Tech Lectures®

For the Pharmacy Technician

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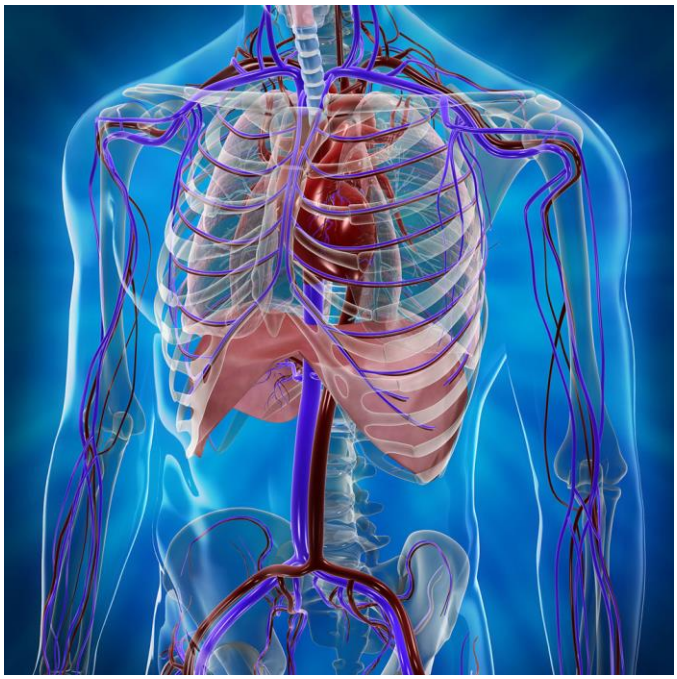

Lecture 7 - About the Cardiovascular System

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Cardiovascular System

Terms:

Pericardium	Myocardium
Atrium	Ventricle
Deoxygenation	Ischemia
Hypoxia	"Strangled chest"
NTG	Embolus
Thrombus	MI
Systolic	Diastolic
Heart Murmur	CHF
Pulmonary Edema	Hypertension
Cardiac Output	Step Care Approach
Diuretic	Ascites
Hypokalemia	Kcl
Beta-blocker	ACE Inhibitor
Renin	Ca Channel blocker
Necrosis	Valve(s)

At the end of this section, the Pharmacy Technician should have a basic understanding of:

1. the Pathophysiology of the Heart
2. the Disease States associated with the Heart
3. the Pharmacological and Non-Pharmacological treatment of Heart Disease
4. the Pathophysiology of Hypertension
5. the Pharmacological and Non-Pharmacological treatment of Hypertension
6. the terms used in this section

The Cardiovascular System

The Heart

1. Center of the cardiovascular system

2. propels blood through thousands of miles of blood vessels

    a. 60,000 miles

3. At rest the heart pumps 5-6 liters of blood/minute to the lungs and body

    a. 7000-8000 liters of blood per day (1800 gallons)
    b. But we don't spend our time resting
        - heart pumps a considerable larger amount

4. Weight ----> 300 grams

5. Size ------> of your fist

6. Has four chambers --------> Superior: right and left Atrium
    a. mainly serve as receiving chambers
    b. thin walled

    Inferior: right and left Ventricle
    a. serve as pumping chambers
    b. thick walled

7. <u>Has Two main valves</u> -----> The atrioventricular orifices between each atrium and ventricle

    Tricuspid valve : between the right atrium and ventricle

    Bicuspid or Mitral valve : between the left atrium and ventricle

    <u>also</u>

    Semilunar valve: between right ventricle and pulmonary artery

    Aortic valve : between the left ventricle and the aorta

8. *Pericardium* : triple-layered that surrounds and protects the heart

Myocardium: heart muscle which makes up the bulk of the heart

a. responsible for pumping action

C*ardiology* : Study of the heart and diseases of the heart

Simplified explanation of what the heart does:

