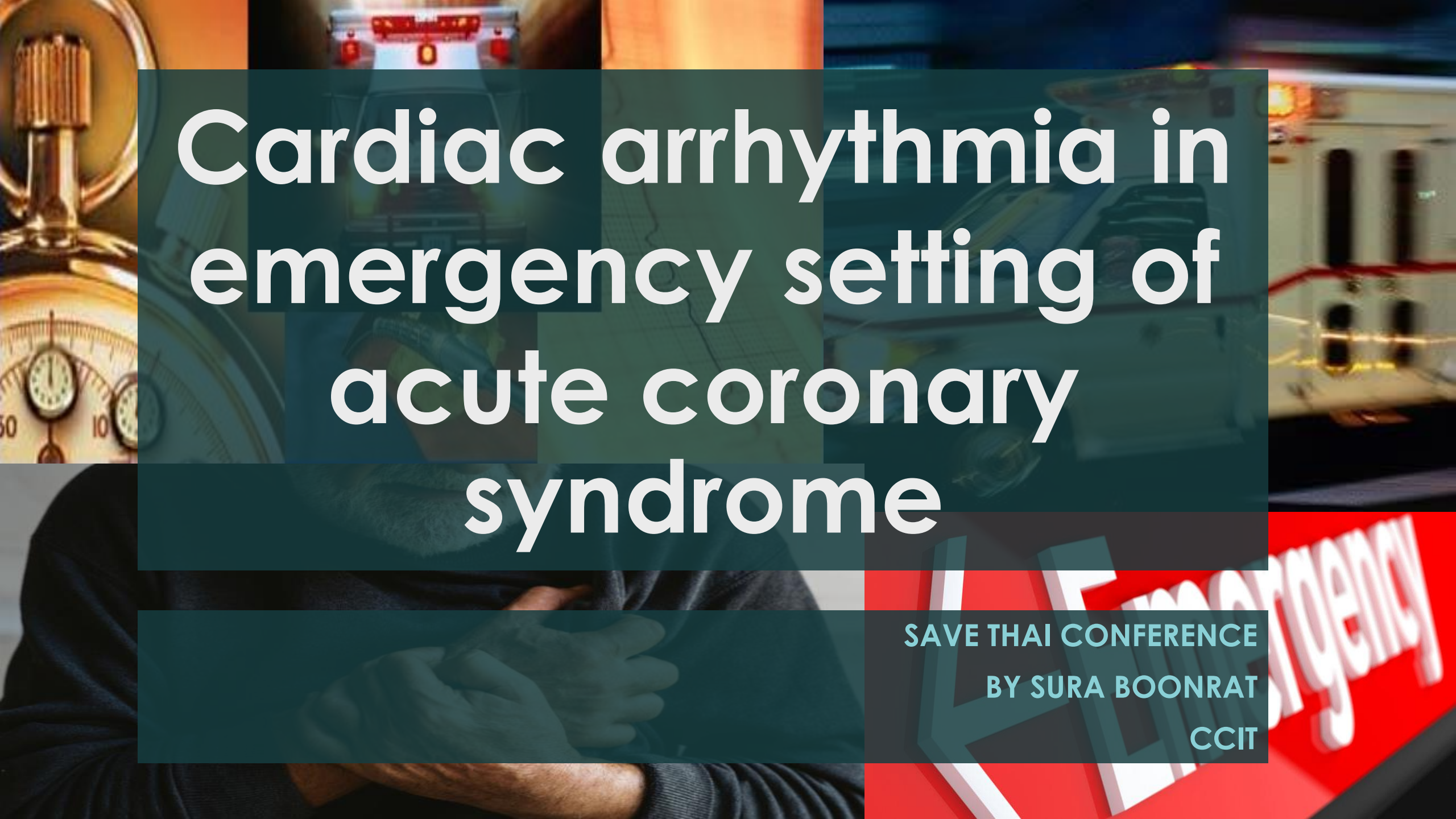


Cardiac arrhythmia in emergency setting of acute coronary syndrome

SAVE THAI CONFERENCE

BY SURA BOONRAT

CCIT

Cardiac arrhythmia in ACS

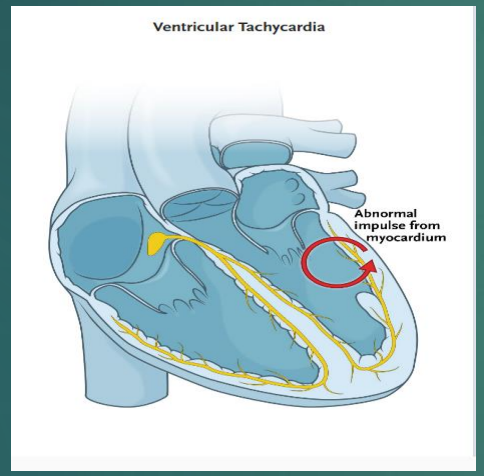
1. ***Ventricular arrhythmia***
   - Ventricular tachycardia (VT) and ventricular fibrillation (VF)

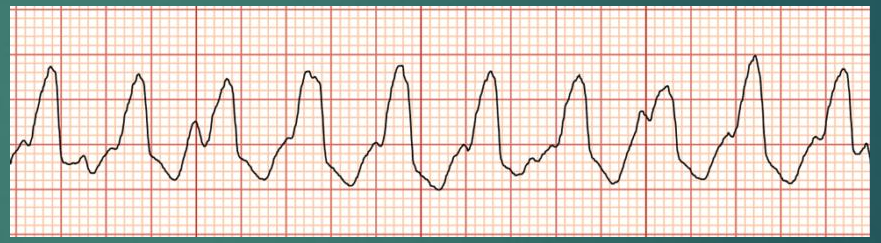
2. ***Supraventricular tachycardia***
   - Atrial fibrillation ; AF

Cardiac arrhythmia

Ventricular arrhythmia ; ventricular tachycardia (VT) and ventricular fibrillation (VF)

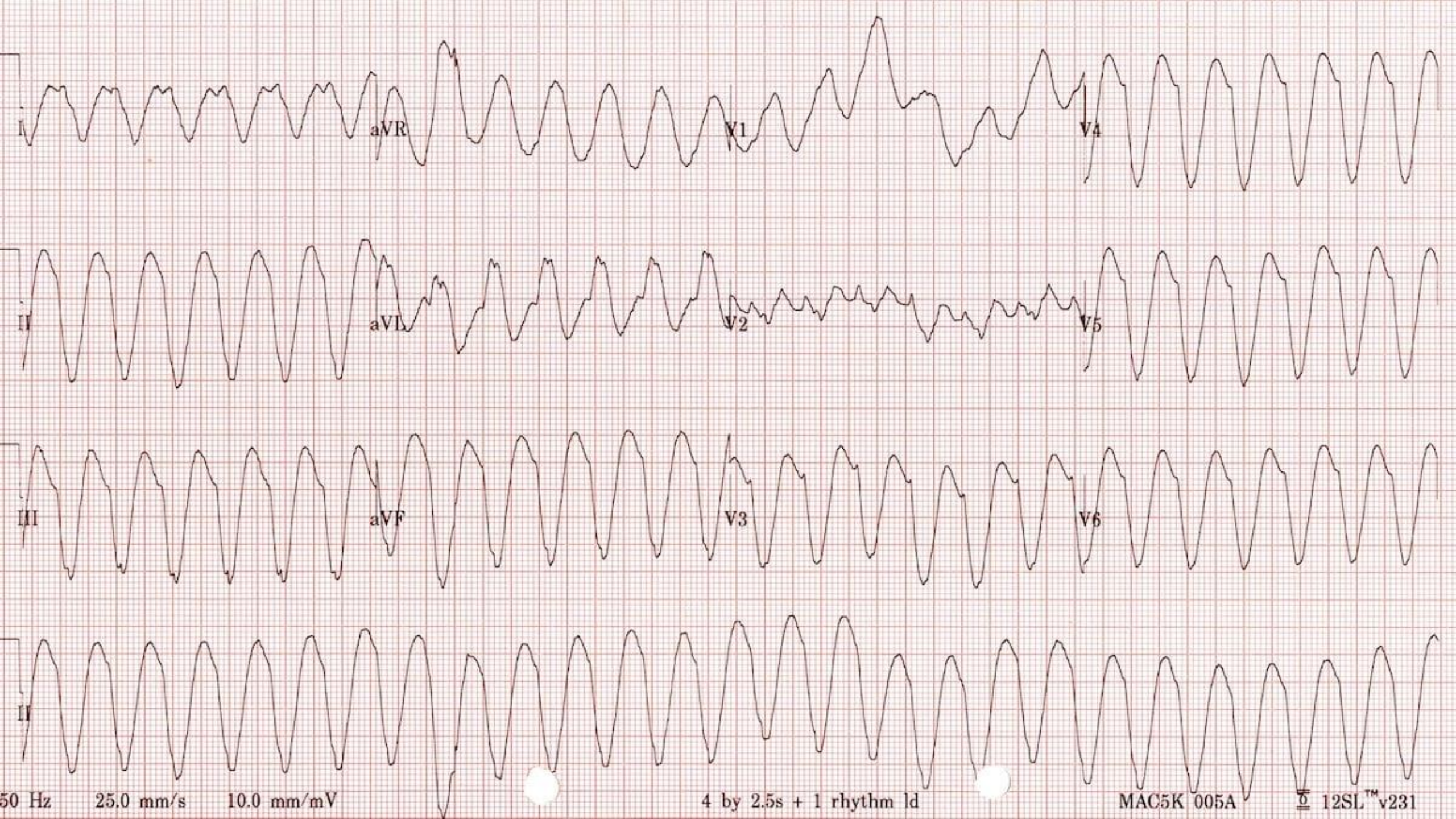
Impulse from ventricle

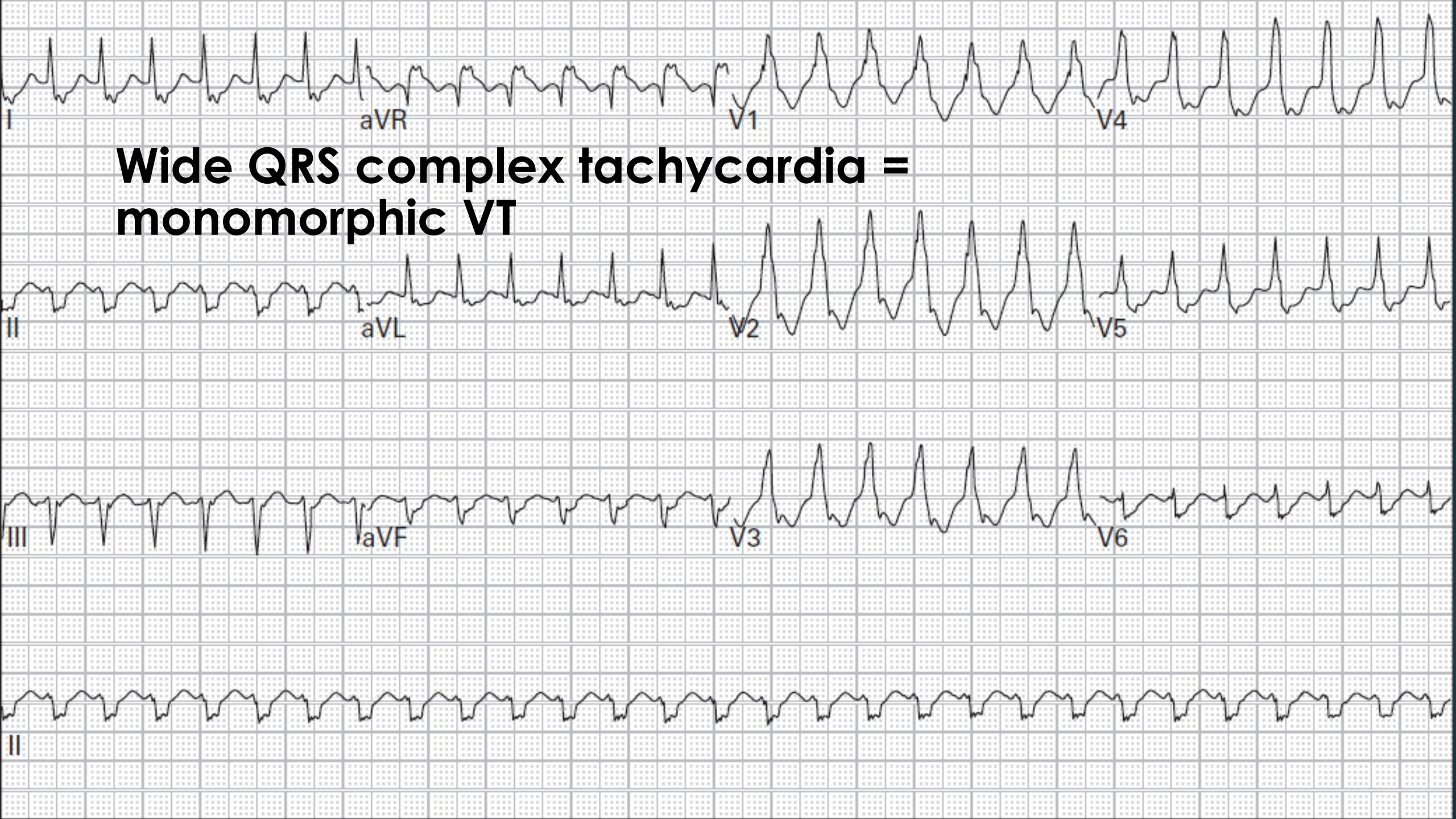




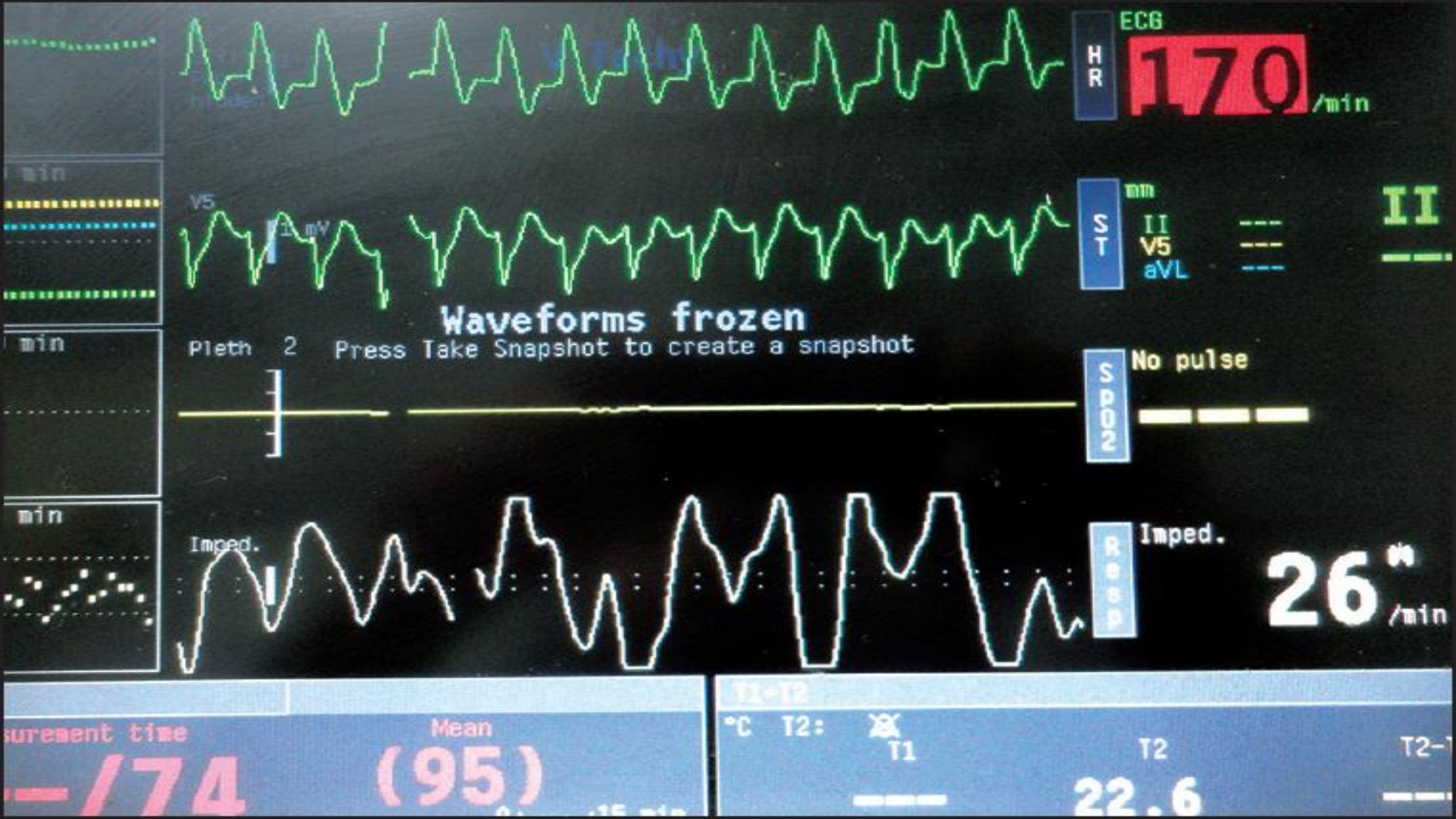
- May occur any time of MI , from early of acute MI until remote post - MI period (pre – hospital to long – term onset)
- Remains increased after MI and to be highest in first 30 days after MI
- Predictor of worse in – hospital outcome in setting of ACS

