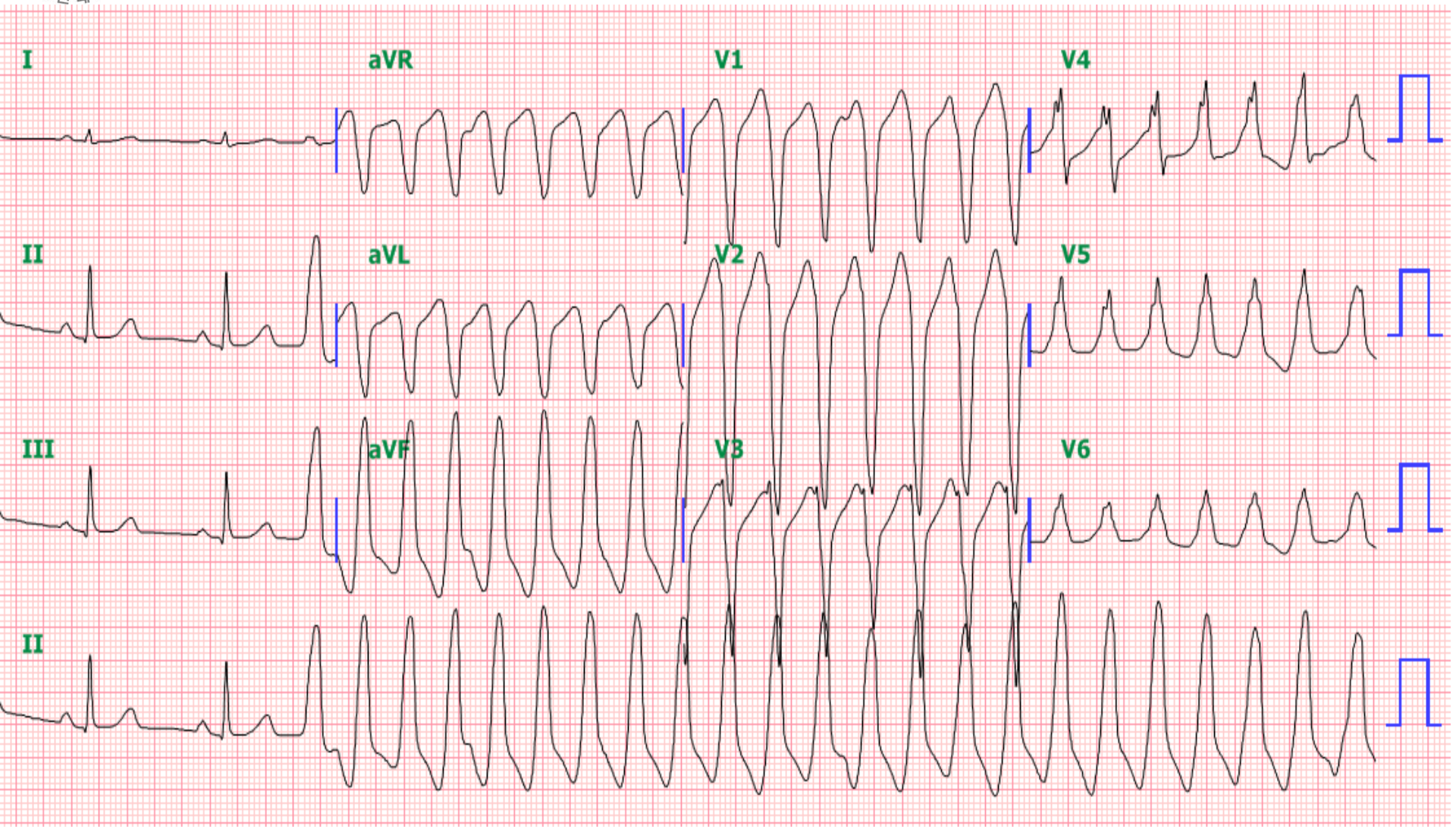
Outflow VT

온 영 근
삼성서울병원
성균관의대

Case

- Female/ 51 year-old
- Palpitation for 2 years
- Symptomatic VPCs and NSVT with beta blocker

- Echo: No RWMA,
  Relaxation abnormality of LV,
  LVEF 73%


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II

RVOT/LVOT Tachycardia

- Ages of **30~50 yrs**
- More frequent in **women**
- LBBB-like complex with tall R-waves in the inferior leads.
- 70~90% of VT patients with a **structurally normal heart**.
- Arrhythmia episodes

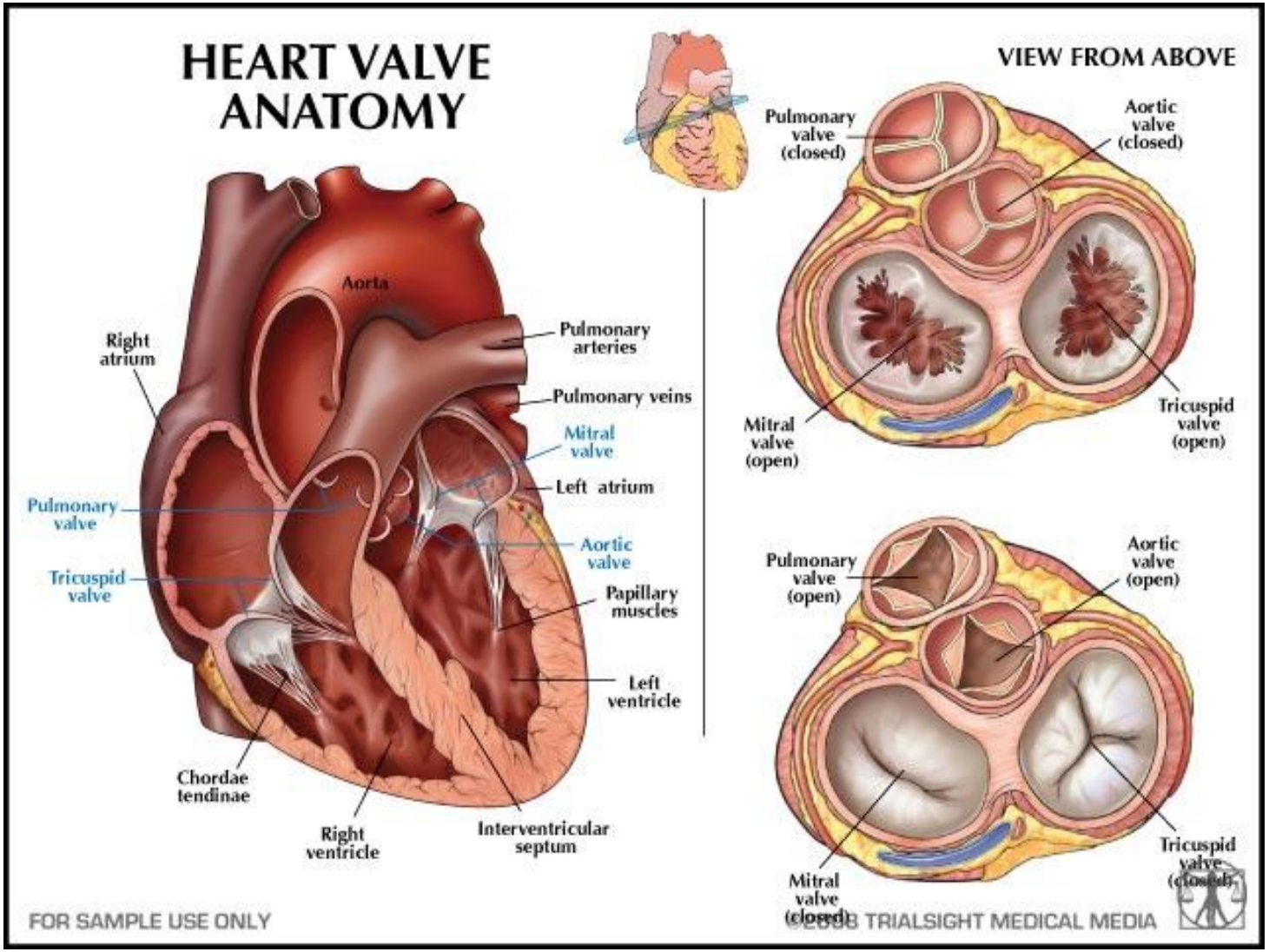
  : rare or frequent isolated **PVCs**, bursts of **nonsustained VT**, or sustained **tachycardia** often facilitated by catecholamines.

