

CONDUCTING SYSTEM OF HEART

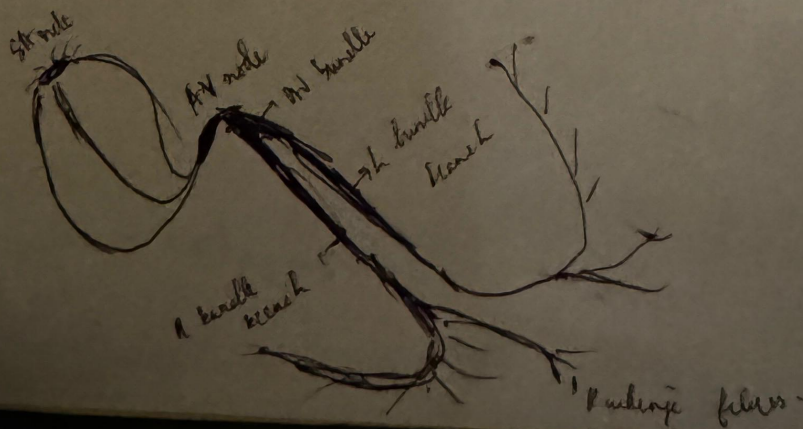
- consists of
 - SA node
 - internodal pathway
 - AV node
 - His bundle
 - Bundle branches
 - Purkinje fibres

SA Node

- primary pacemaker of mammalian heart
- situated in the RA \rightarrow close to the opening of SVC
- 1.5 cm long & 0.5 cm wide in humans
- contains pacemaker (P) cells and few myofibrils
- Cells \rightarrow generate impulse \rightarrow transmitted in the conducting system for excitation of other parts of heart
- AP generated in SA node \rightarrow slow response type
- Vel of conduction of impulse in SA node is slow \rightarrow 0.05 m/s

Internodal Pathway

- 3 internodal pathways connecting SA node & AV node
- 1) Anterior IN pathway \rightarrow tract of Bachman
 - Middle IN " \rightarrow tract of Wenckebach
 - Post IN " \rightarrow tract of Thorel
- 2) IN pathways \rightarrow merge into AV node
 - 3) Vel of conduction of impulse in the IN pathway is 1 m/s
 - 4) From SA node, a conducting tract of axis \rightarrow directly enters left atrium interatrial tract (Bachman's bundle)



- Helps in ventricular filling.
- Otherwise contraction of A & V \rightarrow simultaneous \rightarrow no ventricular filling

2. Maintains low ventricular rate in atrial fibrillation:

- Atrial (F) \rightarrow very high rate of atrial depolarization
- In such conditions, all the electrical impulses from A cannot reach the V's because of inherent AV nodal delay.
- Thus, ventricle contract at a lower rate than atria
- Low V rate \rightarrow helpful \rightarrow diastolic filling

3. Effect of drugs

- many drugs \rightarrow digitalis, β -blockers etc reduce heart rate by promoting AV nodal delay.

4. Vagal stimulation :- causes AV nodal block

- enters ventricular walls & branch out into very small fibres in the inner walls of ventricular muscle.
- Purkinje fibers
- Also have the potential to generate impulse
- RBB → longer, thinner, exclusive supply to RV
- LBB → bifurcates into 2 div 1) ant div → supplies ant portion of LV
2) post div → supplies post portion of LV

Purkinje Fibers

- network of small bundles of conducting fibres
- found throughout subendocardial region of L & RVs
- cells of Purkinje system → largest cells in the heart
- numerous gap junctions present btw cells (low impedance electrical synapses)
- Because of large diameter + presence of low impedance cell to cell connections, rate of impulse conduction → highest in P fibres
- Cond rate → 4 m/s
- AP generated → fast response

AV Nodal Delay

- Conduction of impulse through the AV node occurs at a much slower velocity (0.05 m/s)

- ∴ Transmission of impulse is delayed in AV node → 0.1s

AV nodal delay

- Due to
- 1) small size of nodal cells & branching patterns
 - 2) slow upstroke of AP which occurs due to slow voltage-gated Ca^{2+} channels
 - 3) Weak electrical coupling as a result of relatively few gap junctions

Importance of AV nodal delay

1. Allows ventricular filling :-

- Due to AV nodal delay, atrial depolarization completes before ^{beginning of} ventricular depolarization
- ∴ when atrial systole → ventricular diastole

AV node

- Location :- lower part of the RA close to interatrial septum of just above the AV ring.
- 22mm - length
10mm - width
3mm - thickness
- In AV node - fibres diameter small & has multiple branches
∴ rate of impulse conduction is slow in AV node (0.05 m/s)
- Usually, AV nodal delay \rightarrow 0.1s for impulse transmission
- Delay \rightarrow shortened \rightarrow sympathetic stimulation
lengthened \rightarrow parasympathetic stimulation
- Ability of AV node to slow down the transmission of rapid impulses from SA node to the ventricle \rightarrow decremental conduction
Provides safety to ventricle \rightarrow prevents extreme ventricular tachycardia when SA node discharges rapidly.
- AP in AV node \rightarrow slow response type
- P cells are present but rate of impulse formation \rightarrow less than SA node.
- P cells of AV node \rightarrow suppressed by the SA nodal impulses.
- When SA node stops producing impulses \rightarrow AV node becomes the pacemaker.

His Bundle

- axis from AV node & terminates in Purkinje fibres
- situated below AV node & passes \rightarrow LV septum
- fibres in the form of bundle (hence bundle of His)
- length 1cm, on entering LV septum \rightarrow R & L branches
- When SA node & AV node are defunct \rightarrow Bundle of His generates impulse
- Conduction \approx 1m/s

Bundle Branches

- His bundle \rightarrow RBB (R bundle branch) \rightarrow conducts impulses to the RV.
 \rightarrow LBB \rightarrow LV