Europace (2019) 21, 1603-1604


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
50 Hz
25.0 mm/s
10.0 mm/mV
4 by 2.5s + 1 rhythm ld
MAC5K 005A
12SL™v231

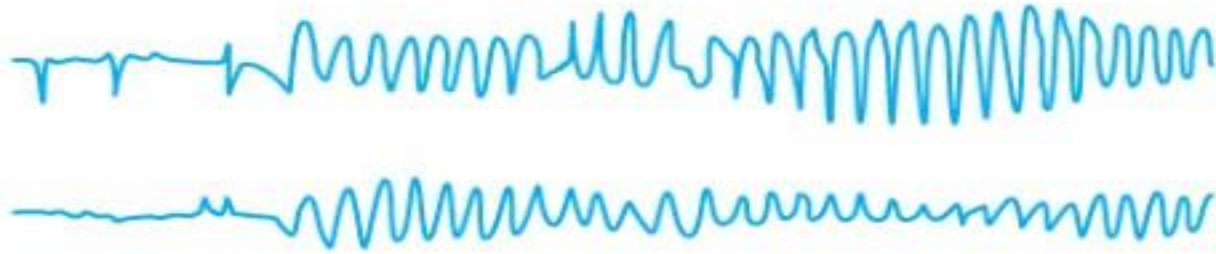


Wide QRS complex tachycardia = monomorphic VT


ECG
HR
170
/min
V5
1 mV
ST
mm
II
V5
aVL
II
Waveforms frozen
Pleth 2 Press Take Snapshot to create a snapshot
SPO2
No pulse
Imped.
RESP
Imped.
26
/min
Mean
(95)
T1-T2
°C T2:
T1
T2
22.6

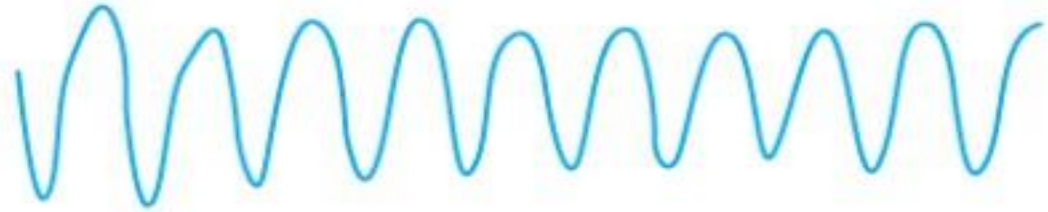
Monomorphic VT

Torsades de pointes



Polymorphic VT

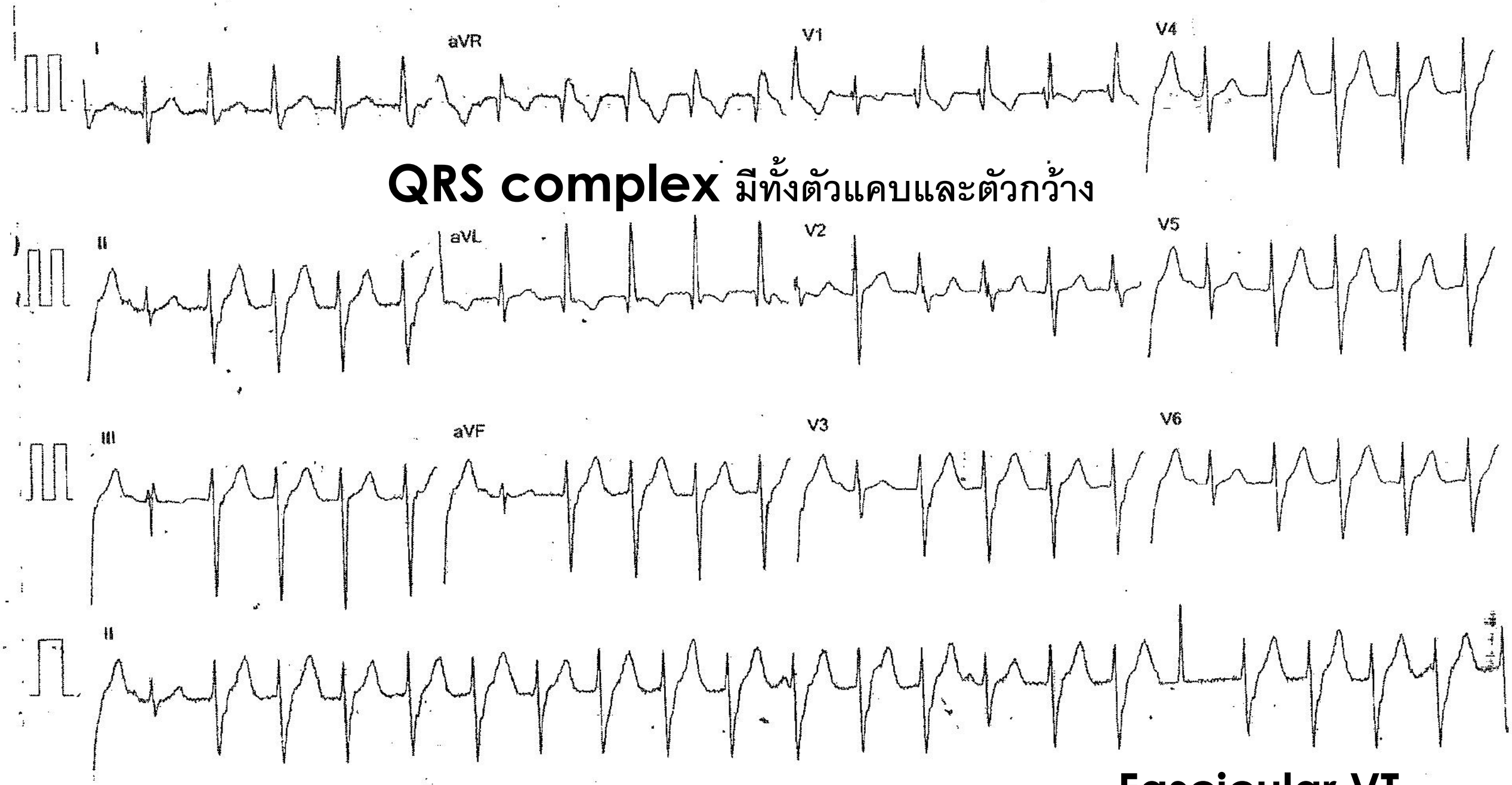
Ventricular flutter



Pleomorphic VT

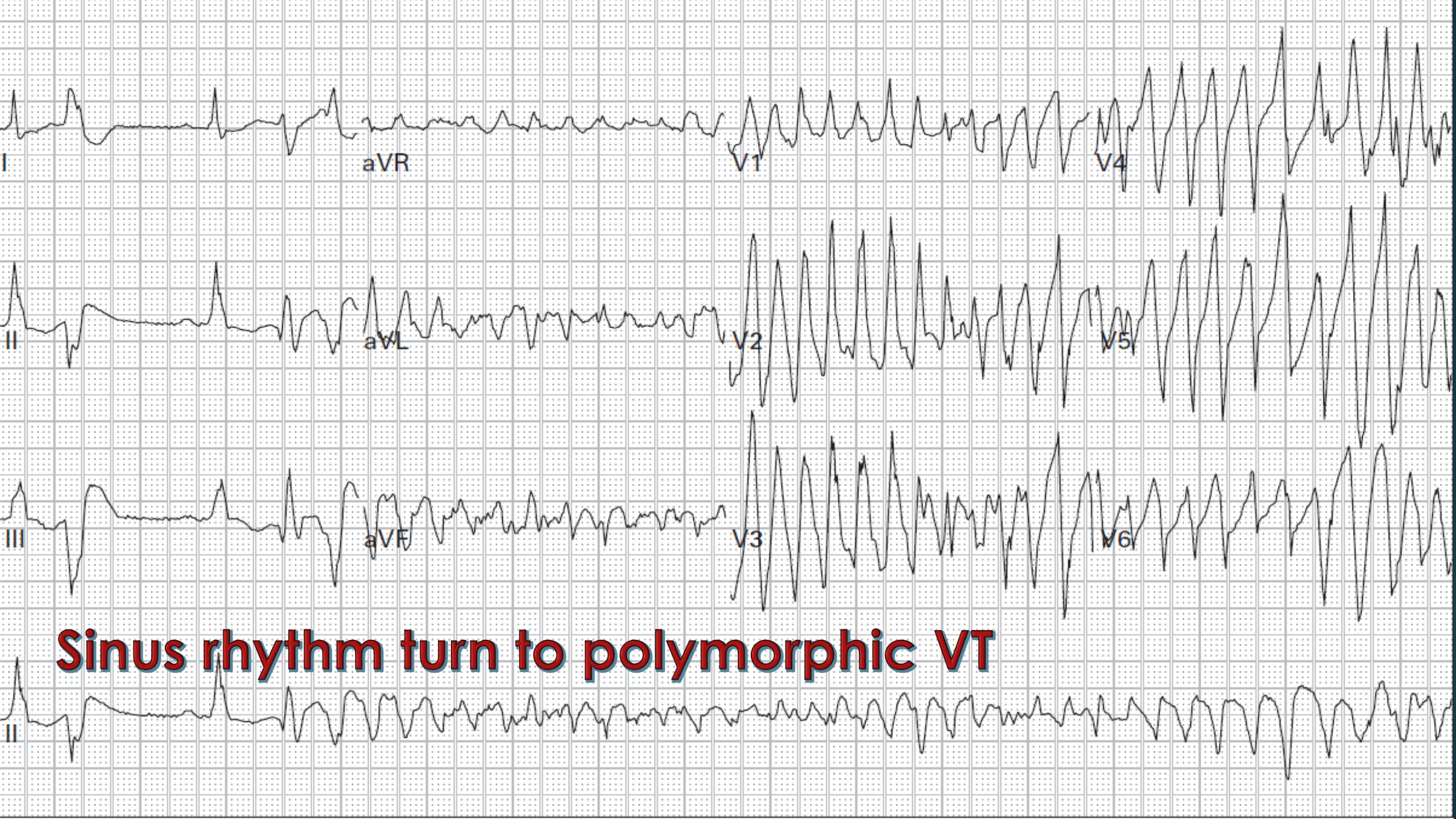
Bidirectional VT

Ventricular fibrillation



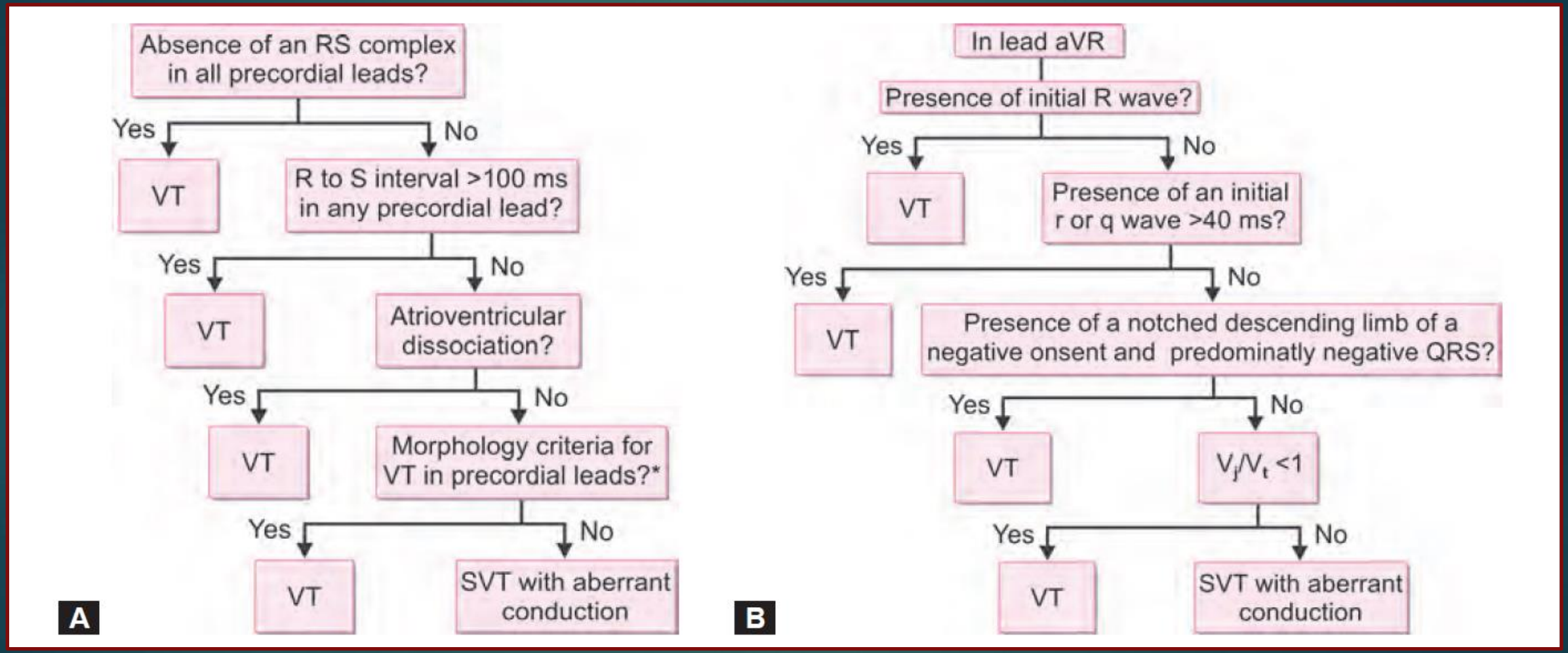
QRS complex มีทั้งตัวแคบและตัวกว้าง

Fascicular VT



Sinus rhythm turn to polymorphic VT

Criteria for ECG diagnosis of VT

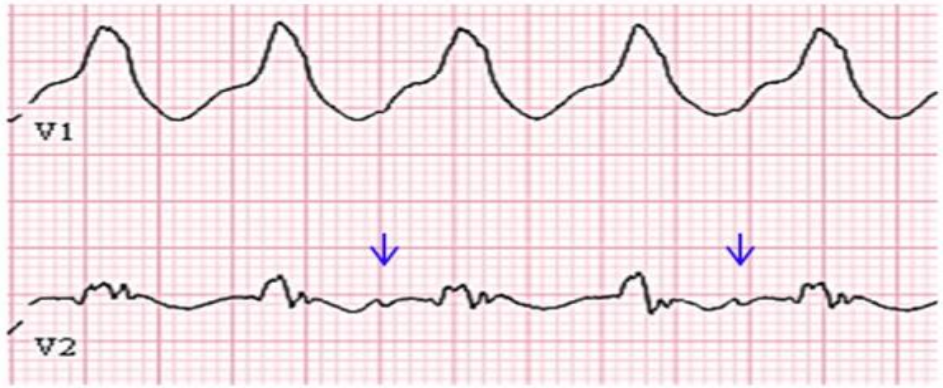


Brugada criteria

aVR criteria

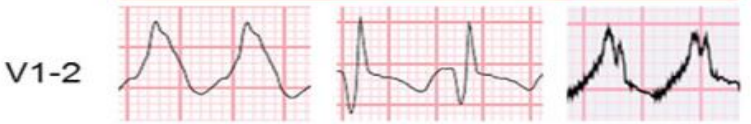
Alan S Maisel , Textbook of emergency cardiology , ISBN: 978-93-86322-24-1

