Arrhythmias A to Z

Melissa Arnold, RN, MPH, FALU, FLMI, CLU
Medical Director, Vice President

WAHLU – October 2023

Swiss Re

Table of Contents

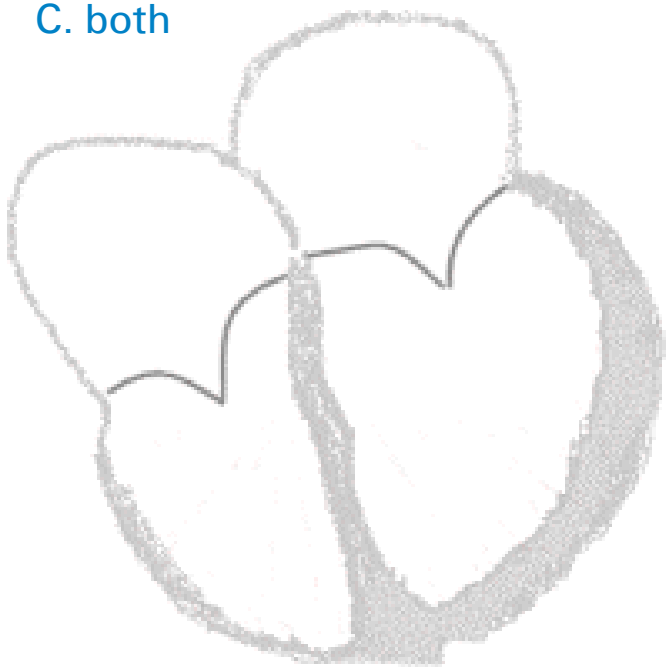
Knowledge Check

This graphic is displaying which type of cardiac action:

A. blood flow

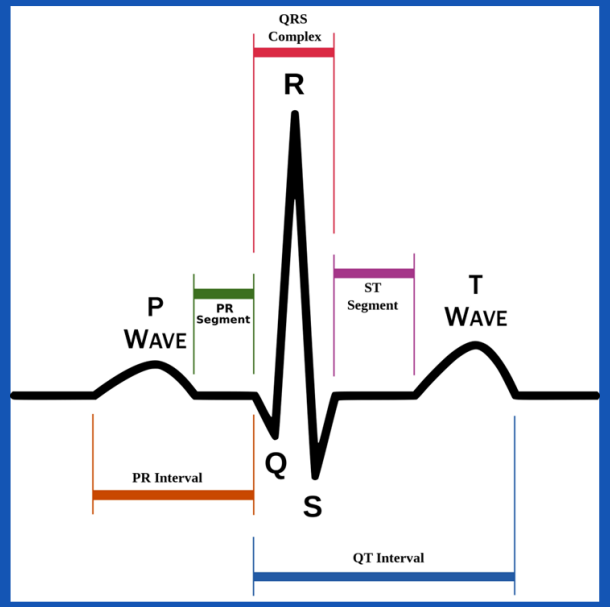
B. electrical conduction

C. both

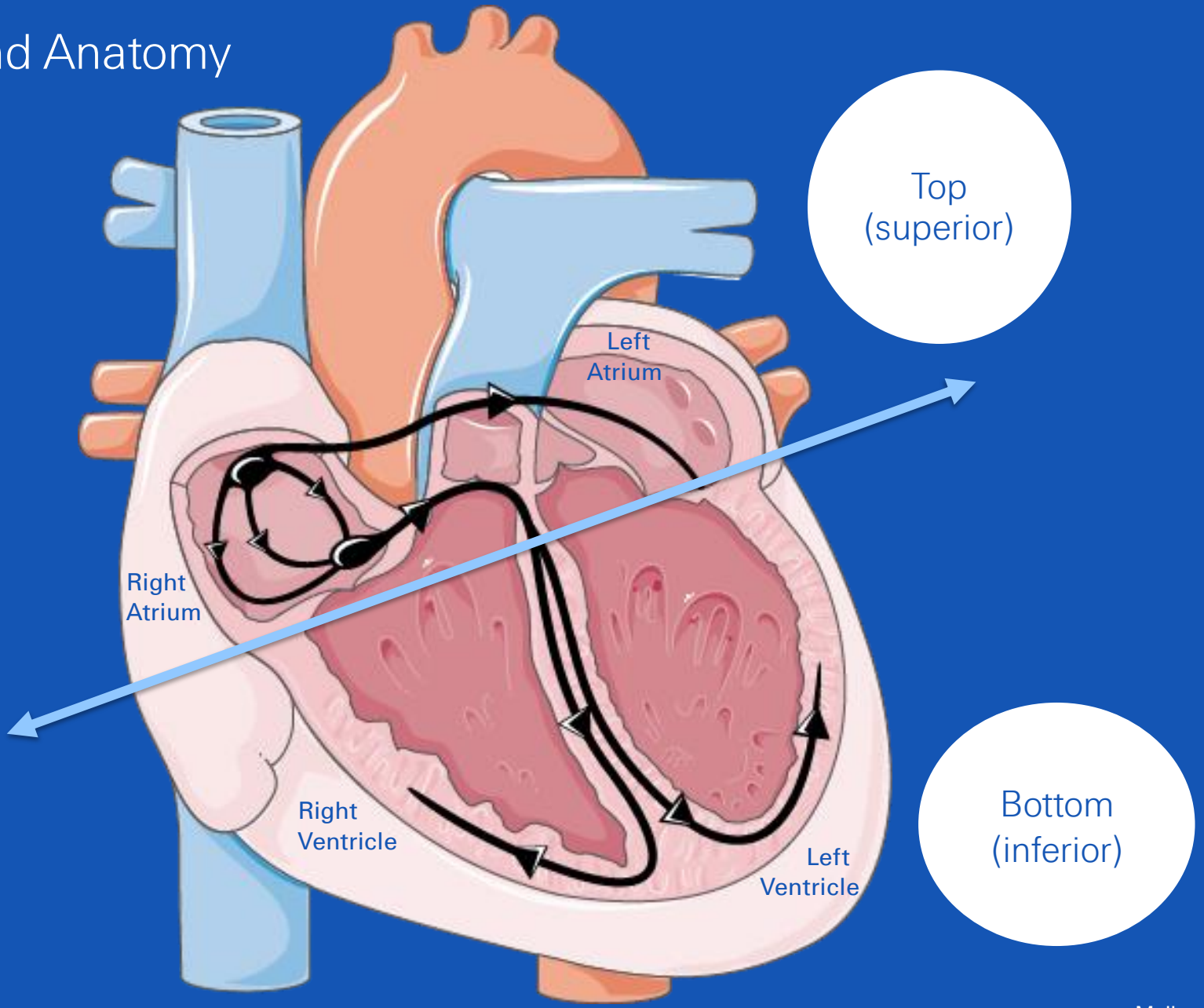


Answer: B. electrical conduction

Cardiac Arrhythmias and Anatomy



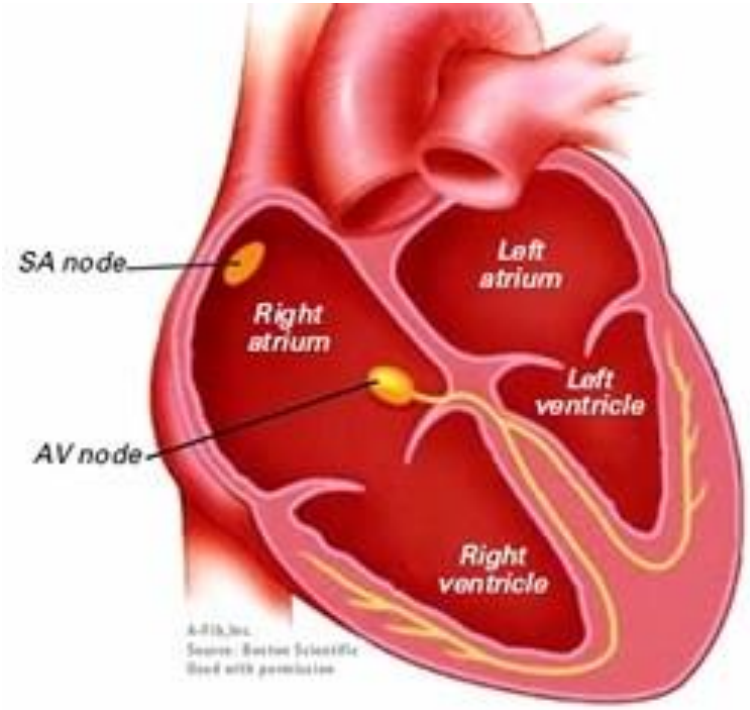
by Unknown Author is licensed under



Anatomy

- Sinus node / Sinoatrial node (SA node)
  - Heart's natural pacemaker
  - Located right atrium
  - Normal Sinus Rhythm (NSR)

- Atrioventricular node (AV node)
  - Secondary pacemaker
  - Connects heart's atria and ventricles in electrical system
  - Leads to Bundle of His, bundle branches and purkinje fibers



Cardiac Rhythms

Normal Sinus Rhythm

- Heart rate 60 – 100 beats per minute (BPM)

Considerations:
- Age (children vs. adults)
- Physical conditioning / fitness
- Medications (Rx)
- Respiratory cycles
- Parasympathetic and sympathetic nervous systems

Bradycardia

- Heart rate < 60 BPM

Considerations:
- Symptoms dizziness or syncope
- Hydration status
- Rx side effects (Beta Blockers)
- Sinus node dysfunction
- Heart block or cardiac condition

Tachycardia

- Heart rate >100 BPM

Considerations:
- Symptoms dyspnea or angina
- Tachycardia induced cardiomyopathy
- Cardiac arrest
- Blood clots – stroke or MI

Underwriting concern is to identify cause

Knowledge Check

When heart rate increases > 100 BPM with intense exercise, this is a form of:

A. Atrial Fibrillation

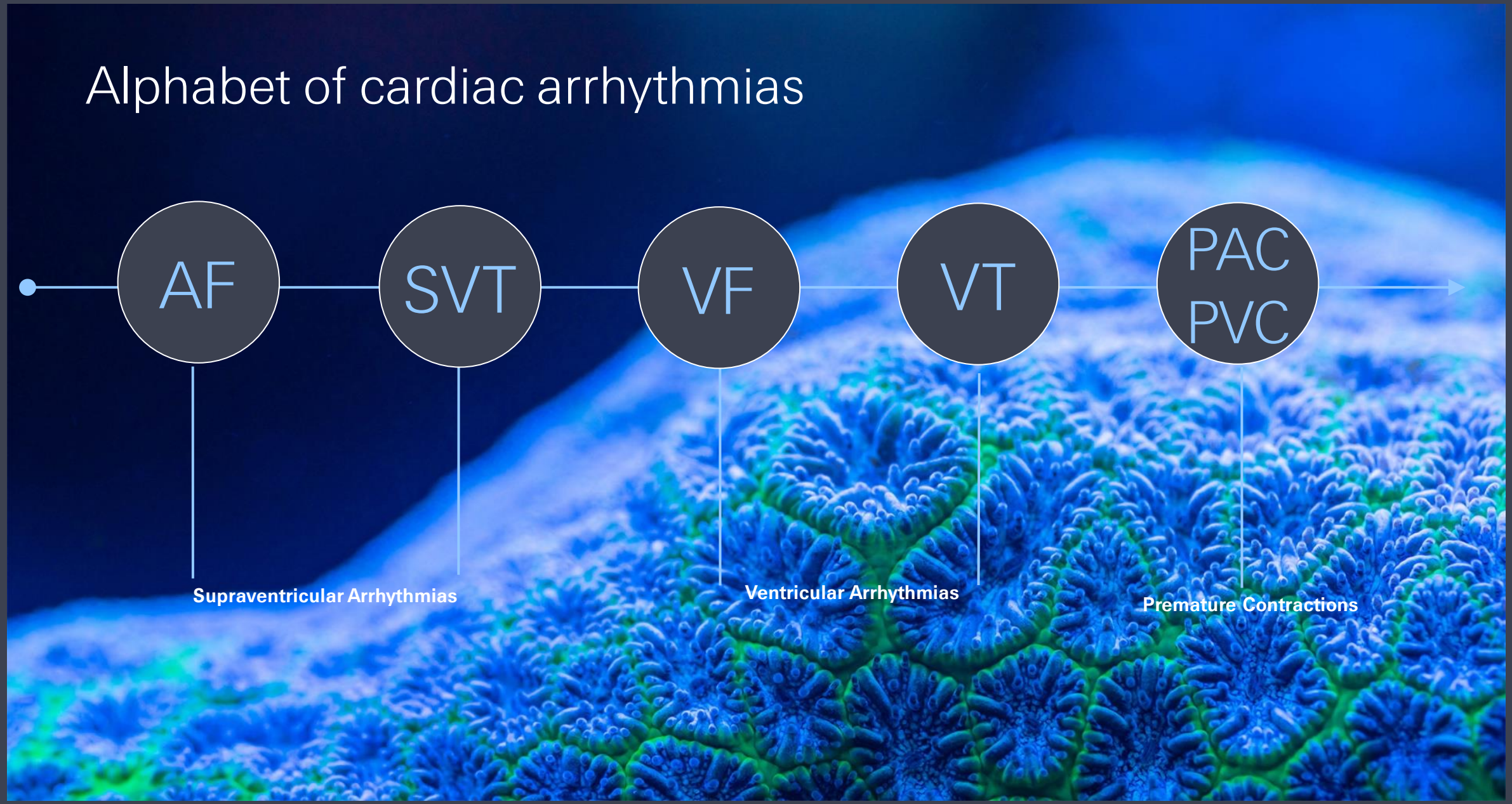
B. Sinus Tachycardia

C. Ventricular Tachycardia

D. Both B and C

Answer: B. Sinus Tachycardia

Alphabet of cardiac arrhythmias



Atrial Fibrillation

- Electrical firing of multiple foci in atrium

- Most common arrhythmia in older ages
  - 1% people over 60 years of age
  - 5% people over 69 years of age
  - 11% people over 75 who are otherwise healthy
  - Males > Females
  - Individuals with HD > without HD (heart disease)
- Medical Risks:
  - Increased HR from 100-200 bpm (symptomatic or asymptomatic)
  - Atrial remodeling with electrophysiological changes in atrial myocytes
  - Atrial Fibrosis
  - Stroke or TIA
- Prognosis: not always life threatening

Atrial fibrillation and flutter (AF) Adult ratings

INFORMATION ADULT RATINGS

- Types:
  - Paroxysmal (intermittent)
  - Persistent (more than 7 days)
  - Chronic / Longstanding (more than a year)
  - Permanent

- Factors to consider:
  - Age
  - Frequency / duration
  - Symptoms
  - Treatment
  - Left Atrial size (normal is <= 4.0 cm)
  - Complications
  - Stability

Atrial Fibrillation contributing conditions

high blood pressure	congenital heart defects	valvular heart disease	atrial inflammation	MI/CAD	obesity
diabetes	hyperthyroidism	COPD	sleep apnea	acute illness/surgery	chronic kidney disease
excess alcohol habits	smoking	family history	catecholamine excess	metabolic stress	extreme physical activity

Atrial Fib Treatment

Cardioversion

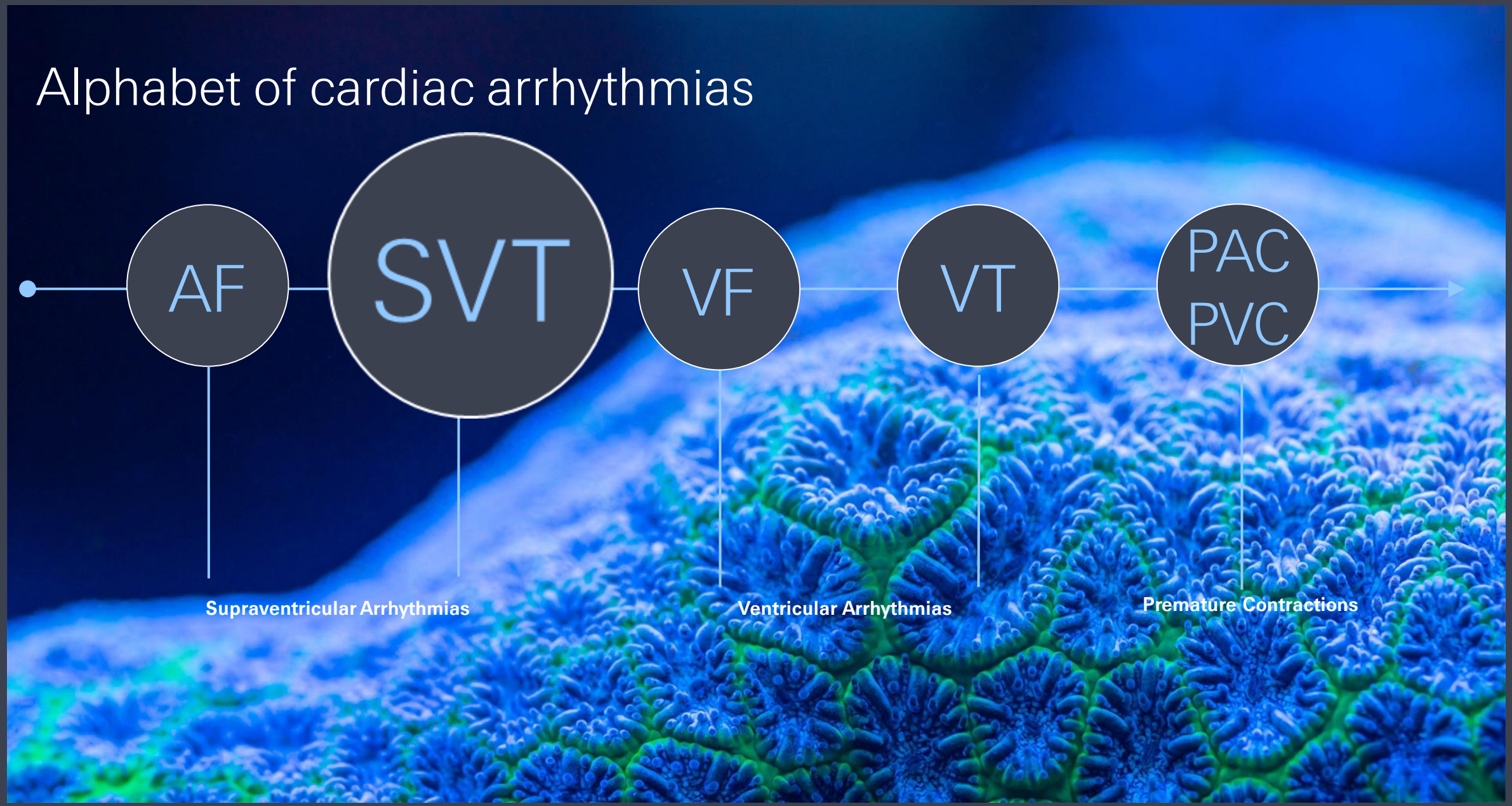
- Pharmacologic Cardioversion
  - Flecainide, propafenone, amiodarone
- Electric cardioversion
  - electrical shock reset heart to normal rhythm
- Efficacy:
  - Electrical initial cardioversion success rate >90%, but this falls as AF duration increases, early recurrence is possible
  - Recurrent AF after electric cardioversion can be high

Ablation

- Electrical mapping needed
- Catheter inserted, destroy (ablate)
  - Radiofrequency
  - Cryotherapy
- Multiple ablations procedures can be done
- Common locations:
  - Pulmonary vein isolation ablation
  - AV node ablation
    - AV node ablation was acutely successful in 97.4% of patients, although 3.5% had recurrence of AV conduction