  : exercise/emotion induced

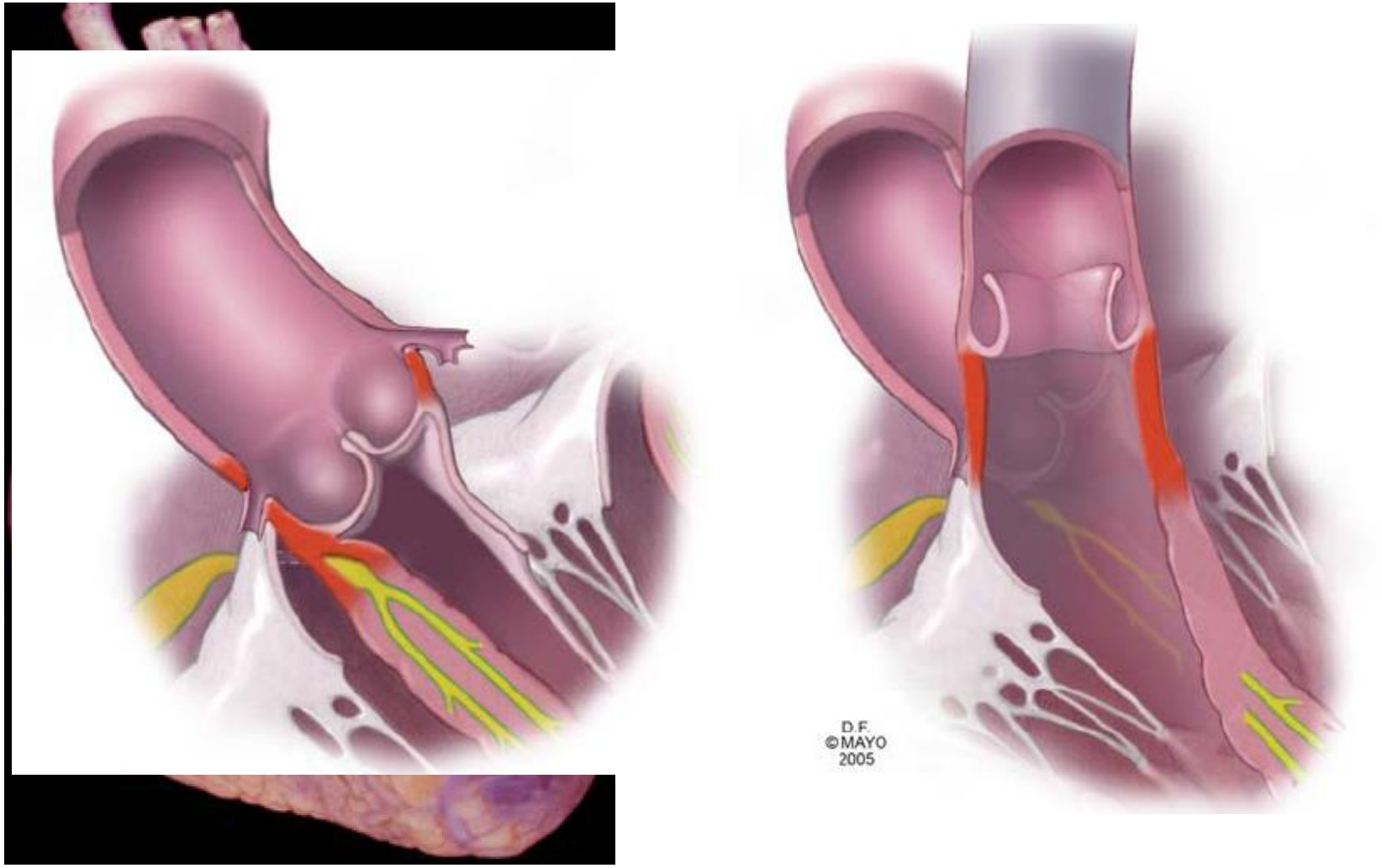
RVOT/LVOT Tachycardia

- Symptoms: ranging from none to palpitations, lightheadedness, dyspnea, presyncope, or syncope.
- Prognosis is almost **benign**
- A *malignant variant* : relatively *early triggered beats* in the vulnerable period of the repolarization phase resulted in VF.

Correlative Anatomy of Outflow Tract

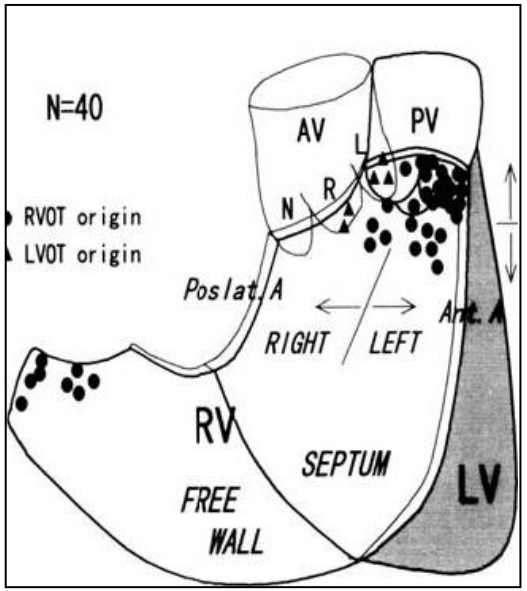


Ventricular Outflow Tract Tachycardia



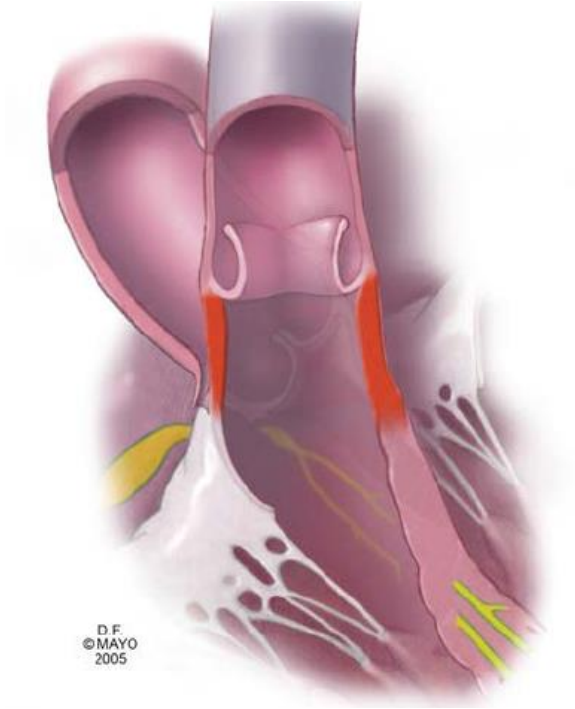
ECG recognition of outflow tract tachycardia location

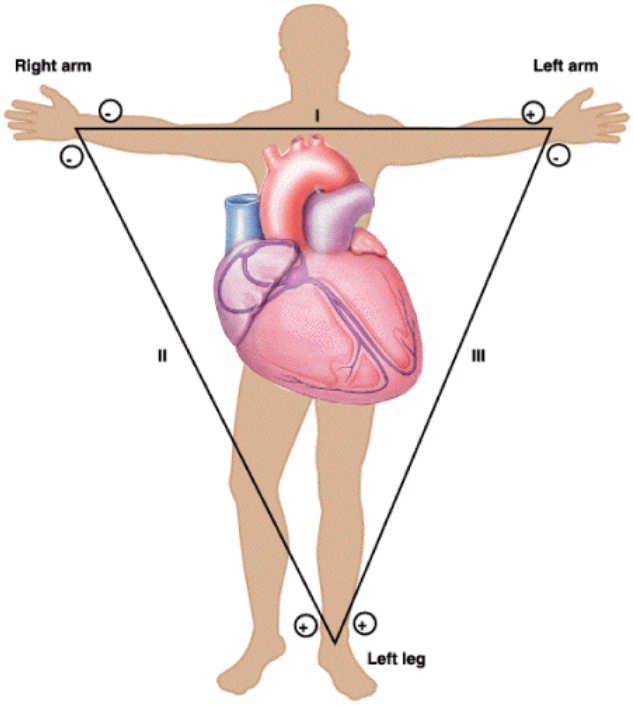
- Frontal plane axis
- Precordial QRS transition
- QRS width
- Complexity of the QRS in the inferior leads