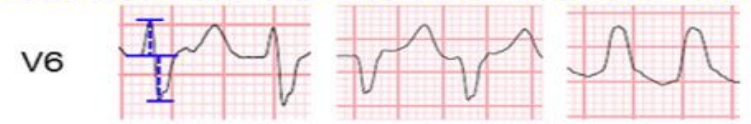
AV Dissociation



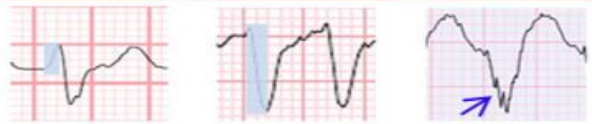
Morphological Criteria

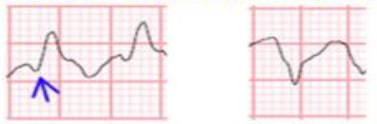
RBBB Morphology



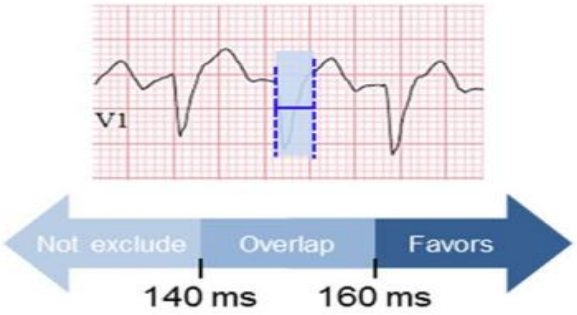


LBBB Morphology



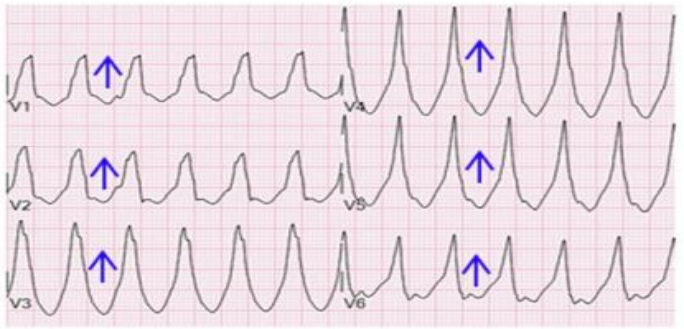


QRS Duration

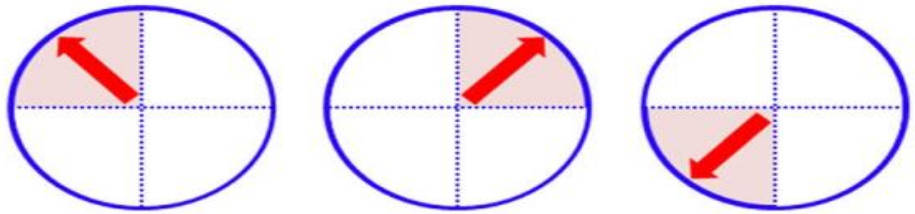


Chest Lead Concordance

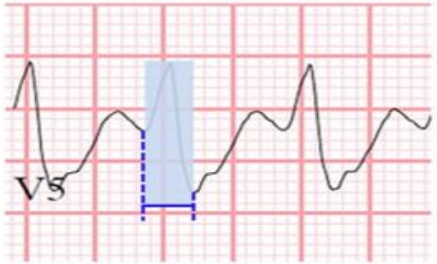
V1-6: positive or negative concordance



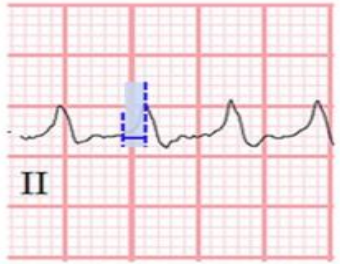
QRS Axis



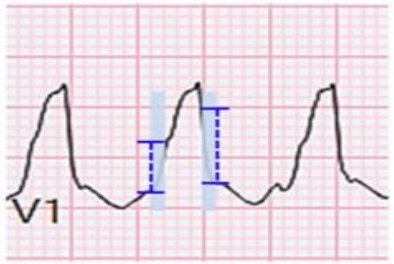
Ventricular Activation Velocity



RS interval ≥ 100 ms

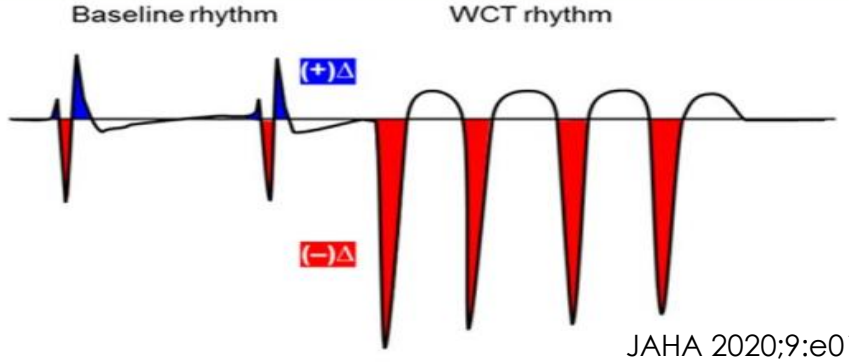


RWPT ≥ 50 ms



$V_i \leq V_t$

Baseline ECG Comparison

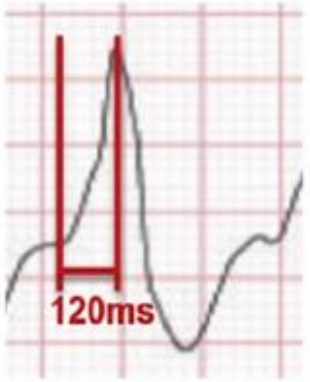


JAHA 2020;9:e016598

Novel criteria for diagnosis VT ; *Basel criteria*

Structural Heart Disease + **Lead-II** Time to First Peak > 40ms + **Lead-aVR** Time to First Peak > 40ms

Structural Heart Disease:
- Myocardial Infarction (history)
- CHF (LVEF <35%)
- Device (ICD, CRT)



≥2 criteria fulfilled -> VT

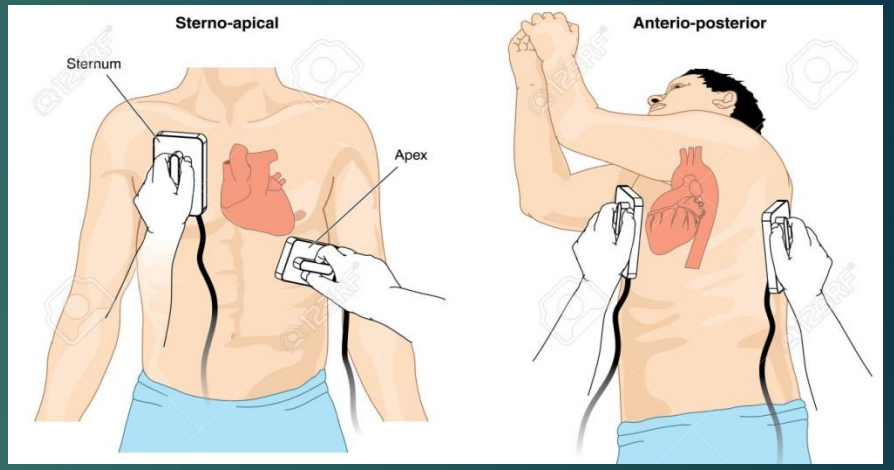
0 or 1 criteria fulfilled -> SVT

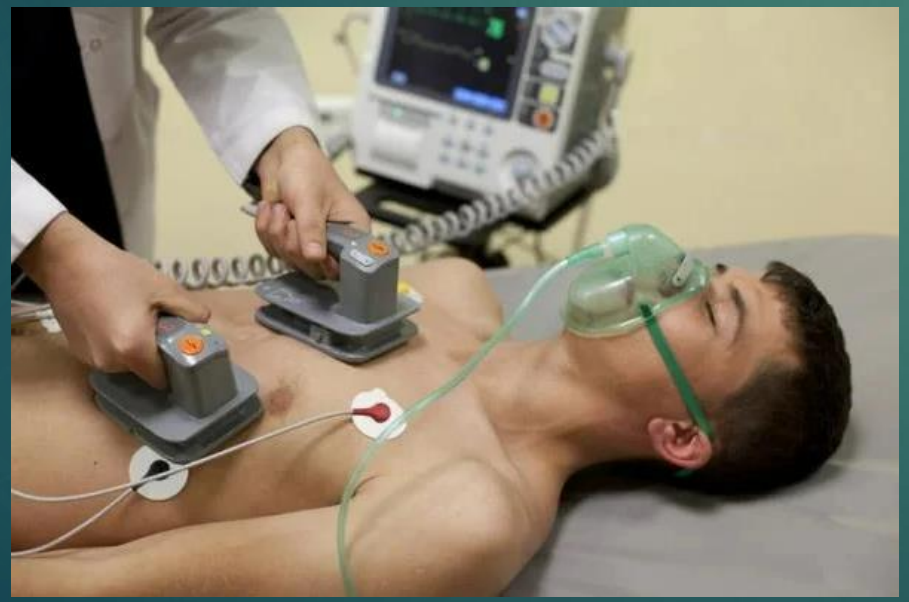
Federico Moccetti , MD , et al , The Basel algorithm , JACC clinical electrophysiology , 2022

Acute management of VT/VF in setting of ACS

- *Assessment of hemodynamic status*

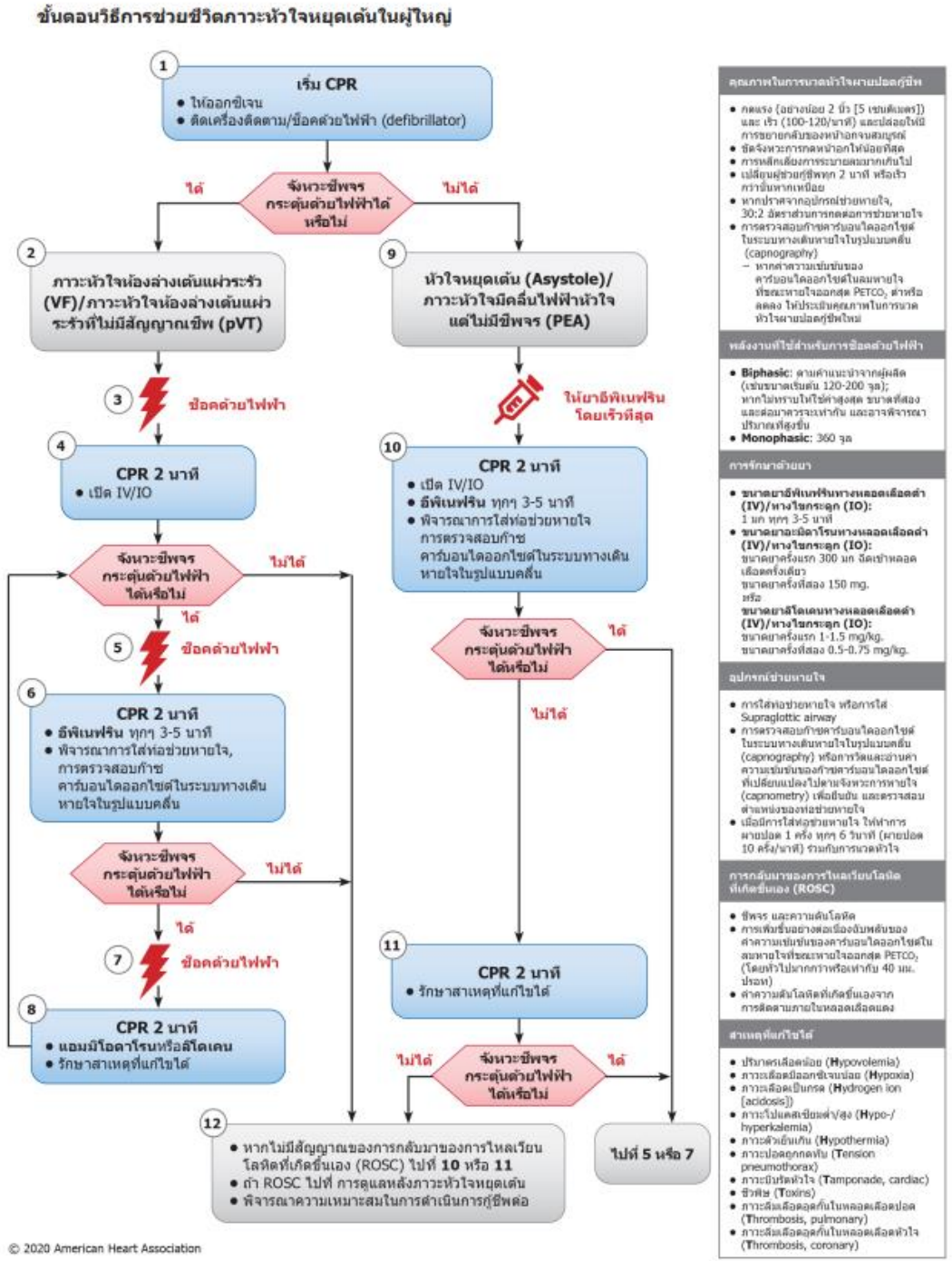
Cardioversion or Defibrillation if hemodynamic unstable





Waveform	Defibrillation energy level (Joules)
Biphasic	120–200 J for initial shock, escalate energy level for subsequent shocks (maximum dose of 360 J)
Monophasic	360 J for initial and subsequent shocks

Alan S Maisel , Textbook of emergency cardiology , ISBN: 978-93-86322-24-1



VT/VF pulseless

↓

Shock ด้วยไฟฟ้า

↓

CPR 2 นาที † เปิดเส้น IV & IO

↓

Shock ด้วยไฟฟ้า

↓

CPR 2 นาที † on ETT † medication
(epinephrine / amiodarone / lidocaine)

