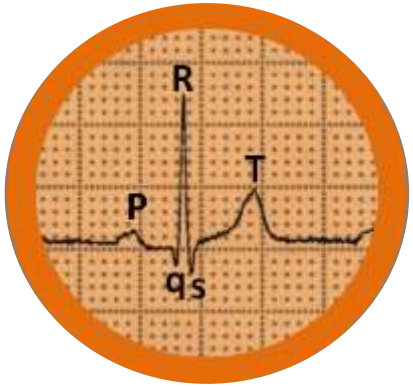


Uncover the mysteries of VT

DR. D.P Khaitan

M.D (Medicine) F.C.G.P(IND) F.I.A.M.S (Medicine) FICP FICCMD
National President CCDSI (2020-21)
Dean ICCMD (2022-2023)
Awarded Prestigious Master Teacher Award from CCDSI in 2022
National Veteran Academic Excellence Award (IMA , 2023)
(100 Articles and 16 e-Books on different aspects of ECG to his credit)

Trailer casting

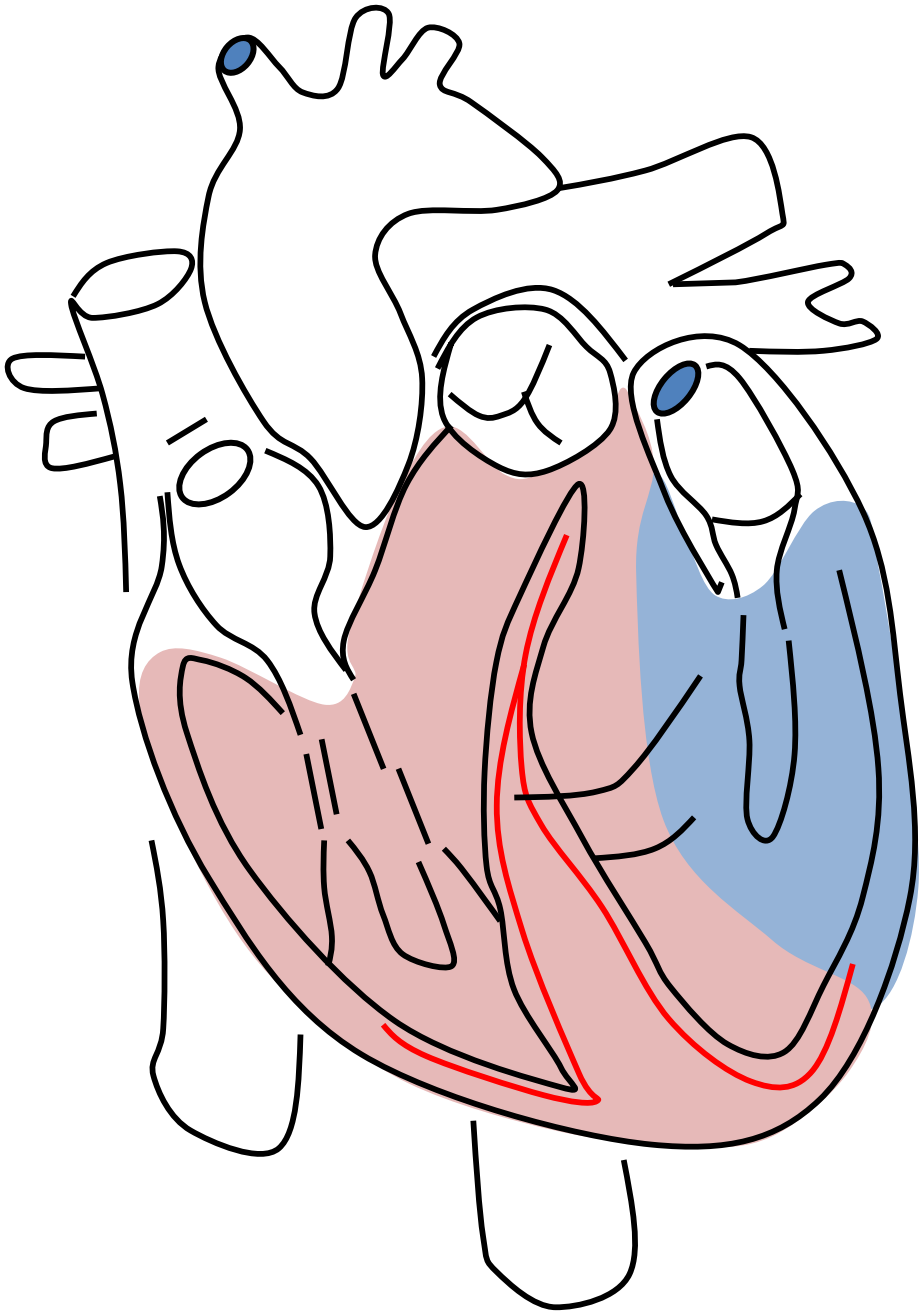
This presentation aims at the concept of Holistic approach and multiple algorithm based approach in accessing VT :

- **Holistic approach to ventricular tachycardia**
  1. Initial M-to-M conduction
  2. The route of journey
     - Journey through frontal leads (QRS axis)
     - Journey through precordial leads
  3. Atria/ventricles beat independently
- **Multistep algorithms**