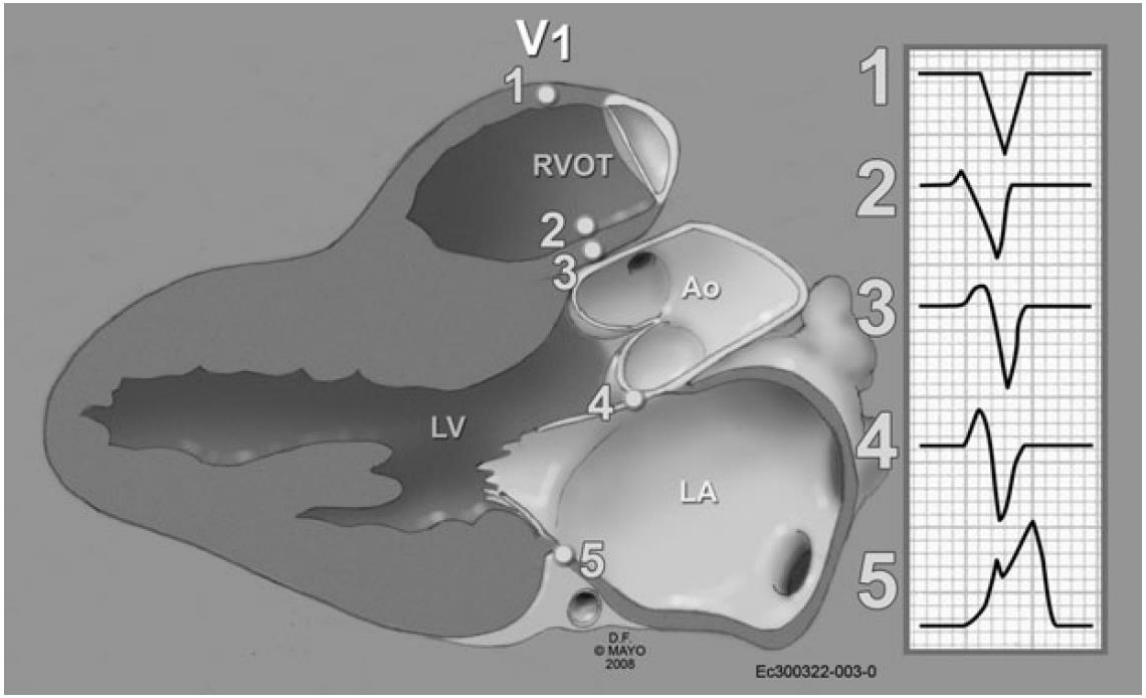
Leads II, III, and aVF

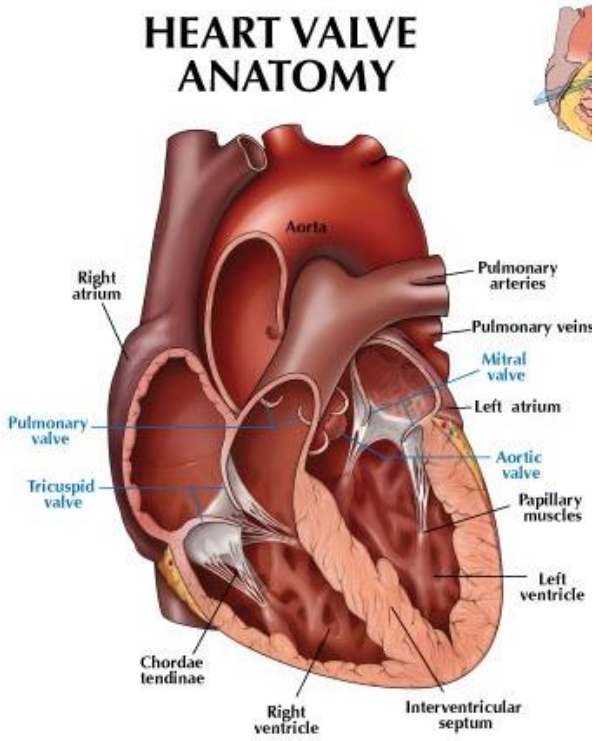
- All **outflow tract arrhythmias** show a positive deflection in leads II, III, aVF.
- The ratio of positivity (R-wave amplitude) : a clue to the site of origin.
- **Suprapulmonary** valve arrhythmia : a taller R wave in **lead III** than in II.
  (the anatomic leftward location of the PV and lead III being an inferior and rightward lead)





R wave in lead V1 : clue to the potential anatomic **sites of origin**



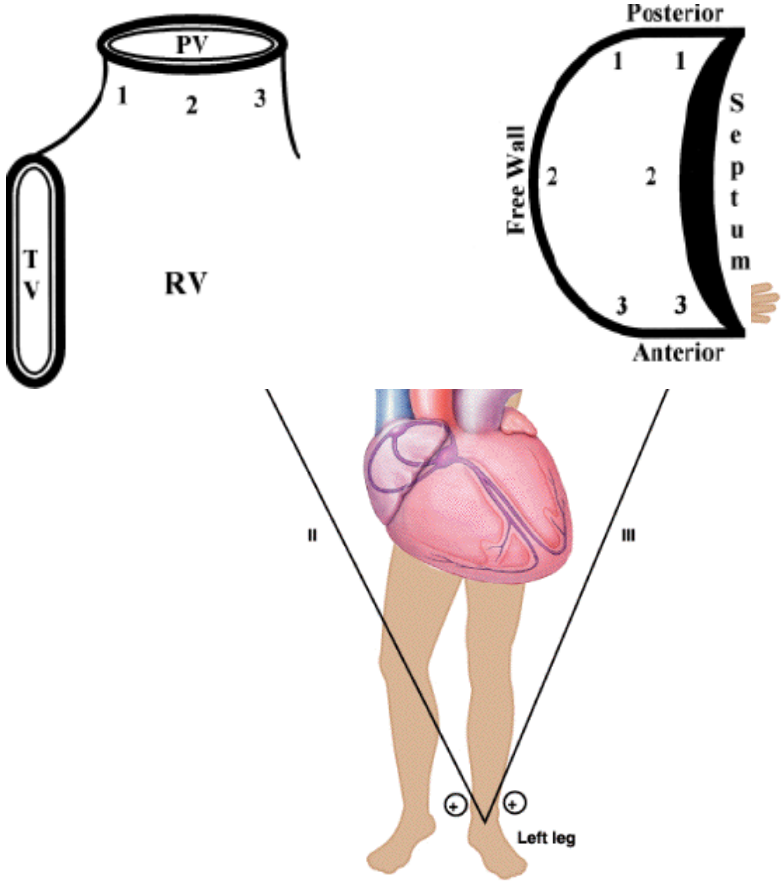


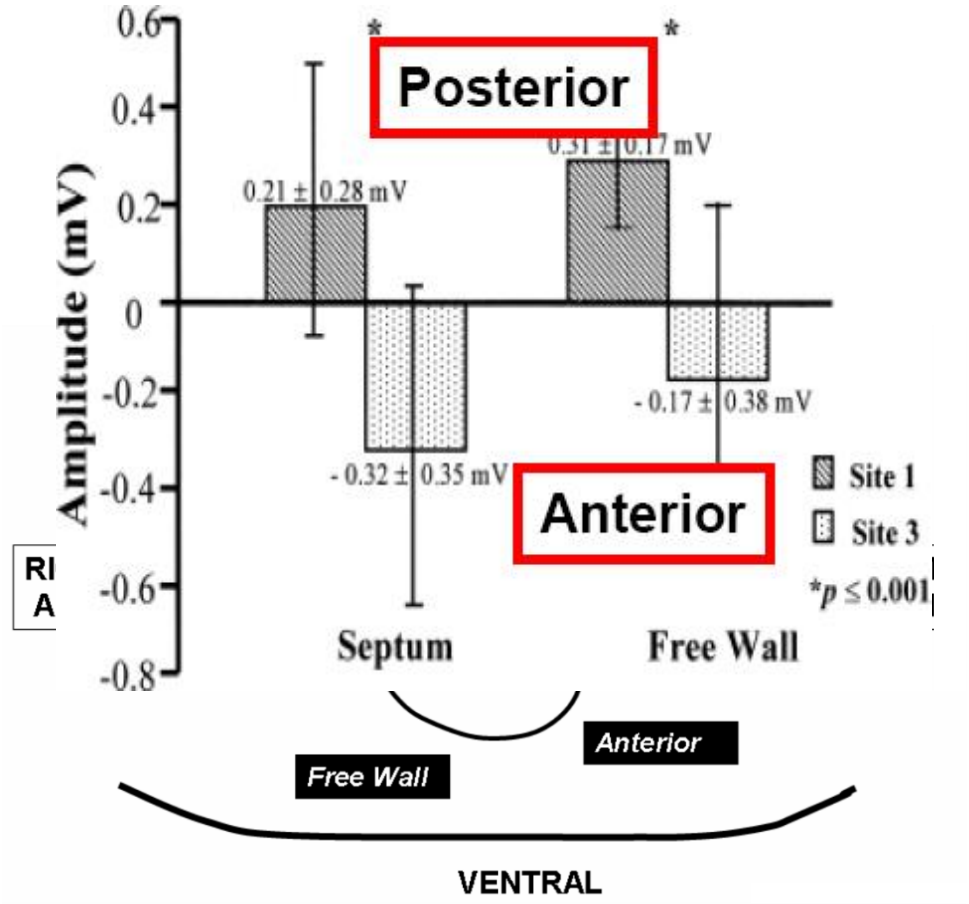
- **Anterior RVOT** (1) : a typical LBBB morphology in lead V1
- (2), (3) : between the **anterior right coronary cusp (RCC) of the aortic valve** and the **posterior RVOT**. A small but variable R wave is seen in lead V1.
- (4) : more posteriorly in the region of the **left coronary cusp (LCC)/aortic mitral continuity(AMC) /noncoronary cusp(NCC)** characterized with a distinct R wave in V1.
- Even more posterior and leftward origin (the **posterior mitral annulus**) : RBBB morphology.