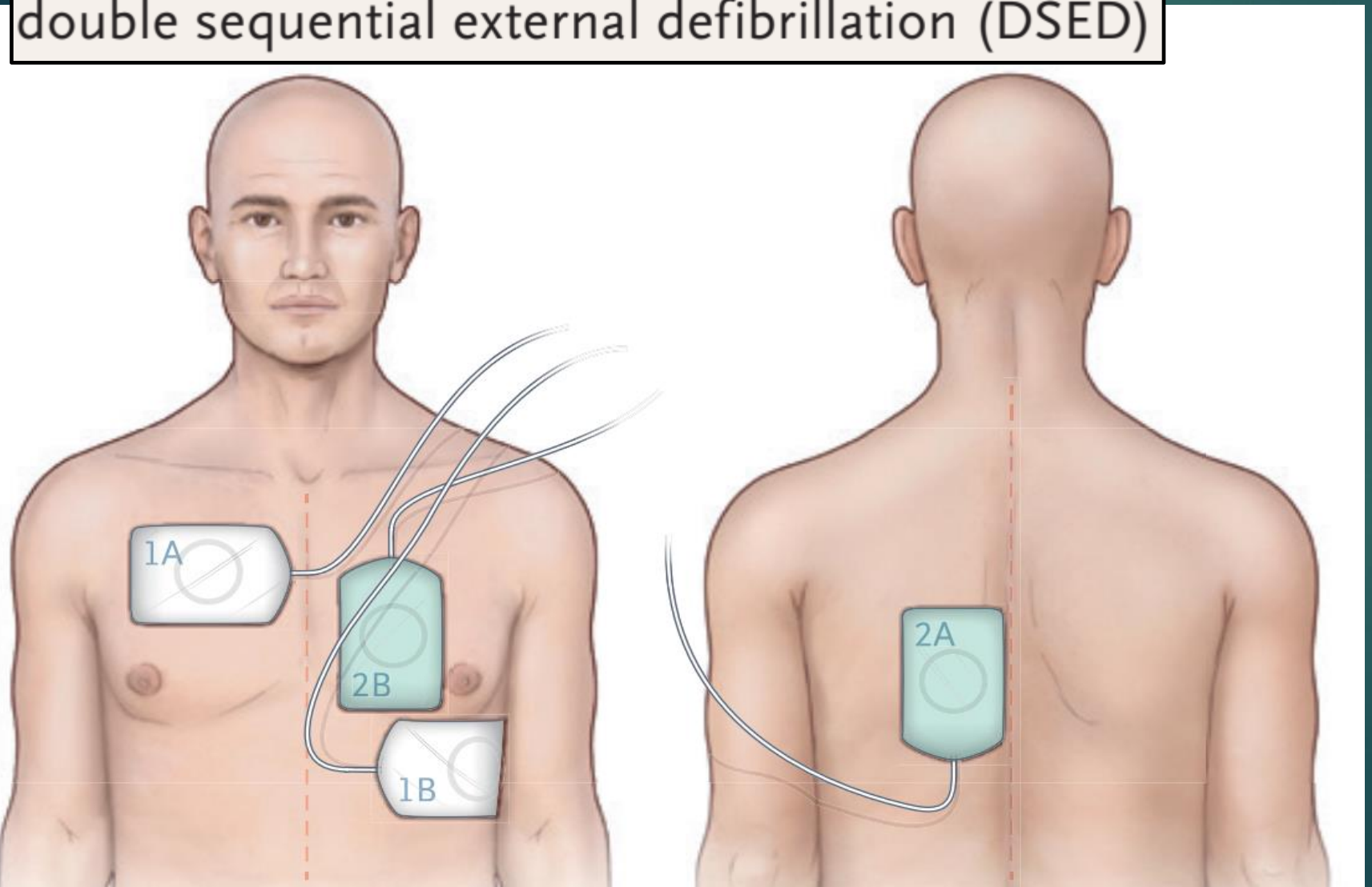
Drug Therapy

- **Epinephrine IV/IO dose:**
  1 mg every 3-5 minutes
- **Amiodarone IV/IO dose:**
  First dose: 300 mg bolus.
  Second dose: 150 mg.
  or
  Lidocaine IV/IO dose:
  First dose: 1-1.5 mg/kg.
  Second dose: 0.5-0.75 mg/kg.

Correctable causes 6H , 6T

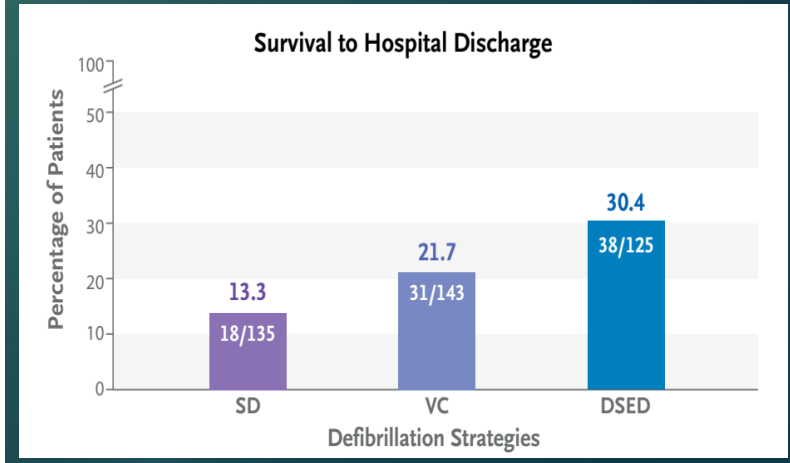
2020 ACC Guideline , Thaiheart ,.org

Defibrillation in vector change (VC) and DSED

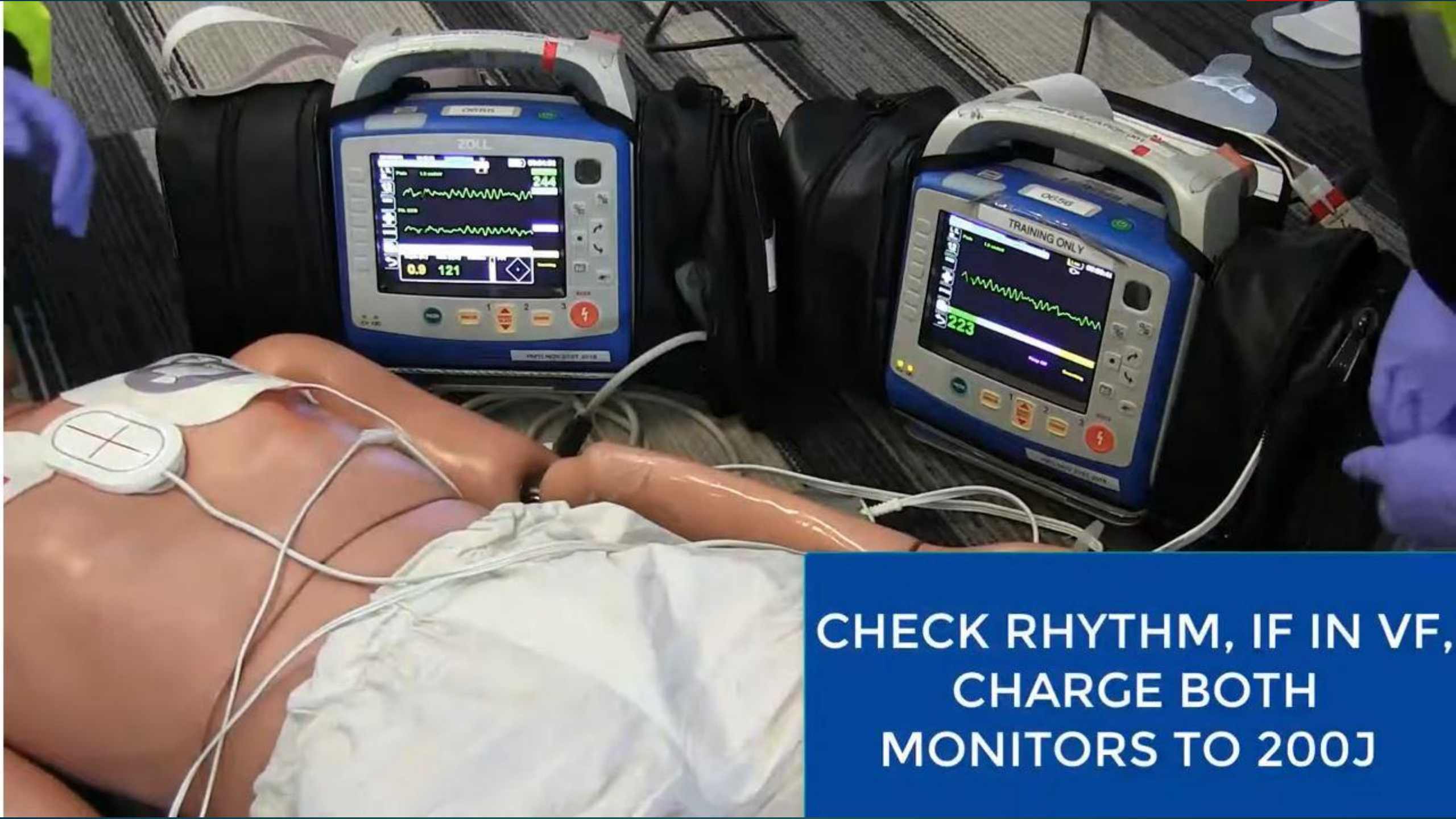


The technique for rapid sequential shocks from two defibrillators with pads in two different planes

- ✓ Anterior – lateral
- ✓ Anterior – posterior



NEJM 2022;387:1947-56


ZOLL
TRAINING ONLY
223
CHECK RHYTHM, IF IN VF,
CHARGE BOTH
MONITORS TO 200J

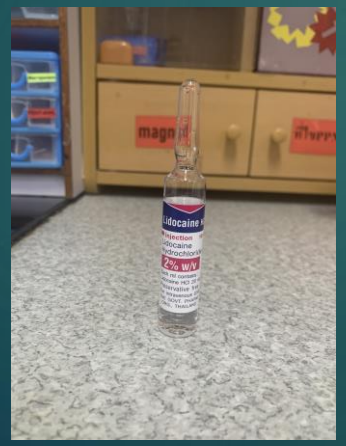
สาเหตุที่พบได้บ่อยของ cardiac arrest ที่ควรค้นหาและรักษา (6H 6T)

สาเหตุที่พบได้บ่อยใน Cardiac Arrest ที่ควรค้นหาและให้การรักษา

- Hypovolemia
- Hypoxia
- Hydrogen ion (acidosis)
- Hypo-/Hyperkalemia
- Hypoglycemia
- Hypothermia
- Thrombosis, cardiac
- Thrombosis, pulmonary
- Tamponade, cardiac
- Tension pneumothorax
- Toxins
- Trauma

Medication for VT/VF arrest

- **Epinephrine IV / IO ;** 1 mg IV q 3-5 minute (**ET** : 2-2.5 mg dilute in 5 – 10 ml NSS)
- **Amiodarone IV/ IO dose** ; 300 mg (dilute in D5W) bolus then 150 mg
- **Lidocaine IV / IO dose** ; 1-1.5 mg / kg then 0.5 – 0.75 mg / kg IV
- **Magnesium sulfate IV/IO dose** ; 1 – 2 g dilute in 10 ml of D5W

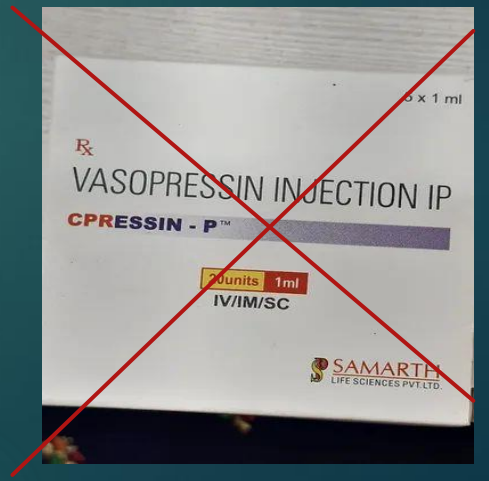


2020 ACC Guideline , Thaiheart ,.org

Recommendations for Vasopressor Management in Cardiac Arrest

COR	LOE	Recommendations
1	B-R	1. We recommend that epinephrine be administered for patients in cardiac arrest.
2a	B-R	2. Based on the protocols used in clinical trials, it is reasonable to administer epinephrine 1 mg every 3 to 5 min for cardiac arrest.
2a	C-LD	3. With respect to timing, for cardiac arrest with a nonshockable rhythm, it is reasonable to administer epinephrine as soon as feasible.
2b	C-LD	4. With respect to timing, for cardiac arrest with a shockable rhythm, it may be reasonable to administer epinephrine after initial defibrillation attempts have failed.
2b	C-LD	5. Vasopressin alone or vasopressin in combination with epinephrine may be considered in cardiac arrest but offers no advantage as a substitute for epinephrine in cardiac arrest.
3: No Benefit	B-R	6. High-dose epinephrine is not recommended for routine use in cardiac arrest.

Epinephrine 1 mg IV every 3 to 5 min for cardiac arrest



2020 ACC Guideline , Thaiheart ,.org

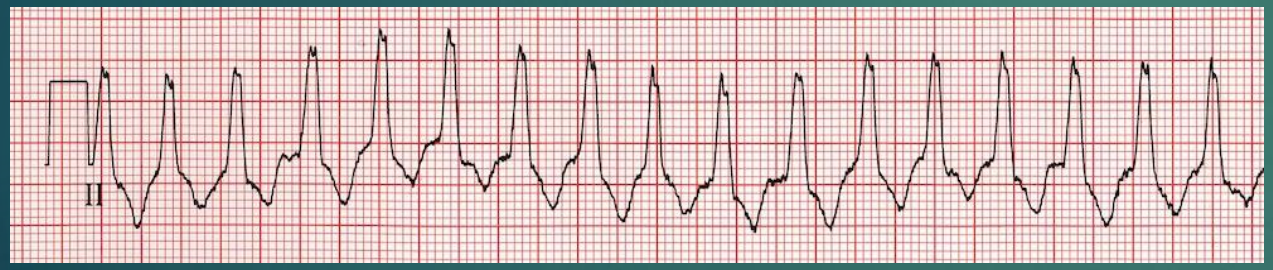
Recommendations for Nonvasopressor Medications

COR	LOE	Recommendations
2b	B-R	1. Amiodarone or lidocaine may be considered for VF/pVT that is unresponsive to defibrillation.
2b	C-LD	2. For patients with OHCA, use of steroids during CPR is of uncertain benefit.
3: No Benefit	B-NR	3. Routine administration of calcium for treatment of cardiac arrest is not recommended.
3: No Benefit	B-R	4. Routine use of sodium bicarbonate is not recommended for patients in cardiac arrest.
3: No Benefit	B-R	5. The routine use of magnesium for cardiac arrest is not recommended.

OHCA = out of hospital cardiac arrest

Out of hospital cardiac arrest

- The incidence of SCD is estimated 4.2 per 1,000 person-years and declined over time
- ¼ of OHCA victims experience cardiac arrest in setting of STEMI

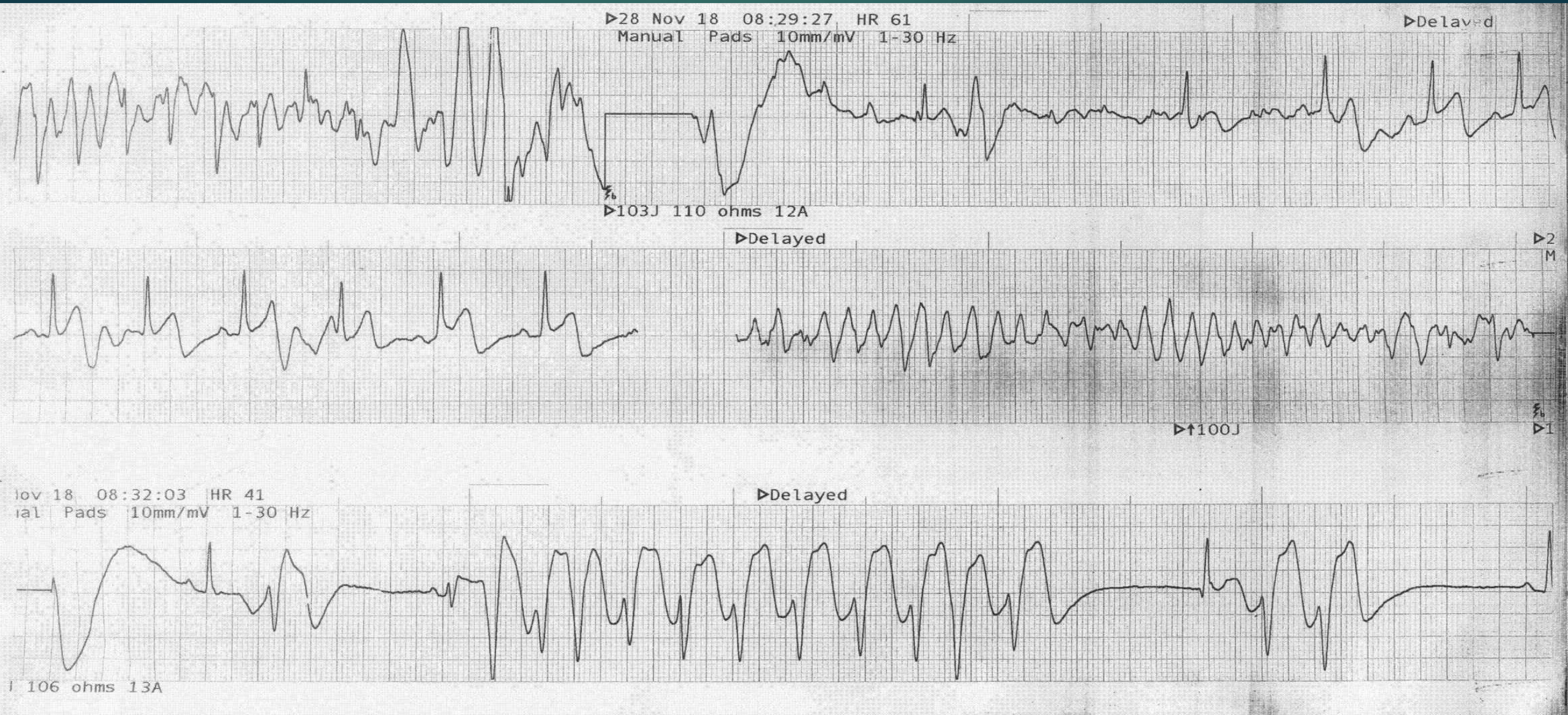


Ventricular tachy-arrhythmia ; VT and VF is most common cause

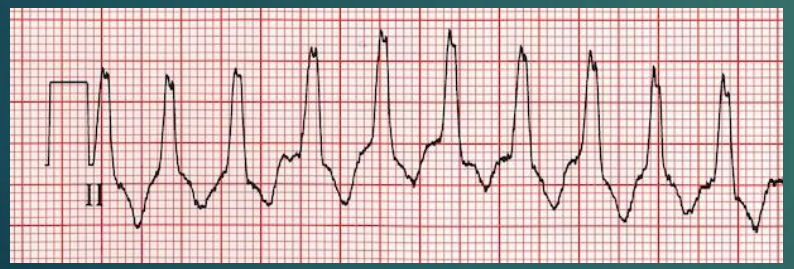
- **Life – threatening arrhythmia**

Europace (2019) 21, 1603-1604

Ventricular fibrillation – complication of STEMI



Consider refer to CAG with PCI in all VT/VF patient ?



