



ACVC

Association for
Acute CardioVascular Care

Edition 2025

CLINICAL DECISION MAKING TOOLKIT

Instant guidance for diagnosis, risk stratification and management





ACVC

Association for
Acute CardioVascular Care

The Clinical Decision Making Toolkit

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ACVC

Association for
Acute CardioVascular Care

The Association for Acute CardioVascular Care Clinical Decision-Making TOOLKIT

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 **ESC**
European Society
of Cardiology

RYTHM DISTURBANCES AND CARDIAC ARREST

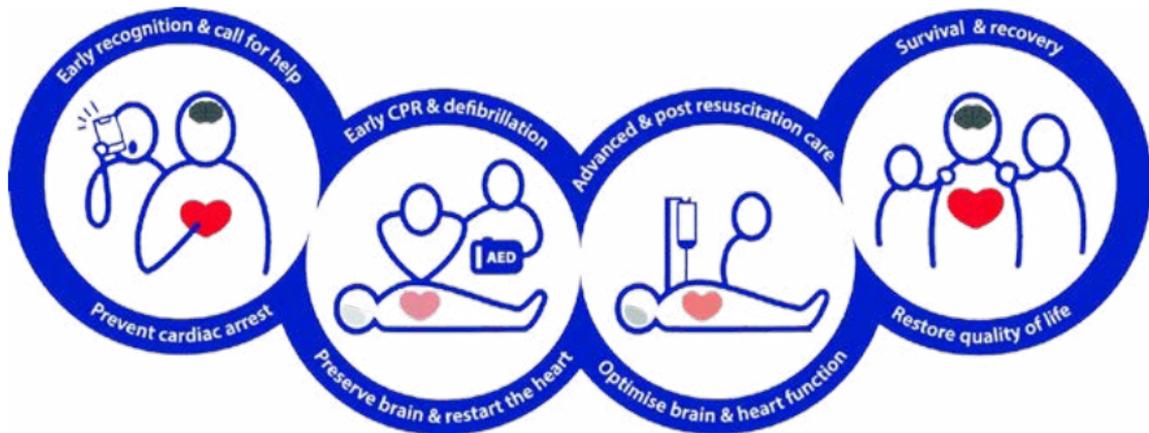
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CHAPTER 5.1

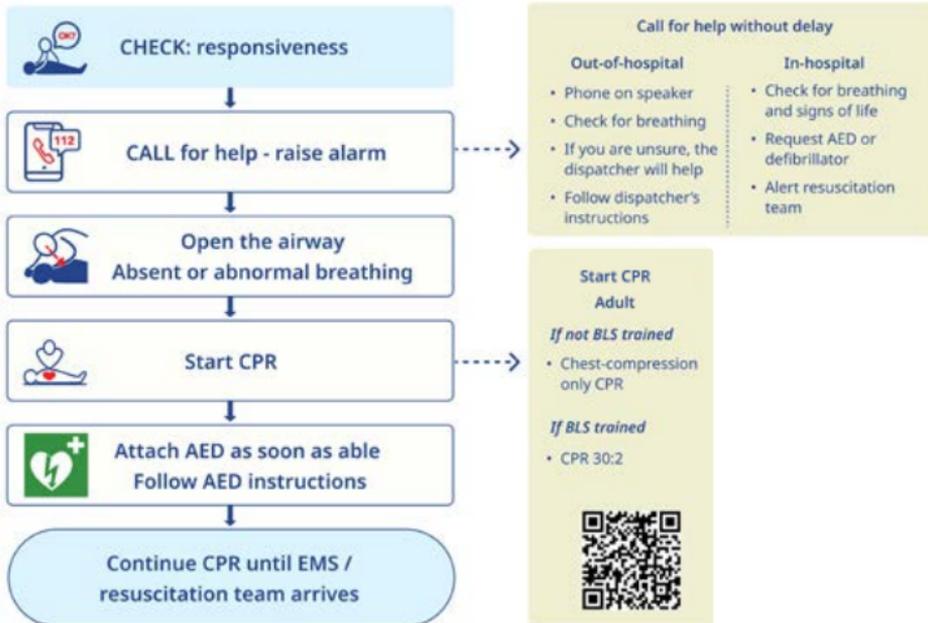
CARDIAC ARREST AND (EXTRACORPOREAL) CARDIOPULMONARY RESUSCITATION

T. Thevathasan, P. Jorge-Perez, J. Pöss & C. Hassager

The chain of survival



Basic Life Support

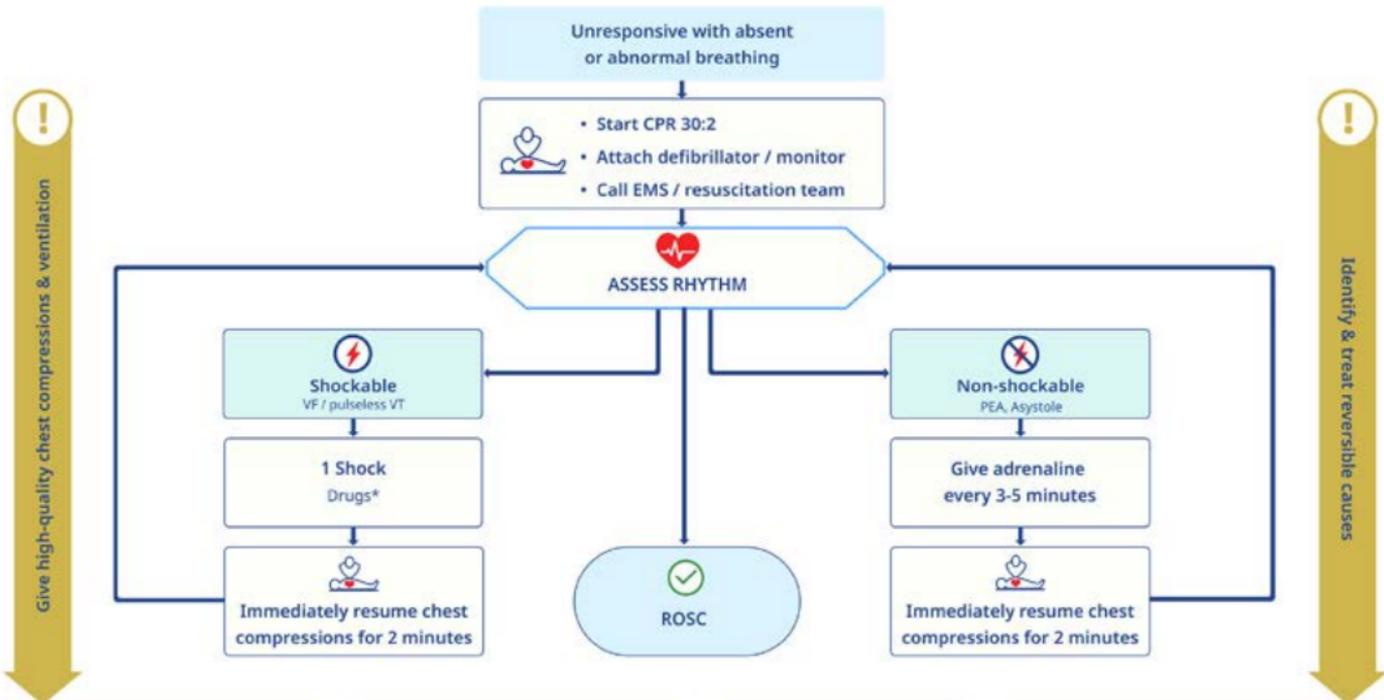


Basic Life Support

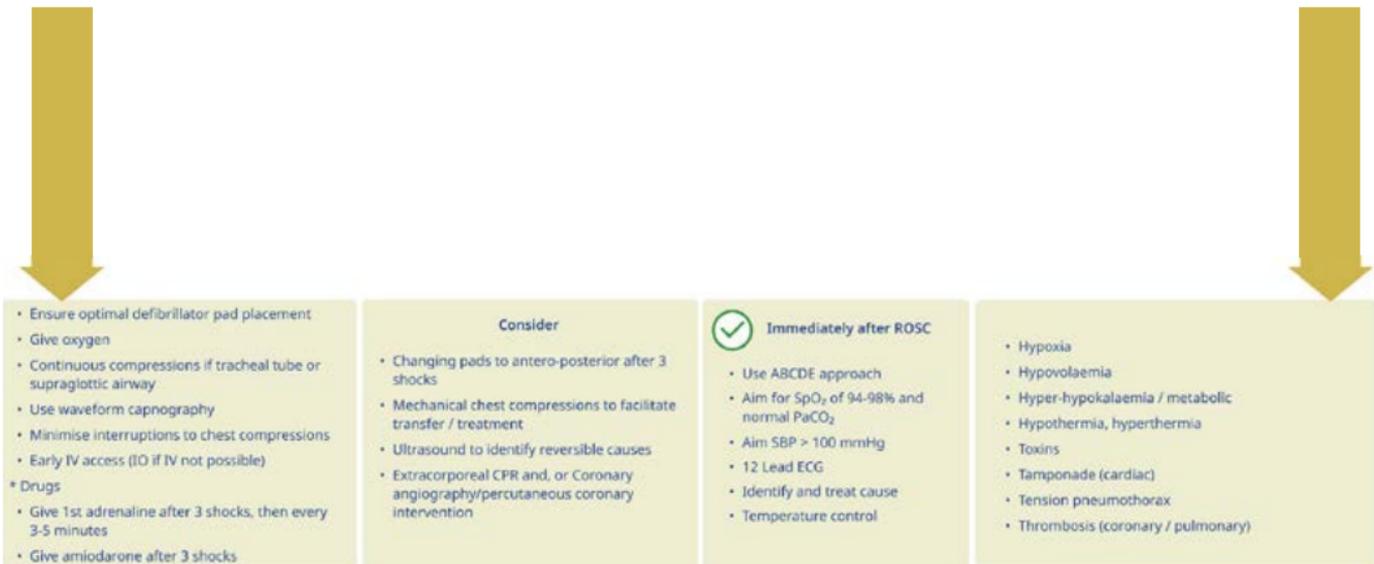
Key messages:

1. Learn how to recognise a cardiac arrest.
2. Call emergency medical services without delay, even if uncertain.
3. Everyone can learn how to perform CPR.
4. CPR and AED save lives.
5. Everyone can use an AED, even if they are not trained.
6. AEDs should not be locked away.

