khanghuynh Cheat Sheet

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Cardiac Muscle

Structure 1

1) striated
2) thin filaments have tropomyosin (belt) and troponin (3 spheres)
3) contains an abundance of mitochondria and myoglobin
4) possess T-tubles and sarcoplasmic reticulum
5) Ca++ enters the cytosol from voltage-gated Ca++ channels (small amount) in the plasma membrane and triggers internal release of Ca++

AP in contractile cardiac muscle cells (P 1)

1) AP in cardiac contractile cells differs considerably from the AP in cardiac autorhymic cells
2) -90mV resting potential
3) rapid rising phase of AP result of Na+ entry on opening of fast Na+ channels at threshold (-70mV)
4) Brief repolarization after potential reaches its peak bc of limited K+ efflux on opening of transient K+ channels, coupled w/ inactivation ofNa+ channels

Anatomy of the heart

dual-pump system includes 4 chambers:
- left and right Atria, Ventricles
- chambers on right pump = oxygen-poor blood through pulmonary circulation -> lungs
- chambers on left pump = oxygen-rich blood through systempic circulation -> body tissues

Path of the blood (based on valves)

1) right AV valve/tricuspid (r.a.->r.v)
2) pulmonary/semilunar valve (r.v.->pu-lmonary artery)
3) left AV valve/bicuspid/mitral (l.a.->l.v.)
4) aprtic/semilunar valve (l.v.->aorta)

Purkinje Fibers

- small terminal fibers of specialized, cardiac pacemaker cells that extend from

Affect of Pressure on Valve

Structure of Heart Valve = ensure a one-way flow of blood (no backflow)

- When pressure is greater behind the valve, it opens
- When pressure is greater in front of the valve, it closes

Heart Walls

Endocardium: thin layer of endothelial tissue lining the interior of each chamber

Myocardium: middle later of heart wall, composed of cardiac muscle
- cardiac muscle cells are connected end-to-end by intercalated disks (formed desmosomes and gap-junctions)

Epicardium: thin external membrane covering the heart and is filled with a small volume of pericardial fluid

Excitation-Contraction Coupling

- mechanism of Ca++ entry into the cytosol is different from that in skeletal muscle cells

- T-tubule membranes have dehydropy-ridine receptors (voltage-gated Ca++ channels). open and allow Ca++ to flow into cytosol

- Ca++ entry triggers further release of Ca++ from sarcoplasmic reticulum. these 2 sources of Ca++ activate power stroke of contrstraction

- # of activated crossbridges is proportional to the cytosolic Ca++ conc.

Cardiac Muscle

Structure 2

6) it displays pacemaker activity intiating its own actions potential
7) connected by gap junctions
8) innervated by atonomic neuronal fibers
9) action potentials are longer ind uration than both smooth and skeletal muscle

Pacemaker Activity

99% of cardiac muscle cells are contractile and don't initiate their own action potentials

1% are autorhythmic and intrinsically initiate their own action potentials at a regular frequency

Myocardium

- intercalated discs
1)desmosomes = mechanically hold cells together
2)gap-junctions = provide paths of low resistance to the flow of electrical current between muscle cells

- gap-junctions enable the cardiac muscle to form a functional syncytium (a group of cells that act as a single functional unit despite maintaining their individual identi-ties)

Valves of the Heart

Right Atrium - Receives oxygen-poor blood from systemic venous circulation (inferior and superior vena cava veins)
- pumps blood into the right ventricle through the right atrioventricular (AV) (tricuspus valve)
Right Ventricle - receives oxygen-poor blood from right atrium and pumps blood through the pulmonary (semilunar) valve into the pulmonary artery

Picture of the heart

Bundle of His and spread throughout the ventricular myocardium
- 30 A.P./min
- In normal conditiona, follow SA node (and AV node) at 70 AP/min

Nodes

Sinoatrial (SA) Node:
- right atrium near the opening of the superior vena cava
- exhibits an autorhythmicity of 70 action potentials per min and leads the activity of the other pacemaker structures int he heart

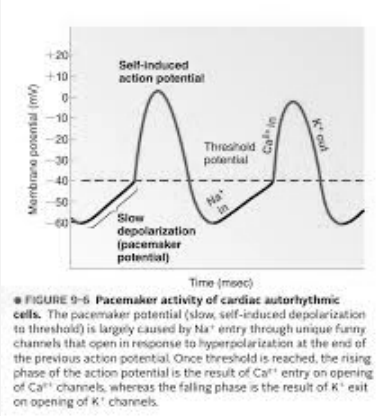
Atrioventricular (AV) Node:
- Cardiac pacemaker cells located at the base of the right atrium
- exhibits an autorhythmicity of 50 action potentials per min
- Under normal conditions, this node follows faster SA node at 70 A.P./min

- longer duration to prevent fatigue but requires a lot of energy

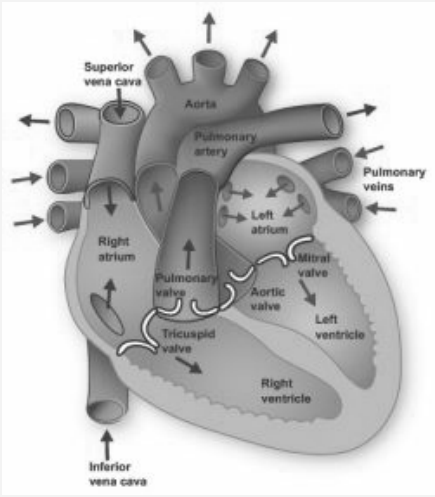
Interatrial Pathway

cardiac cells that conducts pacemaker acitivty fromt he right atrium to the left atrium
- from SA node to AV node