- ✓ History of chest pain before cardiac arrest
- ✓ ECG feature of STEMI
- ✓ Cardiac Enzyme level

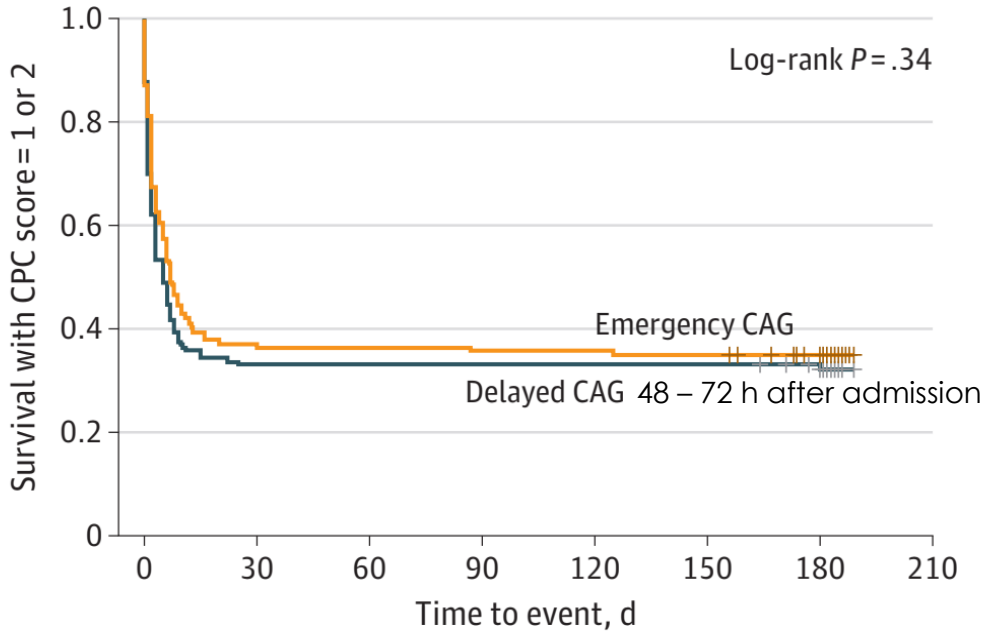
- ✓ Facility of hospital care
- ✓ Other causes of VT/VF for correctable (Electrolyte imbalance , drug induced , toxin , hypoxia etc.)

Out of hospital cardiac arrest Hub

Emergency CAG in "non – STEMI patient" : ***no benefit***

EMERGE Trial

Figure 2. Patient Survival With a Cerebral Performance Category (CPC) Score of 1 or 2

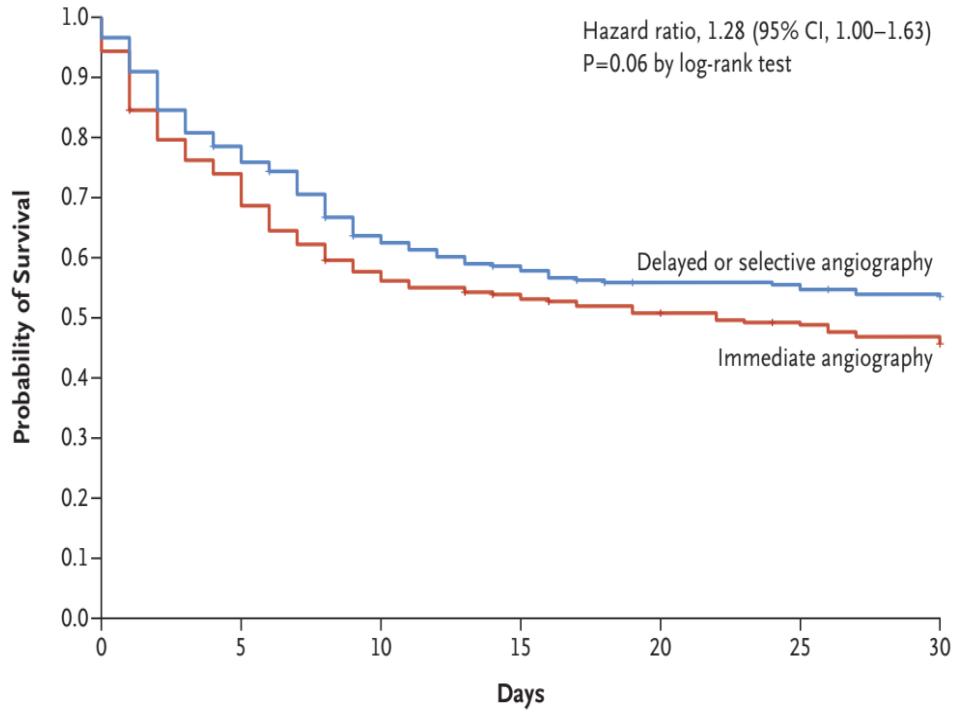


No. at risk							
Delayed CAG	137	45	45	45	45	45	41
Emergency CAG	138	51	50	49	49	48	41

CAG indicates coronary angiogram.

JAMA cardiol 2022:7(7): 700-707

TOMAHAWK



No. at Risk							
Delayed or selective angiography	265	207	163	149	139	138	133
Immediate angiography	265	195	151	138	129	123	117

Figure 1. Kaplan–Meier Estimates of Death from Any Cause at 30 Days.

Shown is the risk of death at 30 days (the primary end point) among patients who underwent either immediate angiography or delayed or selective angiography after out-of-hospital cardiac arrest without ST-segment elevation.

NEJM 2021; 385:2544-53

Reperfusion therapy

Recommendations for evaluation of sudden cardiac arrest survivors

Recommendations	Class[a]	Level[b]
Diagnostic evaluation		
The investigation of a SCA survivor without obvious extra-cardiac cause is recommended to be overseen by a multidisciplinary team.[177,251–256]	I	B
In electrically unstable patients after SCA, with suspicion of ongoing myocardial ischaemia, a coronary angiogram is indicated.	I	C

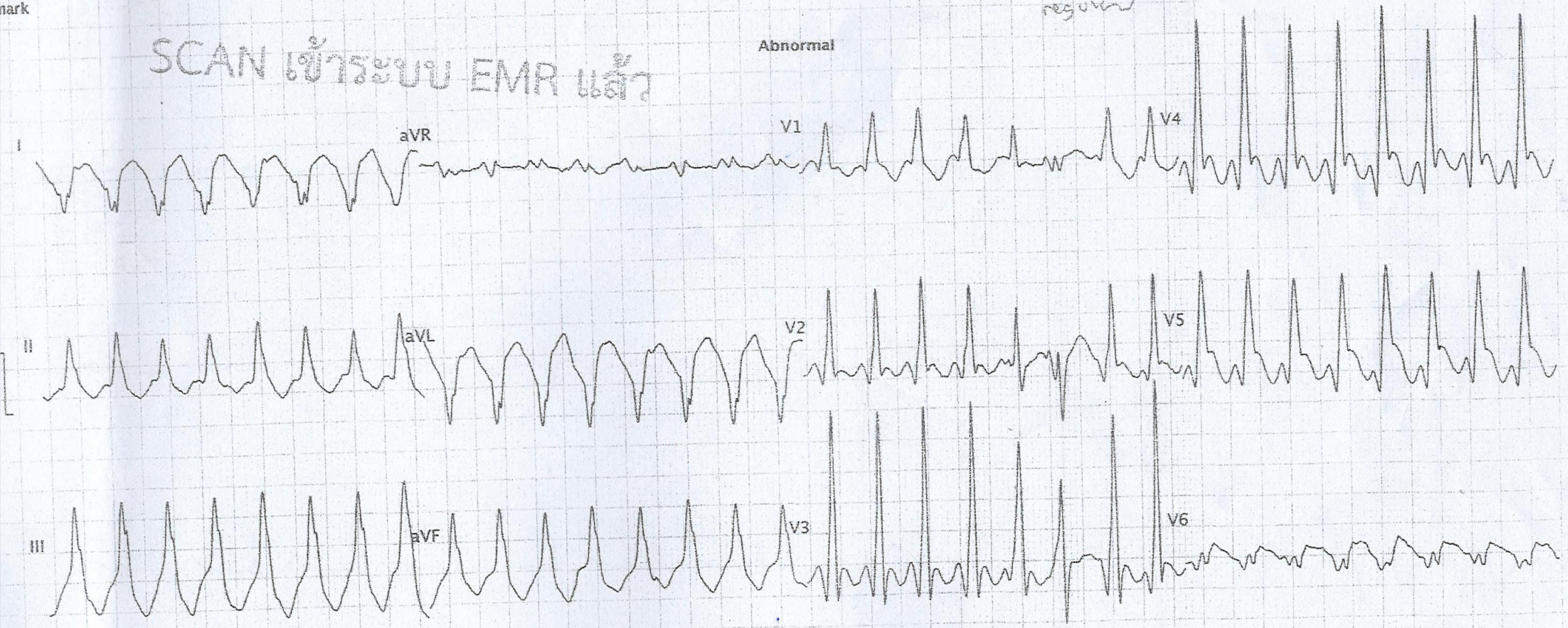
- Suspicion of ongoing myocardial ischemia , a coronary angiogram is indicated

2022 ESC Guidelines for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death , EHJ (2022) 43 , 3997-4126

ication
nark

Ref. phys.
Att. phys.