Advanced Life Support



Advanced Life Support (Cont.)



Advanced Life Support

Key messages:

1. Start advanced life support early - every second counts!
2. Ensure effective ventilation and high-quality chest compressions.
3. Defibrillate early for shockable rhythms:
 - Use correct antero-lateral defibrillator pad placement.
 - Switch to antero-posterior pads if 3 shocks are ineffective.
4. Give IV adrenaline early for non-shockable cardiac arrests.
5. Identify and treat reversible causes without delay.

Extracorporeal CPR:

May be considered as a rescue therapy for selected (witnessed arrest with shockable initial rhythm) adults with IHCA and OHCA when conventional CPR is failing to restore spontaneous circulation, in settings in which this can be implemented.

Neurological Prognostication

Clinical examination



Neurophysiology



Biomarkers

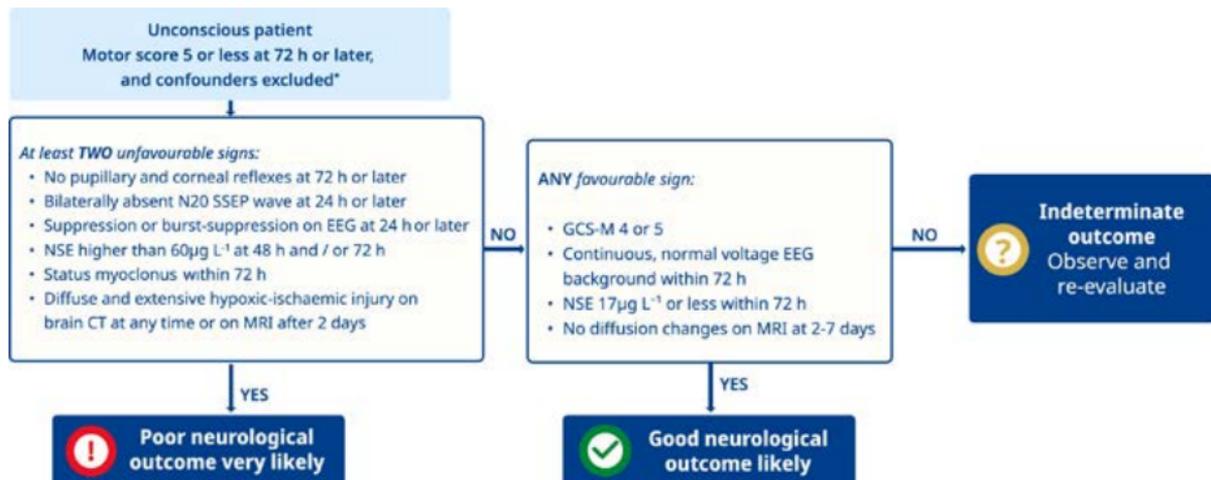


Imaging



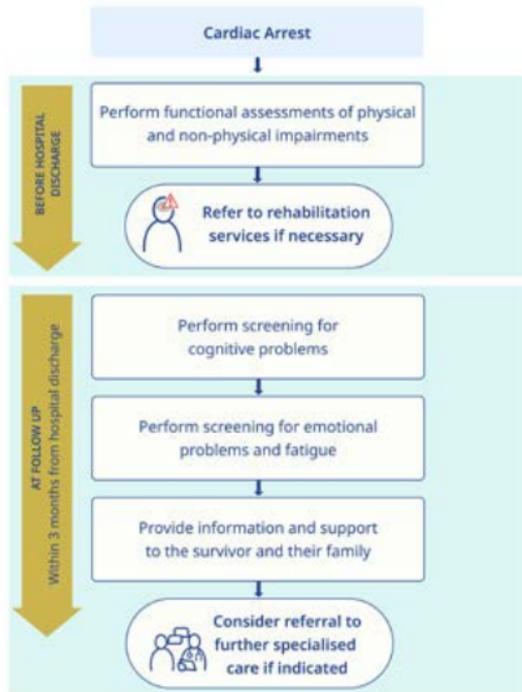
Neurological Prognostication (Cont.)

Avoid the self-fulfilling prophecy bias.



* Major confounders may include sedation, neuromuscular blockade, hypothermia, shock, hypoglycaemia, sepsis, and metabolic and respiratory derangements

Function assessment and rehabilitation



Important considerations:

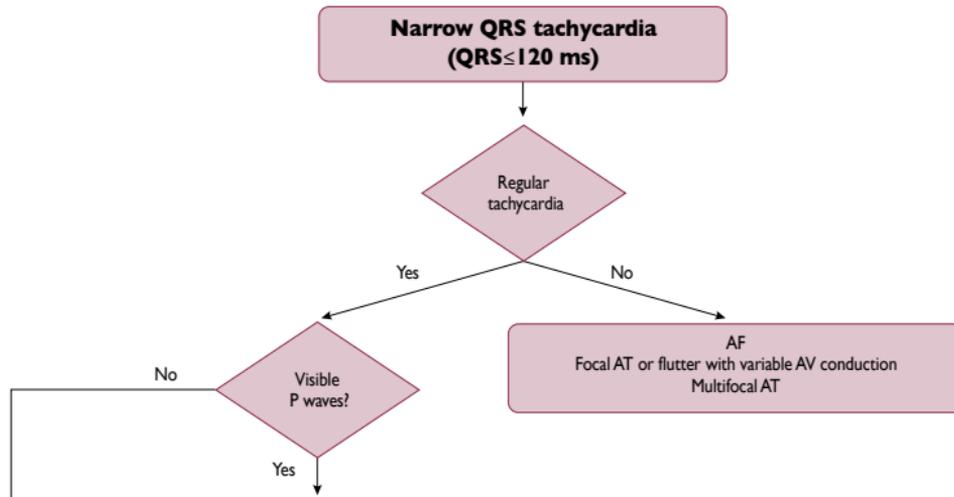
1. Implement early mobilisation, delirium management and ICU diaries during hospitalisation.
2. Provide information to patients and co-survivors.
3. Perform functional assessments of physical and non-physical impairments before discharge to identify rehabilitation needs and refer to early rehabilitation if indicated.
4. Provide cardiac rehabilitation as indicated by the cause of the cardiac arrest.
5. Organise a follow-up of cardiac arrest survivors within three months after hospital discharge; screening for cognitive, physical, emotional problems, fatigue and impact on life roles.
6. Invite co-survivors to the follow-up; ask about emotional problems and impact on life roles.
7. Undertake specialist referral and further rehabilitation as indicated.

CHAPTER 5.2

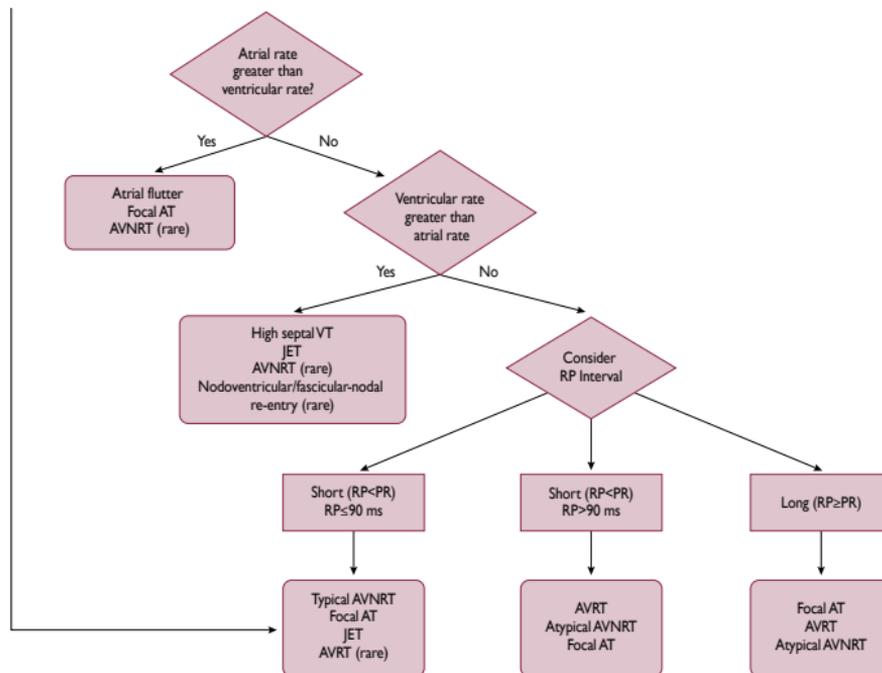
SUPRAVENTRICULAR TACHYCARDIAS AND ATRIAL FIBRILLATION

E. Arbelo & O. Tica

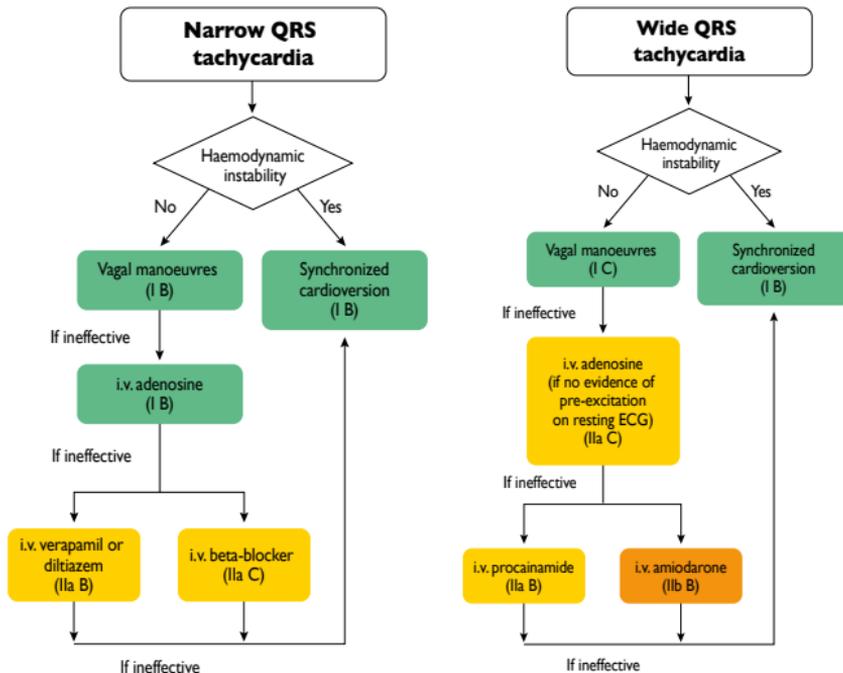
Diagnostic algorithm for regular and irregular supraventricular tachycardias