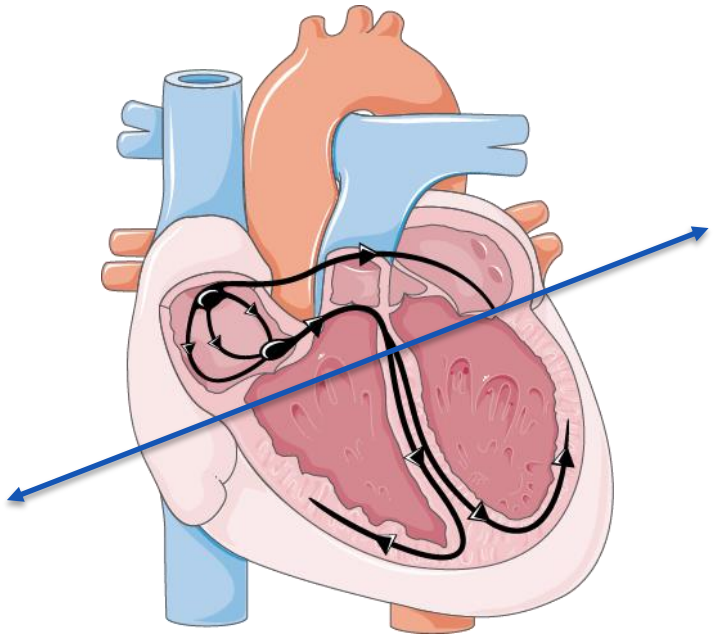
Source: https://www.uptodate.com/contents/atrial-fibrillation-cardioversion?search=atrial%20fibrillation&topicRef=1022&source=related_link

Alphabet of cardiac arrhythmias



Supraventricular Tachycardia (SVT)
Paroxysmal Supraventricular Tachycardia (PSVT)

- **Supra** = Above the Ventricles
- **Paroxysmal** = sudden and intermittent

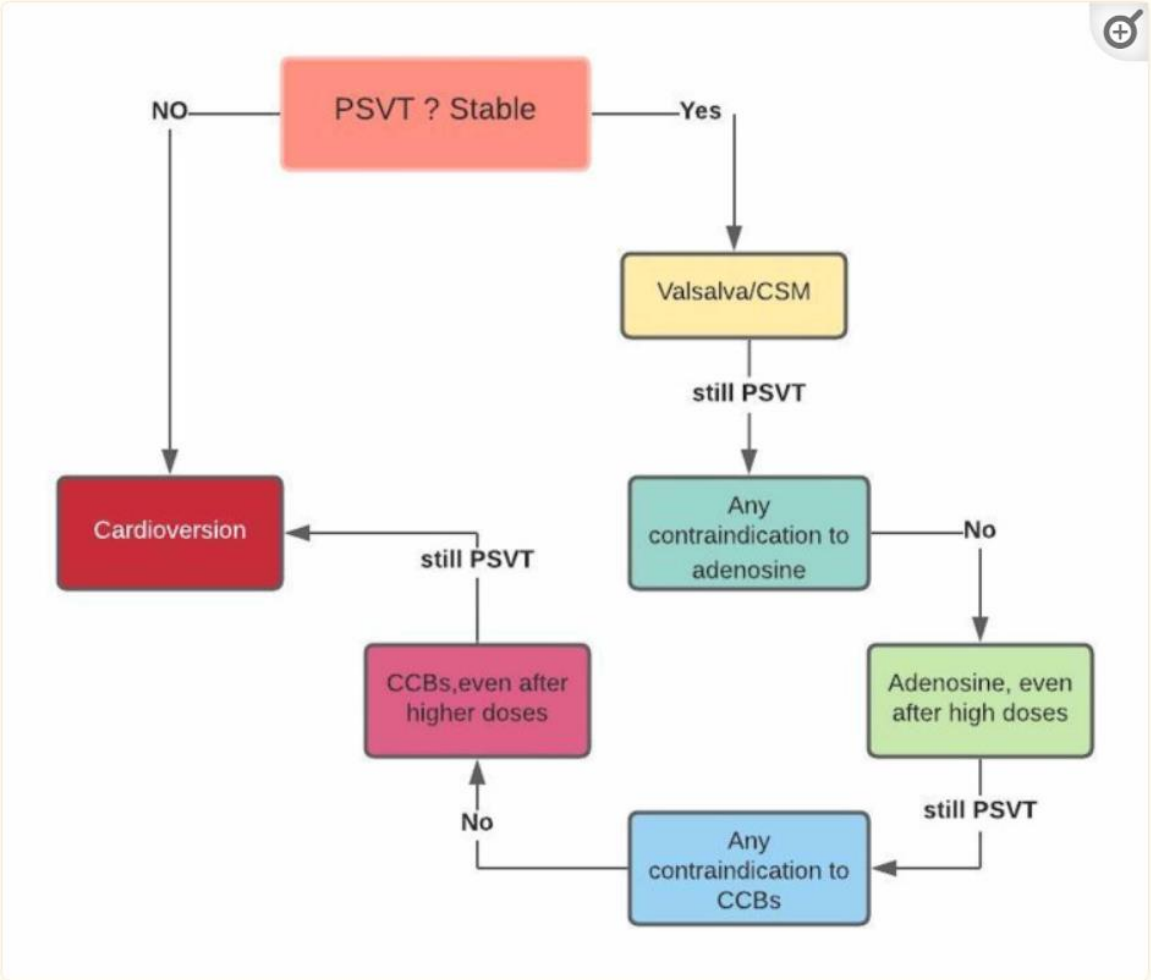


- Occurs in:
  - Healthy persons
  - cardiac disease (MI, mitral valve prolapse, rheumatic heart disease)
  - pericarditis
  - pneumonia or chronic lung disease
  - drug induced / stimulants / caffeine
  - hyperthyroidism / thyrotoxicosis
  - hypoxia, hypovolemia, fever, anxiety, pain,
- Concerns:
  - heart failure, pulmonary edema, myocardial ischemia or infarction, tachycardia induced cardiomyopathy
- Prognosis: dependent on the cause
  - Normal structural heart, no heart disease, excellent prognosis

Source: Paroxysmal Supraventricular Tachycardia: Background, Etiology, Epidemiology (medscape.com)

Treatment of PSVT

Figure 1



Treatment Options for Paroxysmal Supraventricular Tachycardia

PSVT= paroxysmal supraventricular tachycardia, CCBs= calcium channel blockers, CSM= carotid sinus massage

Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8261787/

Types of Atrial Tachycardias

AVNRT
AV nodal reentry tachycardia

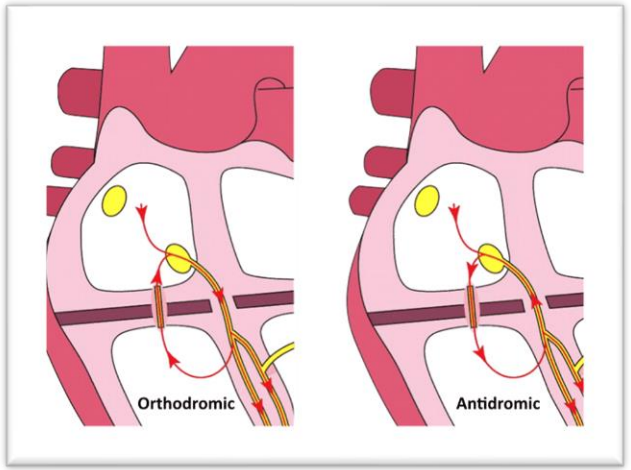
IST
Inappropriate Sinus Tachycardia

MAT
Multifocal Atrial Tachycardia

POTS
Postural Orthostatic Tachycardia Syndrome

AVNRT
AV Nodal Reentry Tachycardia

- Most common type of supraventricular tachycardia (SVT)
- HR >100 bpm, often starts and ends suddenly
- Cause:
  - forming of a reentry circuit confined to AV node and atrial tissue
  - extra pathway (reentrant circuit) located near AV node



  - No apparent precipitating cause for AVNRT
- Occurs frequently in young females

Source: https://www.uptodate.com/contents/atrioventricular-nodal-reentrant-tachycardia?search=torsades%20de%20pointes&topicRef=936&source=see_link

MAT
Multifocal
Atrial
Tachycardia

- Heart rate >100 bpm
- Multiple focal points along different origin
  - at least three or more different P waves seen
- Can be associate with Afib, often difficult to distinguish
- Occurs generally (approx. 60% of cases) in older adults with significant lung disease