1. Right atrium receives deoxygenated blood from
    a. Superior Vena Cava - upper body
    b. Inferior Vena Cava - lower body
2. Blood goes to the right Ventricle, which pumps it into the lungs via
    a. right and left Pulmonary Arteries
3. In lungs, blood releases Carbon Dioxide (CO2) and takes in Oxygen (O2) or oxygenated blood
4. Blood returns to the heart via 4 Pulmonary Veins that empty in the left Atrium
5. Blood then passes into the left Ventricle and is pushed out into the body

Heart: A hollow, muscular, contractile organ, the center of the circulatory system

a. Provides the propulsive force for circulating the blood throughout the vascular system

Problems associated with the Heart

1. Most heart problems result from faulty coronary circulation

   a. due to -------> blood clots
   fatty deposits
   spasms of smooth muscle of the cardiac walls

   Ischemia: Reduction of blood flow

   Hypoxia: Reduction of oxygen supply

Angina Pectoris (strangled chest)

   a. severe pain that usually accompanies myocardial ischemia

      - tight or squeezing sensation
      - as if chest was in a vase
      - weakness and sense of doom

   b. often occurs during exertion

      - when heart requires more oxygen

   c. treatment -----> Nitroglycerin (NTG)
   Cardizem (Diltiazem) - not long acting

Myocardial Infarction (Heart Attack)

   a. In the United States - two most common causes

      1. Coronary Artery Disease (CAD)
      2. Hypertension (HTN)

   b. death of an area of tissue because of interrupted blood supply

      from ----> *thrombus :* stationary blood clot

      embolus: blood clot transported by blood

   usually in a coronary artery - supplies blood to heart

c. What happens?

Hypoxia -------> Ischemia ---------> Myocardial Infarction

1. tissue distal to the obstruction site dies
2. is replaced by noncontractile scar tissue
    a. thus heart loses some of its strength
3. After effects
    a. depends on size and location of infarction
        - dead tissue
    b. The infarction may also disrupt normal conducting (electrical) system of the heart and may cause sudden death by
        - ventricular fibrillation
4. Drug of choice
    - TPA (Tissue Plasminogen Activator) or
        a. expensive (4000 dollars per tx)
    - Streptokinase

Doodle space

Conduction System of the Heart

1. rhythmical electrical activity

2. force behind the heart's continuous beat

3. certain cardiac muscle cells

    a. fire spontaneous impulses that trigger heart contractions

        - Action Potentials

4. why a heart will continue to beat even after it is removed from the body with all of its nerves cut

Heart Beats

1. Average 72 times per minute

    a. 104,000 times per day
    b. 38,000,000 times per year

2. Each heart beat allows the completion of the ***cardiac cycle***

    a. right side receives deoxygenated blood via the veins from the tissues and pumps it into the lungs

    b. left side receives oxygenated blood from the lungs and pumps it into the tissues via the arteries

    c. at every stroke approximately 82ml of blood is pumped

d. during each cardiac cycle four sounds are generated

- we only hear the first two sounds

  - Lubb and Dubb

  - first sound is louder and associated with closure of AV valves

    a. contraction of the heart chambers
    b. called “systole”

  - second sound is not as loud and as long is associated with closure of semilunar valves

    a. relaxation with accompanying dilation
    b. called “diastole”

Doodle space

Heart Murmurs

- a flow sound noise
- heard before or between the normal two heart sounds heard
- some are innocent
- generally though, a valve disorder

examples:

Mitral valve stenosis (narrowing of valve)

Mitral valve insufficiency

- back flow of blood from the left ventricle to the left atrium

Mitral valve prolapse

- inherited disorder
- portion of Mitral valve is pushed back too far
- blood tends to flow back into left atrium
- not a serious threat
    a. up to 10% of healthy young people have

Congestive Heart Failure (CHF)

1. heart becomes a failing pump

2. causes: coronary artery disease
   congenital defects
   long-term high blood pressure

3. As the pump becomes less effective, the left ventricle fails and pushes blood back into the left atrium and into the lungs