A bird's eye view of multiple algorithms

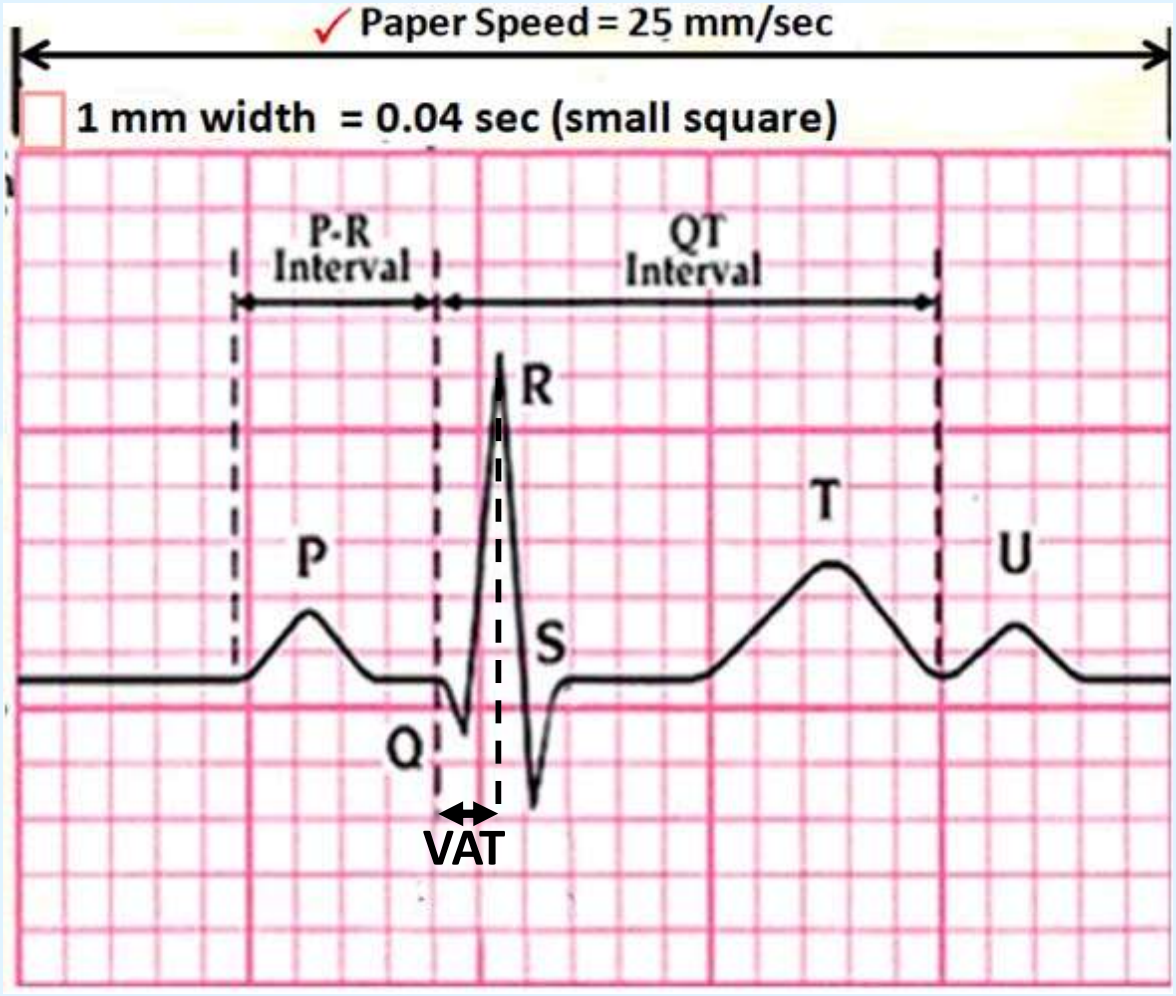
1. Brugada algorithm
2. Vereckei aVR algorithm

Rapid HIS-Purkinje conduction → **Slow M-to-M conduction**



- **VT (Reverse gear)**
  - **Slow muscle to muscle conduction → rapid terminal HIS-Purkinje system conduction**

Normal Initial Conduction time through HIS-Purkinje System



- ❑ 1 small square = 0.04 sec
- ❑ q (septal wave) < 0.04 sec
- ❑ VAT (q-RWPT) upto 0.04 sec
- ✓❑ RWPT maximum upto 0.04 sec (HIS-Purkinje System)

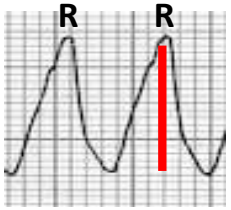
RWPT = R-wave peak time

The Novel Basal Algorithm (VT)

BASIS = Muscle-to-Muscle conduction (RWPT)

Structural Heart Disease + **Lead -II** RWPT >40ms + **Lead-aVR** RWPT >40ms

- H/O Myocardial Infraction
- CHF (LVEF < 35%)
- Device (ICD , CRT)