Source: Multifocal atrial tachycardia – UpToDate

IST
Inappropriate Sinus Tachycardia

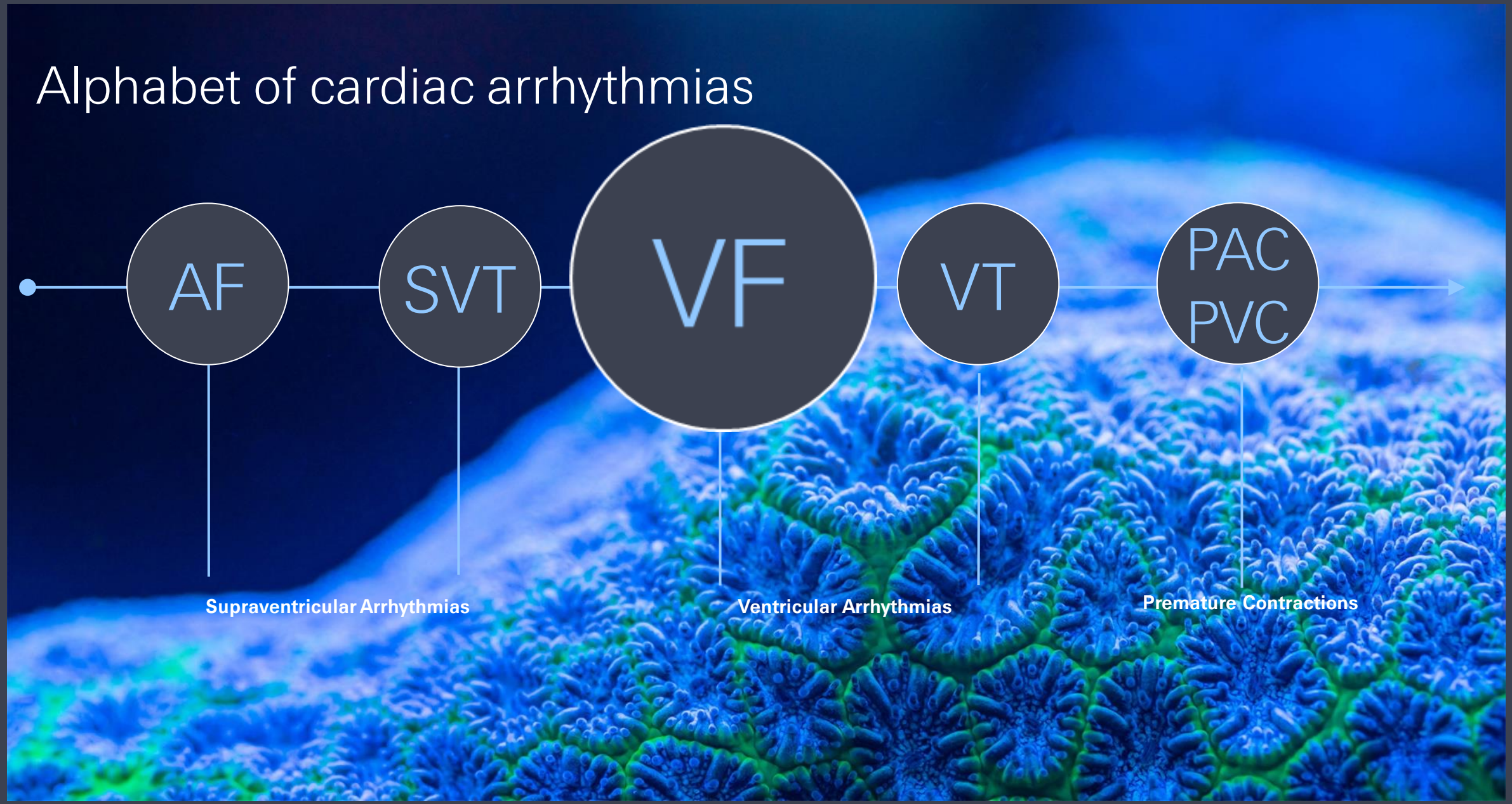
- Unusual tachycardia in person without known cause
- Diagnosis of exclusion – pathology poorly understood
- HR >100 bpm with highly symptomatic palpitations
  - Often HR drops during sleep
  - Rarely does person have syncope
  - low incidence of developing tachycardia associated cardiomyopathy
- Occurs most often young female

POTS

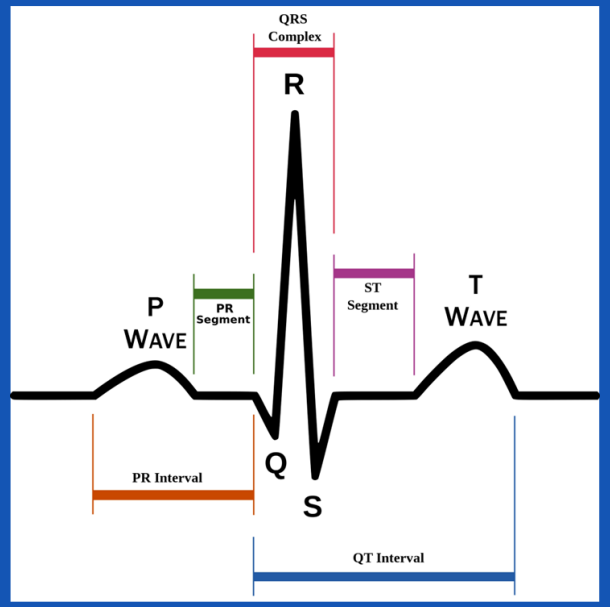
Postural Orthostatic Tachycardia Syndrome

- Disorder of autonomic dysregulation
- Sinus tachycardia only one component
  - Postural component:
    - Normal HR when laying flat, tachycardia prompted upon standing
- Defined as:
  - excessive rise in heart rate ≥ 30 BPM within 10 minutes of standing, in absence of orthostatic hypotension (≥ 20 mmHg systolic BP drop)
- No structural heart disease is present
- Symptoms:
  - Palpitations, fatigue, lightheadedness, exercise intolerance
- Occurs most often in young females

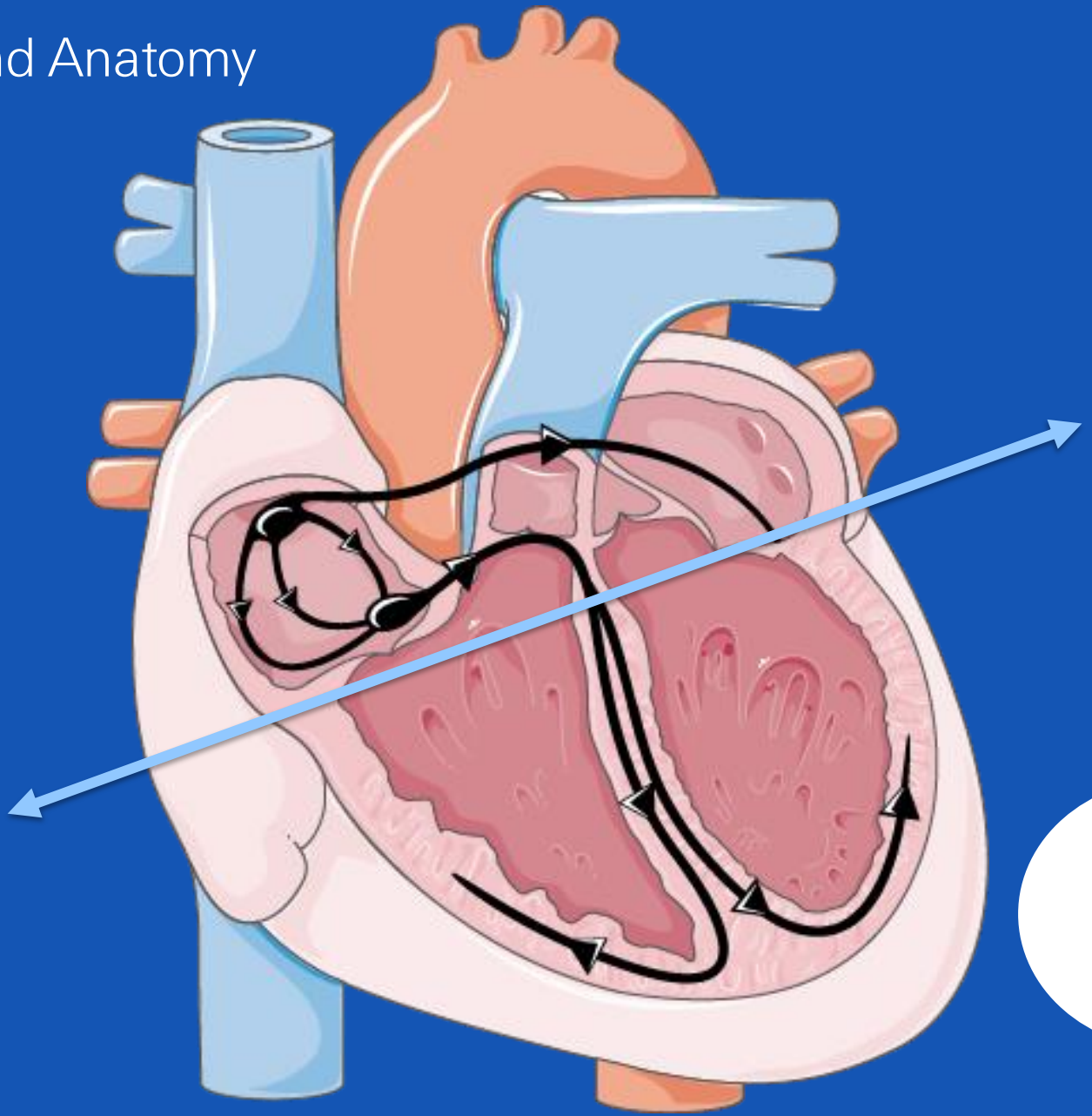
Alphabet of cardiac arrhythmias



Cardiac Arrhythmias and Anatomy



by Unknown Author is licensed under



Bottom (inferior)

Knowledge Check

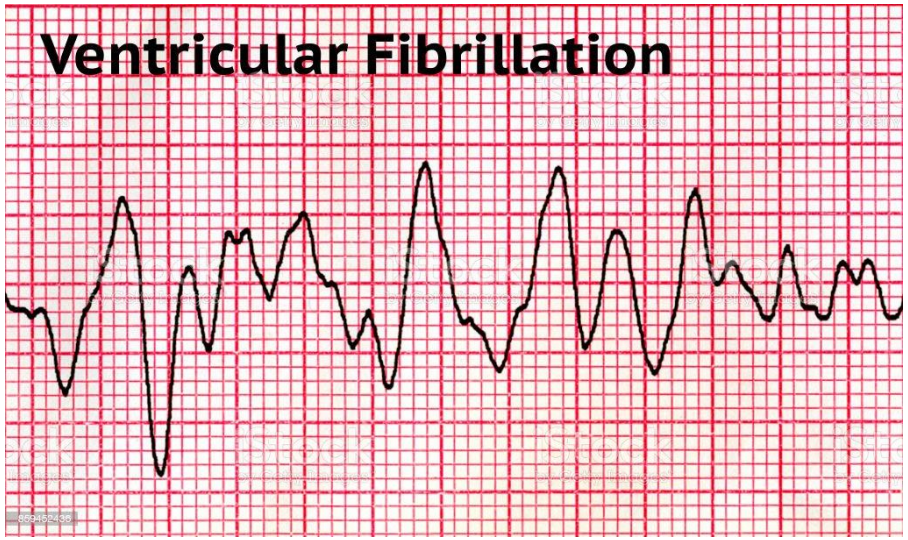
Ventricular Fibrillation is the most common underlying arrhythmia in a person with sudden cardiac death (SCD).