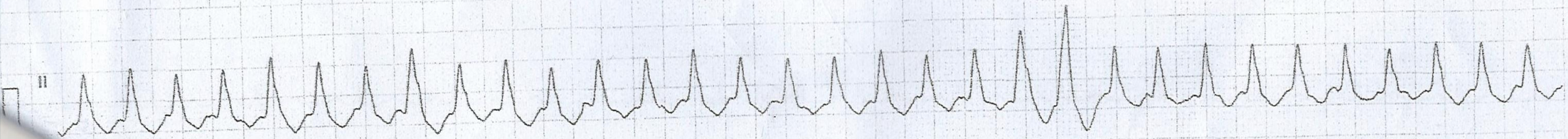
Abnormal

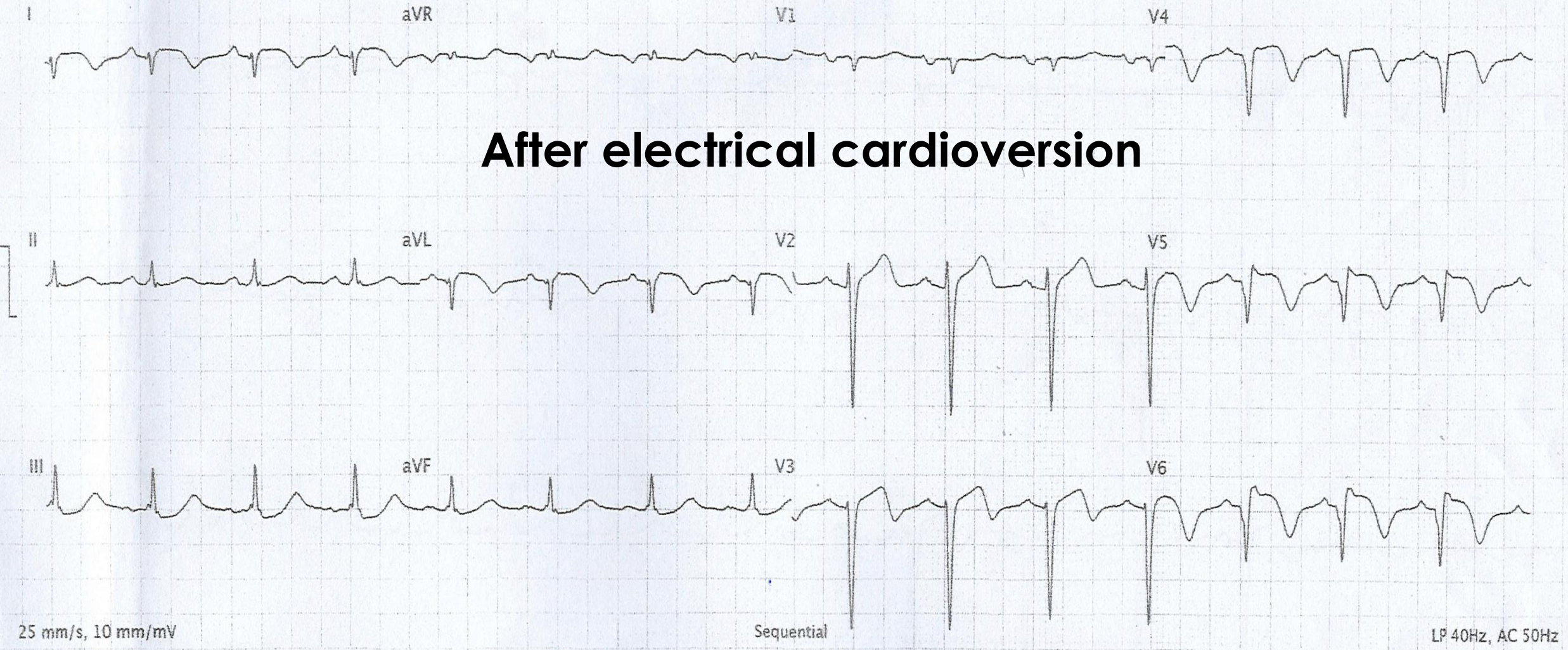


Sequential

LP 40Hz, AC 50Hz

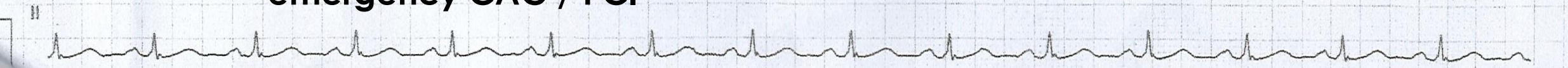
25 mm/s, 10 mm/mV



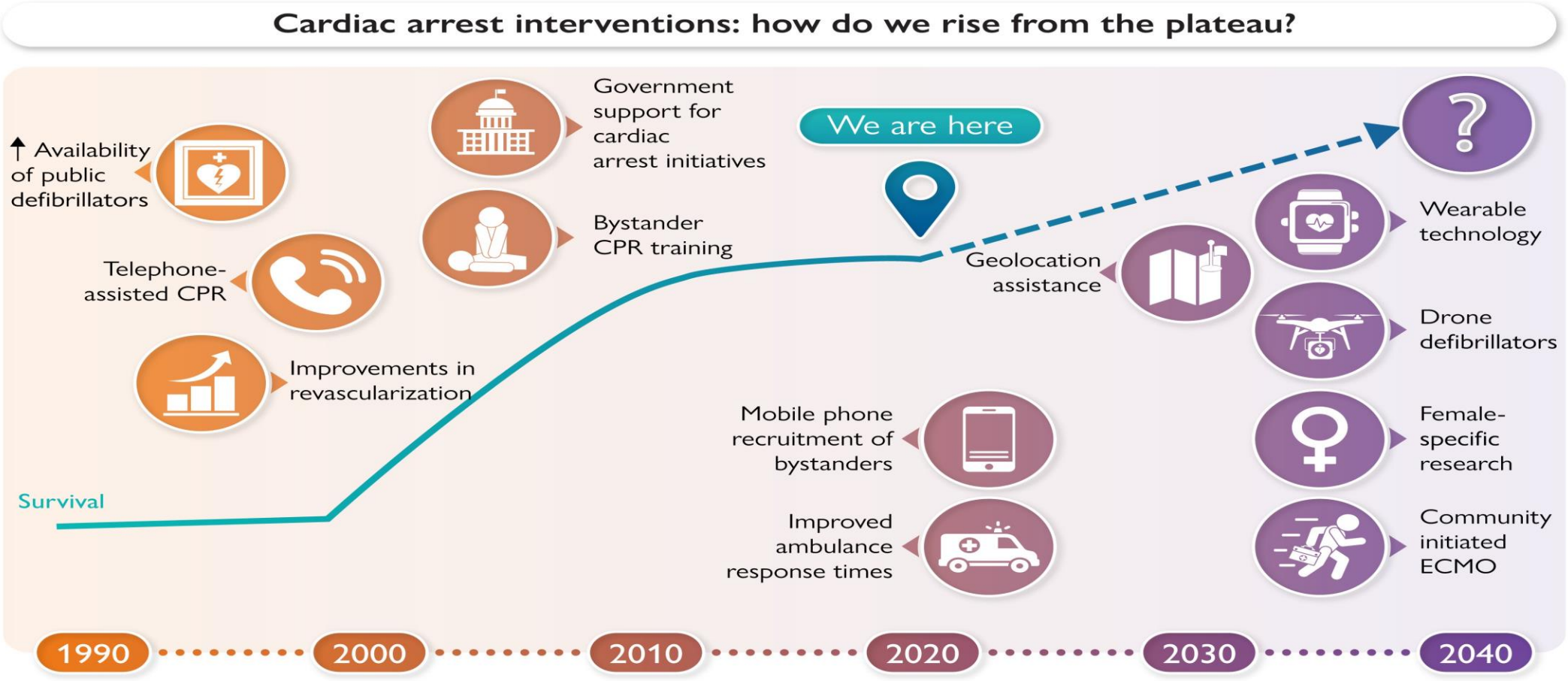


After electrical cardioversion

ST elevation in antero - lateral leads then activate Cath lab for emergency CAG / PCI

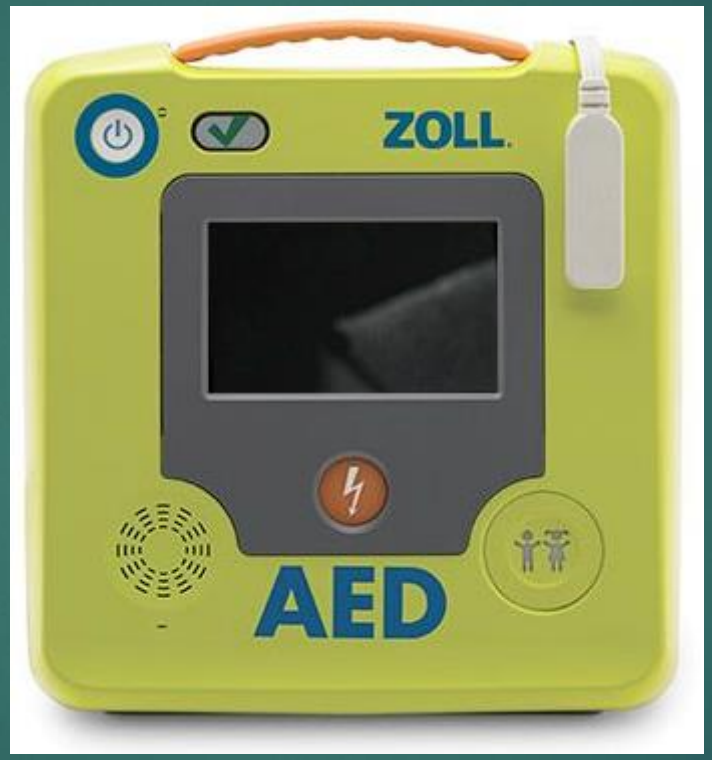


Graphical Abstract A range of public health and education strategies resulted in a marked improvement in survival in the decade ...



Eur Heart J, Volume 43, Issue 46, 7 December 2022, Pages 4830–4831,

Public – assess defibrillation and out – of – hospital arrest management



HOW TO PERFORM HEIMLICH MANEUVER FOR CHOKING

แจ้งอุบัติเหตุ หรือ เจ็บป่วยฉุกเฉิน
โทรหมายเลข
EMS 1669
บริการ 24 ชั่วโมงทั่วไทย
EMERGENCY MEDICAL SERVICES

In-hospital interventions
Novel aspects of AMI care

Pre-hospital interventions
Digital health technology-facilitated earlier EMS contact with AMI patients, rapid initiation of medical therapy and reperfusion

Community-based VF prevention
Reduce cardiac/extra-cardiac VF risk factors:
MI, diabetes, atrial fibrillation, stroke, heart failure, COPD, seizure disorder, syncope, LVH

Eur Heart J, Volume 43, Issue 47, 14 December 2022, Pages 4897–4898, https://doi.org/10.1093/eurheartj/ehac578

Management of ventricular arrhythmias in acute phase in AMI

1. Electrical cardioversion / defibrillation
2. Correction of electrolyte imbalances (hypokalemia and hypomagnesemia) is recommended in patients with VT / VF
3. Intravenous beta – blockers and/or amiodarone treatment
4. Intravenous lidocaine can be considered (as second choice) for recurrent VAs
5. Prompt and complete revascularization is recommended to treat AMI with recurrent VT/VF
6. In patients with recurrent VAs , sedation (preferably with benzodiazepines) or general anesthesia to reduce sympathetic drive should be considered

Europace (2019) 21, 1603-1604

Management of ventricular arrhythmias in acute phase in AMI

7. Temporary pacing with overdrive pacing should be considered

8. In hemodynamically unstable patients with refractory VAs , a percutaneous LVAD (ECMO) may be considered

9. Neuraxial modulation (cardiac sympathetic denervation)

Europace (2019) 21, 1603-1604

Management of ventricular arrhythmias in the acute phase of MI

Correction of electrolyte imbalances (hypokalaemia and hypomagnesaemia) is recommended in patients with VT and/or VF.

Intravenous beta-blockers and/or amiodarone treatment is indicated for patients with recurrent polymorphic VT and/or VF unless contraindicated.

Electrical cardioversion/defibrillation is the intervention of choice to promptly terminate life-threatening Vas.

Prompt and complete (even staged) revascularization is recommended to treat myocardial ischaemia presenting with recurrent VT/VF.

Intravenous lidocaine can be considered (as second choice) for recurrent VAs with haemodynamic intolerance not controlled by amiodarone, beta-blockers, or repetitive electrical cardioversion.

Overdrive pacing should be considered if VT is frequently recurrent despite anti-arrhythmic therapy and cannot be controlled by repetitive electrical cardioversion.

In hemodynamically unstable patients with refractory VAs a percutaneous LVAD (Impella, TandemHeart, or extracorporeal life support) may be considered.

In patients with recurrent life-threatening VAs sedation (preferably with benzodiazepines) or general anaesthesia to reduce sympathetic drive should be considered.

Early administration of iv beta-blockers at the time of presentation should be considered in haemodynamically stable patients.[a]

Asymptomatic, non-sustained and hemodynamically well tolerated VAs should not be treated with anti-arrhythmic drugs before reperfusion ('wait and see').

Prophylactic treatment with anti-arrhythmic drugs, with the exception of beta-blockers, is not recommended.

VT storm (incessant VT)

- **Definition ;**

- ***Occurrence of two or more ventricular tachycardia/ventricular fibrillation(VT/VF) episodes within 24 h***
- ***Or AICD therapy at least 2 or 3 episodes in 24 hours***

- High mortality risk and increase rate of hospitalization

Dongsheng Gao and John L. Sapp , Electrical storm: definitions , clinical importance , and treatment , Current opinion , Vol 28 , Number 1 , January 2013

Management of VT/VF storm

Intensive care unit admission
Device reprogramming (in AICD patient)
Correct underlying problems (ischaemia, electrolyte disturbances, pro-arrhythmic drugs)
Beta-blockade
Antiarrhythmic therapy
Sedation, intubation/deep sedation
Mechanical haemodynamic support (intra-aortic balloon pump)
Neuraxial modulation (thoracic epidural anesthesia, cardiac sympathetic denervation)
Catheter ablation (any time it is feasible)

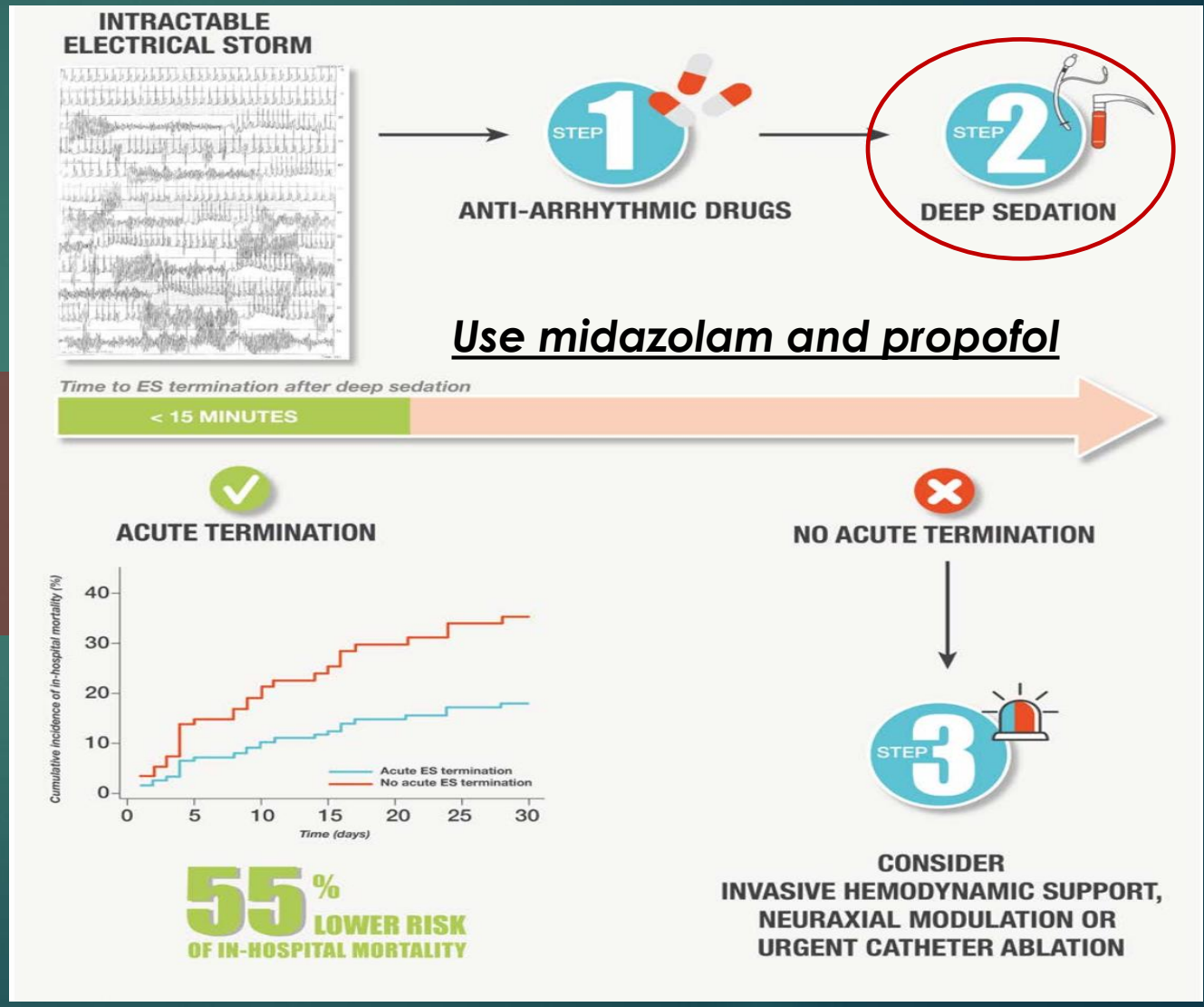
Temporary pacing for bradycardia – induced VT

EHRA/HRS/APHRS Expert Consensus on ventricular arrhythmias, 2014

Sedation / Intubation / deep sedation

To decrease sympathetic stimulation

Admit CCU / ICU



Circulation , 2020 ; 142:1599-1601

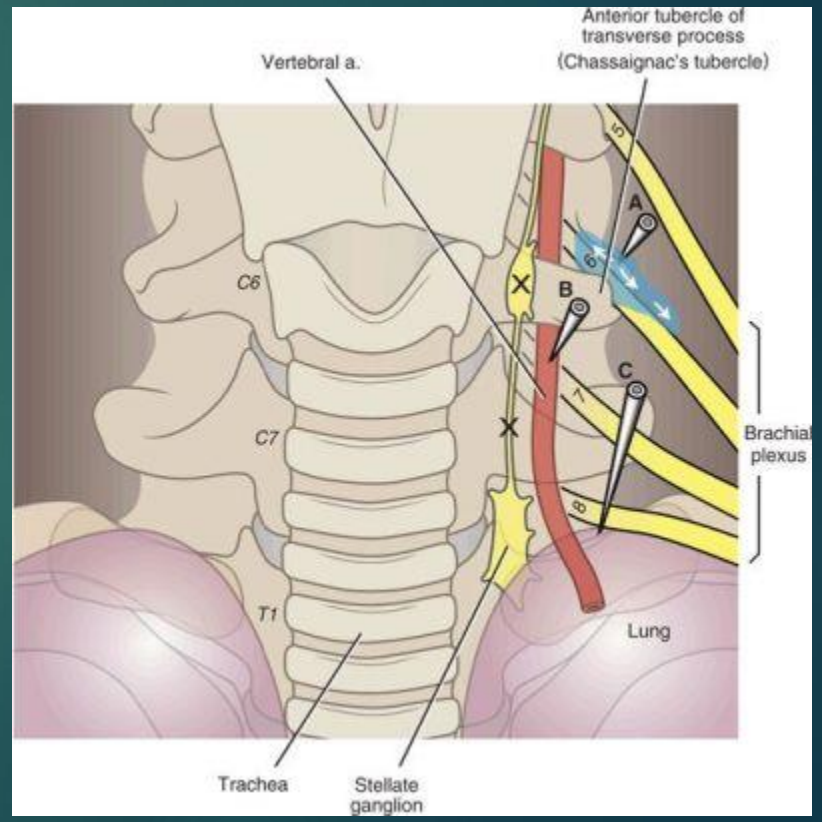
Cardiac sympathetic denervation

- Percutaneous stellate ganglion blockade

Efficacy of various drugs used for stellate ganglion block

Drug	*n*, patients	Concentration	Volume	Duration of effect
Bupivacaine	16	0.25-0.5%	9 +/- 5 ml	6 hrs – 1 week
Ropivacaine	11	0.2%	6 +/- 6 ml	6 - 24 hours
Lidocaine	9	1-4%	8 +/- 4 ml	8 – 18 hours