4. causes pulmonary edema ----> fluid accumulation in the lungs

Risk factors in Heart Disease

1.5 million people suffer a myocardial infarction every year

a. more than 500,000 die before reaching the hospital

Risk factors :

can be modified ---------->	high blood cholesterol level
	high blood pressure
	cigarette smoking
	obesity
	lack of regular exercise
	stress
cannot be modified ------->	Diabetes Mellitus
	Genetic predisposition
	Male gender until the age of 70

Hypertension

1. Abnormal increase in arterial blood pressure

    a. systolic and/or diastolic
        - normal adult -----> 120/80

            - systolic : pressure of cardiac output
            - diastolic : pressure of resting phase

2. Complex state

3. Causes -----> renal disease
    disease of adrenal gland
    other disorders

In a vast number of cases:

a. condition is caused by unknown etiology
    - referred as Essential or Primary hypertension

4. If left untreated may lead to deterioration of cardiac, renal and ocular Functions as well as stroke

    a. *Stroke*
        - formation of embolus or thrombus that occludes an artery
        - rupture of an cerebral vessel causing hemorrhage into brain

        - one of the leading cause of death and disability among adults
            a. estimated 150,000 die each year
            b. several hundred thousand disabled each year

5. Blood pressure dependent on two factors

    a. Cardiac Output - controlled by heart and kidneys

        - how much blood volume is ejected from the heart per minute
        - at rest 4-8 liters per minute

    b. Peripheral resistance

        - controlled by resistance of vessels such as arterioles

Treatment of drug therapy affect one or both of these systems either directly or indirectly

Determination

1. Dependent on at least two blood pressure's done daily on three separate days

2. Symptoms: headache
   palpitations
   tachycardia
   excessive perspiration
   tremor
   pallor
   nervousness
   etc.

3. Lab values increased urinary concentration of

   - metabollic products
   - catacholamines
   - etc.

Step Care Approach

1. A way of treating Hypertension

2. patient is started on steps to control hypertension

3. patients are placed on certain drugs and dose slowly increased.
   If this does not work, patients are put on step 2 or step 3 or step 4

Step 1 ----> a. diuretic
b. Beta-blocker
c. Calcium Channel Blocker
d. Angiotensin-Converting Enzyme Inhibitor
- ACE inhibitor

Step 2 -----> a. Adrenergic Inhibitors

Central Acting
Peripheral Acting

Example drugs:	Clonidine
	Prazocin
	Terazosin
	Methyldopa
	Reserpine

Step 3 -----> a. Vasodilator

Example drugs:	Hydralazine
	Minoxidil

Step 4 ------> a. Guanethidine

Diuretics and Antihypertensive Agents

[Step 1]

Diuretics

- drugs used to remove excess sodium (Na) and water (H2O) from body

- normally used for *edema* or *ascites*

ascites : accumulation of fluid in the peritoneal cavity

- also used to treat high blood pressure or hypertension

a. used to remove excess Na
- high levels of Na has been linked to hypertension

Types

1. *Thiazide Diuretics*

a. developed in 1950's
b. have evolved to be the safest diuretics today
c. MOA - inhibit reabsorption of NaCl in distal tubule
but also inhibit reabsorption of Potassium Chloride
- KCl

Hypokalemia - decrease amount of K+ (Potassiuum) in body

d. Other potential problems

Metabollic Alkalosis - decrease amount of CL- (Chloride) in body

e. Often times necessary to provide KCl as supplement
- for long term therapy
- harsh on stomach therefore long-acting

i.e. -----> K-dur
Micro K
Slow K

f. Example Drugs
- difference is minor
- mainly duration of action or cost

Hydrochlorothiazide (HCTZ, Esidrix, Oretic) Chlorthalidone (Hygroton) Chlorothiazide (Diuril) Indapamide (Lozol) Methyclothiazide (Enduron) Metolazone (Zaroxyln) Hydroflumethiazide (Saluron)

2. *Loop Diuretics*

a. widely used in practice
b. inhibit reabsorption of Na and Cl in the ascending loop of Henle
c. more potent
d. need use of Potassium supplementation