RWPT = R-wave peak time

≥2 criteria fulfilled ->VT

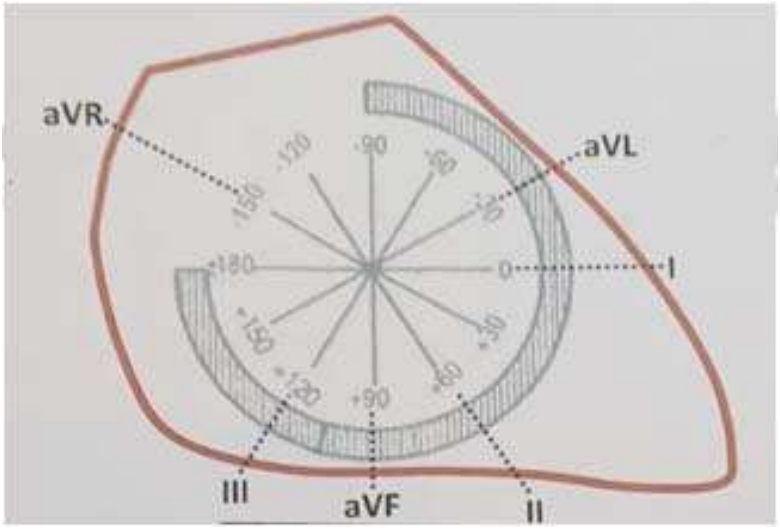
0 or 1 criteria fulfilled ->SVT

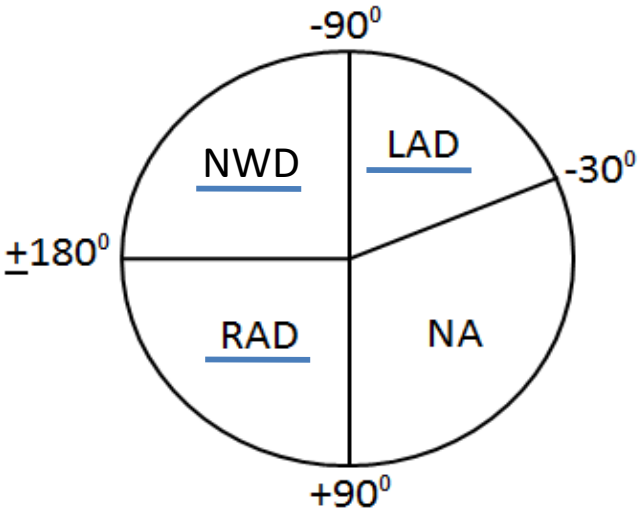
For the algorithm , a cutoff 40 ms was chosen to facilitate user-friendly application in clinical practice (ROC derived optimal cutoffs were 51 ms for lead II time to peak and 46 ms for lead aVR time to peak)

Holistic approach to Ventricular Tachycardia

1.Initial M-to-M conduction	• RWPT > 40 ms (lead-II and lead-aVR)
2. The route of journey ❑ Journey through limb leads (QRS axis) ❑ Journey through precordial leads	• North-west deviation (-90^0 to -180^0) (The rest on the next slide) • QRS contours inconsistent with aberrant conduction (V1, V6) : atypical bundle branch block • Absence of RS complexes in all precordial leads • Chest lead concordance (totally positive or totally negative)
3. Atria/ventricles beat independently	AV dissociation , fusion beat , capture beat

QRS axis as journey through limb leads





- **NWD** = NW axis
- **LAD** with RBBB
- **RAD** with LBBB

Look at QRS complex in lead I and II

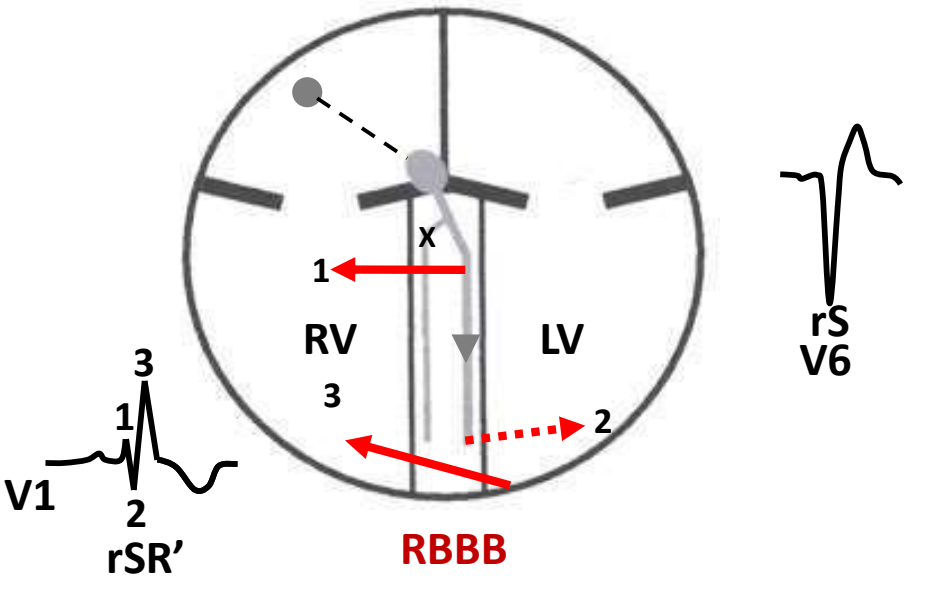
QRS complex is positive in lead I but negative in lead II	**Left Axis Deviation - 30^0 to -90^0**
QRS Negative in lead I but positive in lead II	**Right Axis Deviation $+90^0$ to $+180^0$**

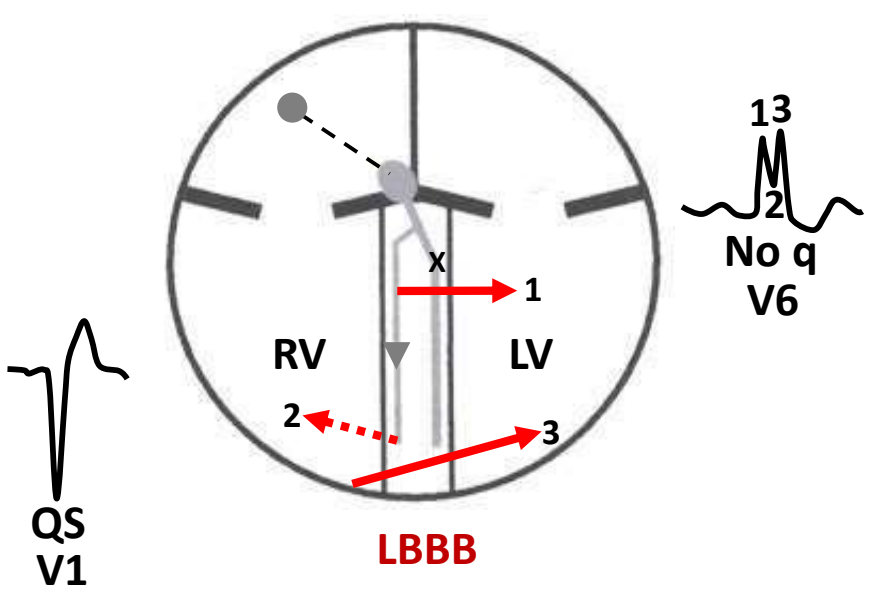
A predominantly positive QRS complex in aVR associated with a predominantly or wholly negative deflection in lead I and aVF- North -west Axis - 90^0 to -180^0