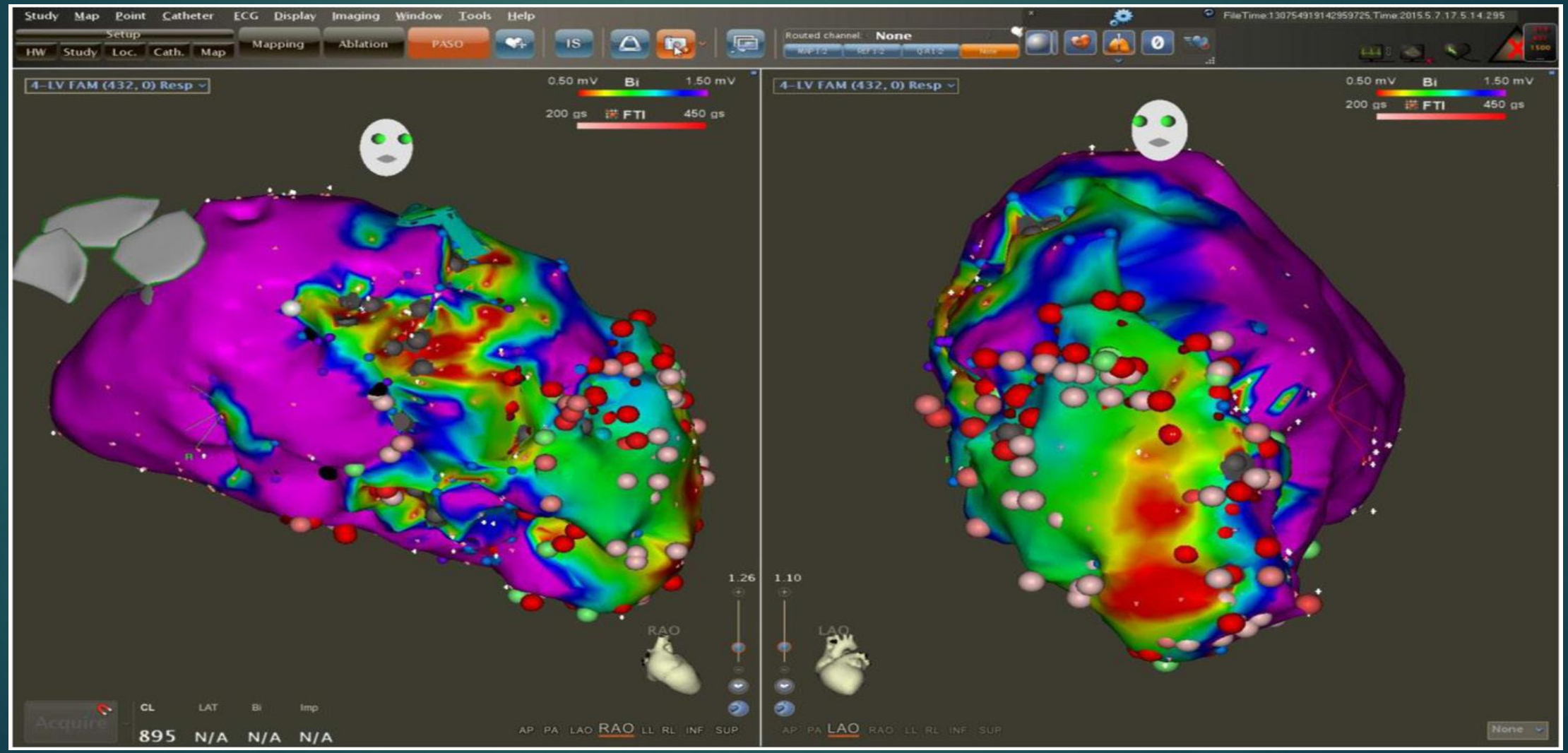
Data from a systematic review of case reports by Meng et al 2017 (PMID 29270467). Long duration of effect might be explained by ability to lyse an episode of storm. However, publication bias is also possible and could exaggerate the benefit of this intervention.
The Internet Book of Critical Care



- Thoracic epidural anesthesia

Lhab Elsokkari , et al , Electrical storm: prognosis and management , Progress in cardiovascular disease 66(2021) 70-79

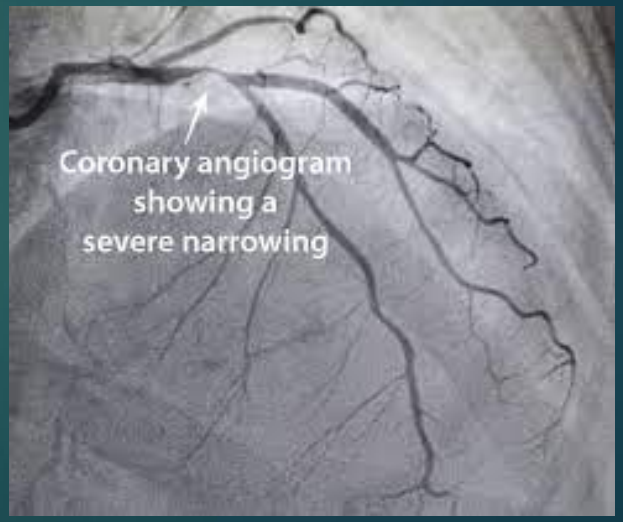
Electroanatomic mapping of endocardial scar in a patient with ischemic cardiomyopathy due to a large anteroseptal infarction



Jason T. Jacobson, Sei Iwai and Wilbert Aronow , Current Approaches to Treatment of Ventricular Arrhythmias in Patients with Coronary Artery Disease

Case study

- Patient 55 year old
- Presented of STEMI of anterior wall
- Emergency PCI to LAD as culprit lesion within 6 hour after transfer to CCIT



- 1 day after PCI , he developed VT storm in CCU
- Fellow notification for treatment

1. Sedate patient with anesthetic drugs ; Dormicum and Fentanyl IV , on ETT tube with ventilator support

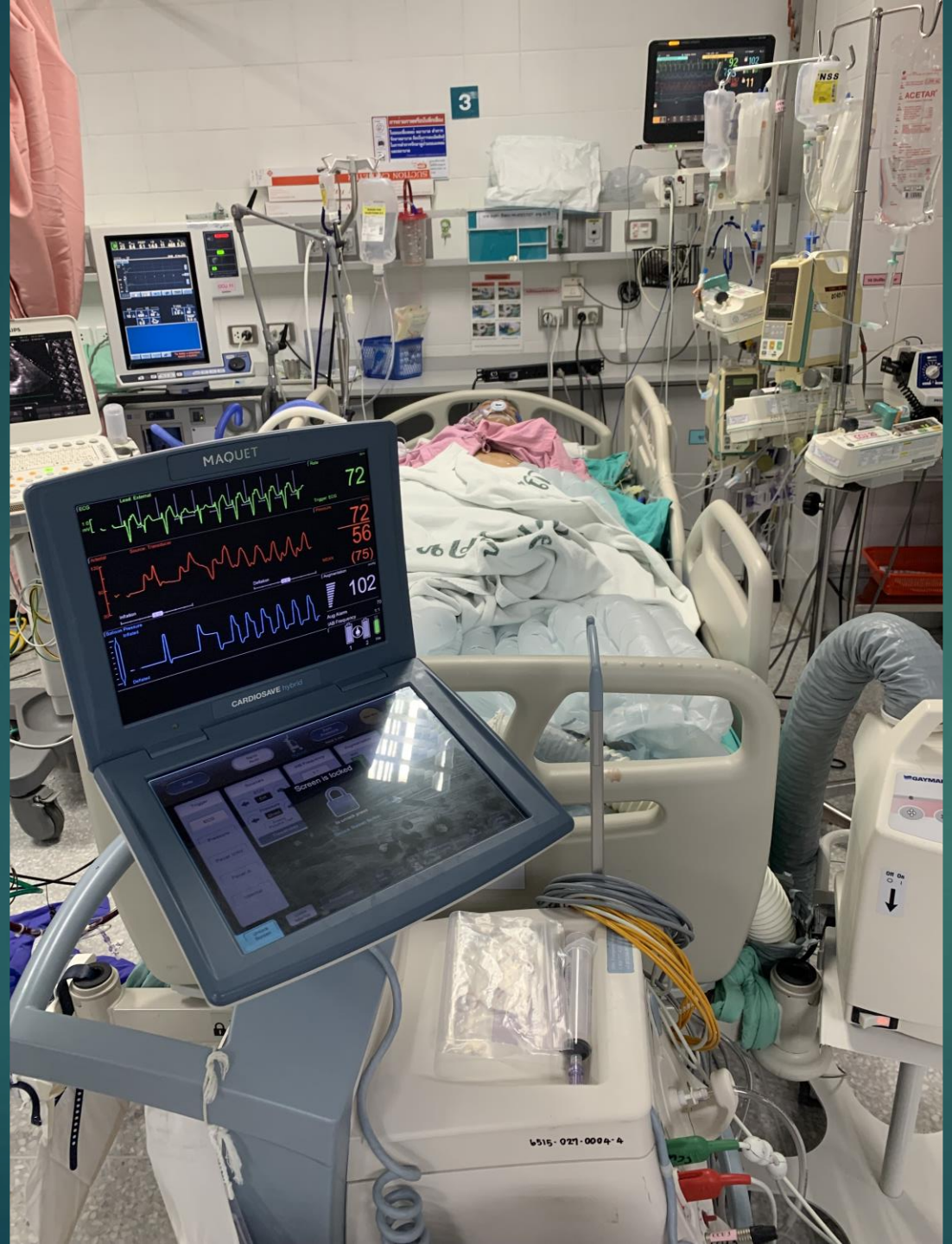
2. Amiodarone and lidocaine continuous drip

3. Temporary pacing insertion for overdrive pacing

ECMO placed by CVT team

ECMO =Extracorporeal membrane oxygenation


2
3
EcMo
PHILIPS



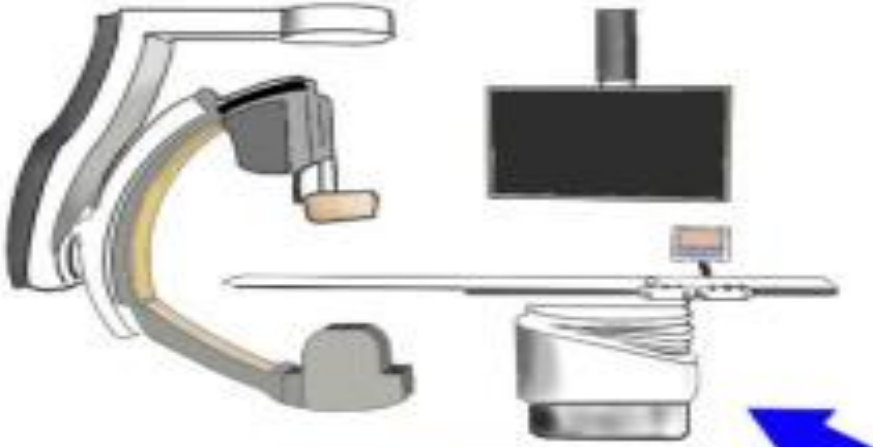
On IABP right femoral artery


3
PHILIPS


2
3
EcMo
PHILIPS
SUCTION CATHETER

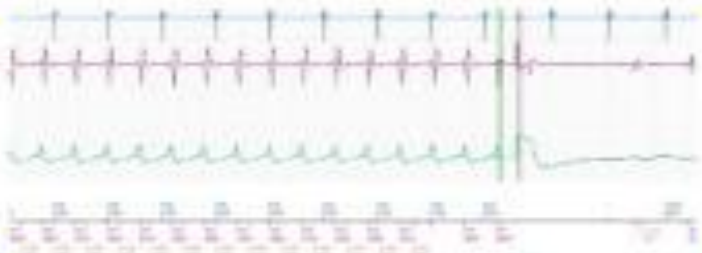
Progress note

- After 4 days of ECMO , VT was disappeared , then the ECMO was removed
- Patient sent to re – CAG and PCI to another coronary vessel for complete revascularization
- Continue amiodarone and additional carvedilol
- Consider AICD implantation



