Objectives

- To understand the unique properties of heart tissue.
- Enumerate the steps of cardiac muscle contraction.
- To recognize the contributions of the intrinsic conduction system.
- To address influence of the extrinsic conduction.
- To introduce the method of heart monitoring.

Unique Properties of Cardiac Muscle Tissue

Similarities to Skeletal Muscle
- Action Potentials.
- Na+ dependent for triggering APs.
- Depolarization wave triggers Ca+ release from sarcoplasmic reticulum.
- Crossbridging of myofilaments.

Differences compared to Skeletal Muscle
- **Automaticity or autorhythmicity**
  - Intercalated discs.
  - Entire myocardium contracts as a whole unit.
  - Very long absolute refractory period.
  - Cardiac muscle is PACKED with mitochondria.

Events of Muscular Contraction (In the heart)

1. Na+ influx, AP fires.
2. Ca+ permeability (inward flux) plateaus.*
3. Tension develops during the contraction. Sustained!!
4. K+ permeability outward is slow and depressed.
5. Repolarization of the membrane potential.
   - Rapid outflux of K+ after the contraction phase.
   - Ca++ is pumped back into the SR & extracellular space.

*Influx is the most important for generating AP.

Intrinsic Conduction System

Composed of:
- Noncontractile cardiac cells specialized to initiate and distribute impulses throughout the heart.
  > Sinoatrial node
  > Atrioventricular node
  > Atrioventricular bundle (bundle of His)
  > Ventricular walls (Purkinje fibers)
Conduction Pathway

- Sinoatrial node (pacemaker)
- Atrioventricular node
- Bundle of His
  - Right and left branches
  - Purkinje fibers (ventricular walls)

Pacemaker Prepotentials

Spontaneous changing membrane potentials:
  > Initiate APs that spread through the heart to trigger its rhythmic contractions.

* Cardiac conduction system coordinates and synchronizes heart activity.

Heart Beat Disorders/Conditions

- **Arrhythmias** - irregular heart beats. (uncoordinated atrial and ventricular contractions).
- **Fibrillation** - a condition of rapid and irregular or out of phase contractions.

Extrinsic Innervation

Modify the beat and regulate variability

I. Sympathetic - “accelerator”
   - Increases heart beat & rate
II. Parasympathetic - “brakes”
   - **Vagus Nerve**
   - Control center - medulla oblongata

Electrocardiography

* Measurement device that records electrical currents generated & transmitted through the heart.

EKG - Electrocardiogram

- Deflection Waves - waves seen in an EKG
  - P (depolarization of SA node)
  - QRS (depolarization of ventricles) - peak
  - T (repolarization of ventricles)
**Role of Conduction System**

Coordinates the heartbeat to accommodate efficient pumping action.

- **Systole** – contraction
- **Diastole** – relaxation

Atria contract together & Ventricles contract together.

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**Heart Sounds**

**Auscultation**

- **Lub** – AV valve closing / beginning of ventricular systole
- **Dup** – SL valves snap shut / ventricular diastole

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**Problematic Valves**

- **Heart murmurs** – abnormal heart sounds
- **Incompetent valve** – partially opened, can be heard as a swishing sound.
- **Stenotic valve** – stiffened and restricts blood flow.

Refer to page 29 in the cardiovascular unit for other examples.

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**Cardiac cycle**

All the events associated with blood flow through the heart, during one heart beat.

- Atrial systole and diastole
- And then Ventricular systole and diastole.
The Cardiac Cycle

Events of the Cardiac Cycle
1) Generation of nerve impulses (EKG)
2) Contraction of the heart muscle.
3) Generation of pressure and volume changes in the heart.

Blood Pressure
The force the blood exerts against the inner wall of a blood vessel.
Two pressures are measured:
Systolic – during ventricular contraction.
Diastolic – during ventricular relaxation

Normal in adults is 120/80
Hypertension is 140/90 or higher
Significant because hypertension is “the silent killer.”
Major cause of heart failure, stroke & kidney failure.