True or False

Answer: True

Ventricular Fibrillation (VF) or Ventricular Flutter

- Heart Rate 150 – 300 bpm
- Ventricular myocardium depolarize in uncoordinated manner
- Often linked to heart disease (>50%)
- Lethal arrhythmia and form of cardiac arrest
- Permanent brain damage within minutes
- Fatal – Sudden Cardiac Death (SCD)



Source: Idiopathic Ventricular Fibrillation: Diagnosis, Ablation of Triggers, Gaps in Knowledge, and Future Directions - PMC (nih.gov)

Ventricular Fibrillation (VF)

Prognosis:

- Prompt defibrillation survival 39.3%
- Delay by 2 mins or more, survival worsens 22.2%
- Often residual neurological deficits from anoxia
- Full recovery is rare

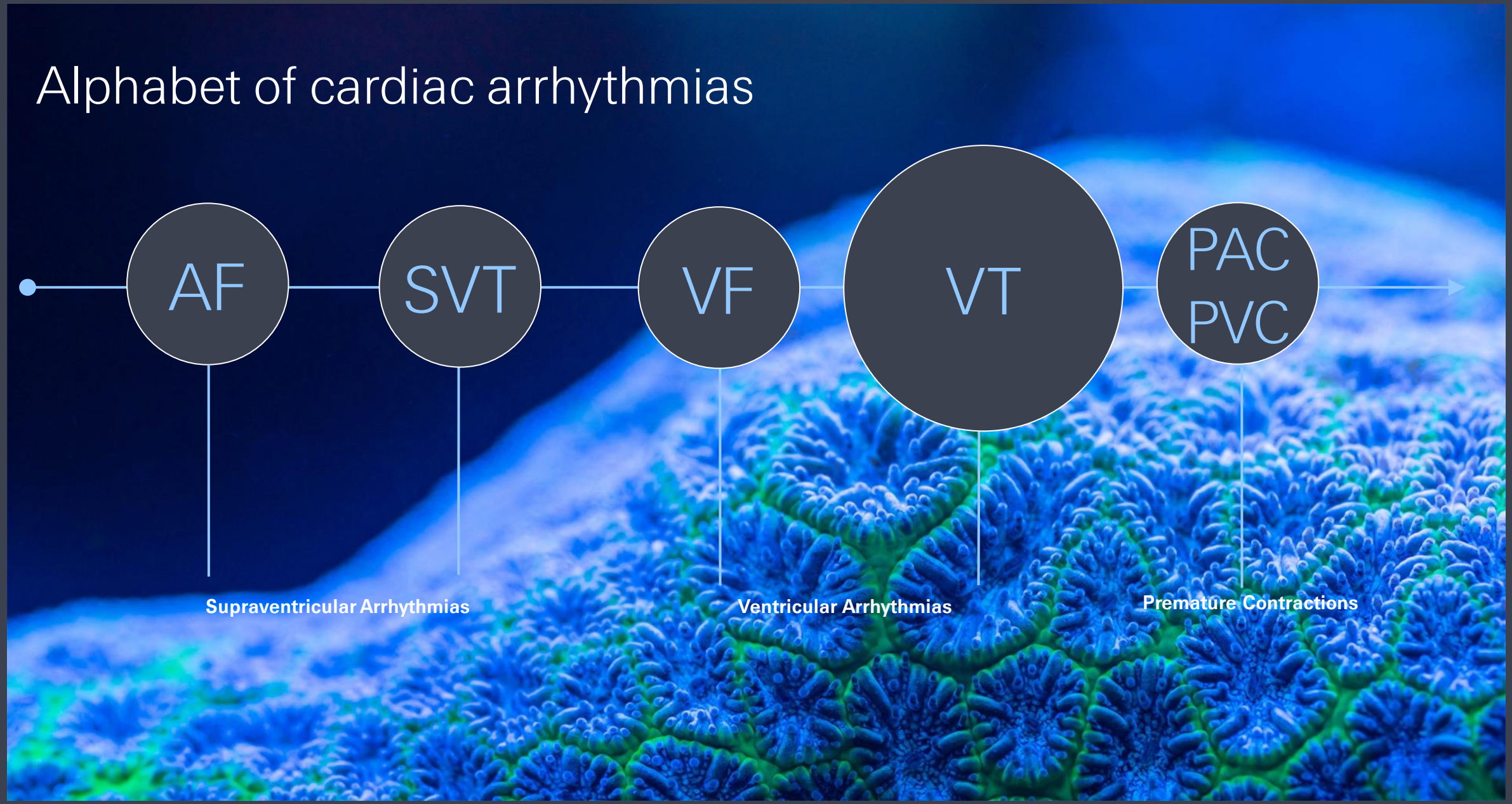
Treatment:

- defibrillation via electric shock
- rarely will VF self-terminate
- ICD / Defibrillator is first line therapy to prevent SCD

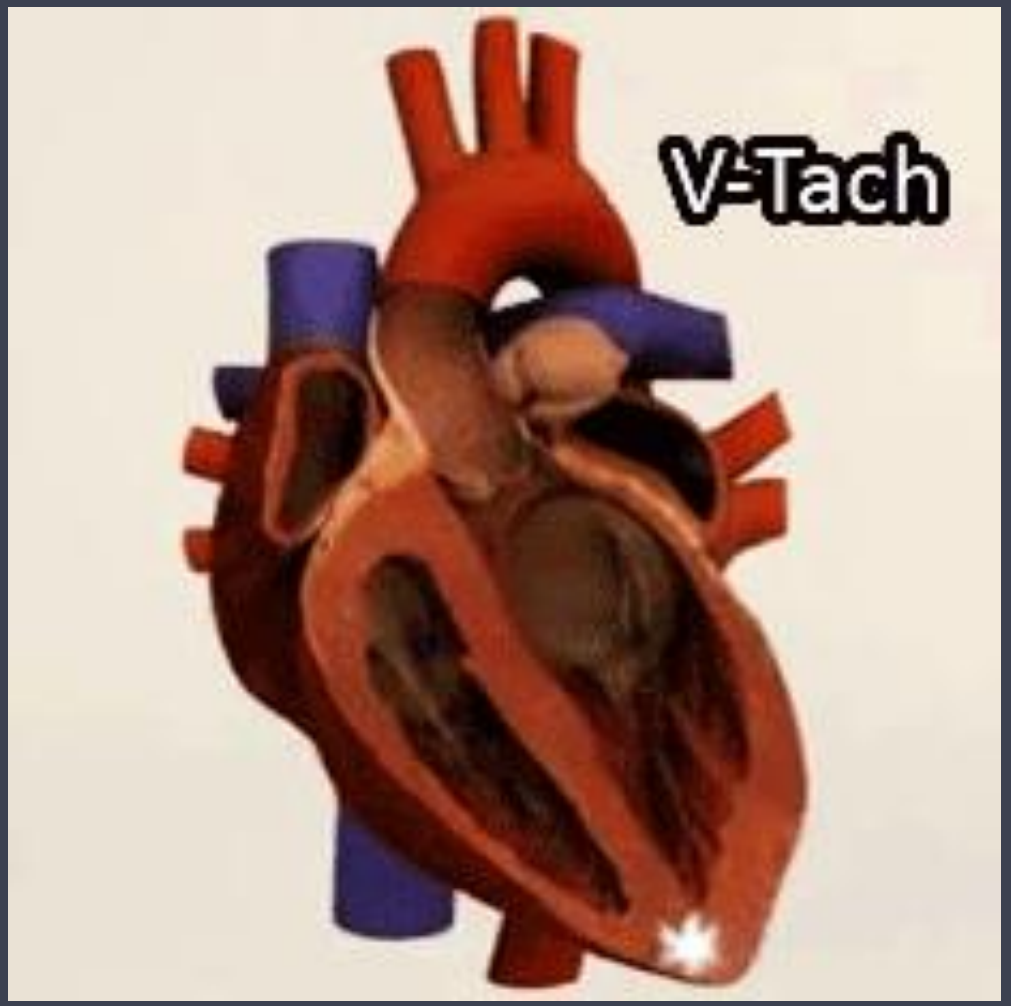
Not a good underwriting risk

Source: https://www.ncbi.nlm.nih.gov/books/NBK537120/

Alphabet of cardiac arrhythmias

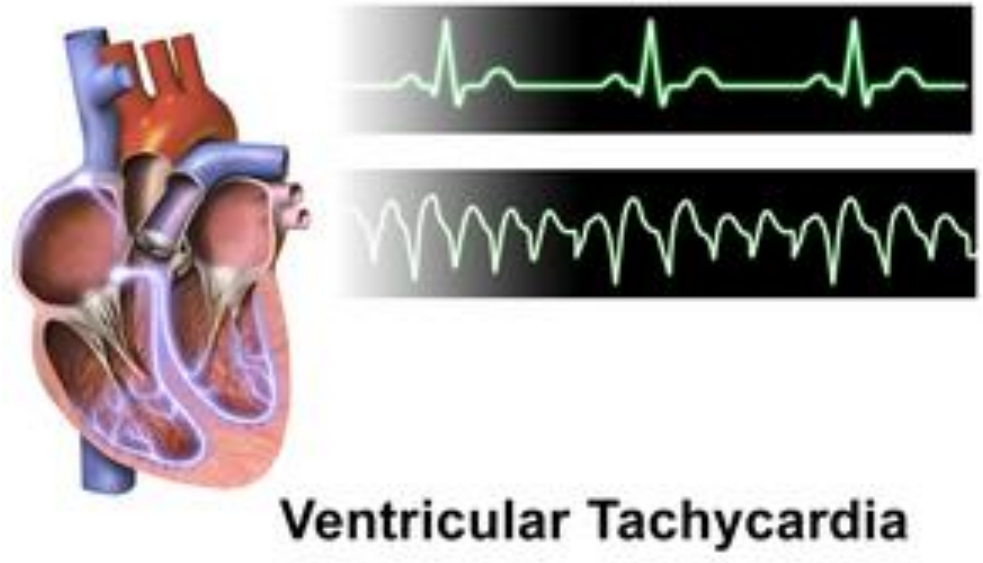


Ventricular Tachycardia (VT)