Asirvatham SJ. J Cardiovasc Electrophysiol. 2009;20:955

RVOT Localization

Lead I: Anterior vs Posterior



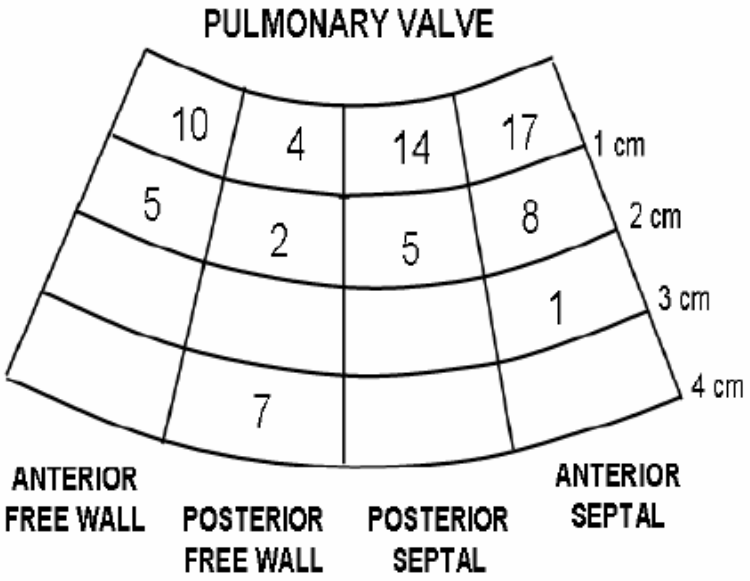


Dixit . JCE 2003;14:1

Joshi . JCE 2005;16suppl:S52

RVOT Localization

QRS: Free wall vs Septal



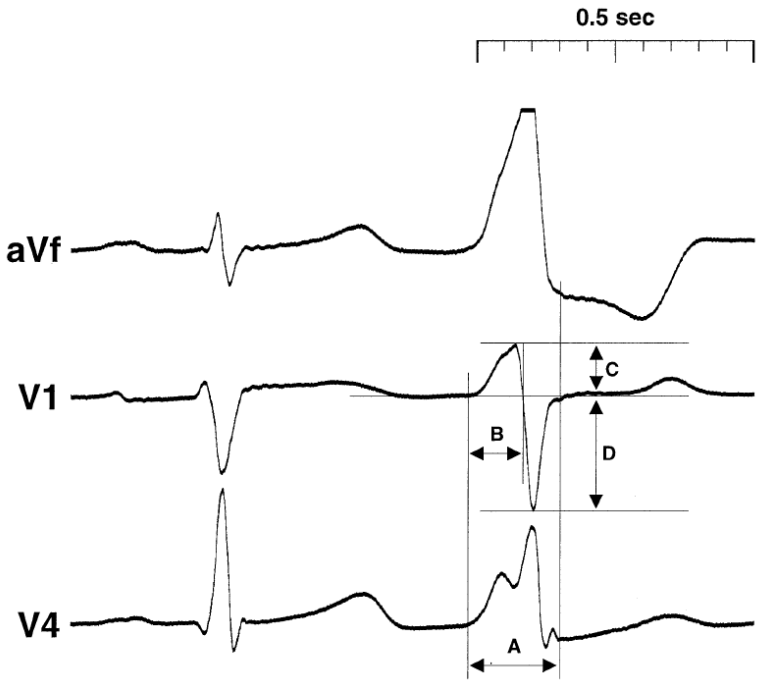
- QRS duration ≥ **140 msec**
- **QRS notching** in inferior leads
- Lead V_3 R/S ratio ≤ 1

Dixit . JCE 2003;14:1

Joshi . JCE 2005;16suppl:S52

Monomorphic VT with LBBB morphology and an inferior axis

: DDx of RVOT and ASC origin

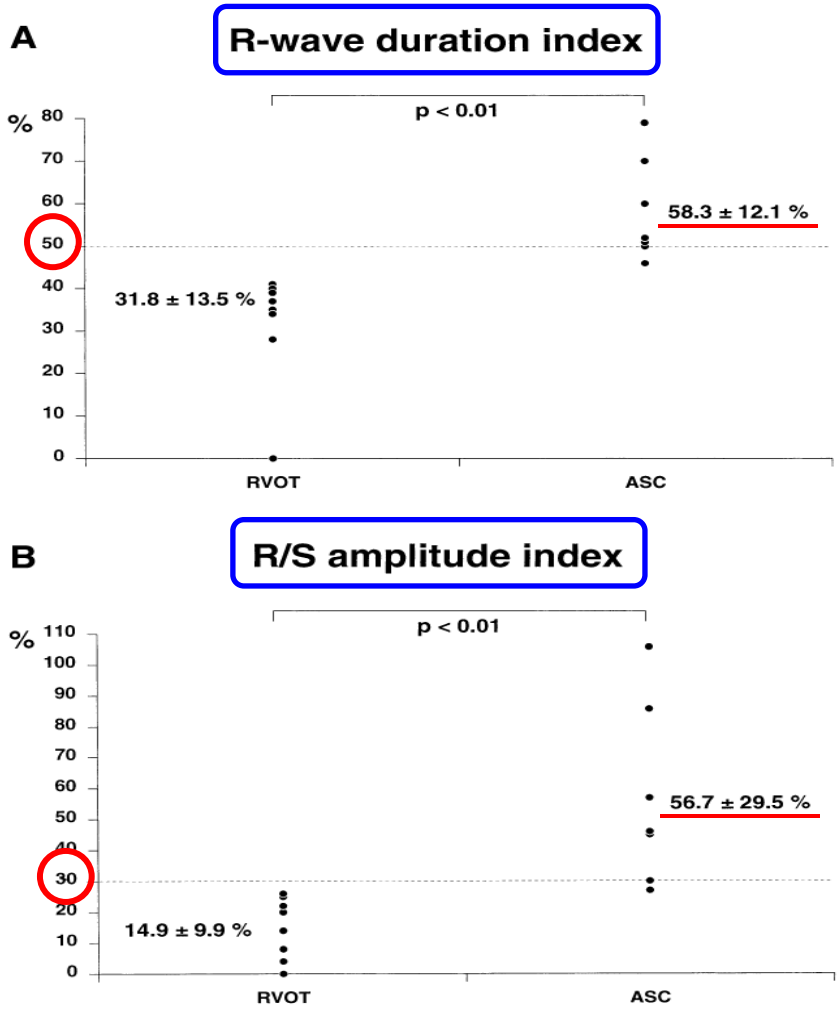


A Total QRS duration(ms)

B R-wave duration (ms)

C R-wave amplitude (mV)

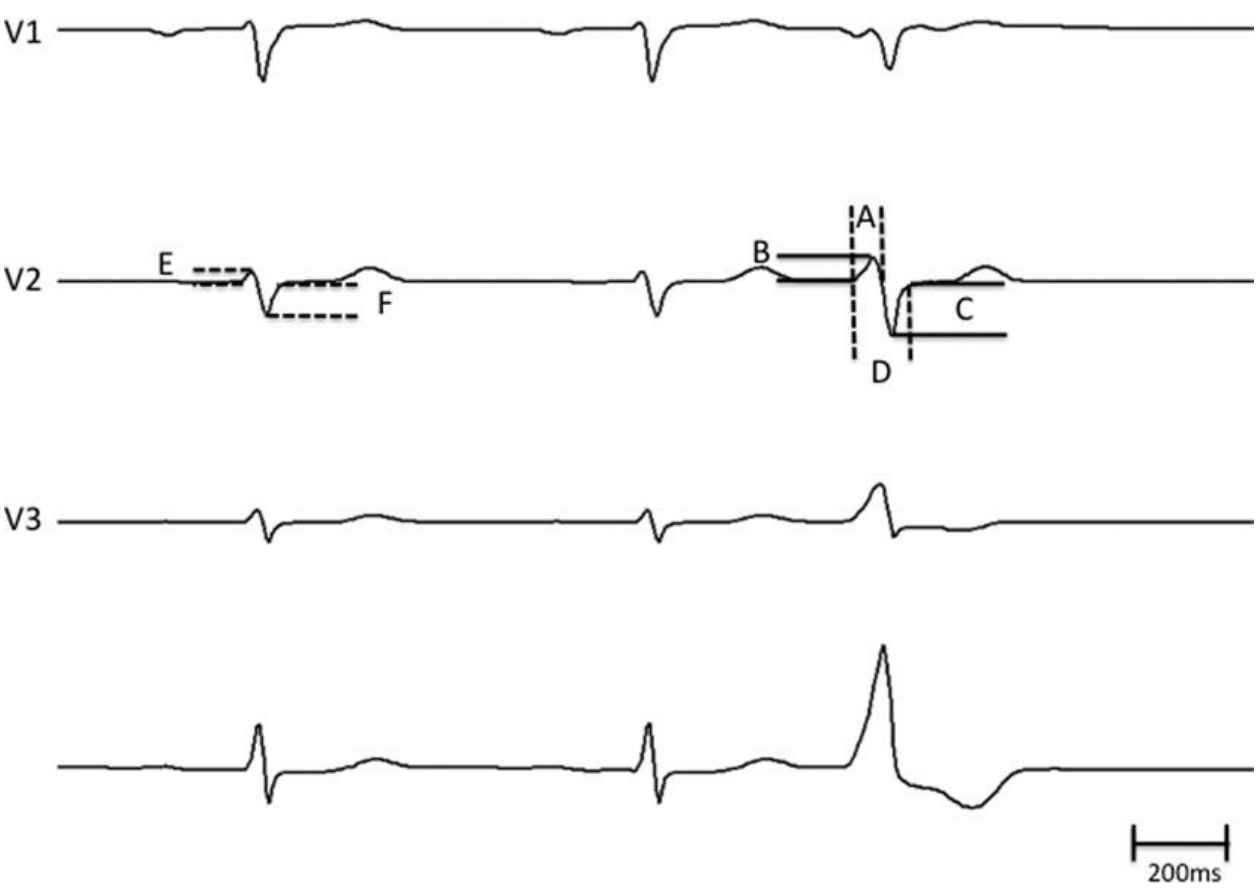
D S-wave amplitude (mV)