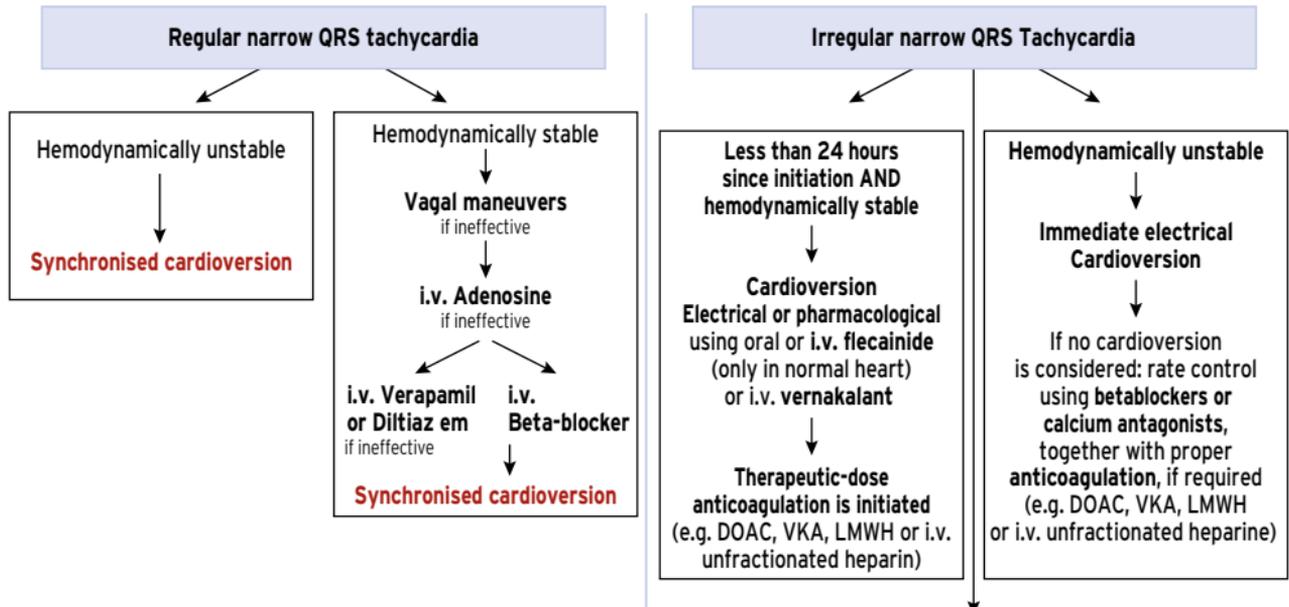
Diagnostic algorithm for regular and irregular supraventricular tachycardias (Cont.)



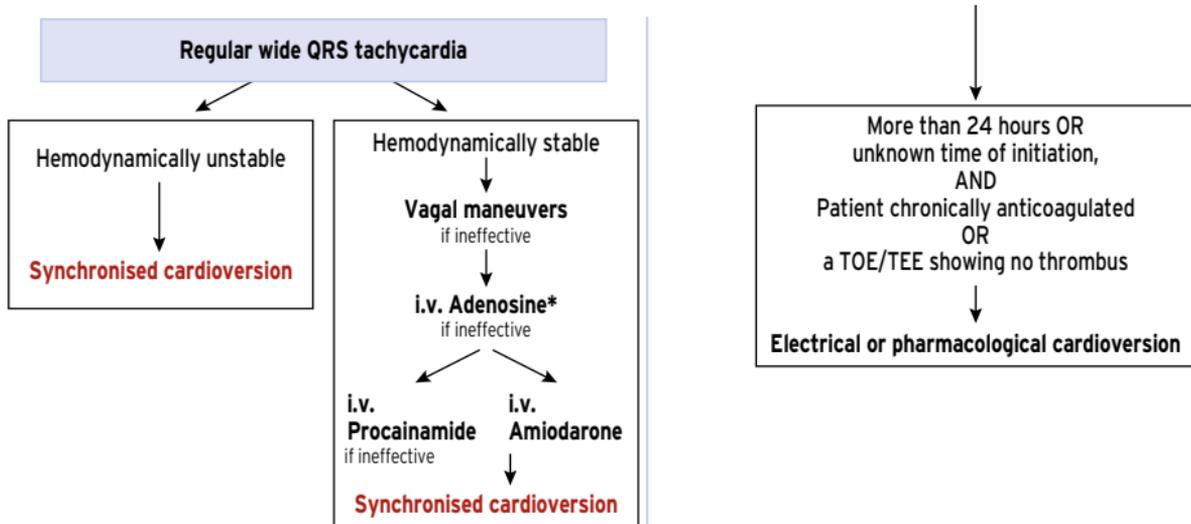
Acute management in the absence of an established diagnosis



Tachyarrhythmias: Therapeutic algorithms

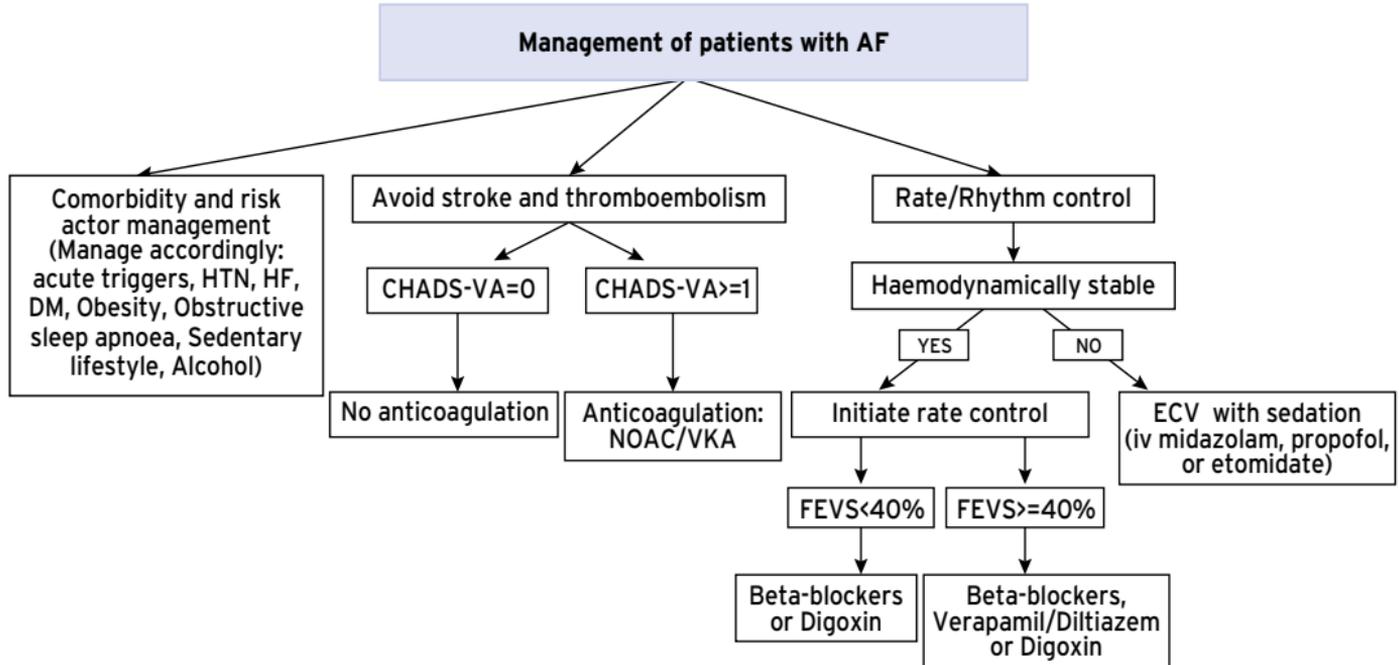


Tachyarrhythmias: Therapeutic algorithms (Cont.)