Bundle branch block consistent with aberrant conduction

Basis :

Septal depolarization from the opposite side (as shown by the flow 1) and depolarization through myocardial connecting link from the opposite ventricle (as shown by the flow 3)





Two Pointing fingers are (1) and (3)

Two Pointing fingers are (1) and (3)

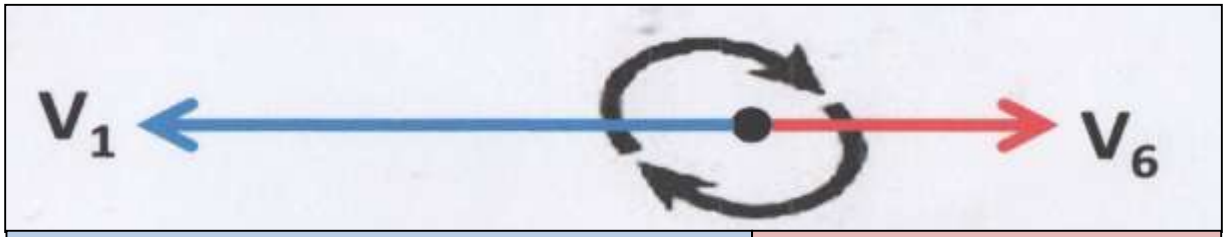
- Positive deflection towards the flow of current and negative deflection when away from the flow of current.

Atypical RBBB pattern with VT

'Monophasic R'

'Left rabbit ear'

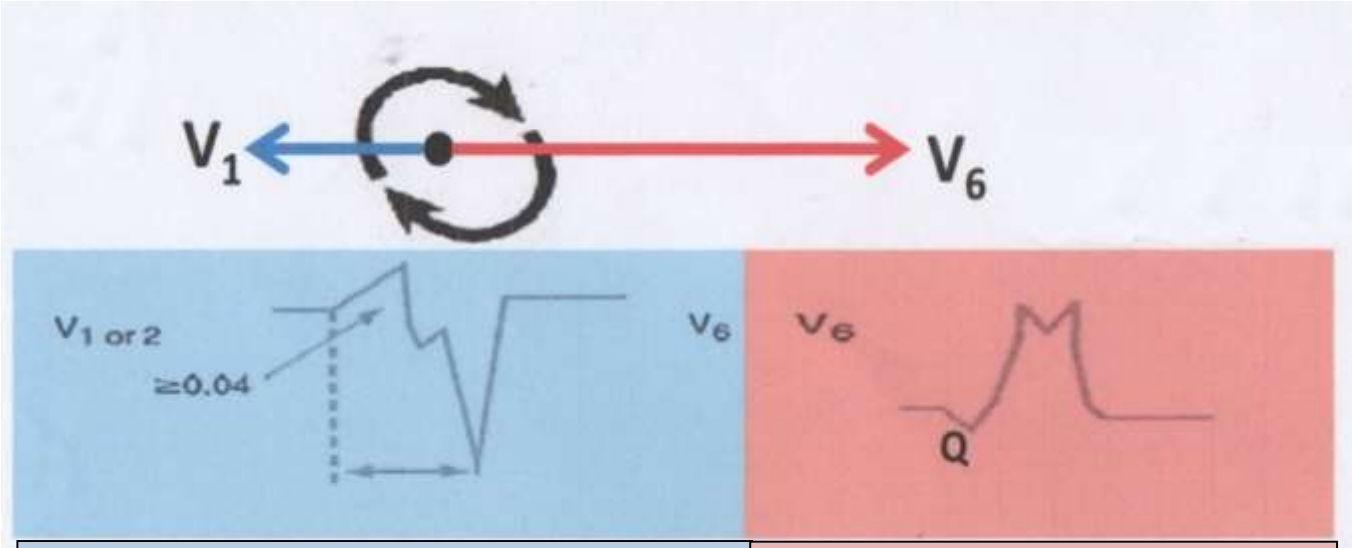
Biphasic qR



Lead V1 :	**Lead V6 :**
Monophasic R, Rsr', biphasic qR – double-peaked R with the left peak taller than the right – Rabbit ear sign	R:S ratio <1 , rS, QS patterns (More or less mirror image)