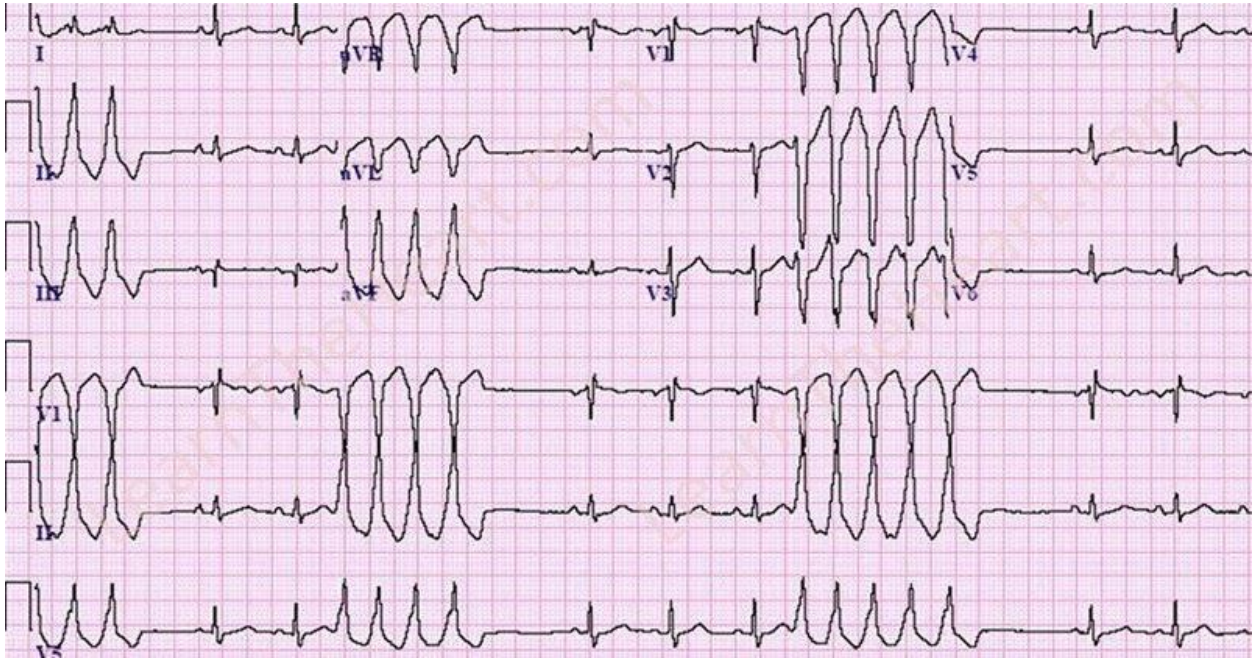
Ventricular Tachycardia VT or V-tach

- Single **ventricular** focus that initiates a rapid, regular rhythm
- Heart rate 100 – 250 bpm
- Prognosis: immediately life-threatening if not treated
- Treatment:
  - Lidocaine, procainamide
  - DC cardioversion
  - Radiofrequency ablation
  - Implantable cardioverter / defibrillator (ICD)
- Underwriting: depends on cause and extent of disease



Nonsustained Ventricular Tachycardia (NSVT)

- Nonsustained VT = spontaneously stops < 30 seconds
  - Sustained VT = lasting > 30 seconds
- Run of 3 or more PVC is considered NSVT
- Types:
  - Focal, reentrant, monomorphic, polymorphic,
  - Torsade de Pointes
- Associated with:
  - Heart disease (organic or ischemic),
  - Prior myocardial infarction
  - cardiomyopathies
  - metabolic disorders
  - drug toxicity
  - long QT syndrome



How does an Underwriter investigate NSVT?

- Age
- History of sudden death and/or syncope in family
- Electrolyte disturbance
- Metabolic imbalance
- Inherited channelopathies
- Heart disease (Ischemic or Valvular)
- Cardiomyopathy
- Drugs (prescription or nonprescription)

Knowledge Check

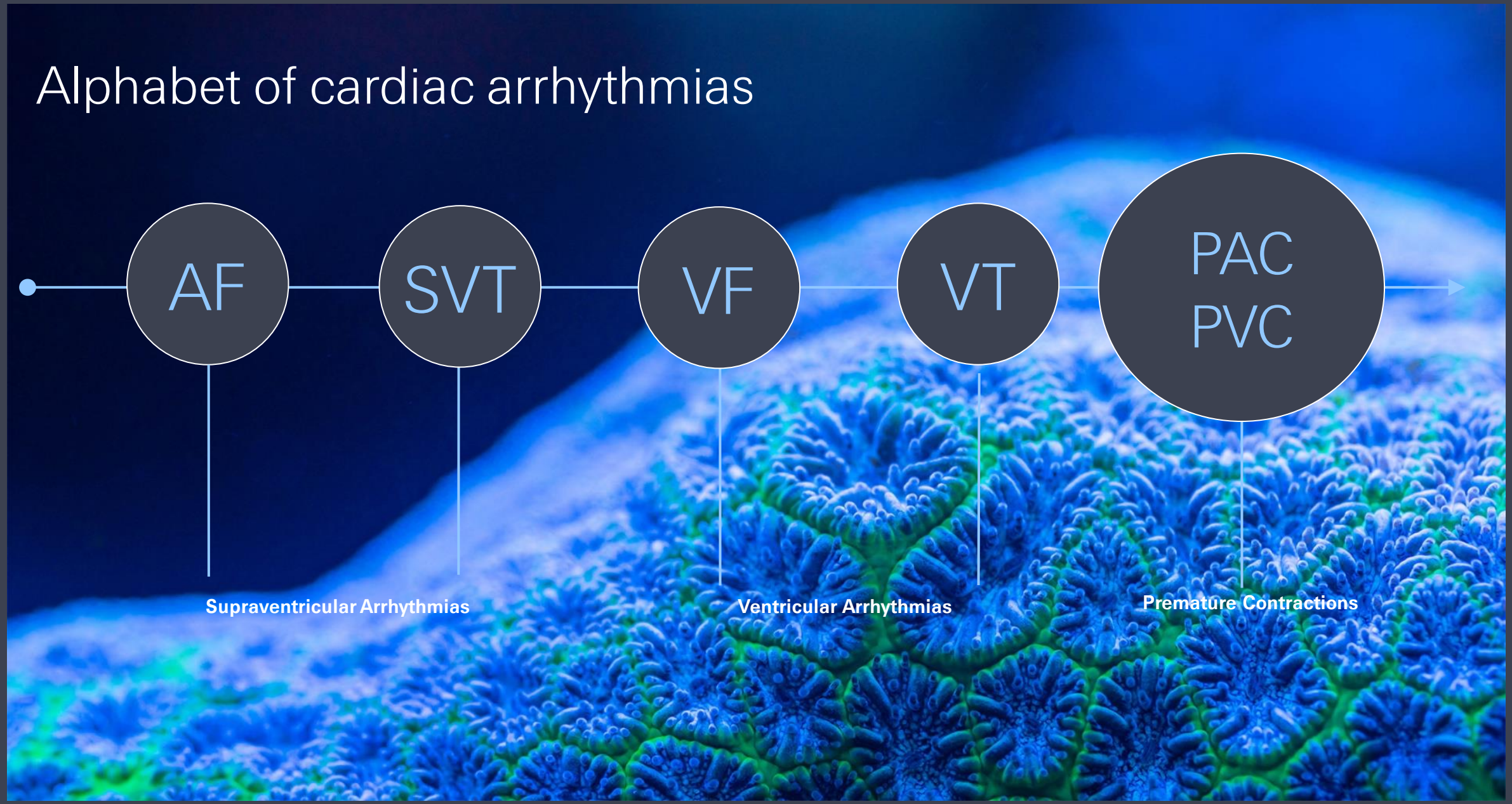
Paroxysmal Supraventricular Tachycardia (PSVT) and Nonsustained Ventricular Tachycardia (NSVT) have the same mortality risk.

True or False

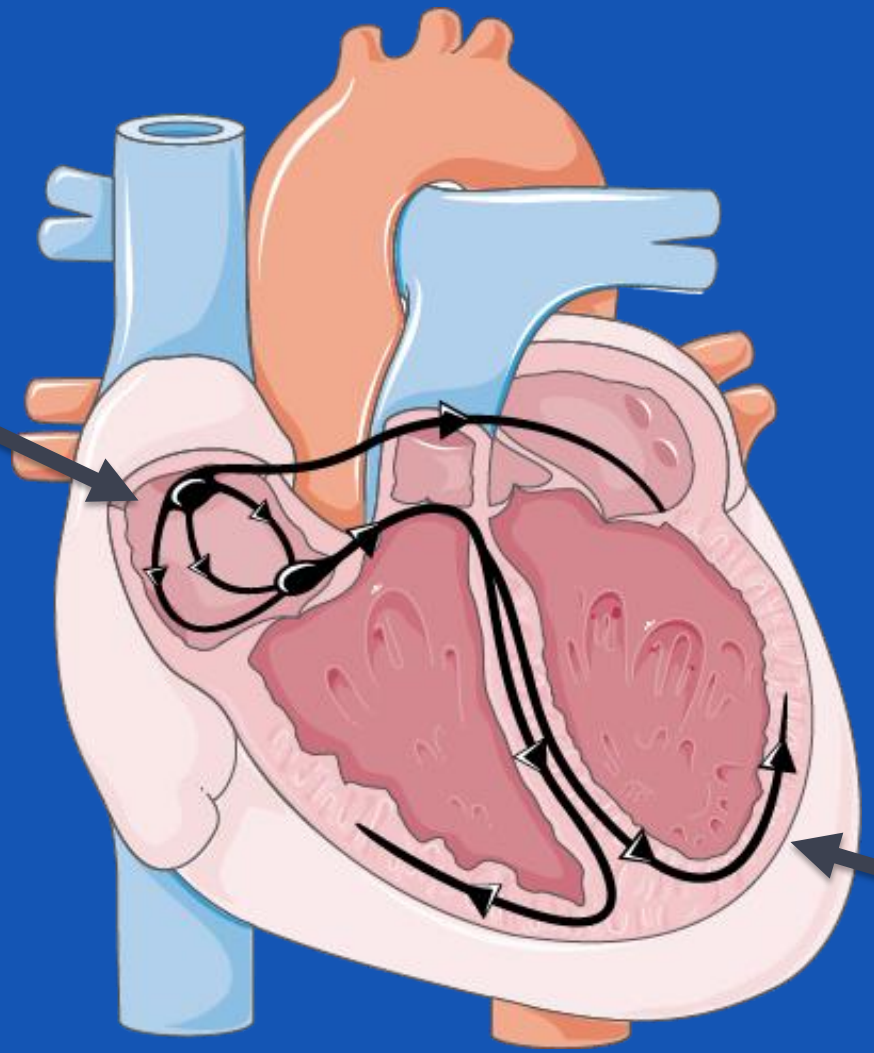
Answer: False

Let’s take an SA node PAUSE!

