Cardiac Arrythmia

- Abnormalities of the cardiac rhythm or electrical activity
- Etiology: could be hereditary or acquired
- Diagnosed mainly by ECG

Types

1-Abnormalities of Impulse **Formation**:

a) Rate disturbances

b) Triggered automaticity

2-Abnormalities of Impulse **Conduction**:

a) Blocks → Blockade of passage of electrical activity through normal conduction pathway.

b) Reentry → Reverberating (repeated) activity along the conduction system

Cardiac Causes

- Ischemic heart disease
- Inflammation
- Trauma e.g. heart surgery
- Congestive heart failure
- Hypotension
- Genetic background: susceptible to cardiac arrythmia (e.g: gene SCN5A, which produces NAV protein, affects Na current)

Non-cardiac Causes

- Electrolyte imbalance
- Acid-Base imbalance
- Hypoxia
- Drugs: Digitalis, Anesthetics, Tricyclic, Diuretics, Bronchodilators: sympathomimetics
- Reflexes

Normal Circuitry

The electrical activity goes through the heart homogeneously. It termeniates when it reaches the birfucation of purkinje fibers, which divides the current into two directions. Since they have the same magnitude and opposite direction, they cancel each other out when they meet at the finish line

Re-entry Rythm

-An ischemic area in the heart contains dead tissues and diseased tissues. When the current reaches the bifurcation, the currents which move into the diseased tissue will reach the finish line while most the currents that move through the dead tissue stop there. When the refractory period ends, currents will propagate again as a retrograde impulse.

-In conclusion: currents moving into the diseases tissue would almost move in a circular path, they would eventually go back to the starting point and re-enter the circuit causing reverbating cycles of cardiac arrythmia

Pre-requisites for Re-entry

1. Anatomic or physiologic obstcles (dead tisses)
2. Unidirectional block
3. Conduction time around the circuit must be longer than the effective refractory period

Arrythmias

Supraventricular Tachycardia

- Multiple, very clear P waves occuring at a higher rate in the atria
- Bengin, occur for a short period and go spontaneously
- It may occur secondary to over-ingestion of stimulants (coffee, tea) or due to stress and anxiety

Atrial Flutter

- Same as supraventricular tachycardia but at a much higher rate than SVT (apparent p waves)

Atrial Fibrillation

- Atria work at an extremely high rate independent of SA node

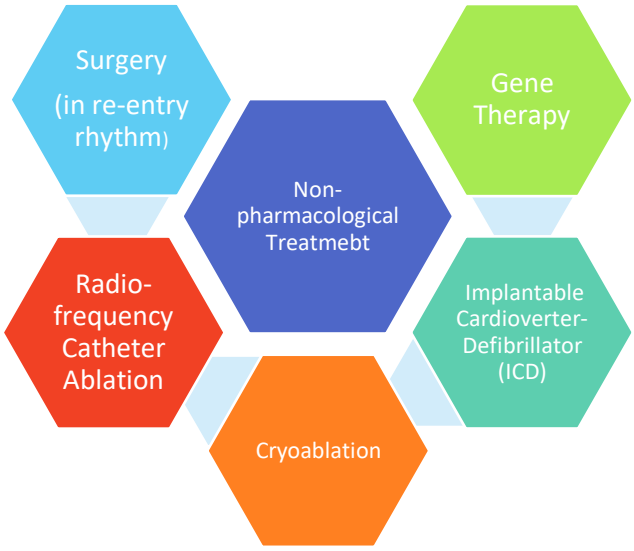
Ventricular tachycardia

- Arrhythmia occurs in the ventricles independent of the activity of atria. There are no P waves this time --> the ventricles take over the electrical activity and contract rapidly

	Characteristics	Causes	Mechanisms	Risk factors	Treatment
Polymorphic Ventricular Tachycardia (Torsade de Pointes)	-Affects very young people -Long QT interval -Syncope (fainting) -Sudden death	-**Familial** long QT interval -**Drug - Induced** (drugs which prolong AP duration): drugs used to treat arrhythmias but at some point, may cause them. -**Genetic** mutations: 300 different mutations in at least 8 ion channel genes	Either by: **-Increased** inward current (called Gain of Function [GF]) **-Decreased** outward current during the plateau (called Loss of Function [LF]).	-Bradycardia -Hypokalemia. -Triggered upstrokes -Drugs which ↑ APD	-Giving **K+** -Prophylaxis of triggered upstrokes by **(β Blockers or Mg++)** -Decreasing APD duration by **artificial pacemaker** or **isoproterenol**

Other Congenital Arrythmias				
Short QT Syndrome	**Catecholaminergic Polymorphic Ventricular Tachycardia (CPVT)**	**Sick Sinus Syndrome**	**Brugada Syndrome**	**Familial Atrial Fibrillation**
GF mutations in three **potassium** channel genes (KCNH2, KCNQ1, and KCNJ2)	-Stress or emotion-induced syncope -It is caused by mutations in sarcoplasmic proteins that control **calcium** -**Inhibiting** RyR2 channels with **flecainide** appears to prevent CPVT	-Mutations in HCN4 and SCN5A	-Ventricular fibrillation, persistent ST elevation, and Bundle branch block (5 in 10,000). -Linked to LF mutations in SCN5A	-Linked to GF mutation in the **potassium** channel gene KCNQ1.

Treatment of Arrythmias



Antiarrhythmic Drugs			
MOA	**Possible Effects on Action Potential**	**Side Effects**	**Classification**
-Readily bind **to** activated channels or inactivated channels but bind **poorly** to rested channels so they are **Use–** Dependent or **State**-Dependent **-**Channels in normal cells will rapidly lose the drug from the receptors during the **resting** phase (we want to target active, arrhythmic cells only) - This selectivity is lost with increasing doses leading to drug-induced arrhythmias	-Decreased phase 4 slope (reaching threshold becomes slower → delay in AP) -Higher (less negative) threshold (reaching threshold takes more time) -Lower (more negative) resting potential and increased threshold leads to a delay in initiation of AP -Increased AP duration can be achieved by increasing plateau duration	- These drugs may become “proarrhythmic or arrhythmogenic” during fast heart rates (even normal cells would be ‘active’), acidosis, hyperkalemia, or ischemia -Can cause arrhythmias especially during long-term therapy	-Divided into 4 classes: I, II, III, and IV -These subclasses vary in dissociation speed from Na channels

Done by: Rama Abbady