Furosemide (Lasix) Ethacrynic Acid (Edecrin) Bumetanide (Bumex)

3. *Potassium Sparing Diuretics*

a. not very potent
b. used often in combination -----> example: Dyazide
c. inhibit potassium excretion

Spironolactone (Aldactone) Ethacrynic Acid (Edecrin) Bumetanide (Bumex)

4. Others

Osmotic Diuretics (Mannitol)

Carbonic Anhydrase Inhibitors

a. example ----> Acetazolamide (Diamox)
b. not used very much as diuretic
c. used for glaucoma - reduces intraocular pressure

Beta Adrenergic Blocking Agents (Beta-Blockers)

1. usually used along with diuretics

2. MOA (Method of Action) ----> beta-1 and beta-2 receptor blockers

    a. results in reduced cardiac output
        - heart does not have to work as hard

    b. also, unfortunately, bronchial constriction
        - due to beta-2 receptor blockade
        - not recommended for asthmatics

3. Medication can be selective or non selective

    Non Selective (affects both beta-1 and beta-2 receptors)

        Propranolol (Inderal)
        Timolol
        Labetolol

    Selective beta-1 or Cardioselective

        Metoprolol (Lopressor)
        Atenolol (Tenormin)

Doodle Space

Calcium Channel Blockers

1. MOA ----> reduces arterial pressure at rest and during exercise by dilating arterioles

2. Examples : Felodipine
   Isradipine
   Nicardipine
   Verapamil
   Diltiazem
   Nifedipine

Angiotensin Converting Enzymes Inhibitors (ACE Inhibitors)

1. MOA - prevents the conversion of Angiotensin I to Angiotensin II causing vasodilaton

ACE Enzyme
Renin -----> Angiotensin I ----------> Angiotensin II

conversion produces -----> Vasoconstriction
Sodium Retention
Fluid Retention

[**Step 2]**

Centrally Acting Antiadrenergic Agents

1. Potent Antihypertensive Agents

2. frequently cause sedation

3. MOA - stimulate alpha-adrenergic receptors in CNS causing sympathetic outflow and vasodilation of blood vessels and reduction of heart rate

4. Examples ----> *Methyldopa (Aldomet®)*

    a. results in dilation of peripheral blood vessels thus reduction of pressure

    b. considerable sedation

    c. needs to be used 2 to 4 times per day

Clonidine (Catapres®)

    a. usually used in conjunction with diuretics

    b. Do not miss dose, rapid elevation can occur

Peripheral Acting Antiadrenergic Agents

1. MOA -----> very confusing

   Selectively blocks peripheral alpha-adrenergic receptors which results in dilation of both arterioles and veins thus lowering pressure

2. Examples ---->

   Prazocin (Minipres)
   Terazosin (Hytrin)

3. First dose effect

   a. development of severe hypotension with first dose

      - loss of consciousness
      - injury may result
      - normally take at bedtime while lying down

   b. need to taper dose upward slowly

Doodle Space

Lecture 7 - The Cardiovascular System Worksheet

True or False

_____ 1. The "*Step Care Approach*" is a way of treating Hypertension

_____ 2. Atenolol or Tenormin® is an example of a beta-blocker

_____ 3. The heart will average 72 beats per second

_____ 4. In the lungs, blood releases 02 and takes in CO2 or oxygenated blood

_____ 5. Mitral valve prolapse is an inherited disorder

_____ 6. In CHF or Congestive Heart Failure, the heart becomes a failing pump

_____ 7. Lasix® or Furosemide is an example of a potent Loop Diuretic

_____ 8. Enalapril or Vasotec® is an example of a Calcium Channel Blocker

_____ 9. Diuretics will remove excess Na (sodium) and H20 (water) from the body

_____ 10. A heart Murmur is when it is difficult to hear the heart beats

_____ 11. Dyazide® is an example of a Potassium Sparing Diuretic

_____ 12. After effects of a *myocardial infarction* is dependent on the size and location

Submit your answers online at the following URL:

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