Yan Yu, 2012 (www.yanyu.ca)

Pathophysiology of Cardiac Arrhythmias

Brady-arrhythmias

↓ SA node automaticity *(i.e. sinus bradycardia)*

(↑ parasympathetic, ↓ sympathetic stimulation)

→If SA node rate ↓ enough, AV node & perkinje fibers initiate impulses called "*espcape beats*".

→A series of escape beats = "*escape rhythm*"

Conduction Block

(i.e. AV block, BB block)

→Delayed propagation of impulse due to electrically unexcitable tissue (from ischemia, fibrosis, inflammation, drugs)

Altered Impuse Formation

↑ automaticity

↑ SA node automaticity

(↑ sympathetic stimulation of β1-adrenergic receptors)

↑ automaticity of latent pacemakers

→If the AV node and purkinje fibers intrinsically depolarize *faster* than SA node (produce "ectopic beats"), they'll control impulse formation (produce an "ectopic rhythm") – I.e. AV Junctional Tachychardia

Abnormal automaticity

(ectopic pacemakers in atrial &/or ventricular myoctes)

→If normally non-conducting heart cells depolarize *faster* than SA node, they'll produce an abnormal ectopic rhythm

→Usually due to myocyte injury

Triggered activity

("R on T phenomenon")

→"*after-depolarizations*" cause extra ventricular contractions during their repolarization.

→*Early after-depol's* in Long QT pts → *torsades de pointes*

→*Delayed after-depol's* in high-Ca^{2+}-pts → idiopathic *V-tach*

Altered Impulse Conduction

Re-entry loops

→An impulse travels continuously around a circular (re-entrant)path in the myocardium, continuously depolarizing that cardiac region.

→Re-entry loops occur in branched, dysfunctional/fibrotic myocardium w/:

1) **Unidirectional block**: when impulses can't conduct forwards, but can be conducted backwards, in the piece of myocardium
2) **Slowed retrograde conduction velocity:** backward impulse conduction speed is slow, allows normal myocardium to repolarize so that the impulse propagates in a loop

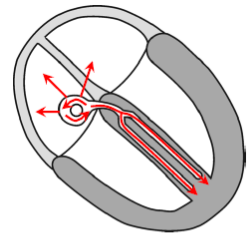
Tachy-arrhythmias

More on Re-entry loops:

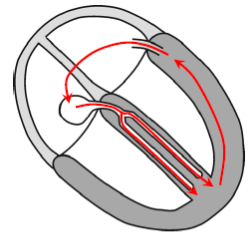
→Rate of re-entrant circuits is only limited by the refractory period of the tissues involved. Thus, re-entry can ↑ contractions >300bpm!

→Re-entry loops around distinct anatomical pathways → *monophorphic tacychardia on ECG* (each QRS looks the same) — Ex. VT due to ventricular scar, A-flutter, AVNRT, AVRT (WPW)

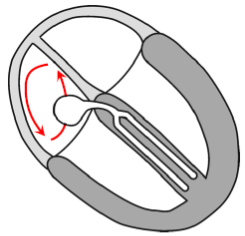
→Re-entry loops that are disorganized and constantly changing → *Polymorphic tachycardia on ECG* (no distinct QRS complexes visible) — Ex. Polymorphic VT, V-fib, A-fib



AV nodal reentry tachycardia (AVNRT)



AV reentry ("reciprocating") tachycardia (AVRT)



Atrial flutter & some atrial tachycardias