Physiology Lecture One

The conduction system is a network of specialized cardiac muscle fibers called Autorhythmic fibers. They are 1% of cardiac muscle fiber.

In Bachman bundle ….conduction reach to 1 m\sec and in most atrial muscle is about 0.3 m\sec

There are 3 small bands curve through the anterior , lateral and posterior and terminate :

Anterior-> Anterior internodal pathway

Lateral -> Middle internodal pathway

Posterior -> Posterior internodal pathways

In these 3 bands and Bachman bundle the cause of more rapid velocity of conduction is the presence of specialized conduction fibers , these fibers are similar to Purkinje fibers.

THE AV NODE IS LOCATED IN THE POSTERIOR WALL OF RIGHT ATRIUM BEHIND THE TRICUSPID VALVE.

From SA node to AV node about 0.03 second

AV delay is about 0.09 second

AV bundle delay is about 0.04 second

↘ Separating the atria from the ventricles.

Thus, the total delay in the AV is 0.16 second

A special characteristic of the AV node is INABILITY ,except in abnormal states….only from atria to ventricles.

Everywhere, except AV BUNDLE , the atrial muscle is separated from ventricular muscle by continuous fibrous barrier .

Pacemaker RATE

SA>AV>Bundle of His/Purkinje/Ventricles. From FA

Speed of conduction

His/Purkinje>Atria>Ventricles>AV. From FA

* After penetrating the fibrous tissue …

The distal portion of the AV node passes downward for 5 to 15 mm toward the apex of the heart -> then, the bundle divides into left and right bundle toward the apex of the ventricles and then back toward the base of the heart , in the end Purkinje fibers penetrate about 1/3 of muscle mass and finally become continuous with cardiac muscle fibers .

Slow conduction in the AV bundles transitional, nodal and penetrating fibers is mainly due to fewer gap junction , which increase resistance to ion flow between cells, making excitation spread more slowly. This reduced connectivity causes each cell to take longer time to activate .

Cardiac impulse -> termination of the Purkinje fibers ONLY 0.03 second .

IMPORTANT NOTE

Purkinje fibers have rapid transmission of action potentials is believed to be caused by a very high level of permeability of gap junctions at the intercalated discs the successive cells that make up the Purkinje fibers .

Purkinje fibers are :

very large , even larger than the ventricular muscle fibers.

Velocity of 1.5 to 4.0 m/sec..... this 6 times of ventricular velocity.

Then from the end of Purkinje fibers to ventricular muscle fibers

(the velocity in ventricular muscle only 0.3-0.5 m/sec.....1/6 that in Purkinje).

From endocardial surface to.... Epicardial surface of ventricles requires another 0.03 .

Then the total time for transamission of cardiac impulse = 0.03 +0.03= 0.06 second.

#Effective ventricular pumping requires synchronous. When impulse transmission through the ventricles slow reducing overall pumping efficiency 20%-30%.

Discharge rates

The AV intrinsic rhythmical rate (not from outside source) = 40 to 60 times per minute.

Purkinje rate = 15 to 40 times per minute.

For SA node the rate= 70 to 80 times per minute.

Ectopic Pacemaker

a pacemaker elsewhere than the sinus node, this can happen in the AV node or Purkinje fibers due to abnormalities ,or in rare case, in excitable atrial or ventricular muscle and may result from a blockage of impulse transmission from SA, forming new pacemaker in AV node or bundle ,but when there is a blockage of AV node , the new pacemaker is Purkinje system with a rate of 15-40 beats per time ……this affect yhe heart coordination and rhythm significantly.

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