A QRS duration > 140ms with RBBB pattern suggest VT

Atypical LBBB pattern with VT



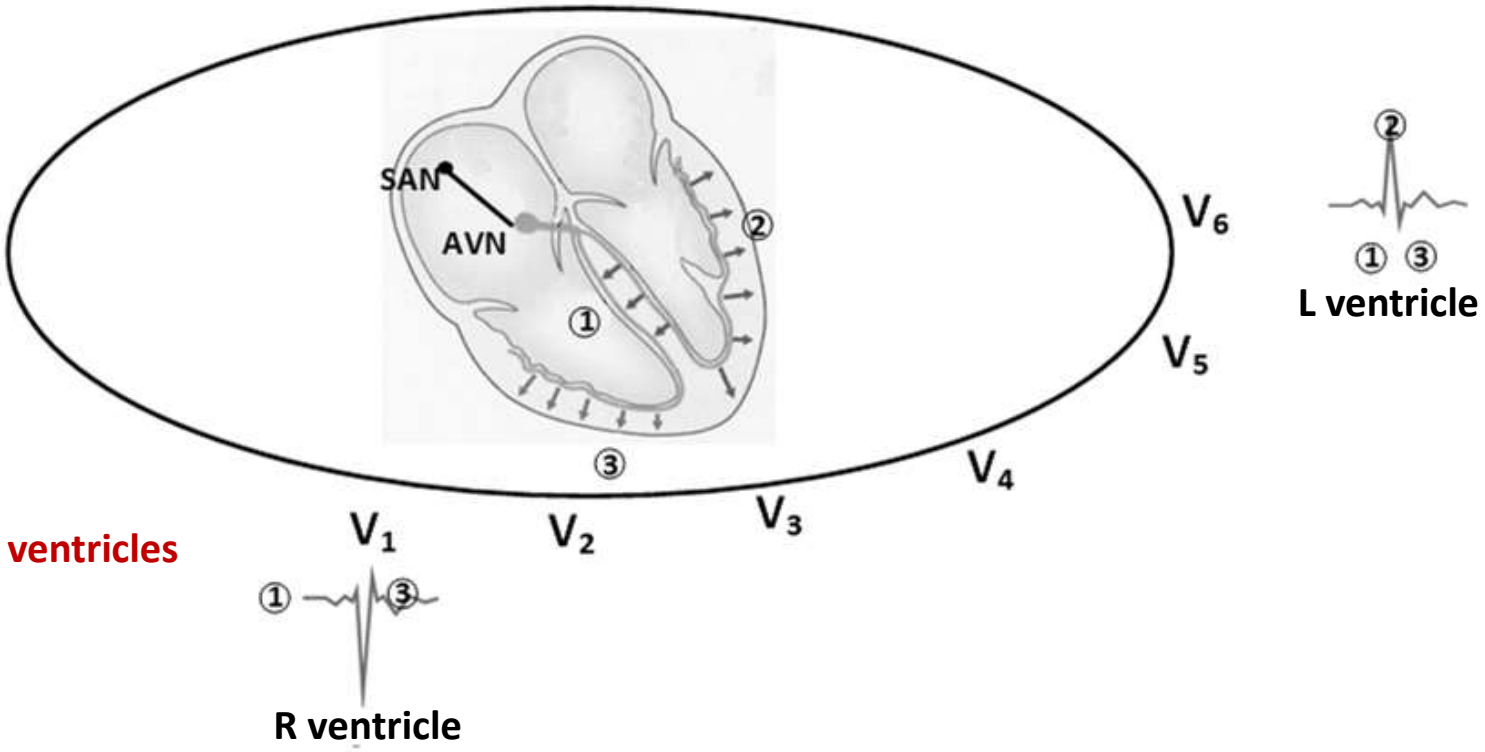
Lead V1/V2 : Initial broad R wave (>40 ms) slurred or notched-down stroke of the S wave, and delayed nadir of S wave (>60 ms)	**Lead V6 :** Any Q or QS

A QRS duration > 160ms with LBBB pattern suggest VT

Why absence of RS pattern in all precordial leads in VT ?

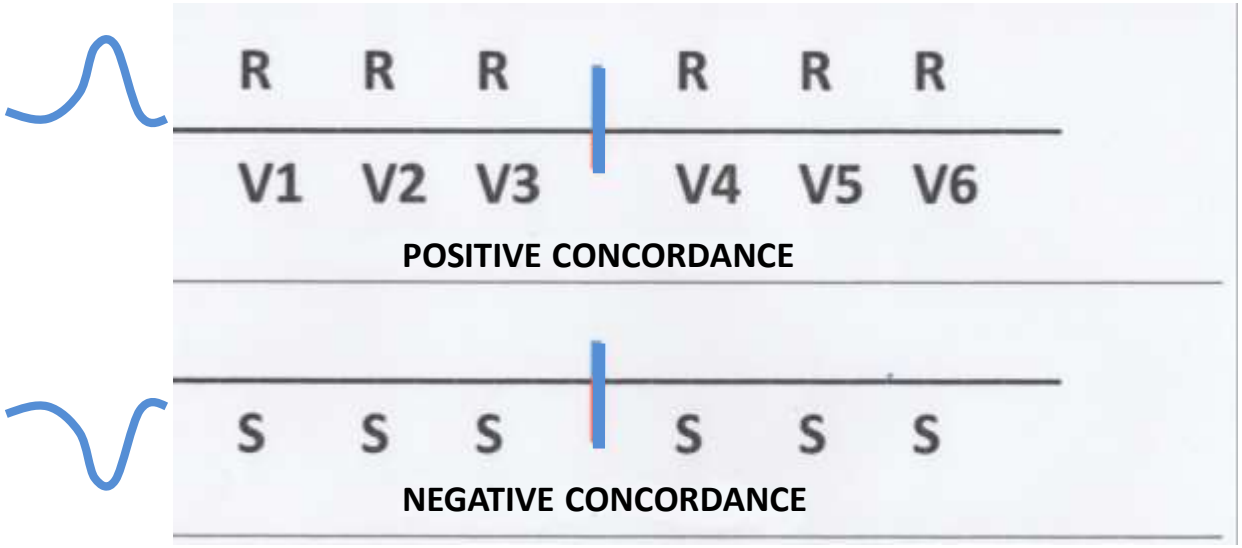
Basic :