Pacemaker activity of cardiac autorhythmic cells



● FIGURE 9–6 **Pacemaker activity of cardiac autorhythmic cells.** The pacemaker potential (slow, self-induced depolarization to threshold) is largely caused by Na^+ entry through unique funny channels that open in response to hyperpolarization at the end of the previous action potential. Once threshold is reached, the rising phase of the action potential is the result of Ca^{++} entry on opening of Ca^{++} channels, whereas the falling phase is the result of K^+ exit on opening of K^+ channels.



AP in contractile cardiac muscle cells 1

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Relationship of AP and Refractory Period

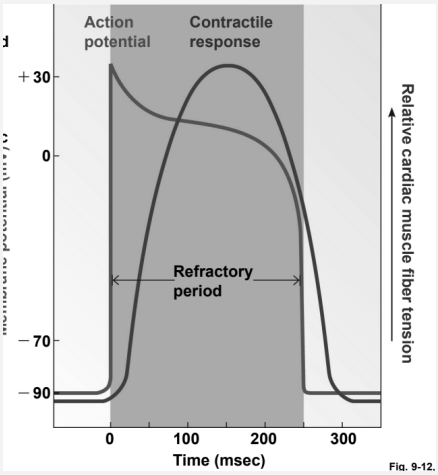


Fig. 9-12.

Electrical Activity of the Heart

- heart muscle generates its own rhythmic electricla activity (autorhythmicity)
- occurs due to pacemaker activity
- nodes: pacemaker cells grouped together in specialized regions
- 2 nodes
- control rate and coordination of cardiac contractions

Connective Tissue

- separates atria from ventricles and provides a rigid base for attachment of heart valves and cardiac muscle
- a ring of dense fibrous connective tissue surrounds each of the valves of the heart

Valves of the Heart

Left Atrium - receives oxygen-rich blood from left and right pulmonary veins
- pumps blood through the left atrioventricular (AV) (biscuspid or mitral) valve into the left ventricle
Left Ventricle - Receives oxygen-rich blood from left atrium and pumps blood through aortic (semilunar) valve into the aorta

Nodes

Sinoatrial (SA) Node:
- wall of the right atrium near opening of superior vena cava

bundle of his

tract of specialized, cardiac pacemaker cells that originate sa tthe AV node and divides and projects into the left and right ventricles

AV Nodal Delay

- PA conducted relatively slowly through the AV node resulting in a delay of approx. 100ms
- to ensures that ventricles contract after atrial contraction

System Overview

Circulatory stsmtems include:
1) heart (pump)
2) blood vessels (pipes)
3) blood (fluid)

This system function is impacted by nervous system and kidneys (endocrine system)

Functions:
- supply oxygen and nutrients
- remove "wastes"
- temperature regulation
- distribute hormones
- immuno-vigilance

Definition

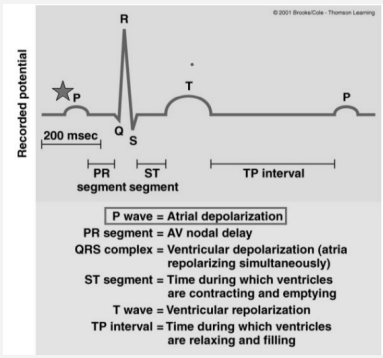
found only in the heart and shares characteristics of both skeletal and smooth muscle

AP contractile cardiac muscle cells 2

1) Prolonged plateau phase is result of slow Ca2+ entry on opening of :-type Ca2+ channels, coupled w/ reduced K+ efflux on closure of several types of K+ channels
2) rapid falling phase is result of K+ efflux on opening of ordinary voltage-gated K+ channels, as in other excitable cells
3) Resting potential is maintained by opening of leaky K+ channels

Picture of AP in cardiac cell

Electrocardiogram (ECG)

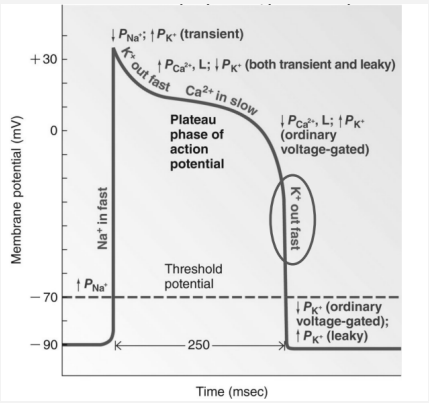


- electrical currents generated by coodinated action potentials of the heart muscle can reach the surface of the body and detected as voltage differences between 2 points on the body surface

- can detect disturbances in heart function

- 70 action potentials per min

Atrioventricular (AV) Node:
- base of right atrium
- exhibits an autorhythmicity of 50 action potentials per min
- Under normal conditions, this node follow faster SA node at 70 A.P./min



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