Ouyang F. J Am Coll Cardiol 2002;39:500

OT VT with precordial transition in V_3

V_2 Transition ratio

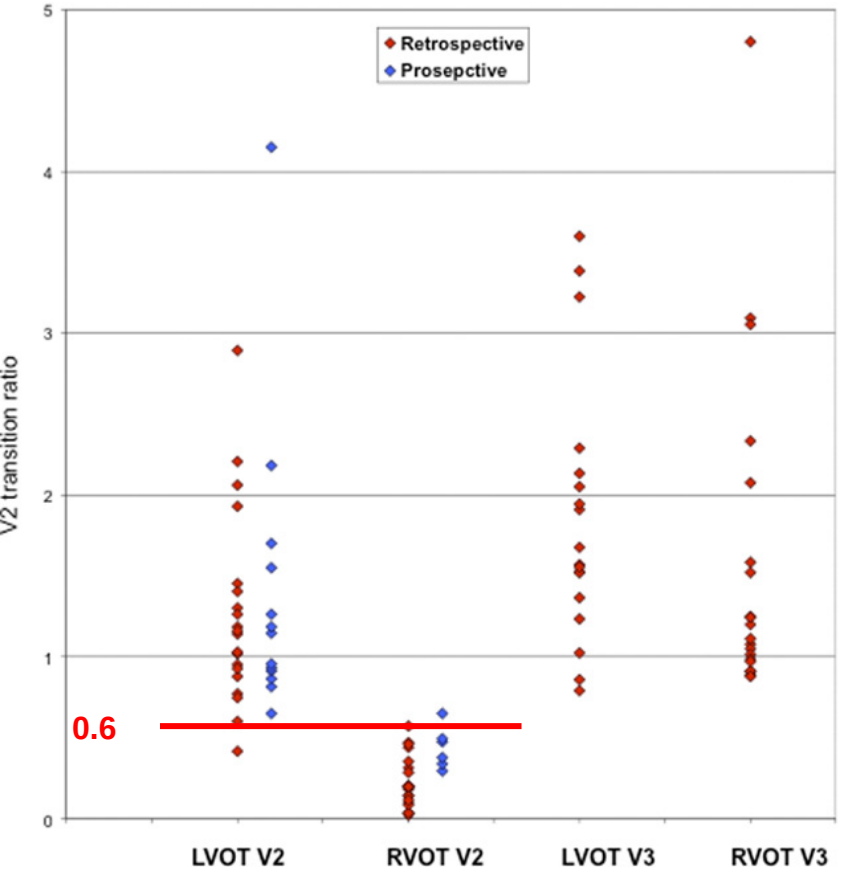


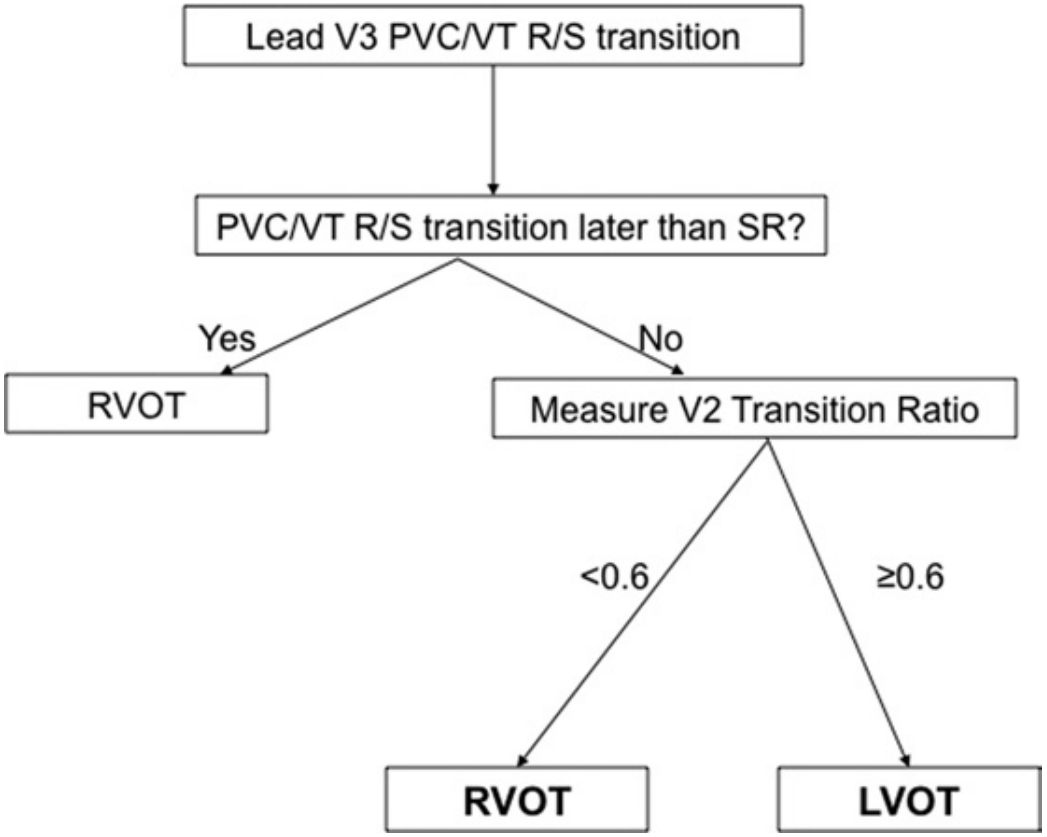
$$\frac{B/(B+C)_{VT}}{E/(E+F)_{SR}}$$

Betensky el al. JACC 2011;57:2255

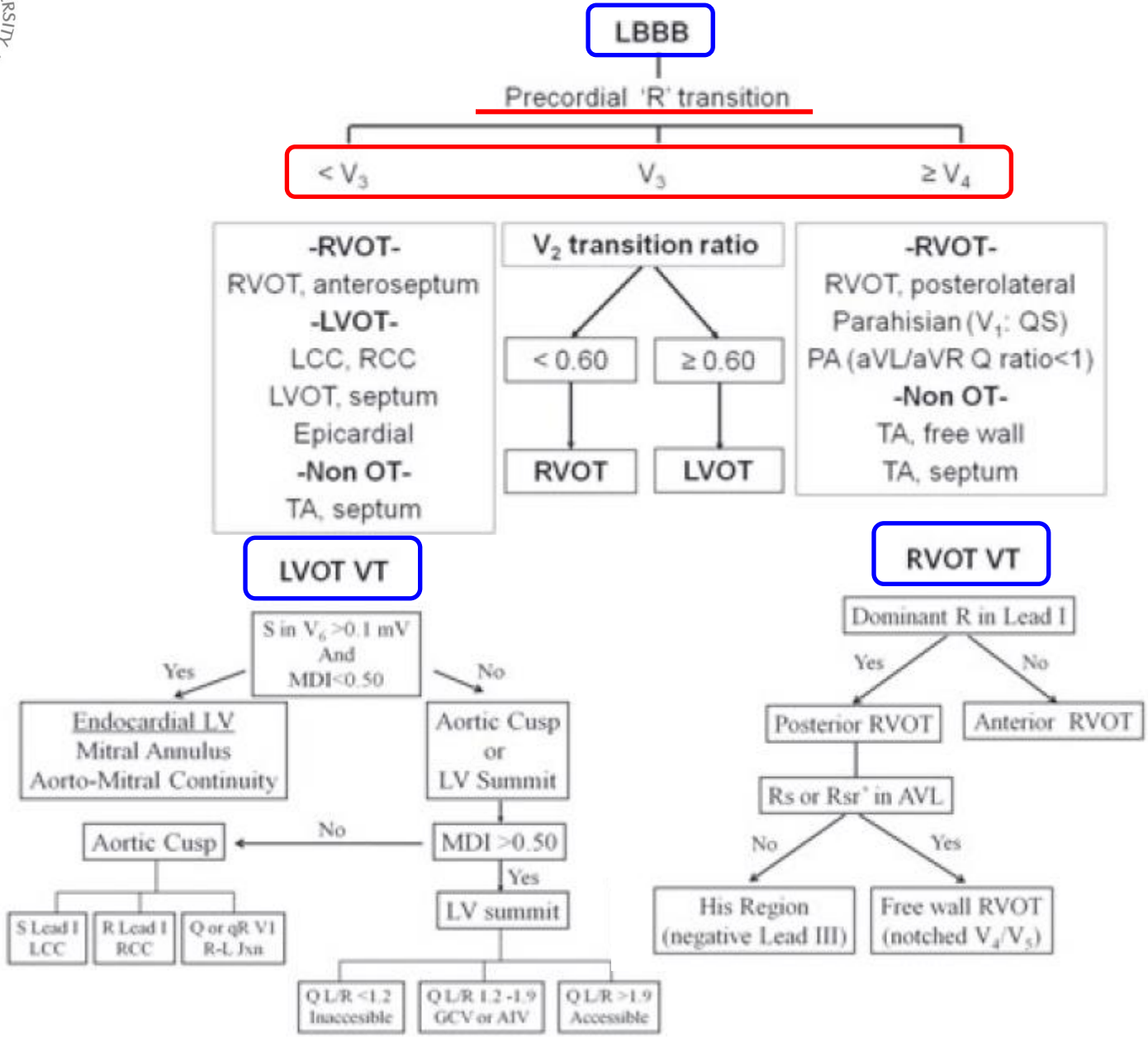
Diagnostic Algorithm for Outflow Tract VT with Lead V3 PVC/VT R/S Transition