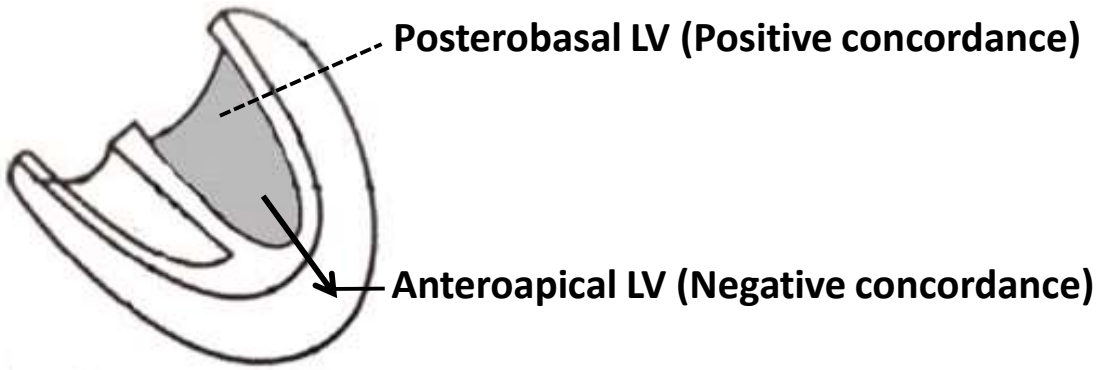
In VT muscle-to-muscle conduction , not the sequential activation is illustrated below :