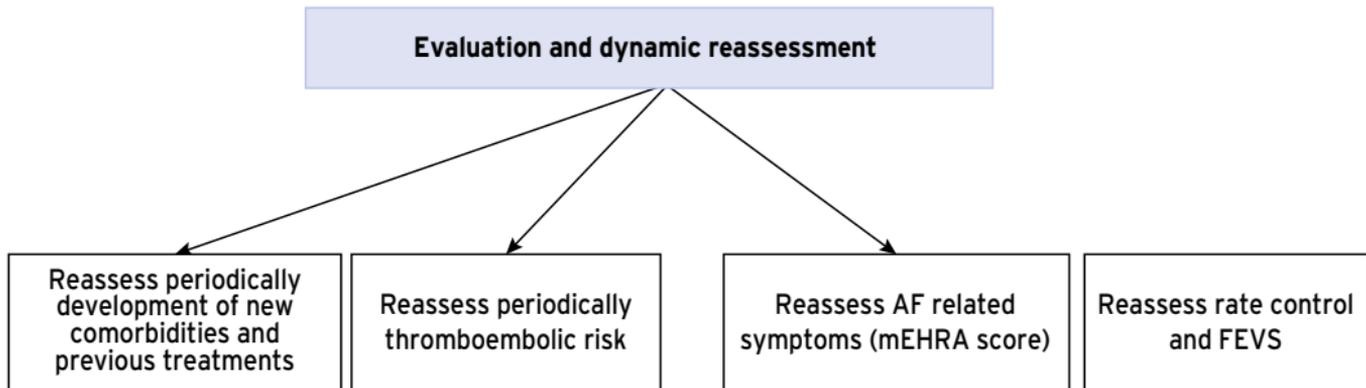


*If no evidence of pre-excitation on the resting ECG

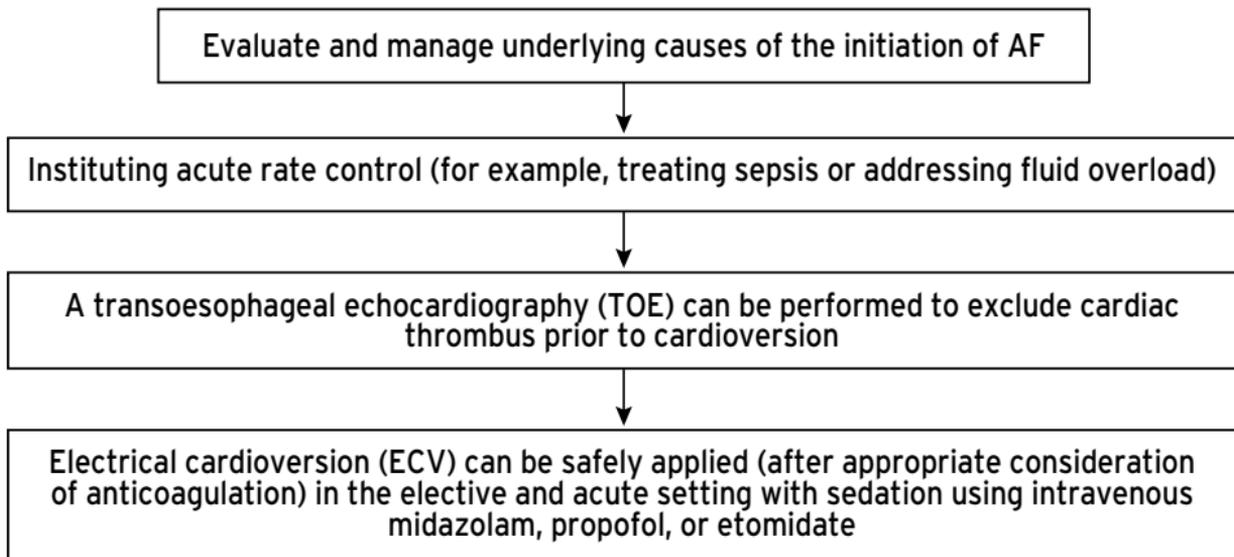
Management patient with AF



Evaluation and dynamic reassessment



Acute management of atrial fibrillation



CHAPTER 5.3

VENTRICULAR TACHYCARDIA

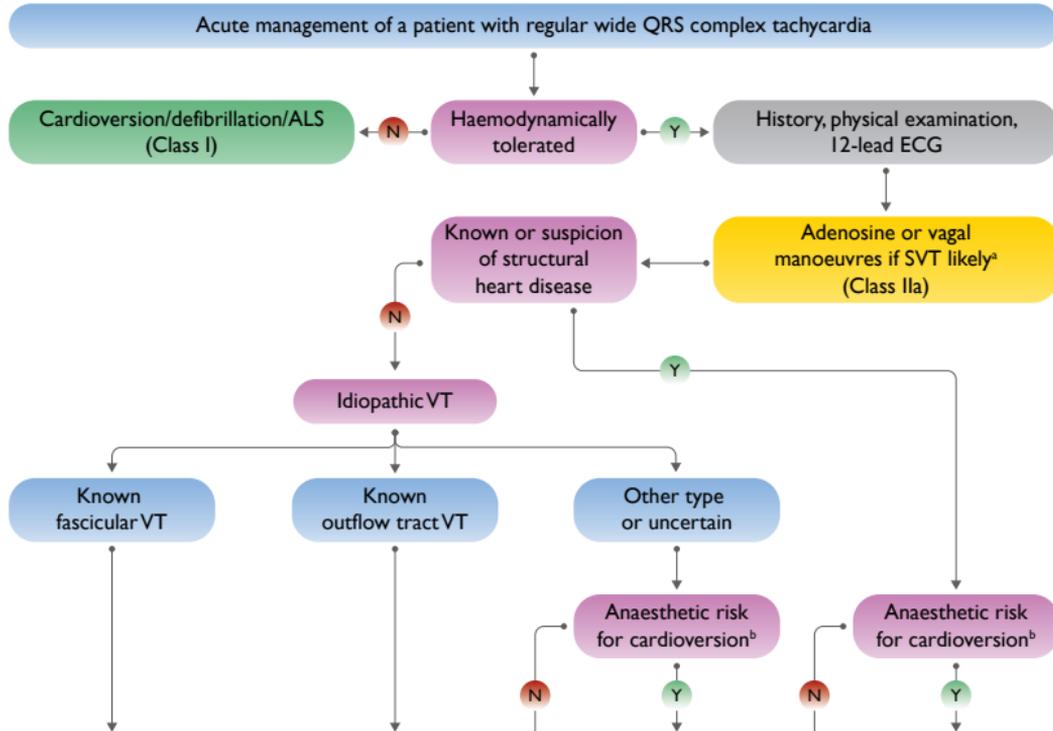
E. Arbelo & M. Spartalis

Summary of key electrocardiographic criteria

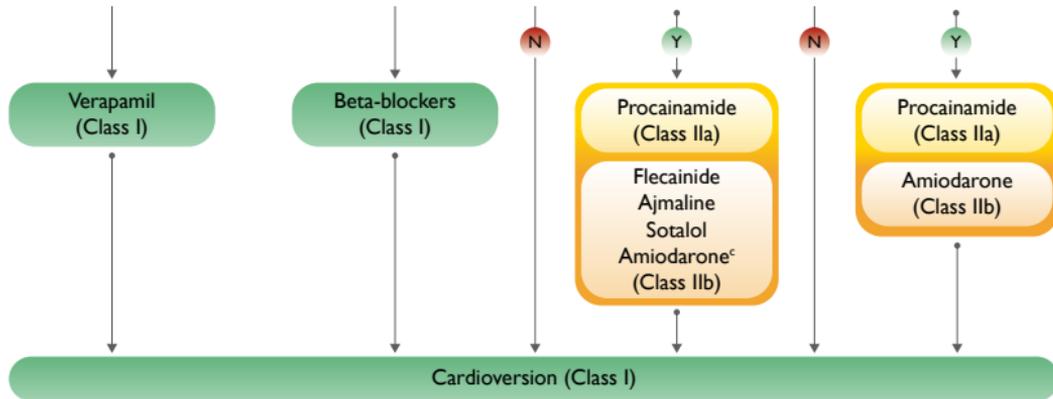
AV dissociation	Ventricular rate > atrial rate
Fusion/capture beats	Different QRS morphology from that of tachycardia
Chest lead negative concordance	All precordial chest leads negative
RS in precordial leads	<ul style="list-style-type: none"> - Absence of RS in precordial leads - RS > 100 ms in any lead^a
QRS complex in aVR	<ul style="list-style-type: none"> · Initial R wave · Initial R or Q wave > 40 ms · Presence of a notch of a predominantly negative complex
QRS axis – 90 to $\pm 180^\circ$	Both in the presence of RBBB and LBBB morphology
R wave peak time in lead II	R wave peak time ≥ 50 ms
RBBB morphology	<p>Lead V1: Monophasic R, Rsr', biphasic qR complex, broad R (>40 ms), and a double-peaked R wave with the left peak taller than the right (the so-called 'rabbit ear' sign)</p> <p>Lead V6: R:S ratio <1 (rS, QS patterns)</p>
LBBB morphology	<p>Lead V1: Broad R wave, slurred or notched-down stroke of the S wave, and delayed nadir of S wave</p> <p>Lead V6: Q or QS wave</p>

AV = atrioventricular, LBBB = left bundle branch block; RBBB = right bundle branch block. aRS: beginning of R to deepest part of S.