Calculated V2 and V3 Transition Ratios



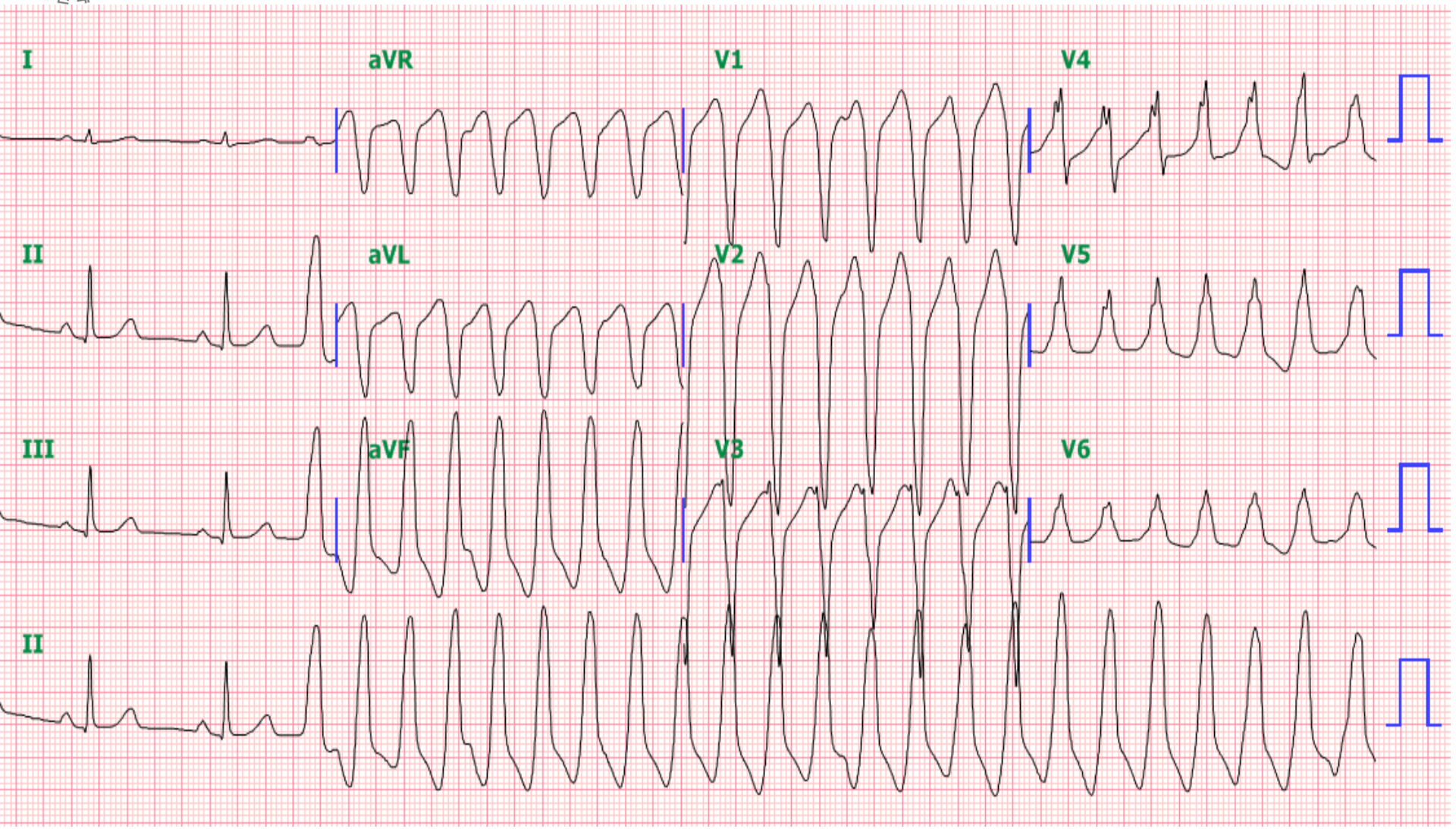


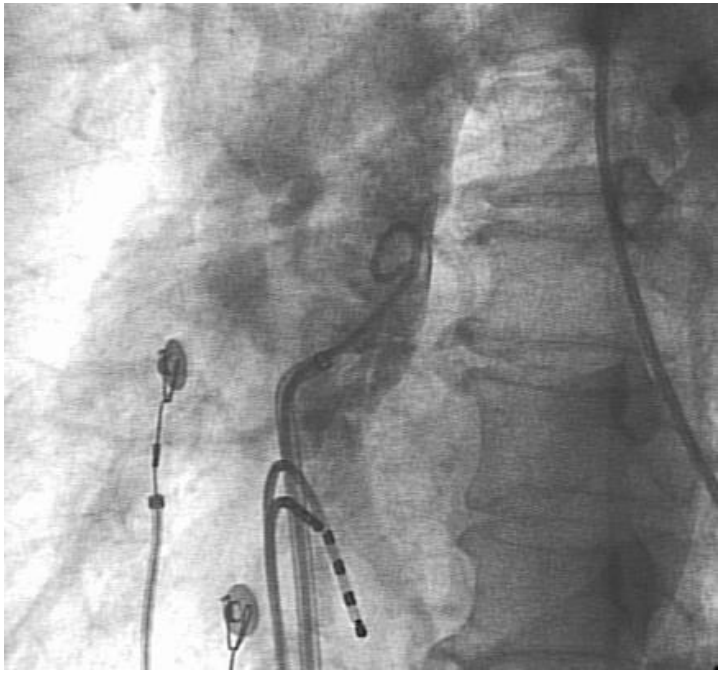
Betensky el al. JACC 2011;57:2255

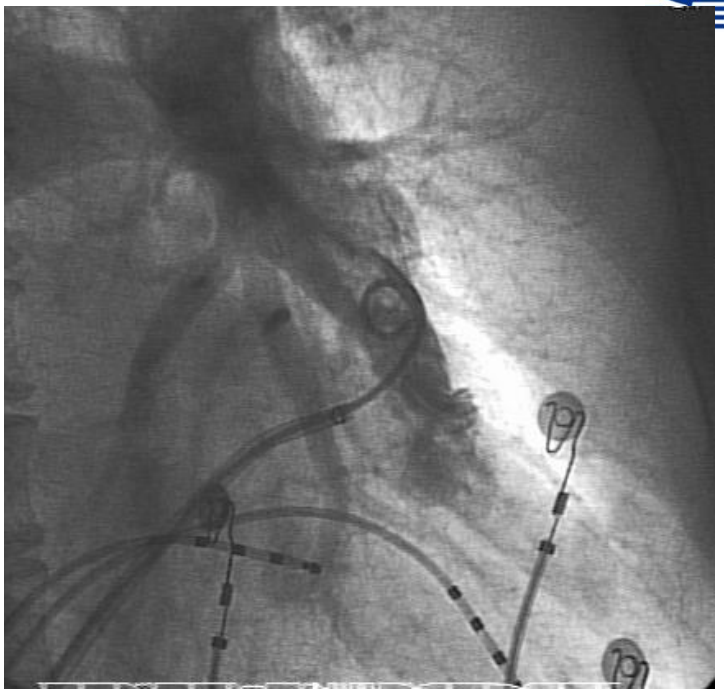


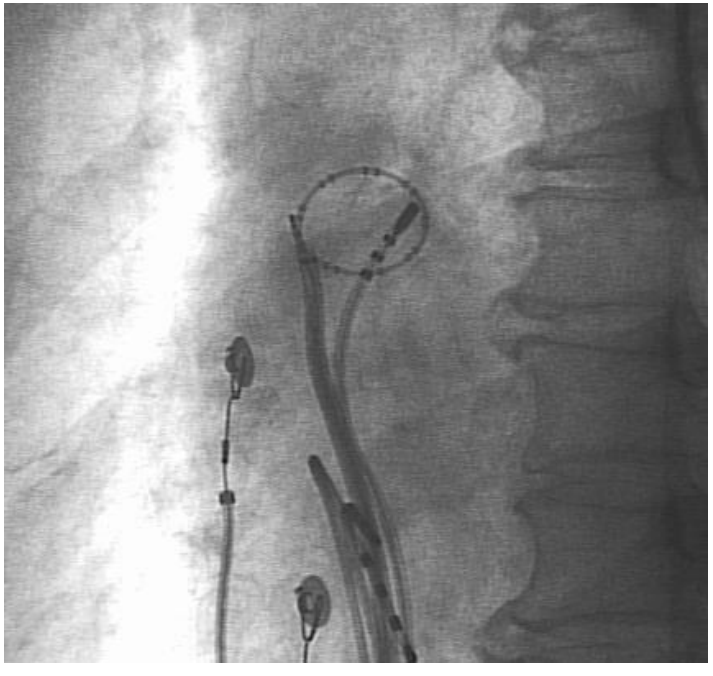
Park el al. PACE 2012; 35:1516

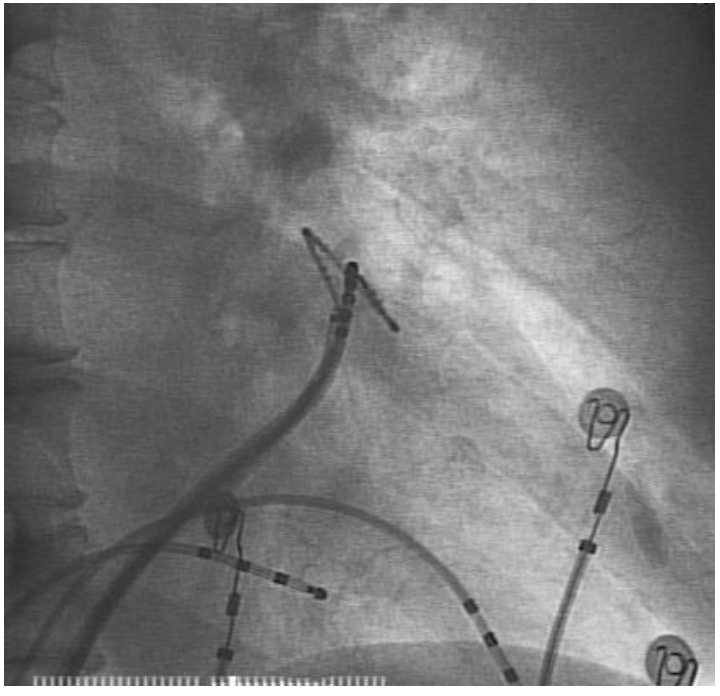
Case 1



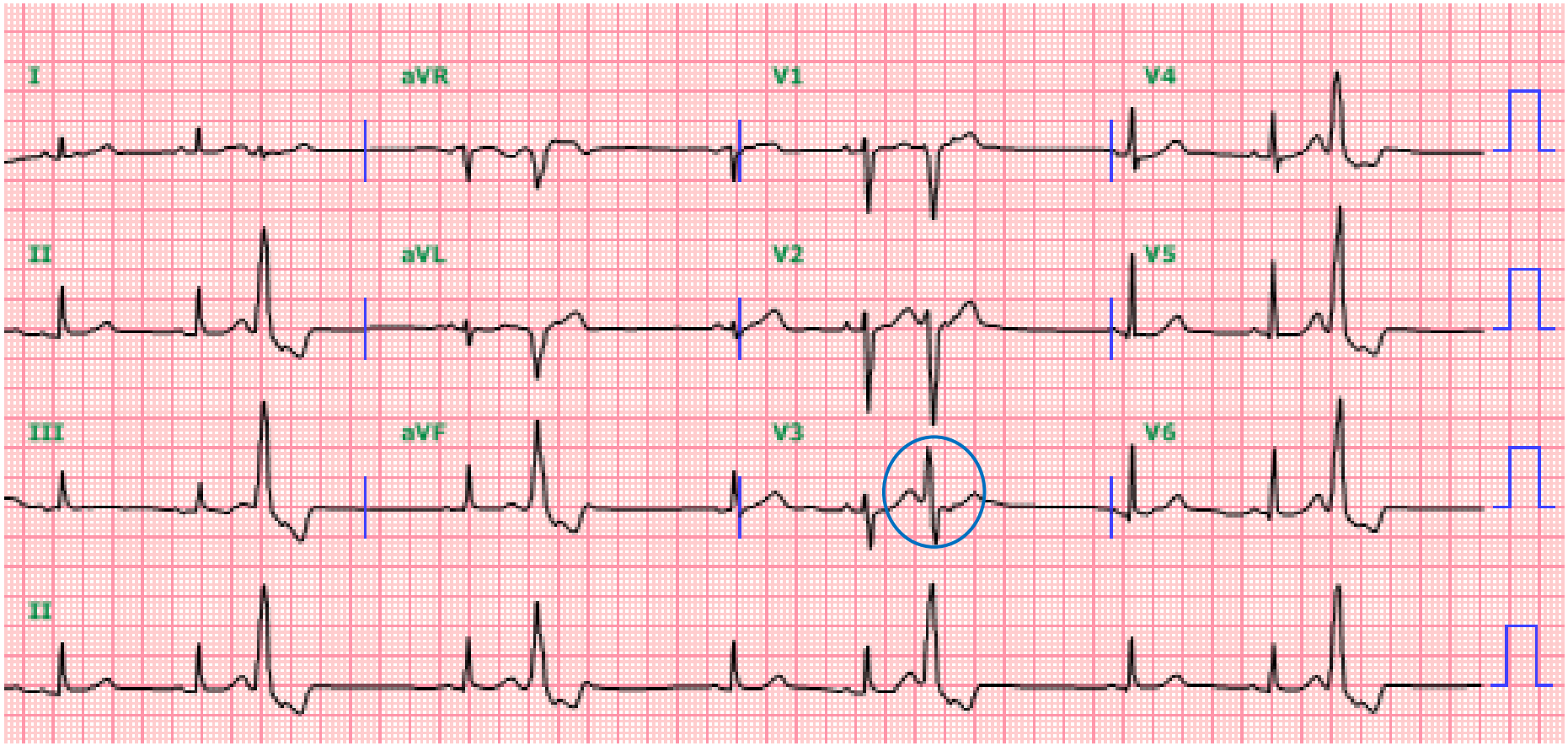




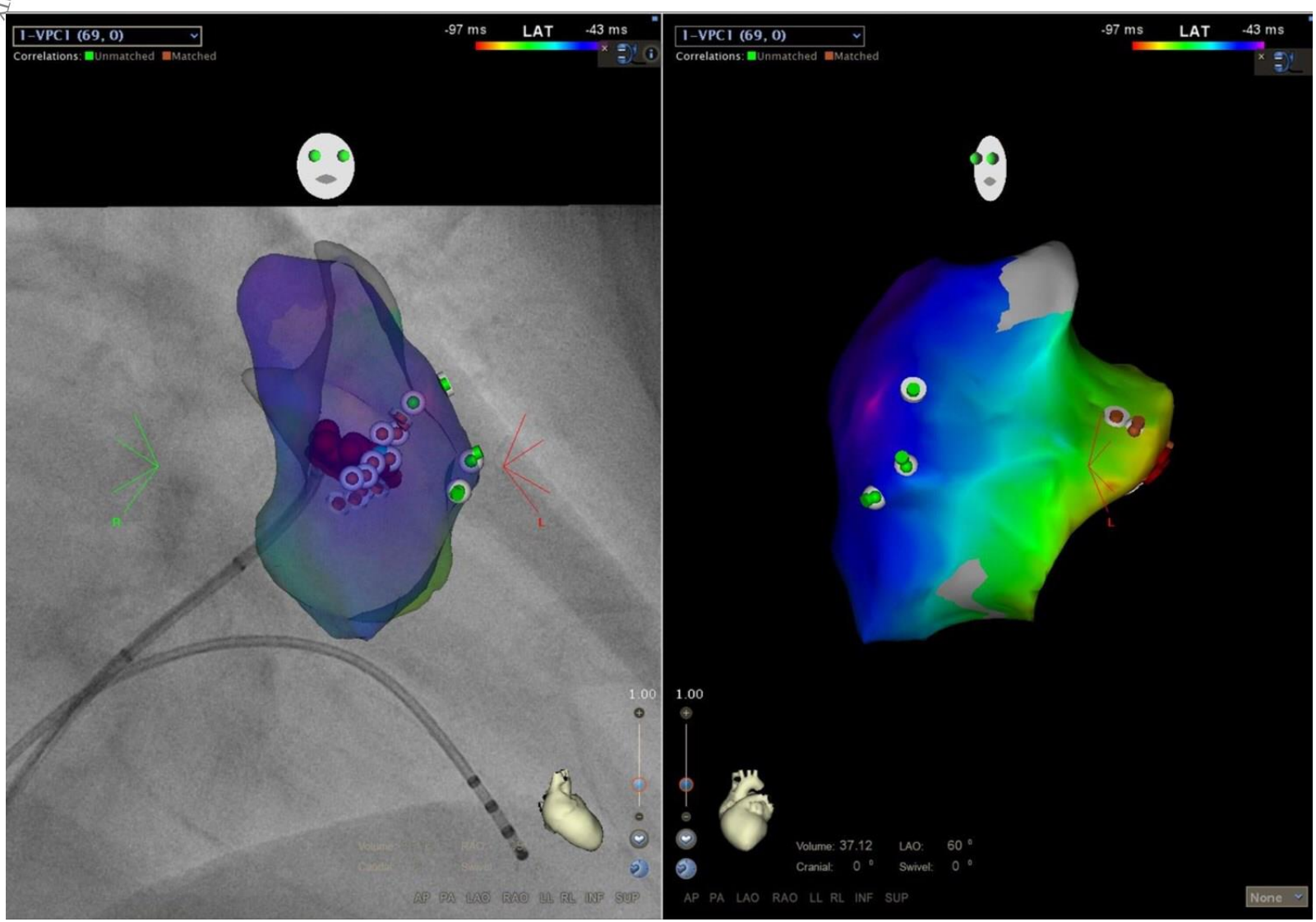




Case 2

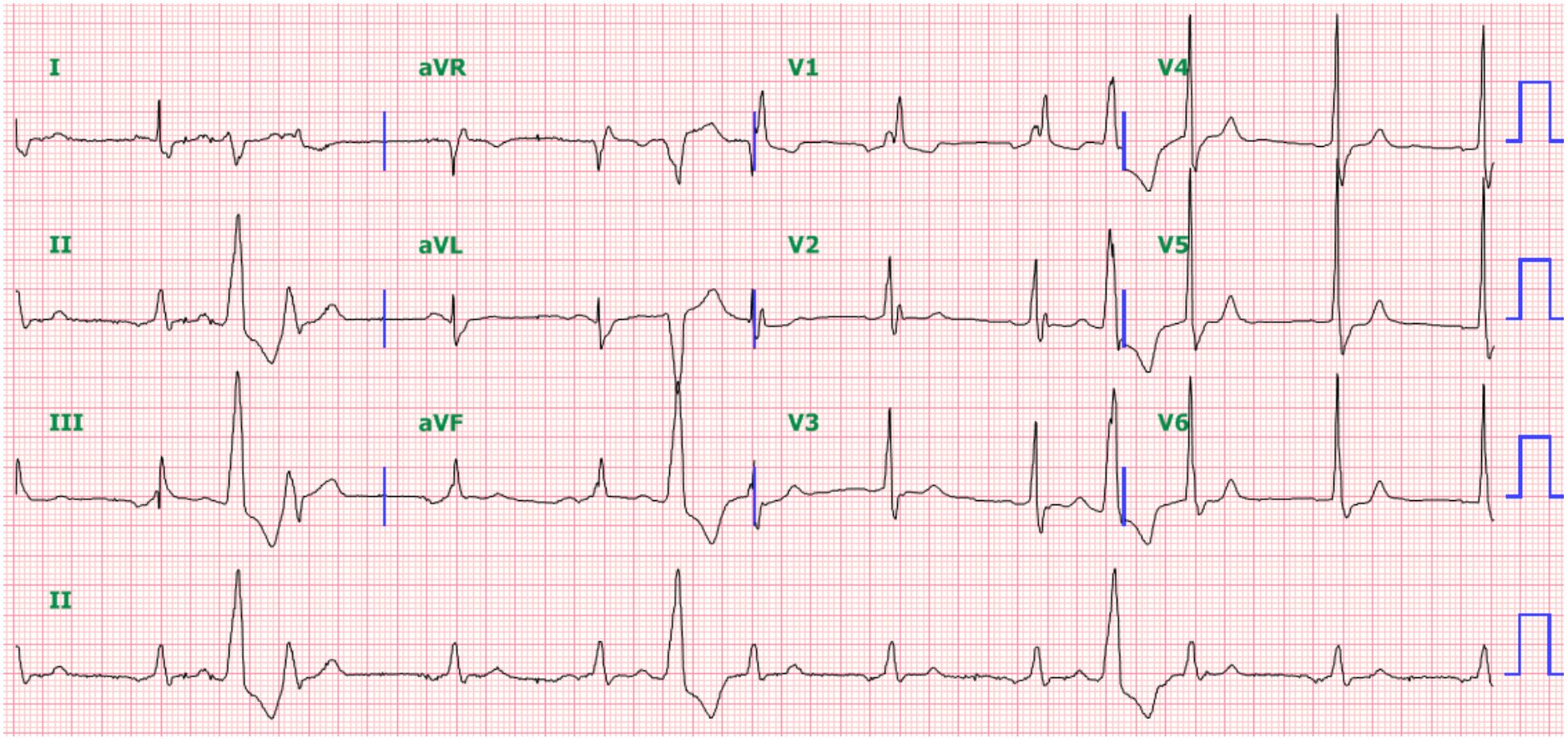


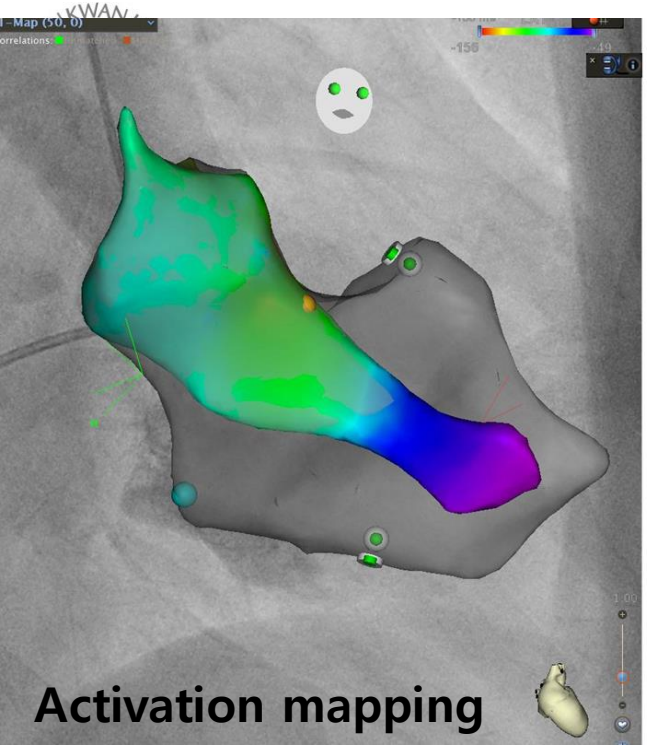
V2 trans ratio 2/19 ÷ 3/17 = 0.59 < 0.6 → RVOT

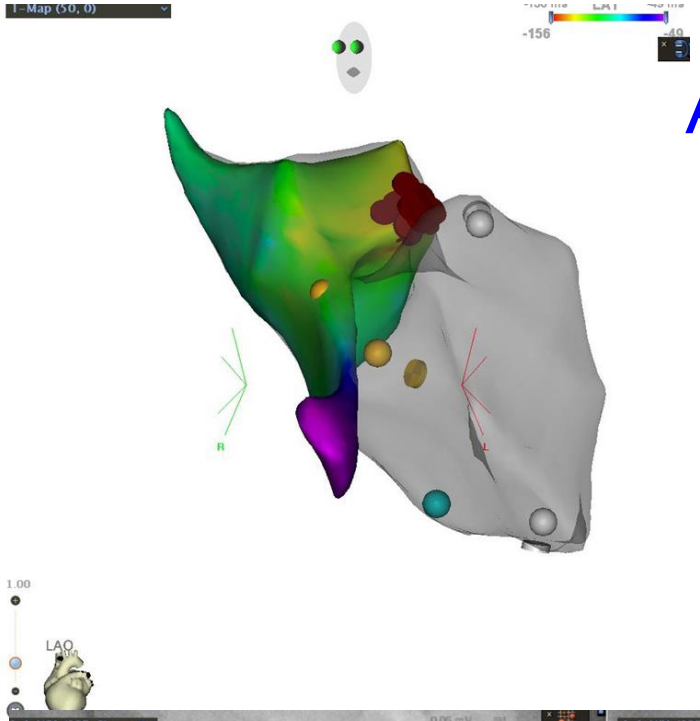


Intermediate septum of RVOT

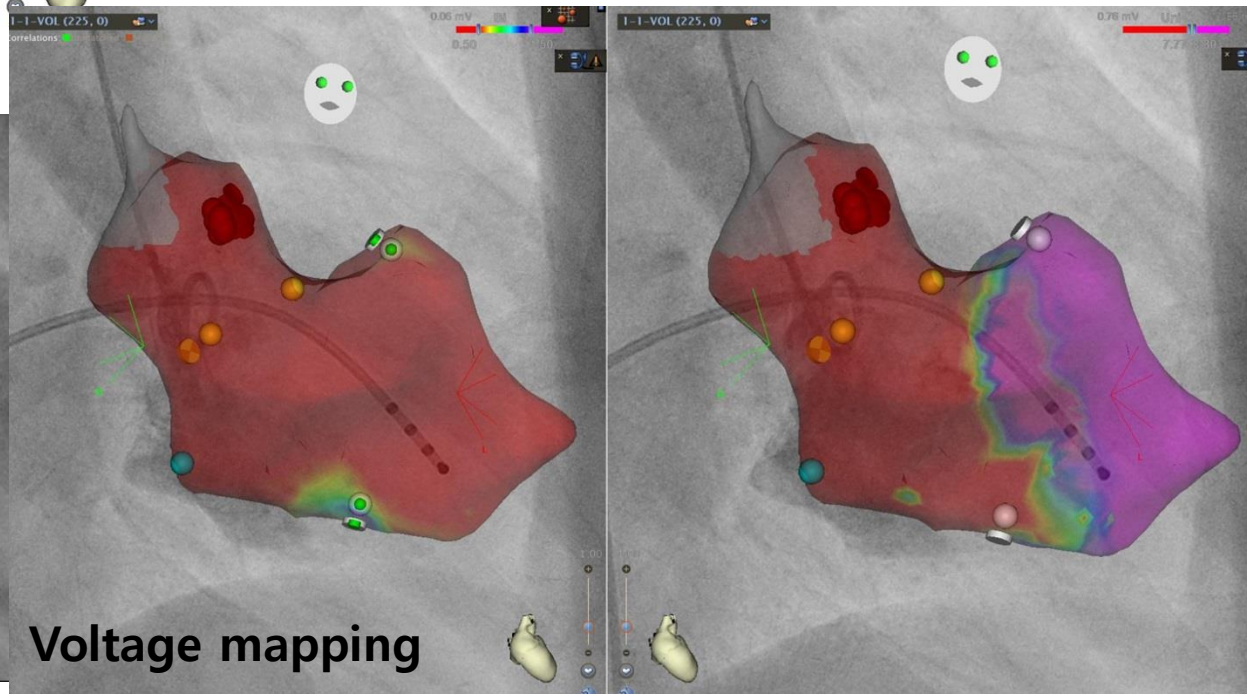
Case 3







Ablation site



VT with LBBB morphology and inferior axis