Alphabet of cardiac arrhythmias



Premature Atrial Contractions



Premature Ventricular Contractions

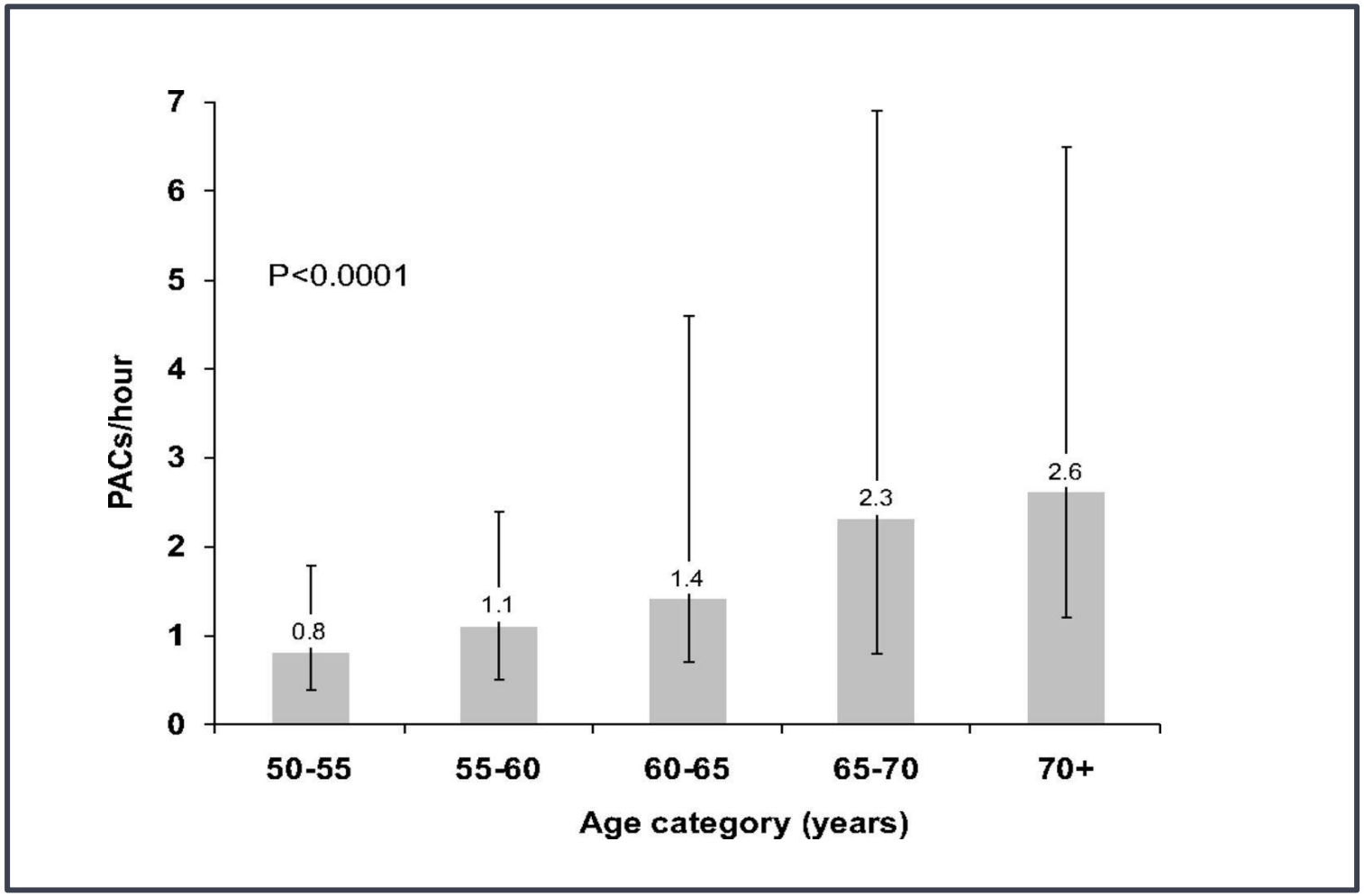
Premature Atrial Contractions (PAC or APC)

- PAC are common
  - Ages young and old
  - Cardiac disease present or not present
- Sample study:
  - Ages 50+ with Holter monitor (1742 participants)
  - Findings: only 1% did not have at least 1 PAC
- How benign are PAC's?
  - PAC may predict afib, stroke, cardiac risk for death

- Factors to consider:
  - Age
  - Cardiovascular disease or structural heart disease
  - Blood pressure
  - Habits i.e., smoking, alcohol, activity
  - NTproBNP (>= 125 considered elevated in study)

Source: Supraventricular premature beats – UpToDate
Premature Atrial Contractions in the General Population | Circulation (ahajournals.org)

Premature Atrial Contractions – frequency increases with age



Source: Conen, et al. 2012. PMID: 23048073

Premature Ventricular Contraction (PVC or VPB)

- Common in broad population
  - approx. 1% - 6% of routine EKGs
  - Approx 80% seen in 24-hr Holter of healthy people
  - Age related increase
- Symptoms:
  - Palpitations (most common)
  - dizziness, lightheadedness, syncope, chest pain, dyspnea
  - can be asymptomatic

Single lead electrocardiogram (ECG) showing an interpolated ventricular premature beat (VPB)

The third beat is a ventricular premature beat (VPB). It is called an interpolated VPB since it does not alter the underlying sinus RR interval.

Graphic 72768 Version 3.0

Source: https://www.uptodate.com/contents/premature-ventricular-complexes-clinical-presentation-and-diagnostic-evaluation?search=PVC&source=search_result&selectedTitle=1~150&usage_type=default&display_rank=1

Mortality with PVCs

Cardiac Conditions:

HTN

LVH

Acute MI

Myocarditis

ARVC (arrhythmogenic right ventricular cardiomyopathy)

Hypertrophic cardiomyopathy

Congenital heart disease

Idiopathic ventricular tachycardia

Non-Cardiac Conditions:

COPD

Sleep apnea syndromes

Pulmonary HTN

Endocrinopathies (thyroid, adrenal, or gonadal abnormalities)

Nicotine, alcohol, or stimulants or illicit drugs,

Medications (beta-agonists, decongestants, antihistamines)

Testing for Arrhythmias

Swiss Re

Arrhythmia Testing

ECG

LABS

AMBULATORY MONITORING

ECHOCARDIOGRAM

EPS ELECTROPHYSIOLOGICAL STUDIES

STRESS TEST / NUCLEAR STRESS / MYOCARDIAL PERFUSION

CARDIAC MRI

TILT TABLE TEST

Ambulatory Monitoring

Continuous EKG monitor (Holter)

- Records 24-48 hours, three lead monitoring

Patch Monitor (Zio Patch)

- Monitoring up to 2 weeks, single lead

Mobile cardiac outpatient telemetry (MCOT)

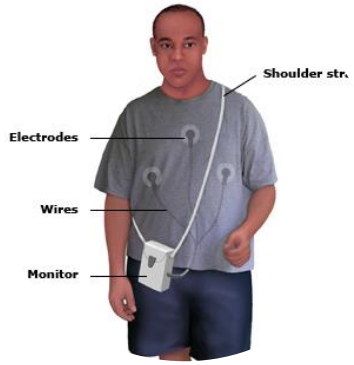
- Up to 30 days, single or triple lead forms, daily report transmitted

Implantable loop recorder

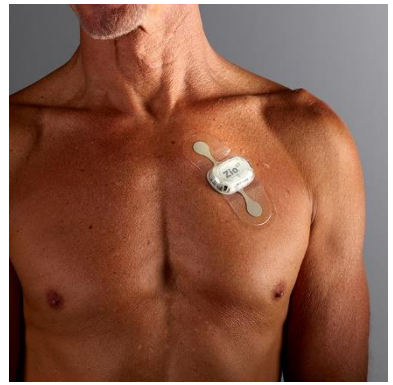
- Long-term monitoring up to years, inserted under local anesthesia

Commercially available cardiac monitors

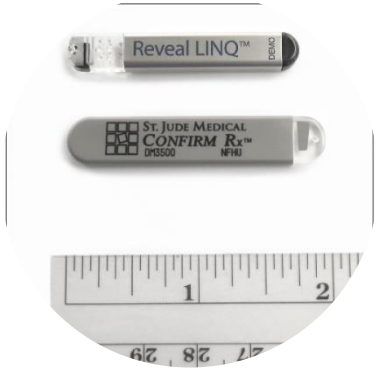
- Smart watch, Fitbit, handheld device, wristband. No approved indications



Holter monitor



Patch Monitor (Zio Patch)