The sequence of activation of the ventricles

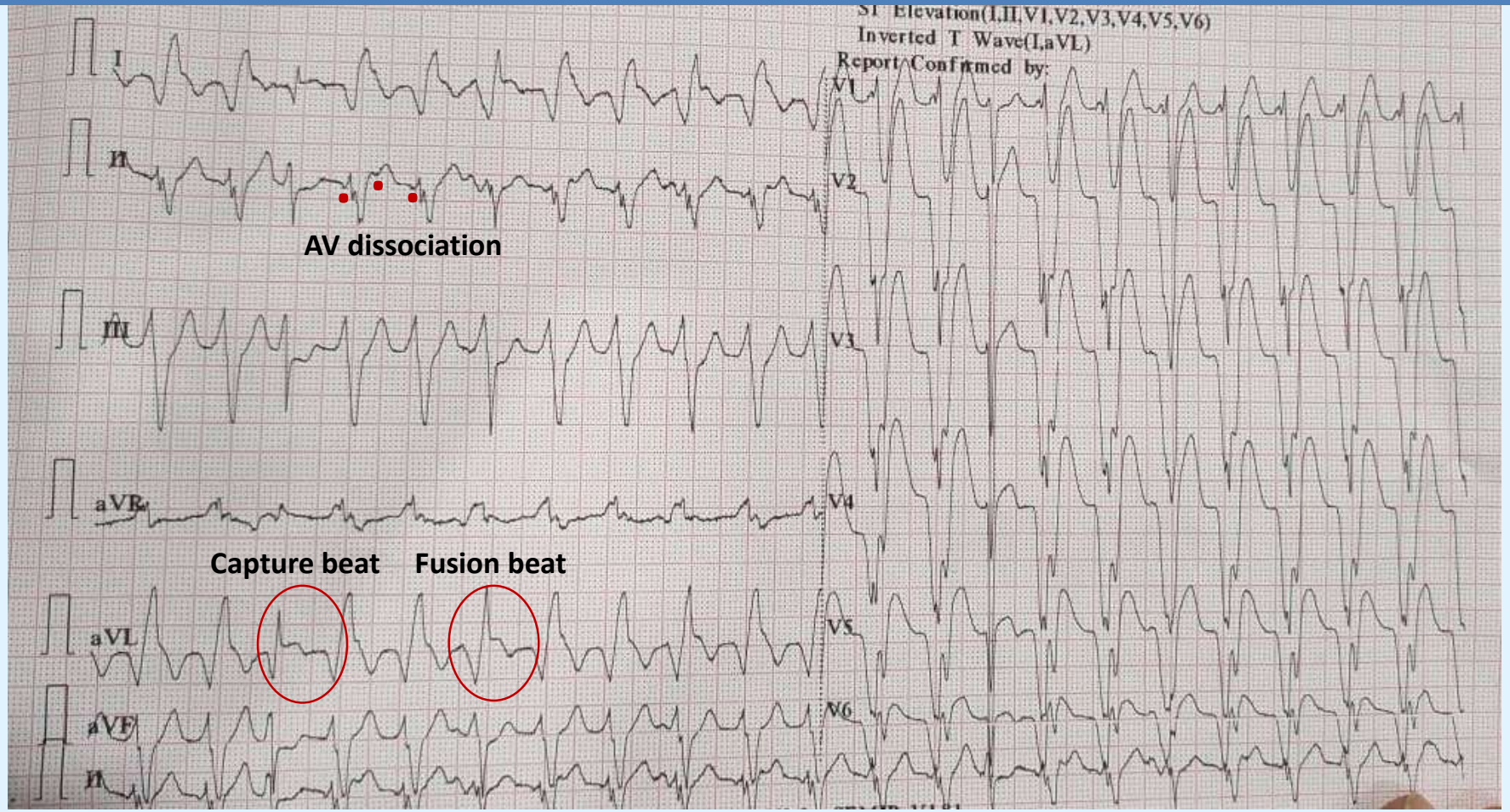
Chest lead concordance



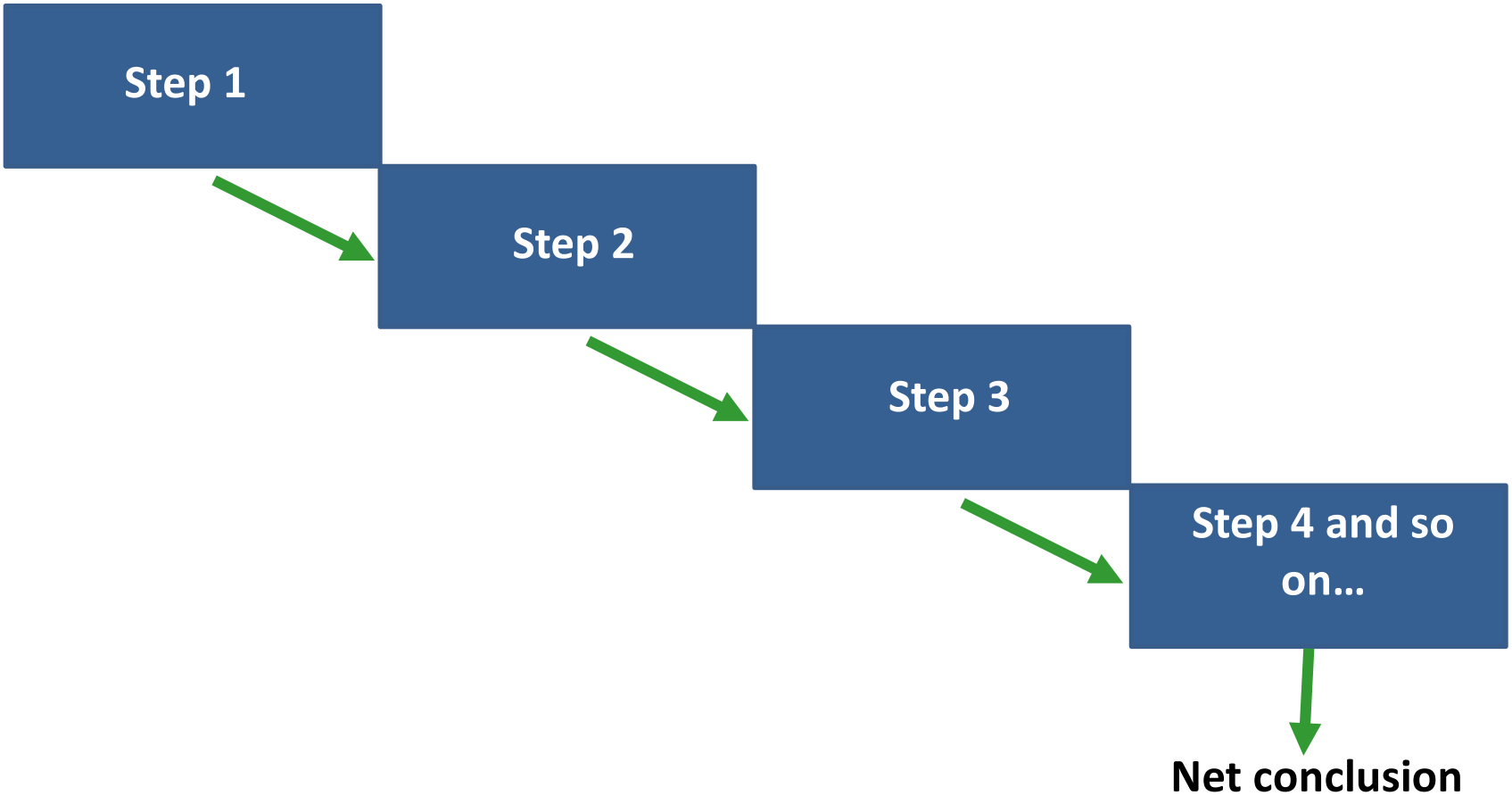


Positive concordance = Origin of VT from posterobasal left ventricle
Negative concordance = Origin of VT from anteroapical left ventricle

VT showing atria / ventricles beating independently



Multistep algorithm



- Multistep-approach to diagnose VT/SVT includes a sequential application of concerned clusters of ECG findings – it needs a constant skilled practice
- It may escape certain pertinent points which might be essential
- This is more time consuming , even then no multipstep algorithm is completely perfect

Multistep Algorithms ----------

WCT Tachycardia Differentiation : A Reappraisal of the State- of-the-Act
Anthony H. Kashou et al , Journal of the American Heart Association

Brugada Algorithm

1. No RS in V1-V6
2. RS interval > 100 ms in precordial lead
3. AV dissociation
4. VT morphology criteria in V1-V2 & V6

None of the above → SWCT

VT

Vereckei aVR Algorithm

1. Initial dominant R wave
2. Initial r or Q wave > 40 ms
3. Notched downstroke of negative QRS
4. Vi ≤ Vt

None of the above → SWCT

VT

Limb Leads Algorithm

1. Monophasic R wave in aVR
2. Negative QRS in I , II & III
3. Opposing QRS in limb leads

None of the above → SWCT

VT

VT as Default Diagnosis

Bayesian Approach

Single Criterion Method

Griffith Algorithm

VT unless typical BBB morphology present

	RBBB	LBBB
V1-V2	rSR'	rS or QS , delay to S wave nadir <70 ms
V6	RS (R>S)	R wave, no Q wave

Bayesian Algorithm

Pre-test LR : 4

X

Specific ECG feature (s) LR

=

POST-test LR : <1 SWCT , ≥1VT

RWPT Algorithm

RWPT>50 ms in II

VT

Point-based Scoring Methods

The VT Score

- +1 Initial R wave in V1
- +1 Initial r wave > 40 ms in V1-V2
- +1 Notched S wave in V1
- +1 Initiate R wave in aVR

- +1 Initial R wave in V1
- +1 Initial r wave > 40 ms in V1-V2
- +2 Notched S wave in V1
  ≥3(99.6% specific for VT)
  ≥4(100% specific for VT)

Pachon Scoring Algorithm

- +1 WCT QRS morphology indentical to baseline
- +1 Baseline ECG : abnormal Q wave
- +1 AV dissociation
- +1 Q wave or initial q wave in V6 with LBBB pattern

- +1 Sudden normalization & morphology changes with AF on baseine ECG
- +1 WCT with complete or high-grade AV block
- +1 Contralateral BBB morphology in patients with organic BBB

Brugada Algorithm for VT

Step 1 Absence of RS complexes in all precordial leads

Yes → VT

Step 2 R to S interval > 100 msec in 1 precordial lead

Yes → VT

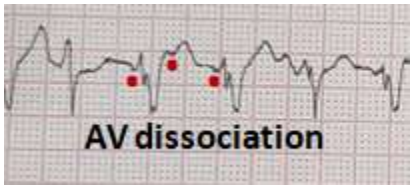
Step 3 More QRS complexes than P waves (AV dissociation)