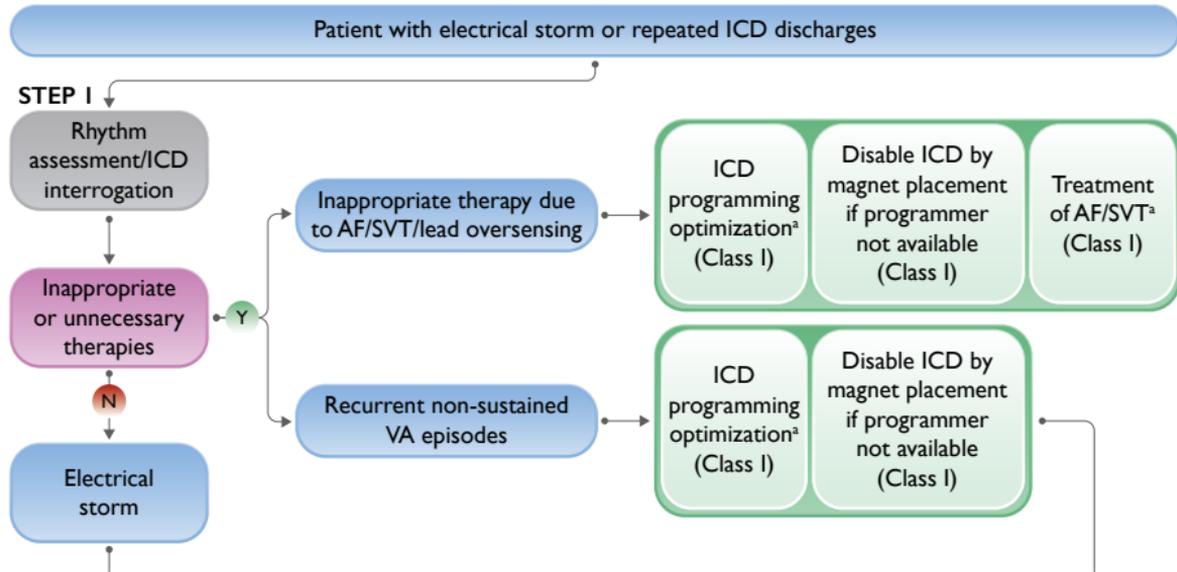
Management of wide QRS Tachycardia



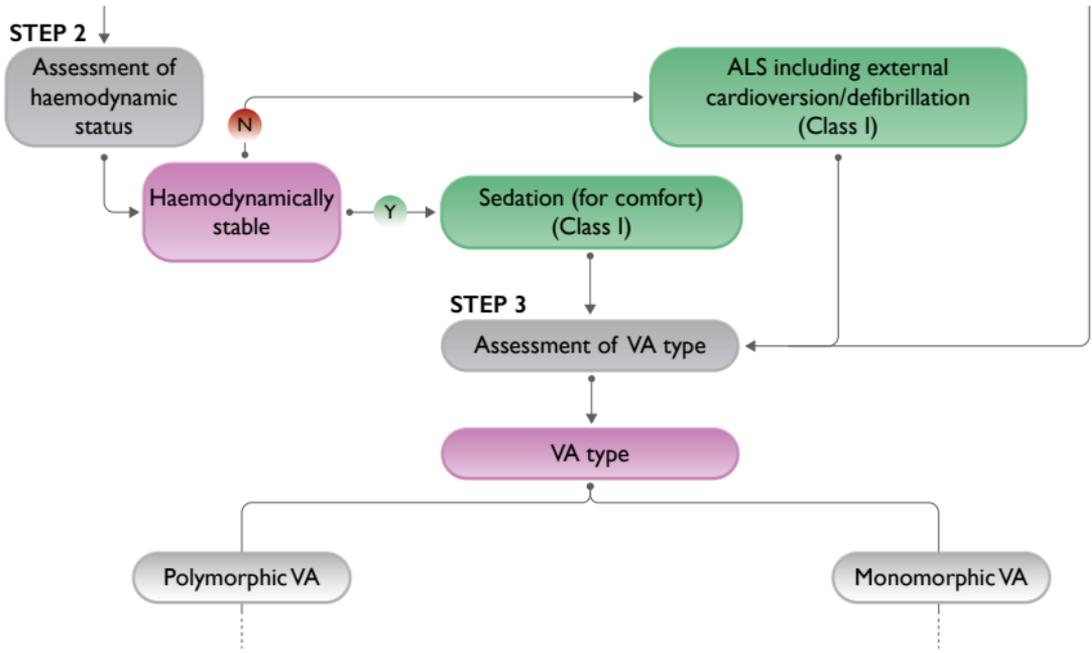
Management of wide QRS Tachycardia (Cont.)



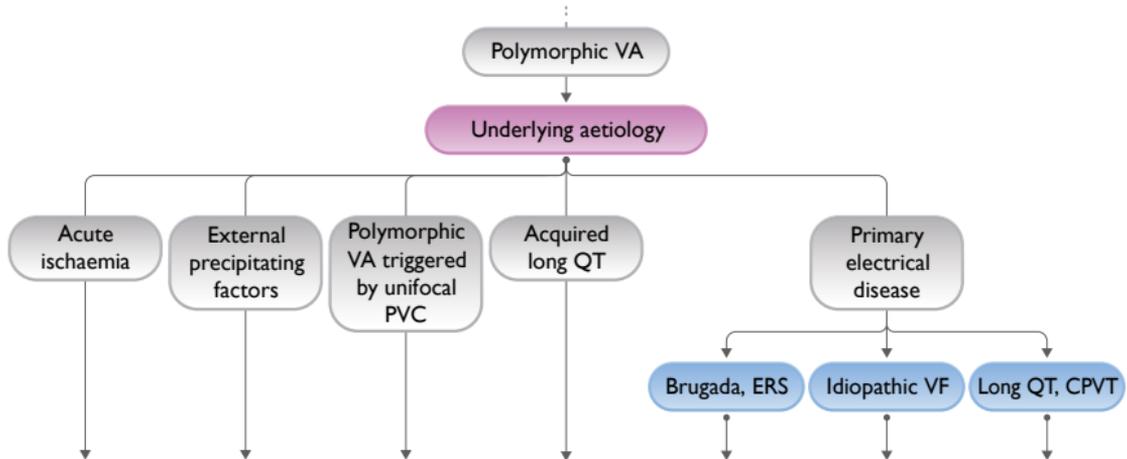
Management of ventricular arrhythmias



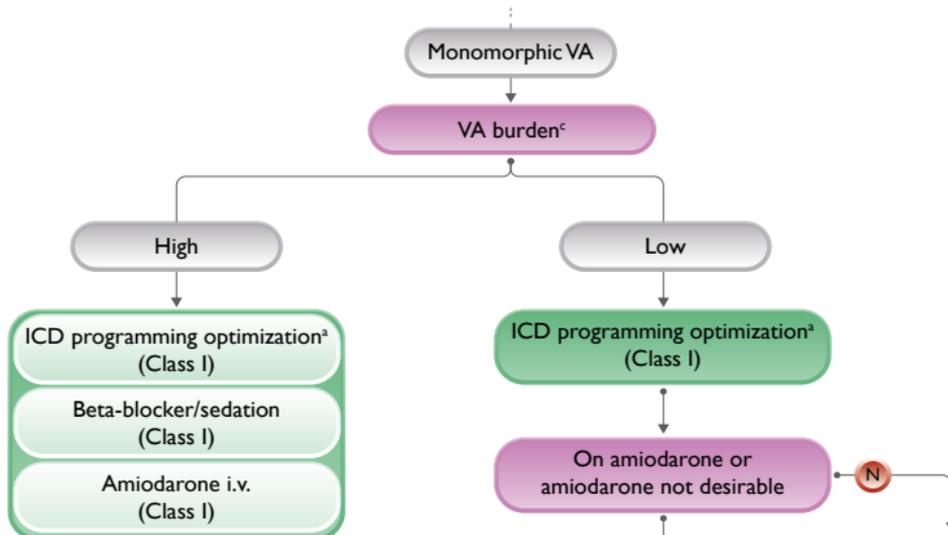
Management of ventricular arrhythmias (Cont.)



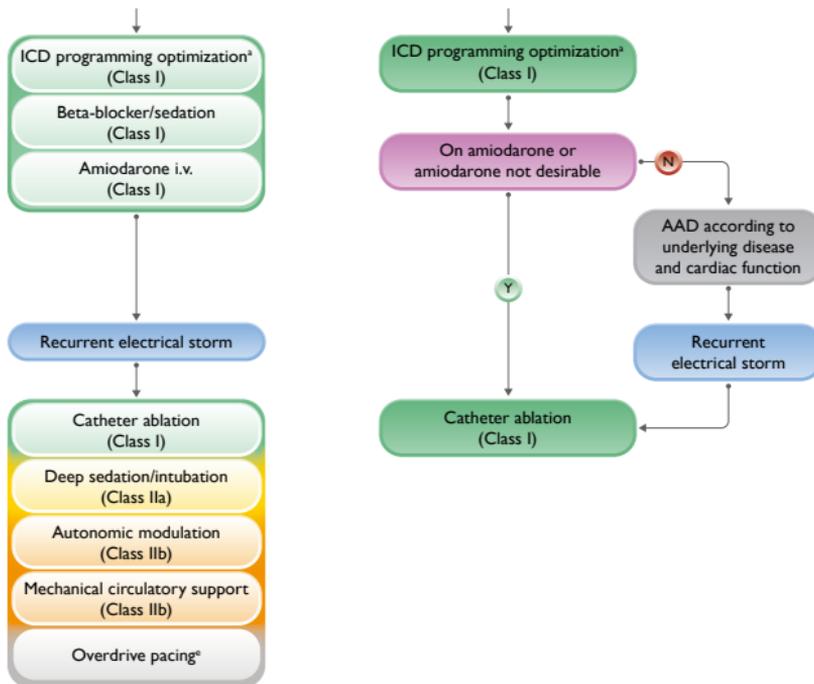
Management of ventricular arrhythmias (Cont.)



Management of ventricular arrhythmias (Cont.)



Management of ventricular arrhythmias (Cont.)



CHAPTER 5.4

BRADYARRHYTHMIA

B.J. David & A. Goette

Bradyarrhythmias: Definitions and diagnosis

Defined as a group of heart rhythm disorders characterized by a slower than normal heart rate, typically defined as a heart rate of less than 60 beats per minute.

Sinus node

Sinus Bradycardia

Sinus rate < 60 b.p.m.



Sinus Pause

Absence of sinus P waves > 2 s, Sinus pause may be a consequence of sinus arrest or sinoatrial exit block.



Bradyarrhythmias: Definitions and diagnosis

Atrioventricular junction

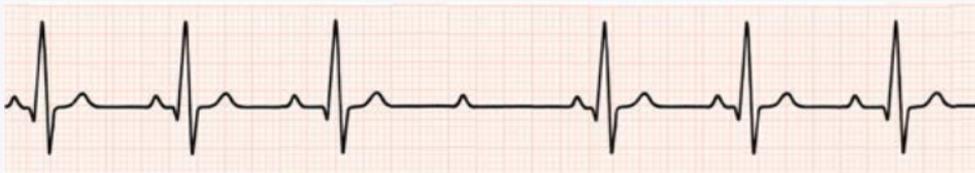
First degree

PR > 200ms associated with 1:1 AV block



Second degree Mobitz type I or Wenckebach

Single, consecutive, non-conducted P wave associated with inconstant PR before and after the blocked impulse provided there are at least two consecutive conducted P waves (i.e. 3:2 AVB) to determine the behaviour of the PR. The PR after the blocked impulse always shortens.