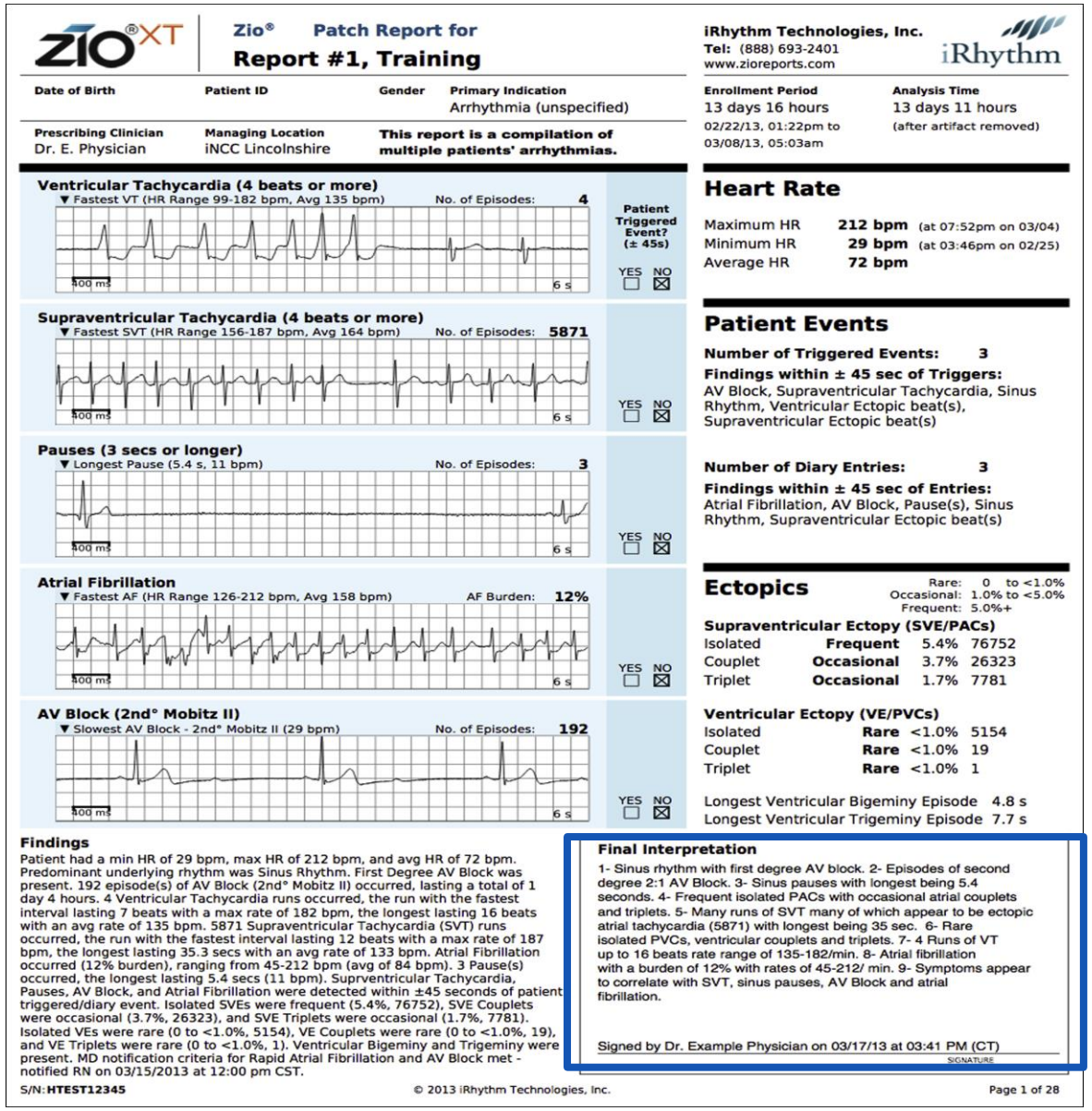


Implantable Loop Recorder

Commercially available cardiac monitors

Source: UpToDate [Ambulatory ECG monitoring – UpToDate](https://www.amjmed.com/article/S0002-9343(13)00870-X/fulltext)
https://www.amjmed.com/article/S0002-9343(13)00870-X/fulltext

Zio Patch Report



ZIO®XT

Zio® Patch Report for
Report #1, Training

iRhythm Technologies, Inc.
Tel: (888) 693-2401
www.zioreports.com

iRhythm

Date of Birth	Patient ID	Gender	Primary Indication
			Arrhythmia (unspecified)

Prescribing Clinician	Managing Location	
Dr. E. Physician	iNCC Lincolnshire	**This report is a compilation of multiple patients' arrhythmias.**

Enrollment Period	Analysis Time
13 days 16 hours 02/22/13, 01:22pm to 03/08/13, 05:03am	13 days 11 hours (after artifact removed)

Ventricular Tachycardia (4 beats or more)
▼ Fastest VT (HR Range 99-182 bpm, Avg 135 bpm) No. of Episodes: 4
Patient Triggered Event? (± 45s) YES ☐ NO ☒

Supraventricular Tachycardia (4 beats or more)
▼ Fastest SVT (HR Range 156-187 bpm, Avg 164 bpm) No. of Episodes: 5871
YES ☐ NO ☒

Pauses (3 secs or longer)
▼ Longest Pause (5.4 s, 11 bpm) No. of Episodes: 3
YES ☐ NO ☒

Atrial Fibrillation
▼ Fastest AF (HR Range 126-212 bpm, Avg 158 bpm) AF Burden: 12%
YES ☐ NO ☒

AV Block (2nd° Mobitz II)
▼ Slowest AV Block - 2nd° Mobitz II (29 bpm) No. of Episodes: 192
YES ☐ NO ☒

Heart Rate

Maximum HR	**212 bpm**	(at 07:52pm on 03/04)
Minimum HR	**29 bpm**	(at 03:46pm on 02/25)
Average HR	**72 bpm**	

Patient Events

Number of Triggered Events: 3
Findings within ± 45 sec of Triggers:
AV Block, Supraventricular Tachycardia, Sinus Rhythm, Ventricular Ectopic beat(s), Supraventricular Ectopic beat(s)

Number of Diary Entries: 3
Findings within ± 45 sec of Entries:
Atrial Fibrillation, AV Block, Pause(s), Sinus Rhythm, Supraventricular Ectopic beat(s)

Ectopics

Rare: 0 to <1.0%
Occasional: 1.0% to <5.0%
Frequent: 5.0%+

Supraventricular Ectopy (SVE/PACs)

Isolated	**Frequent**	5.4%	76752
Couplet	**Occasional**	3.7%	26323
Triplet	**Occasional**	1.7%	7781

Ventricular Ectopy (VE/PVCs)

Isolated	**Rare**	<1.0%	5154
Couplet	**Rare**	<1.0%	19
Triplet	**Rare**	<1.0%	1

Longest Ventricular Bigeminy Episode 4.8 s
Longest Ventricular Trigeminy Episode 7.7 s

Findings
Patient had a min HR of 29 bpm, max HR of 212 bpm, and avg HR of 72 bpm. Predominant underlying rhythm was Sinus Rhythm. First Degree AV Block was present. 192 episode(s) of AV Block (2nd° Mobitz II) occurred, lasting a total of 1 day 4 hours. 4 Ventricular Tachycardia runs occurred, the run with the fastest interval lasting 7 beats with a max rate of 182 bpm, the longest lasting 16 beats with an avg rate of 135 bpm. 5871 Supraventricular Tachycardia (SVT) runs occurred, the run with the fastest interval lasting 12 beats with a max rate of 187 bpm, the longest lasting 35.3 secs with an avg rate of 133 bpm. Atrial Fibrillation occurred (12% burden), ranging from 45-212 bpm (avg of 84 bpm). 3 Pause(s) occurred, the longest lasting 5.4 secs (11 bpm). Suprventricular Tachycardia, Pauses, AV Block, and Atrial Fibrillation were detected within ±45 seconds of patient triggered/diary event. Isolated SVEs were frequent (5.4%, 76752), SVE Couplets were occasional (3.7%, 26323), and SVE Triplets were occasional (1.7%, 7781). Isolated VEs were rare (0 to <1.0%, 5154), VE Couplets were rare (0 to <1.0%, 19), and VE Triplets were rare (0 to <1.0%, 1). Ventricular Bigeminy and Trigeminy were present. MD notification criteria for Rapid Atrial Fibrillation and AV Block met - notified RN on 03/15/2013 at 12:00 pm CST.

Final Interpretation
1- Sinus rhythm with first degree AV block. 2- Episodes of second degree 2:1 AV Block. 3- Sinus pauses with longest being 5.4 seconds. 4- Frequent isolated PACs with occasional atrial couplets and triplets. 5- Many runs of SVT many of which appear to be ectopic atrial tachycardia (5871) with longest being 35 sec. 6- Rare isolated PVCs, ventricular couplets and triplets. 7- 4 Runs of VT up to 16 beats rate range of 135-182/min. 8- Atrial fibrillation with a burden of 12% with rates of 45-212/ min. 9- Symptoms appear to correlate with SVT, sinus pauses, AV Block and atrial fibrillation.

Signed by Dr. Example Physician on 03/17/13 at 03:41 PM (CT)
SIGNATURE

S/N: **HTEST12345**

The American Journal of Medicine 2014 12795.e11-95.e17DOI: (10.1016/j.amjmed.2013.10.003)

Case Study 60 Male

January
New onset cardiomyopathy (NICM), systolic heart failure, echo EF 30-35%

February
Heart cath showed normal coronary arteries

March
continued palpitations, PVCs, possible atrial flutter,

Monitoring device: narrow complex tachycardia (SVT) with HR 170 bpm

Treatment: atorvastatin, bisoprolol, Entresto, spironolactone

LifeVest wearable defibrillator

April
Updated echo with EF 40-45%, no longer needs LifeVest given improvement in HF

June
EPS study focal right atrial tachycardia, ablated successfully

July
No recurrence of sustained tachycardia since procedure. Continue beta blocker

Initially, high risk with no offer. Over time, as remains stable, would consider insurable

Questions?

Thank You.

Melissa Arnold, RN, MPH
Medical Director, Vice President

Legal notice