Yes → VT

Step 4 Morphologic criteria for VT present in V1-V6

Yes → VT

SVT with aberrant conduction

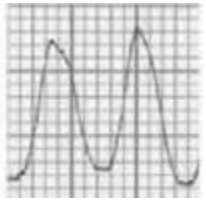


(Already discussed)

Vereckei aVR Algorithm

Initial dominant R wave

Step 1

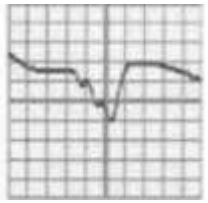


Initial r or q wave > 40 ms

Step 2

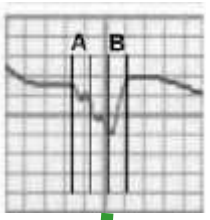
Notched downstroke of negative QRS

Step 3



V(i)/V(t)≤1

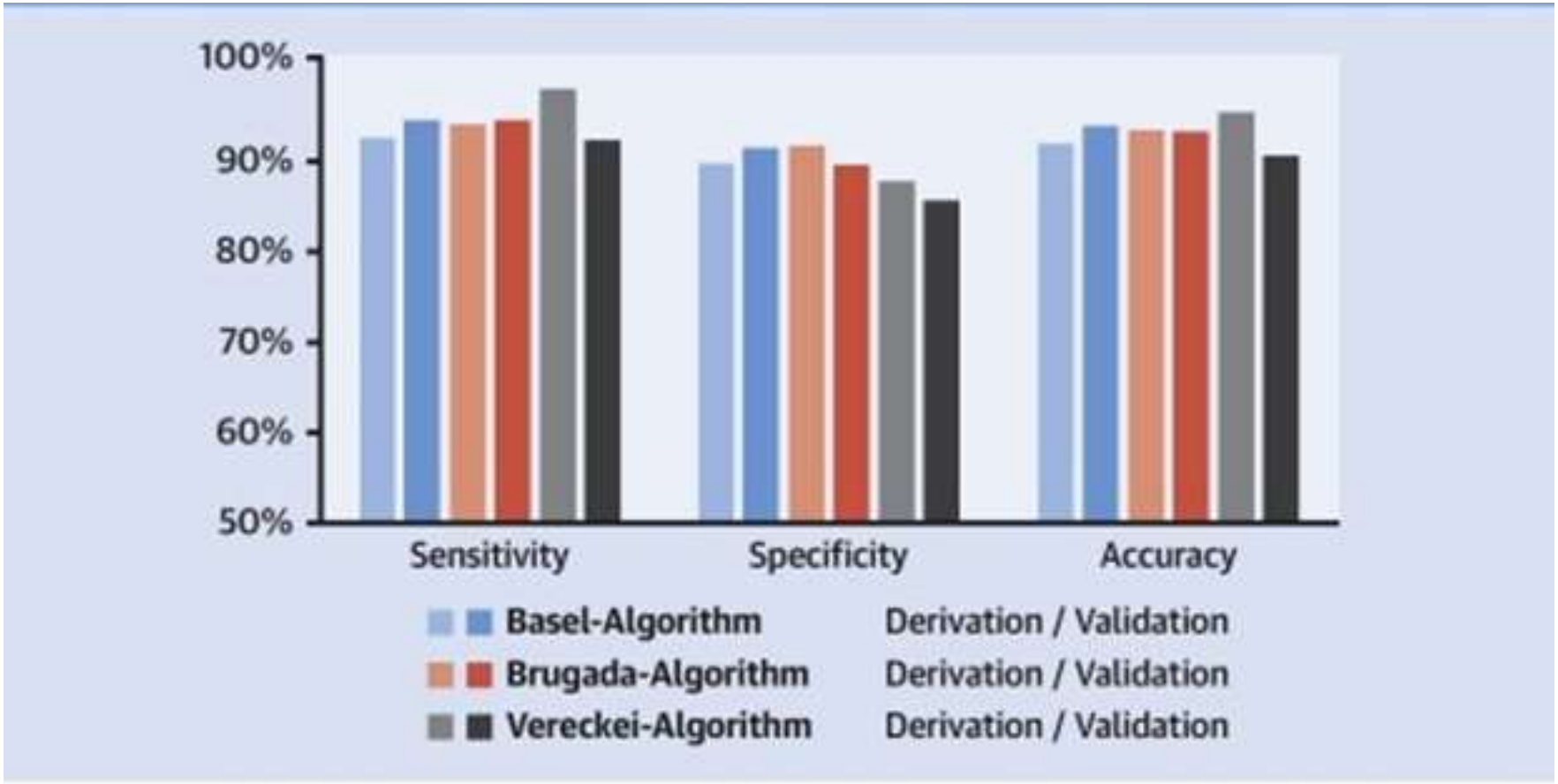
Step 4



VT

(Any +Ve sequential step suggests VT)

Comparision of Algorithm Performance



Ref : Moccetti F, et al. J Am coll Cardiol EP. 2022; 8 (7):831-839

Take Home Message

1.Initial M-to-M conduction	• **RWPT > 40 ms (lead-II and lead-aVR)**
2. The route of journey ❑ **Journey through limb leads (QRS axis)** ❑ **Journey through precordial leads**	• **North-west deviation (-90^0 to -180^0)** • **QRS contours inconsistent with aberrant conduction (V1, V6) : atypical bundle branch block** • **Absence of RS complexes in all precordial leads** • **Chest lead concordance (totally positive or totally negative)**
3. Atria/ventricles beat independently	**AV dissociation , fusion beat , capture beat**


Thanks