Bradyarrhythmias: Definitions and diagnosis

Atrioventricular junction

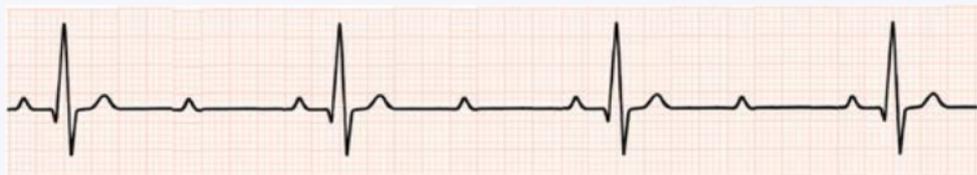
Second degree Mobitz type II

Single, consecutive, non-conducted P wave associated with constant PR before and after the non-conducted impulse, provided the sinus rate or the P-P interval is constant (no slowing) and there are at least two consecutive conducted P waves (i.e. 3:2 AVB) to reveal the behaviour of the PR.



2:1 AVB

P waves with a constant rate (or near-constant rate because of ventriculophasic sinus arrhythmia) where every second beat is non-conducted.



Bradyarrhythmias: Definitions and diagnosis

Atrioventricular junction

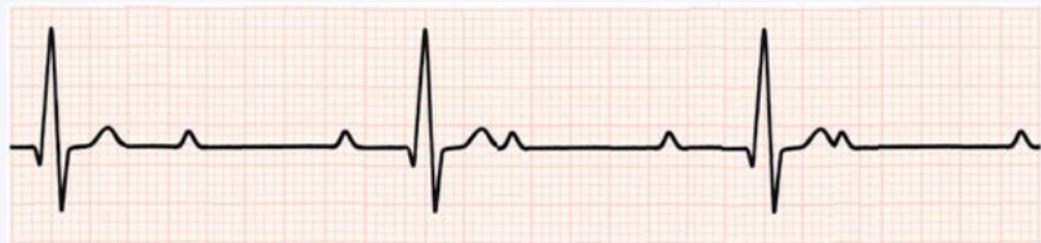
Advanced or high-grade or high-degree AVB

>2 consecutive P waves at a constant physiological rate that do not conduct to the ventricles, with evidence of some AV conduction.

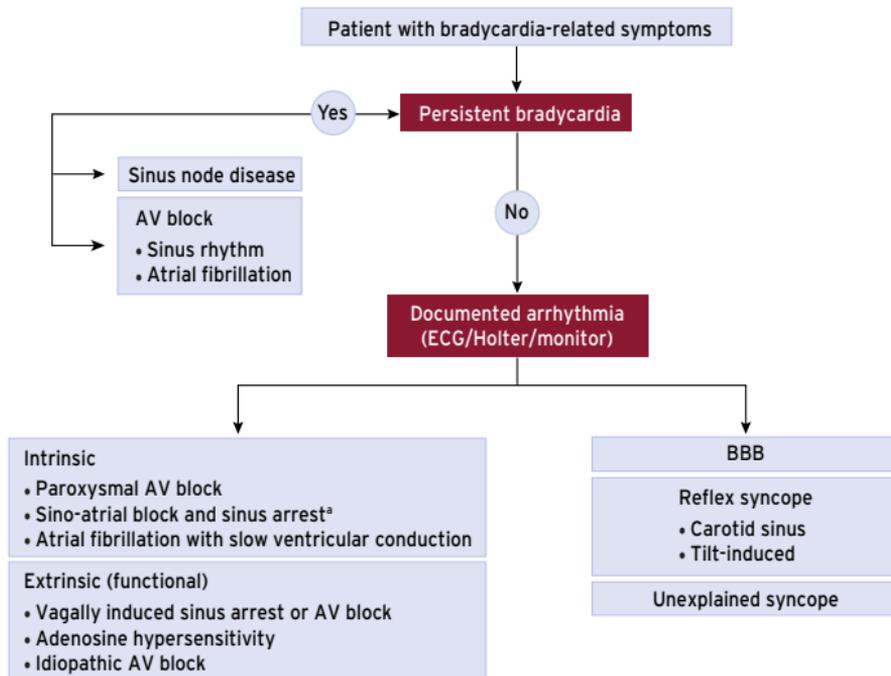


Third degree AVB

No evidence of AV conduction.

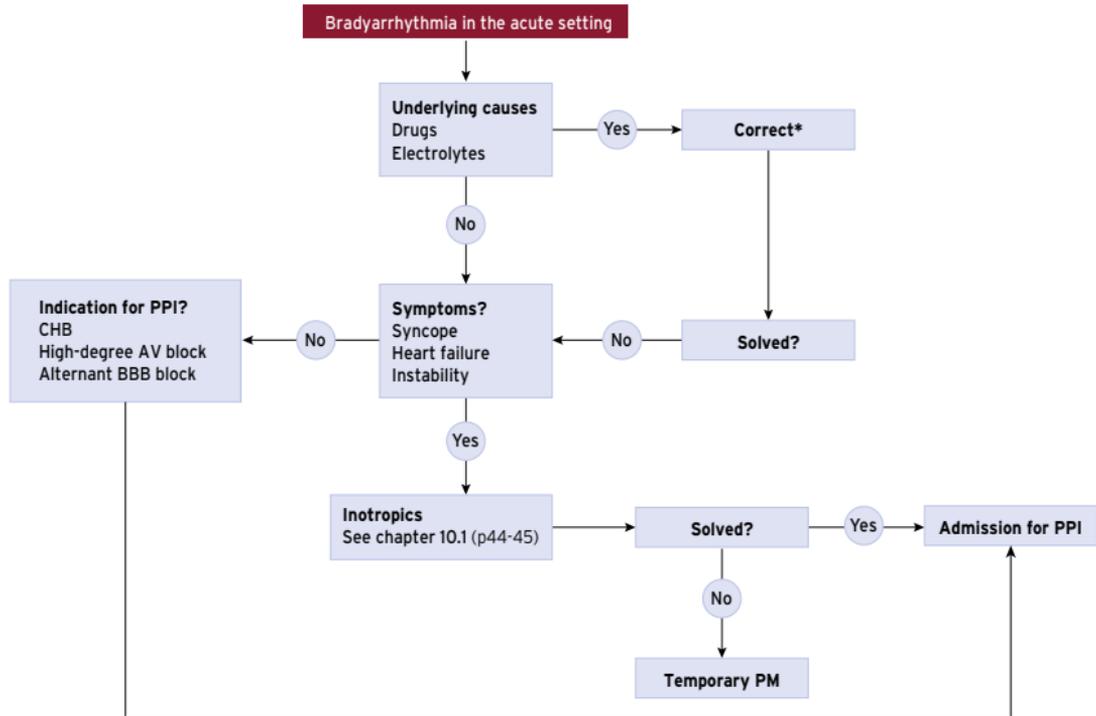


Classification of documented and suspected bradyarrhythmias



^a Including the bradycardia-tachycardia form of sick sinus syndrome.

Bradyarrhythmias: Management



* Consider inotropic support or temporary pacemaker while underlying causes are being corrected

CHAPTER 5.5

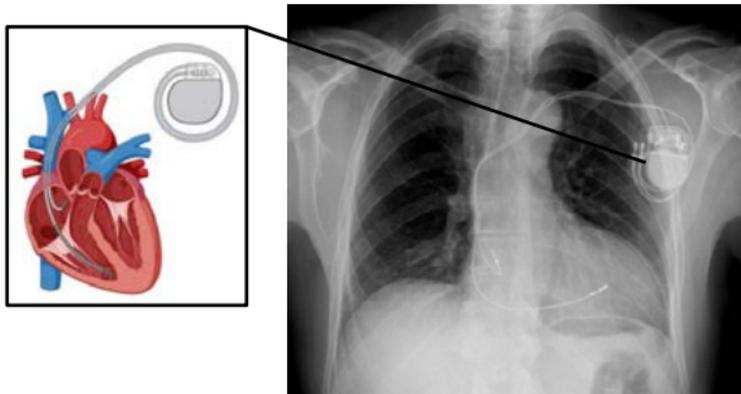
PACEMAKERS AND ICDS TROUBLESHOOTING

A.Goette, A. Giubertoni & L.Cumitini

Pacemakers and ICDs troubleshooting

Pacemaker: a small battery-operated device that helps the heart beat in a regular rhythm

Implantable cardioverter-defibrillator (ICD): a device that monitors the heart and delivers shocks to restore a normal heartbeat



Pacemakers and ICDs nomenclature

The revised NASPE/BPEG generic code for antibradycardia, adaptive-rate, and multisite pacing.

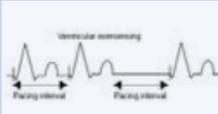
Category	Chamber(s) paced	Chamber(s) sensed	Response to sensing	Rate modulation	Multisite pacing
	O	O	O	R	O
	A	A	I	O	A
	V	V	T		V
	D	D	D		D
Manufacturers' designation only	S	S			V
Position	I	II	III	IV	V

A=atrium; D=dual (A+V); I=inhibited; O=none; S=single (A or V); Y=triggered;

Pacing mode

Pacing mode	Explanation
VOO	Asynchronous ventricular pacing at a set basal rate without sensing. ECG will show V pacing at a set rate despite any underlying intrinsic activity
VVI(R)	A ventricular-sensed event inhibits ventricular pacing but resets the timing cycle. Provides backup or rate-responsive ventricular pacing
AAI(R)	Atrial pacing and sensing only. An atrial-sensed event inhibits a paced atrial response but resets the timing cycle
DDD(R)	Pacing and sensing of both A and V, with the AV interval triggered after atrial sensed/paced event. A or V pacing inhibited if intrinsic event sensed
DDI(R)	Pacing and sensing of both A and V, with pacing at the lower rate interval. AV dissociation will result if the patient is in sinus rhythm with complete AV block
VDD(R)	Although sensing occurs in both A and V, only V can be paced

Pacemakers and ICDs malfunction

	Non capture/Failure to pace	Failure to deliver shock therapy or to convert ventricular arrhythmia	Undersensing	Oversensing
Definition	<p>NON CAPTURE: A pacemaker spike without capture in the appropriate chamber following the pulse.</p> <p>FAILURE TO PACE: absence of delivery of a pacing spike where this is to be expected.</p> <p>Potentially lethal in a pacemaker-dependent patients.</p>	<p>Failure of the ICD to deliver anti-tachycardia therapy or shock.</p> <p>May be lethal.</p>	<p>Non-tracking of P waves or lack of inhibition of pacing by intrinsic QRS complexes.</p>	<p>Inappropriate inhibition of the pacemaker leading to bradycardia or asystole. In a dual-chamber device leads to mode switching from the DDDR mode to a non-tracking mode, or tracking of the oversensed signal to deliver ventricular pacing.</p>
EKG example	 <p>Non capture</p>	 <p>Failure to convert ventricular arrhythmia</p>	 <p>Ventricular undersensing</p>	 <p>Ventricular oversensing</p>

Pacemakers and ICDs malfunction (cont.)