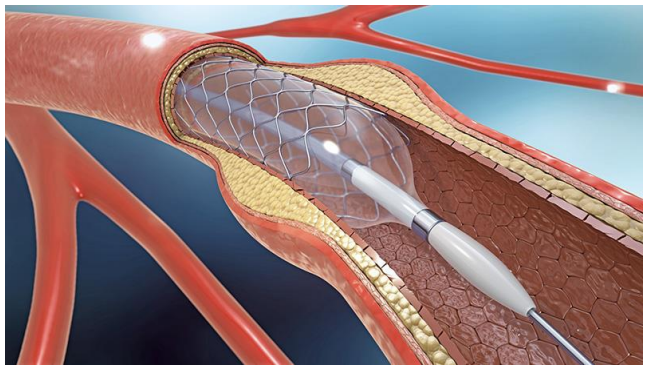
Ablation

ICD Reprogramming



VT Storm

Sedation, Autonomic Modulation



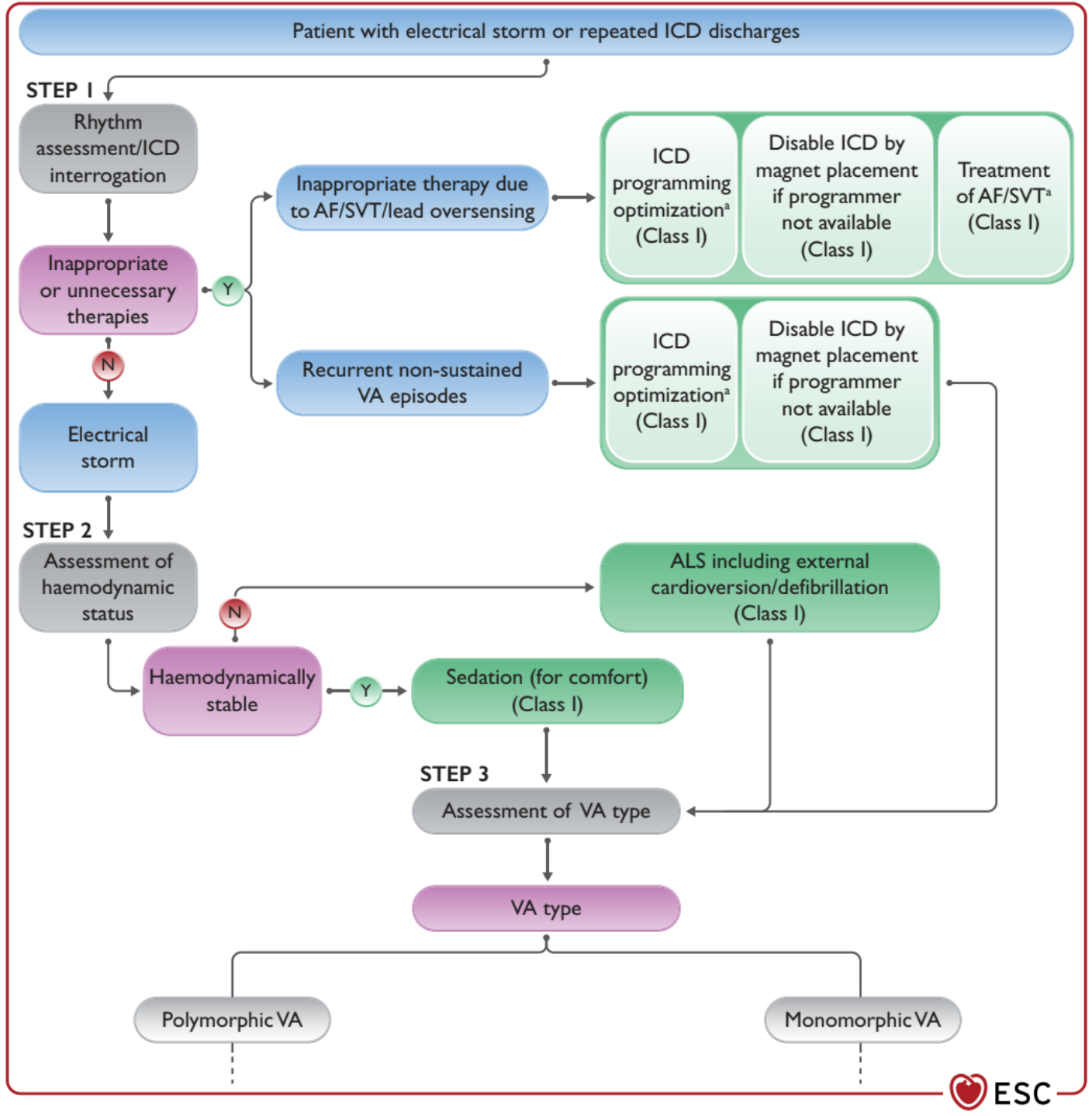
CAG / PCI if indicated

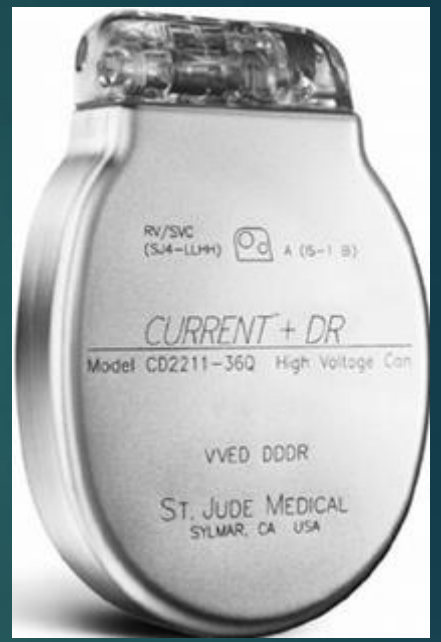
Antiarrhythmic Drugs

Progress in cardiovascular disease , Vol 66 , May–June 2021, Pages 70-79

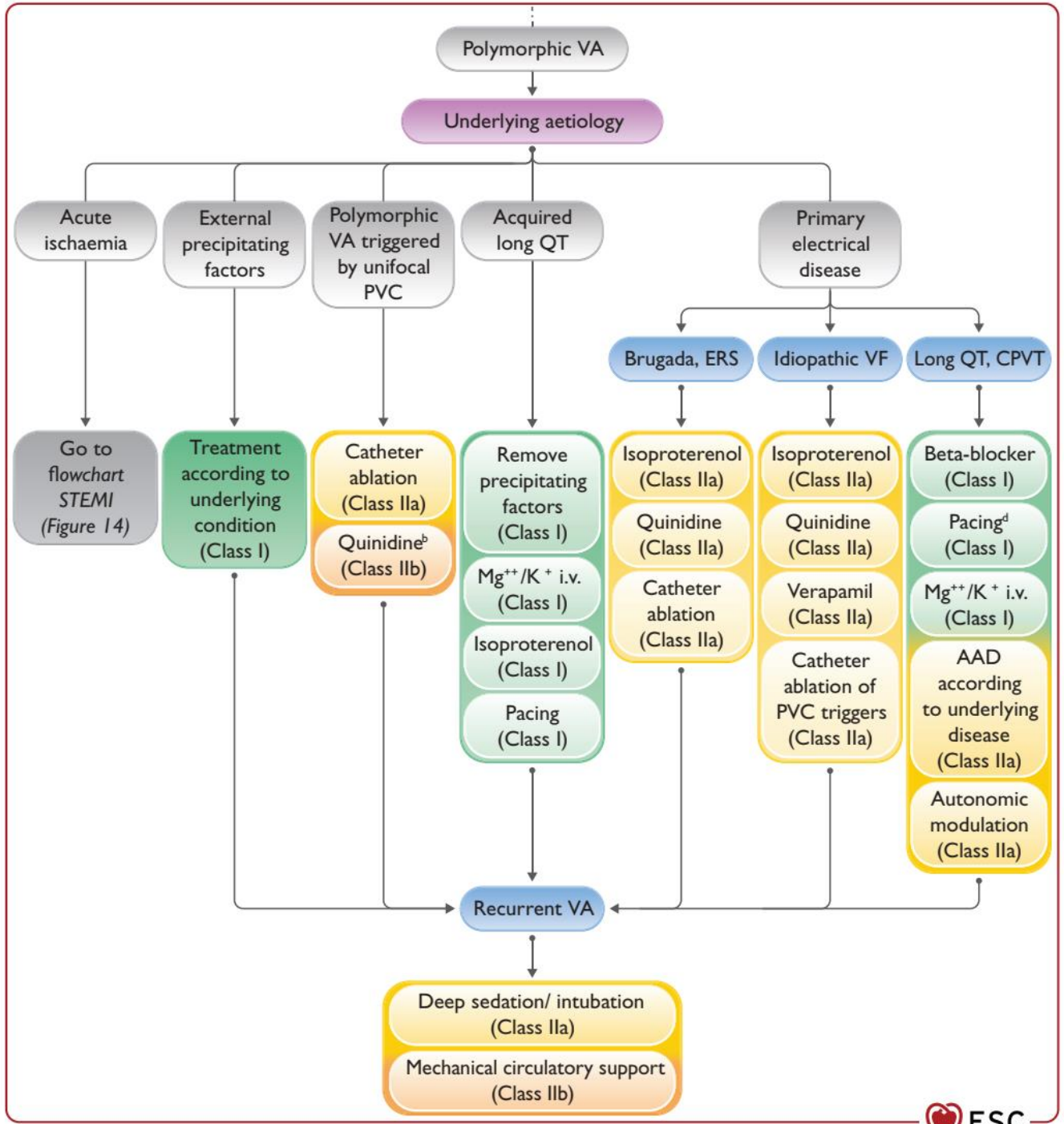
Thank you for your Attention

BY SURA BOONRAT





2022 ESC Guidelines for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death , EHJ (2022) 43 , 3997-4126



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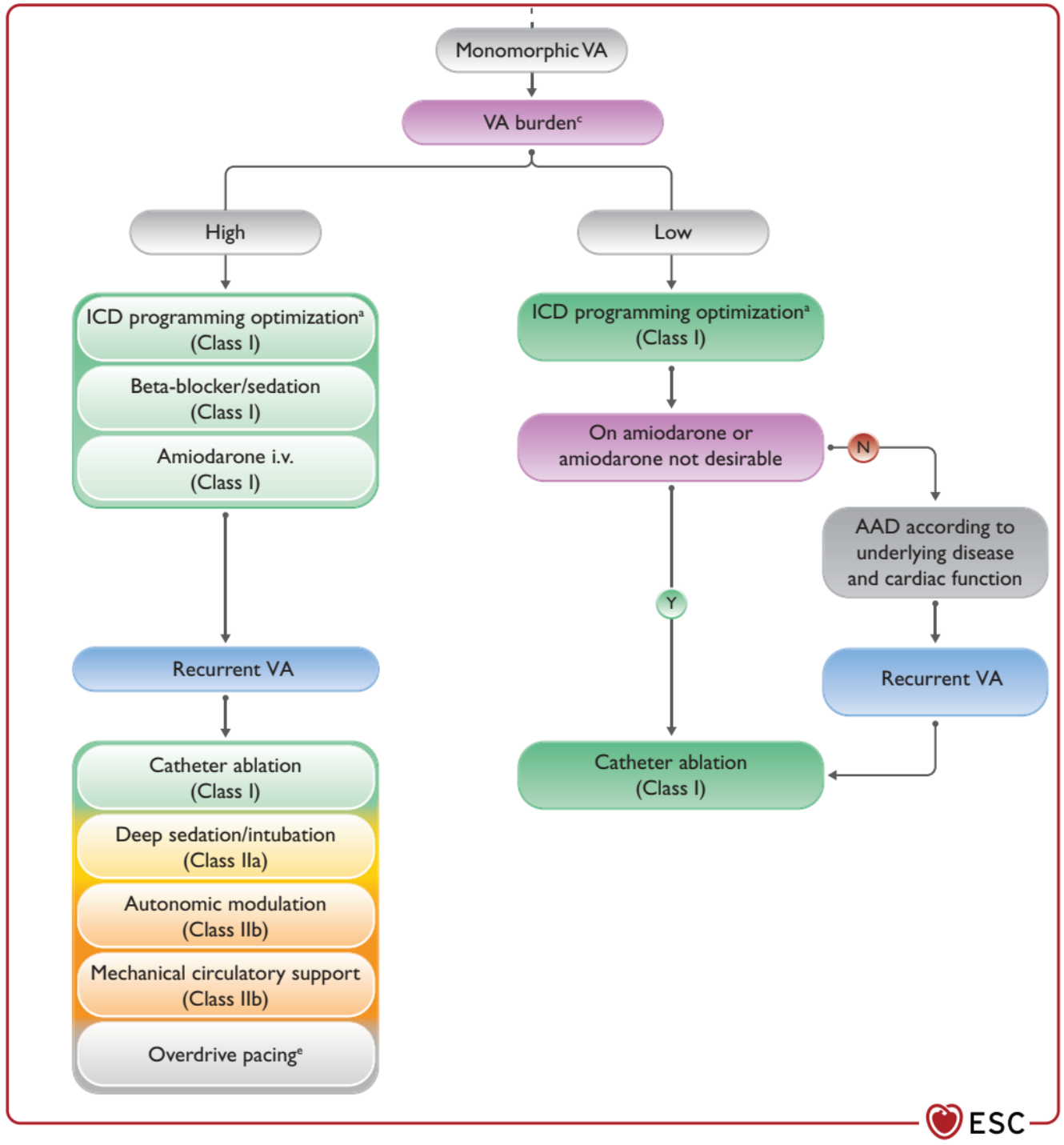


2022 ESC Guidelines for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death , EHJ (2022) 43 , 3997-4126

Anti-arrhythmic medications for acute and long-term treatment of electrical storm

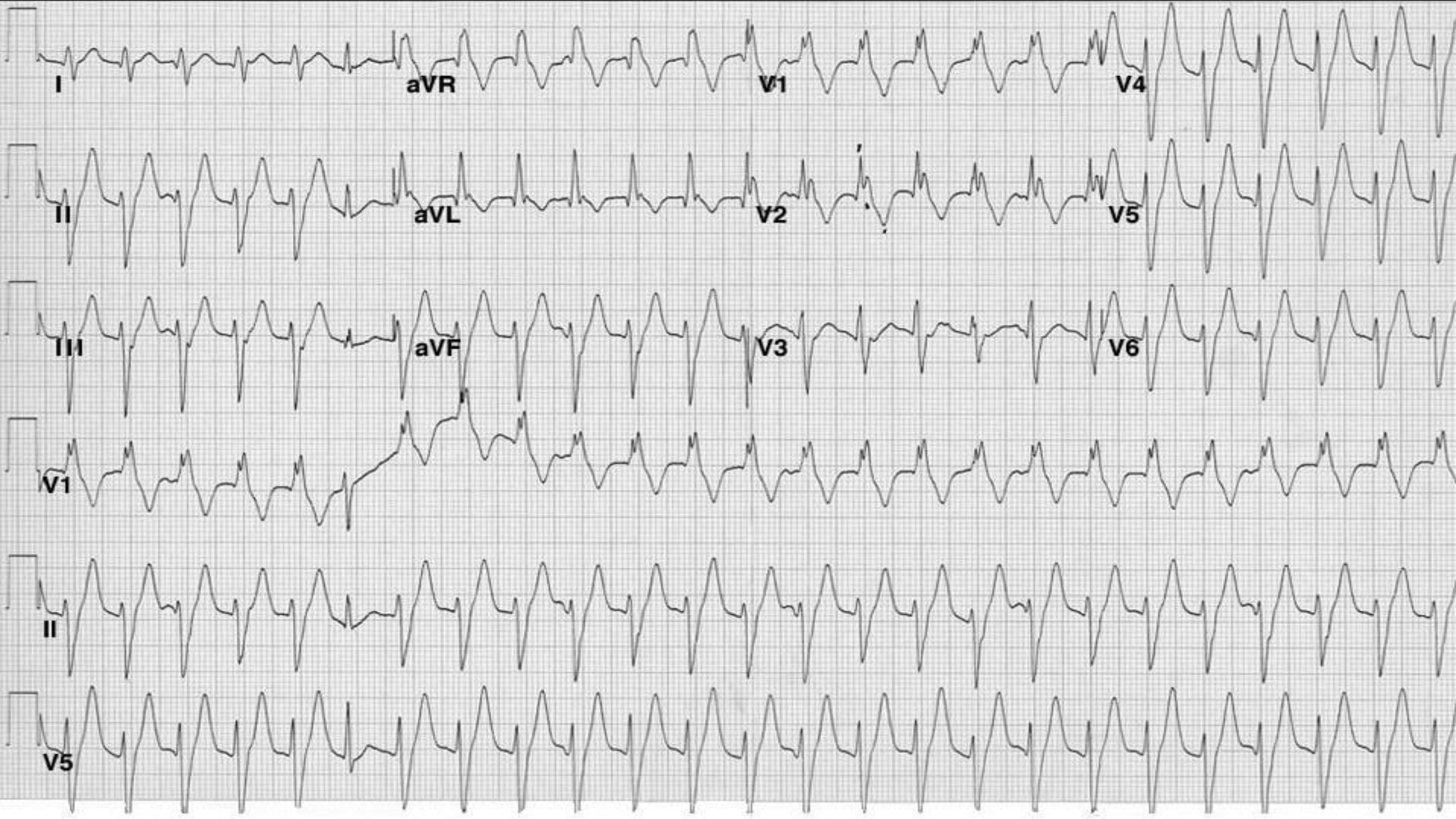
		Acute management	Long-term treatment	Desired plasma concentration
β-blockers	Propranolol	Bolus: 0.15 mg/kg IV over 10 min	10-40 mg by mouth three-four times a day	NA
	Metoprolol	Bolus: 2-5 mg IV every 5 min up to 3 doses in 15 min	25 mg by mouth twice a day up to 200 mg a day	NA
	Esmolol	Bolus: 300 to 500 mg/kg *IV* for 1 min Infusion: 25-50 mg/kg per minute up to a maximum dose of 250 mg/kg per minute (titration every 5-10 min)	Not recommended	NA
Class Ⅲ agents	Amiodarone	Bolus: 150 mg *IV* over 10 min, up to total 2.2 g in 24 h Infusion: 1 mg/min for 6 h, then 0.5 mg/min for 18 h	Oral load: 800 mg by mouth twice a day until 10 g total Maintenance dose: 200-400 mg by mouth daily	1.0-2.5 μg/mL No efficacy proven for plasma concentrations < 0.5 μg/mL Serious toxicity risk for plasma concentrations > 2.5 μg/mL
	Sotalol	Not recommended	80 mg by mouth twice a day, up to 160 mg twice a day (serious side effects > 320 mg/d)	1-3 μg/mL (not of great value, usually monitored by QT prolongation with indication to reduction/discontinuation if prolongation > 15%-20%)
Class Ⅰ agents	Procainamide	Bolus: 10 mg/kg *IV* over 20 min Infusion: up to 2-3 g/24 h	3-6 g by mouth daily fractionated in ⩾ 3 administrations	4-12 μg/mL
	Lidocaine	Bolus: 1.0 to 1.5 mg/kg *IV*, repeat dose of 0.5-0.75 mg/kg *IV* up to a total dose of 3 mg/kg Infusion: 20 μcg/kg per minute *IV*	Not recommended	2-6 μg/mL
	Mexiletine	Not recommended	200 mg by mouth three times a day, up to 400 mg by mouth three times a day	0.6-1.7 μg/mL

B - blocker

Amiodarone

Lidocaine

Daniele Muser , et al , World Journal of cardiology , 2017 , June 26; 9(6) 521-530


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