	RV OT	PA	LVOT	ASC	LV epi	CS	Total
Ito S	55(69%)		7(9%)	11(14%)	7(9%)		80
Tanner	20(61%)	1(3%)	5(15%)	2(6%)	2(6%)	3(9%)	33
Sekiguchi Y	92(72%)	24(19%)		11(9%)			148
Iwai S	100(82%)			22(18%)			122
	267(70%)	25(7%)		58(15%)		12(3%)	383 (100%)

Ito S. J Cardiovasc Electrophysiol. 2003;14:1280
Tanner H. J Am Coll Cardiol 2005;45:418
Sekiguchi Y. J Am Coll Cardiol 2005;45:887
Iwai S. J Cardiovasc Electrophysiol, Vol. 2006;17:1

SMC experience of VT with LBBB morphology and inferior axis

2014년 8월~2017년 3월 Idiopathic VT RFCA cases, 128 cases

RV OT **Septum sites 62**
Free wall sites 11
RV **Tricus valve septal site 3**
Free wall 2
Parahisian 1

RV cases; 79 cases

LVOT **LCC 11 (AIV site 의심되는 under the valve 3 case포함)**
RCC 6
NCC 1
RCC-LCC junction 3
AIV 3
AMC 8
LV **Fascicular VT anterior 3**
posterior 7
Papillary muscle VT 3
Mitral annulus 4

LV cases; 49 cases

RVOT: LVOT = 73 (69.5%): 32 (30.5%)

Summary

- ECG recognition of outflow tract tachycardia location
- **R wave** in **lead V1** : clue to the potential anatomic sites of origin
- Precordial **QRS transition**: RVOT vs LVOT (ASC)
- **Lead I** : right vs left side of RVOT site

  QRS width: free wall vs septum of RVOT
- **R-wave duration index** ≥50% and **R/S ratio** ≥30% in lead V_1 or V_2 : LVOT (ASC)
- **V_2 transition ratio** : distinguish left from right OT PVC/VT origin in patients with lead V_3 precordial R/S transition. (V_2 transition ratio ≥0.6 : LVOT origin)