	Non capture/Failure to pace	Failure to deliver shock therapy or to convert ventricular arrhythmia	Undersensing	Oversensing
Causes	<ul style="list-style-type: none"> • Low battery output • Metabolic or electrolytic imbalance • Exit block (high capture threshold) or inappropriate programming • Lead dislodgement, fracture or insulation failure • Lead-to-device connector problem • Elevated capture thresholds • Circuit failure • Threshold rise due to drug effect • "Pseudo-noncapture" (pacing during the myocardial refractory period due to undersensing of the preceding complex) 	<ul style="list-style-type: none"> • Undersensing • Lead malposition, dysfunction, fracture or insulation failure • Lead-to-device connector problem • Sensitivity set too low • Poor electrogram amplitude due to change in myocardial substrate • Drug therapy changes • Metabolic or electrolytic imbalance • "Fine" ventricular fibrillation • Primary circuit or battery failure • Shock therapy turned off (by programming or magnet) • Strong magnetic field present • Detection rate set too high or slowing of tachycardia below detection rate • Failure to meet detection criteria (supraventricular-ventricular tachycardia discriminators misclassifying) • Low (inadequate) shock energy • Ineffective polarity • Arrhythmic storm 	<ul style="list-style-type: none"> • Progression of disease (cardiomyopathy, new bundle branch block, myocardial infarction) • Ectopic complexes (with low-amplitude signals) • Transient decrease in signal amplitude (post-cardioversion or defibrillation, metabolic derangement) • Device malfunction (sensing circuit abnormality, battery depletion) • Lead malposition, dysfunction, fracture or insulation failure • Pseudomalfunction: ECG recording artefact • Normal device function (functional undersensing -> blanking periods, fusion and pseudofusion beats) • Programming error (inappropriate sensitivity setting, asynchronous pacing mode) 	<ul style="list-style-type: none"> • Myopotentials • Electromagnetic interference • T-wave sensing • Far-field R-wave sensing (atrial lead) • Lead dislodgement, fracture or insulation failure • Crosstalk

Pacemakers and ICDs malfunction (cont.)

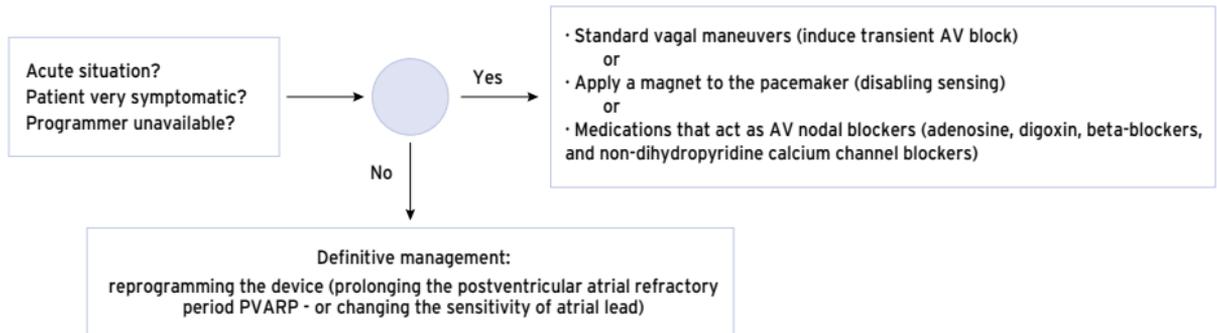
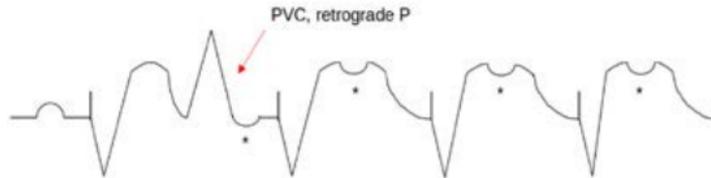
	Non capture/Failure to pace	Failure to deliver shock therapy or to convert ventricular arrhythmia	Undersensing	Oversensing
Corrective actions	<ul style="list-style-type: none"> • Correct metabolic imbalance • Increase pacemaker output • Repair, replace or upgrade the lead or the pacemaker • Adjust the sensitivity to a more sensitive setting • Program to unipolar polarity 	<ul style="list-style-type: none"> • Correct metabolic imbalance • Increase ICD sensitivity • Device replacement • Repair, replace or upgrade the lead or the pacemaker • Reprogram detection rate and criteria 	<ul style="list-style-type: none"> • Increase pacemaker sensitivity • Repair, replace or upgrade the lead • Reprogramming polarity • If the problem is very infrequent then careful observation may be acceptable 	<ul style="list-style-type: none"> • Decrease pacemaker sensitivity • For far-field or T-wave oversensing, prolongation of the refractory period • Reprogram the sensing polarity to bipolar • Repair, replace or upgrade the lead

Perioperative management of patients with cardiac implantable electronic devices

			Pacemaker	Implantable cardioverter-defibrillator	
		Device always accessible and outside operation field		Bradycardia function	Tachyarrhythmia function
No or minimal cautery			No reprogramming Have magnet available	No reprogramming	Apply magnet
Significant cautery	Not pacemaker-dependent	Yes	No reprogramming Have magnet available	No reprogramming	Apply magnet
		No	No reprogramming	No reprogramming	Reprogramme
	Pacemaker-dependent	Yes	Apply magnet	Consider reprogramming	Apply magnet
		No	Reprogramme	Reprogramme	Reprogramme

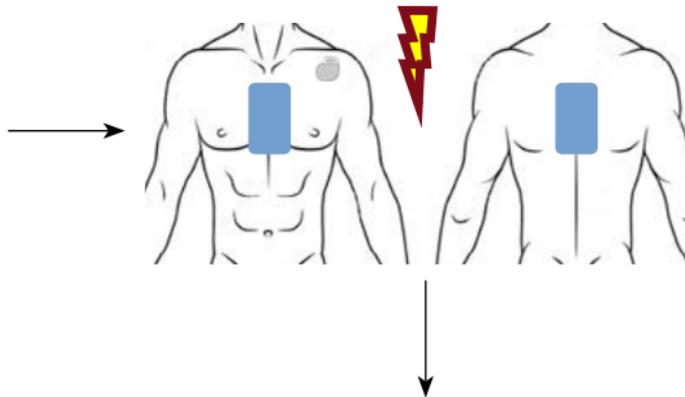
Pacemaker-mediated tachycardia

The two-chamber pacemaker acts as an accessory conducting pathway causing a tachycardia. The mechanism is similar to that seen in Wolff-Parkinson-White Syndrome, beginning with a premature ventricular beat. The pacemaker senses the retrograde P-wave and paces the ventricle, and then the retroconduction makes the cycle continue.



Electrical cardioversion in patients with cardiac implantable electronic devices

Pads should be placed in the anteroposterior position



Device check afterwards to ensure stability of programmed parameters, battery longevity, lead thresholds, and sensing

Twiddler's syndrome

Permanent malfunction of the cardiac implantable electronic device due to the dislodgement of the leads around the generator. The malfunction is due to the patient's manipulation of the pulse generator



Risk factors: female gender, elderly, obese patients, cognitive impairment and capacious pocket pacemaker

Consequence: the leads are dislodged and ventricular pacing ceases. Ipsilateral phrenic nerve is stimulated, resulting in diaphragmatic pacing and the sensation of abdominal pulsation. As the leads are further wrapped around the generator, rhythmic arm twitching occurs when the brachial plexus is paced

Corrective actions: Creation of a small surgical pocket and suturing of the device to the fascia can help prevent manipulation of the pulse generator and lead displacement

Cardiac implantable electronic devices lead perforation

Timing:

- Early lead perforation: < 30 days
- Late lead perforation: > 30 days

Symptoms:

Pericardial or pleuritic chest pain, fatigue, dyspnea, hiccups, shortness of breath, hemoptysis

Signs:

Hypotension and hemodynamic instability, changes in electrical parameters of the device (\downarrow P or R wave sensing, \uparrow pacing threshold, \uparrow lead impedance)

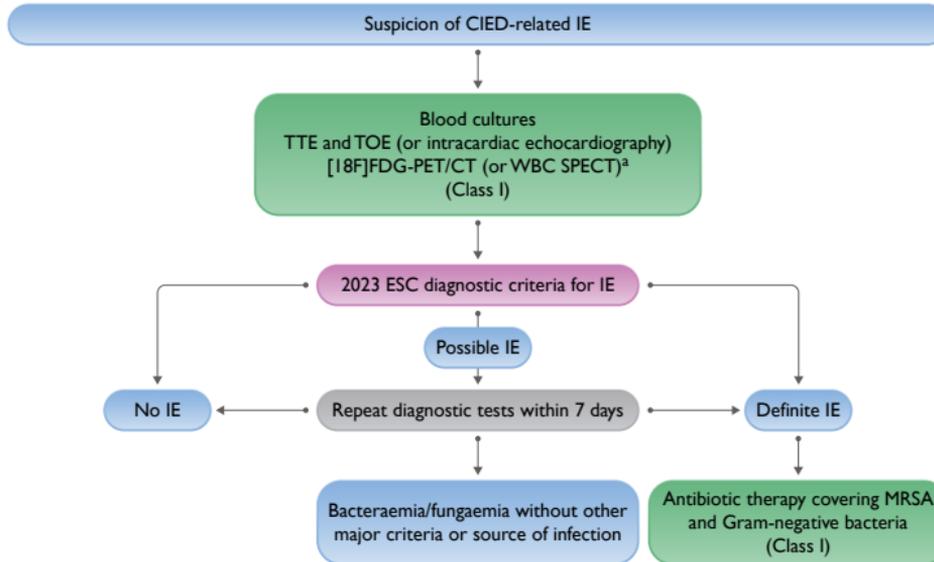
Diagnosis:

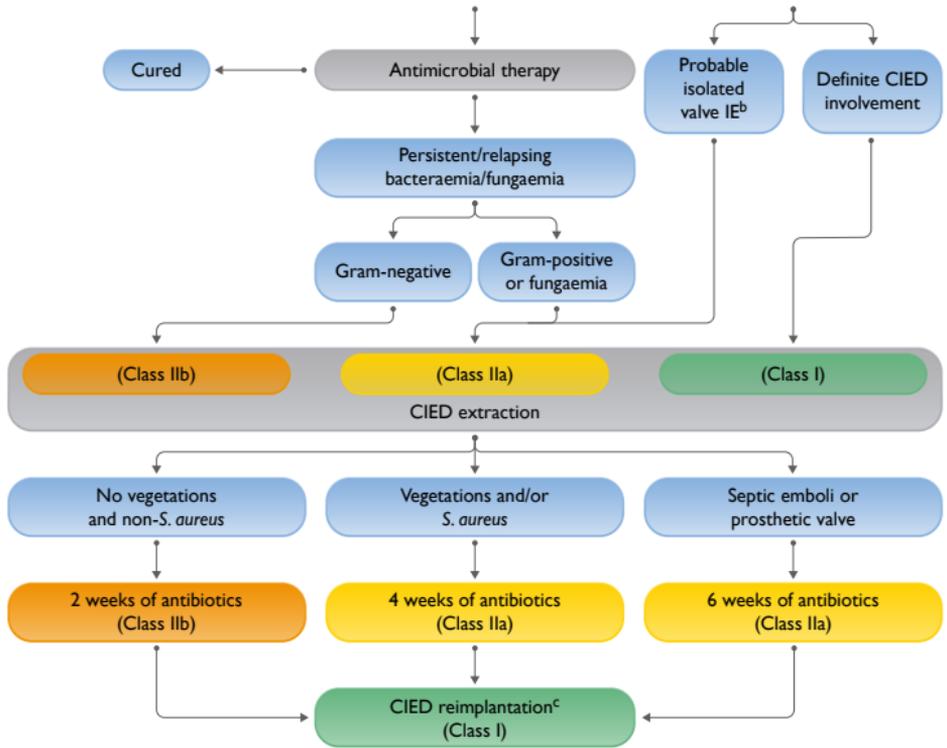
- Transthoracic echocardiography (pericardial effusion, perforation site);
- Chest radiography (perforation site, pneumothorax, hemothorax);
- Computed tomography (perforation site)

Management:

- Pericardiocentesis in case of pericardial tamponade;
- Surgical approach (thoracotomy, mini-thoractomy and thoracoscope);
- Transvenous lead extraction;
- Combination therapy

Infective endocarditis affecting cardiac implantable electronic devices





Reference 2023 ESC Guidelines for the management of endocarditis, European Heart Journal, Volume 44, Issue 39, 14 October 2023, Pages 3948-4042
Figure 13

Abbreviations

APTT = Activated partial thromboplastin time

AB = Airway and breathing

ABG = Arterial blood gas

AADs = Antiarrhythmic drugs

AAS = Acute aortic syndrome

ACEI = Angiotensin converting enzyme inhibitor

ACLS = Advanced cardiovascular life support

ACS = Acute coronary syndrome

ACT = Activated clotting time

AD = Aortic Dissection

AED = Automated external defibrillator

AF = Atrial fibrillation

ANA = Antinuclear antibodies

Ao = Aortic

aPTT = Activated partial thromboplastin time

ARB = Angiotensin receptor blockers

AS = Aortic stenosis

AV = Atrioventricular

AVB = Atrioventricular conduction block

AVN = Atrioventricular node

AVNRT = Atrioventricular nodal re-entrant tachycardia

AVNT = Atrioventricular nodal tachycardia

BID = Twice a day

BBB = Bundle branch block

BLS = Basic life support

BNP = Brain natriuretic peptide

BP = Blood pressure

CABG = Coronary artery bypass grafting

CAD = Coronary artery disease

Cath Lab = Catheterisation laboratory

CCB = Calcium channel blockers

CCU = Coronary care unit

CHF = Congestive heart failure

CMR = Cardiovascular magnetic resonance

COPD = Chronic obstructive pulmonary disease

CPAP = Continuous positive airway pressure

CPR = Cardiopulmonary resuscitation

Cr = Creatinine blood level (mg/dL)

CrCl = Creatinine clearance

CRP = C-reactive protein

CS = Cardiogenic shock

CSM = Carotid sinus massage

CSNRT = Corrected sinus node recovery time

Abbreviations (Cont.)

CSS = Carotid sinus syndrome

CT = Computed tomography

CT-angio = Computed tomography angiography

cTn = Cardiac troponin

CUS = Compression venous ultrasound

CV = Cardiovascular

CVA = Cerebrovascular accident

CXR = Chest X-ray

DAPT = Dual antiplatelet therapy

DD = Diastolic dysfunction

DM = Diabetes mellitus

dTT = Diluted thrombin time

DVT = Deep vein thrombosis

ECG = Electrocardiogram

Echo = Echocardiogram

ECMO = Extracorporeal membrane oxygenation

ECT = Ecarin clotting time

ED = Emergency department

EF = Ejection fraction

EG = Electrograms

eGFR = Estimated glomerular filtration rate
(ml/min/1.73 m²)

EMB = Endomyocardial biopsy

EMS = Emergency medical services

EPS = Electrophysiological study

ERC = European Resuscitation Council

ESR = Erythrocyte sedimentation rate

ETT = Exercise treadmill testing

FFP = Fresh frozen plasma

FMC = First medical contact

GER = Gastroesophageal reflux

GFR = Glomerular flow rate

GI = Gastrointestinal

GP = Glycoprotein

Hb = Haemoglobin

HF = Heart failure

HIT = Heparin-induced thrombocytopenia

HOCM = Hypertrophic obstructive cardiomyopathy

HTN = Hypertension

HR = Heart rate

hsTn = High-sensitive troponin

IABP = Intra-aortic balloon pump

ICC = Intensive cardiac care

ICCU = Intensive cardiac care unit

Abbreviations (Cont.)

ICD = Implantable cardioverter defibrillator

ICI = Immune checkpoint inhibitors

IHD = Ischemic heart disease

IMH = Intramural hematoma

IRF = Immediate-release formulation

ISFC = International Society and Federation of Cardiology

i.o. = Intraosseous

IV = Invasive ventilation

i.v. = Intravenous

KD = Kidney disease

LBBB = Left bundle branch block

LD = Loading dose

LGE = Late gadolinium enhancement

LMWH = Low-molecular weight heparin

LOC = Loss of consciousness

LV = Left ventricular

LVAD/Bi-AD = left ventricular, bi-ventricular assist device

LVD = Left ventricular dysfunction

LVEF = Left ventricular ejection fraction

LVH = Left ventricular hypertrophy

LVSD = Left ventricular systolic dysfunction

MCS = Mechanical circulatory support

MD = Maintenance dose

MDCT = Computed tomography with >4 elements

MI = Myocardial infarction

MRA = Mineralocorticoid receptor antagonist

MRI = Magnetic resonance imaging

Mvo = Microvascular obstruction

NIV = Non-invasive ventilation

NOAC = New oral anticoagulants

NSAID = Non-steroidal anti-inflammatory drugs

NSVT = Non-sustained ventricular tachycardia or recurrent

NSTE-ACS = Non ST-segment elevation acute coronary syndrome

NSTEMI = Non ST-segment elevation myocardial infarction

NTG = Nitroglycerin

NT-proBNP = N-terminal pro brain natriuretic peptide

NVAF = Non-valvular atrial fibrillation

NYHA = New York Heart Association

Abbreviations (Cont.)

OH = Orthostatic hypotension
PAP = Pulmonary arterial pressure
PAU = Penetrating aortic ulcer
PCI = Percutaneous coronary intervention
PCM = Physical counter-measures
PCP = Pulmonary capillary pressure
PE = Pulmonary embolism
PEA = Pulmonary endarterectomy
PEEP = Positive end expiratory pressure
PPC = Prothrombin complex concentrate
PR = Pulmonary regurgitation
PRECISE-DAPT = PREdicting bleeding Complications In patients undergoing Stent implantation and subsequent Dual Anti Platelet Therapy
PRF = Prolonged-release formulation
ProCT = Procalcitonin
PRN = Pro re nata
PS-PEEP = Pressure support-positive end-expiratory pressure
PSVT = Paroxysmal supraventricular tachycardia
QD = Once a day

QPM = Every evening
rFVIIa = Recombinant factor VIIa
rtPA = Recombinant tissue plasminogen activator
RV = Right ventricular
RVOT-VT = Right ventricular outflow tract ventricular tachycardia
SBP = Systemic blood pressure
s.c = Subcutaneous
SIRS = Systemic inflammatory response syndrome
SLE = Systemic lupus erythematosus
SMU = Syncope management units
STE-ACS = ST-segment elevation acute coronary syndrome
STEMI = ST-segment elevation myocardial infarction
SVT = Supraventricular tachycardia
Spo₂ = Oxygen saturation
TEE = Transesophageal echocardiography
TEVAR = Thoracic endovascular aortic repair
TIA = Transient ischemic attack
TID = Three times a day
TLOC = Transient loss of consciousness
TOE = Transoesophageal echocardiography

Abbreviations (Cont.)

TSH = Thyroid-stimulating hormone
TTE = Transthoracic echocardiography
UA = Unstable angina
UFH = Unfractionated heparin
ULN = Upper limit of normal
VBGA = venous blood gas analysis
VF = Ventricular fibrillation
VR = Vascular resistance
VT = Ventricular tachycardia
VTE = Venous thromboembolism
VVS = Vasovagal syncope
WBC = white blood cell count
WHO = World Health Organization
WPW = Wolff-Parkinson-White

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