CARDIOVASCULAR MEDICATIONS

Cardiovascular system is comprised not only of the heart but as well as other organs like the blood and the blood vessels.

Cardiovascular drugs are classified according to the areas by which they take effect

**Brief Background about the Heart:**
- A muscular organ responsible for pumping blood all throughout other organs of the body
- Systole refers to ventricular contraction while Diastole refers to Ventricular Relaxation, although the atria also has its own diastole and systole, the ventricular relaxation and depolarization is more palpable and audible.
- Usual range of heartbeat according to age groups:
  - Adults and adolescents: 60-100
  - Infants: 120-160
  - Toddlers: 90-140
  - Preschoolers: 75-100
- Any deviation from the normal heart rate can be considered as Bradycardia (decreased HR) or Tachycardia (increased HR)

**How is Heart Rate controlled?**
- HR is controlled primarily by the AUTONOMIC NERVOUS SYSTEM
- However, Parasympathetic (Cholinergic) nerve endings, sometimes called Vagal nerve endings, when stimulated can decrease cardiac function through inhibiting effects of Acetylcholine in the heart

**How can Cardiac drugs affect the heart’s function?**
- INOTROPIC EFFECT: Increase the heart’s contraction force
- CHRONOTROPIC EFFECT: Increase the heart rate
- DROMOTROPIC EFFECT: Increase the heat electrical conduction

**MAJOR CLASSIFICATIONS OF CARDIOVASCULAR MEDICATIONS:**
I. Cardiac Stimulants and Cardiac Depressants
II. Anti-Arrhythmics
III. Anti-hypertensives
IV. Anti-coagulants, Thrombolytic, and Hemostatic Agents
V. Lipid Lowering Agents
VI. Anti-anginals

**ANTI-HYPERTENSIVES**

**MUST KNOW ABOUT BLOOD PRESSURE:**
- Blood pressure is the product of Cardiac Output and Peripheral Vascular Resistance
- Cardiac Output is the Product of Stroke Volume and Heart rate
- Note: Any increase in the components of Cardiac Output would increase CO, thus, would also increase HR and vice versa

**A quick Review on How the Body Tries to Compensate whenever the Body’s Blood Pressure Drops:**

**A. SYMPATHETIC STIMULATION**

Baroreceptors located in the aortic arch and the carotid sinuses becomes stimulated with decreased BP and send impulses to the cardiac center of the spinal cord

The spinal cord’s reflex response becomes activated causing the release of EPINEPHRINE in the adrenal medulla

EPINEPHRINE stimulates:

1. B1 adrenergic receptors in the heart causing POSITIVE INOTROPIC AND DROMOTROPIC EFFECTS
2. B1 adrenergic receptors in the Kidneys causing the RAA MECHANISM to function
3. B2 adrenergic receptors in your smooth muscles causing Peripheral Vasodilation and Coronary Vasodilation

**B. RAA MECHANISM (Renin – Angiotensin – Aldosterone Mechanism)**

Renin becomes released from the kidneys as Baroreceptors are able to recognize the decrease in blood pressure


Renin reacts with the substance angiotensinogen found in the blood and forms Angiotensin I

Angiotensin I circulates in the blood and is converted in the lungs into Angiotensin II by your Angiotensin Converting Enzyme

Angiotensin II causes:

1. Peripheral vasoconstriction
2. Aldosterone release which causes Sodium in the blood to be retaining thus retaining water in the blood increasing the blood volume

C. Interplay of the ANTIDIURETIC HORMONE

Decreased Bp causes decreased Perfusion to the Kidneys

The Kidneys send impulses to the brain that BP is decreasing

Brain response by releasing VASOPRESSIN or antidiuretic hormone

This causes water reabsorption in the kidneys increasing serum volume level and blood pressure

Common Medications Used to Address Hypertension:

1. Diuretics
2. ACE Inhibitors
3. ARBs
4. B-adrenergic blockers
5. CCBs
6. Sympatholytics
7. Selective Aldosterone Receptor Antagonist

Mechanism of Action:
decreases the blood pressure and angina by decreasing cardiac output through blocking epinephrine from its receptor sites thus inhibiting the release of rennin from the kidneys and decreasing the sympathetic outflow of the body to increase blood pressure.

Also used as anti-anginal and anti-arrythmic because of its capacity to decrease Heart Rate (decreased automaticity and conduction rate) and Heart Contractility giving the heart a greater refractory period. (negative chronotropic and dromotropic effect)

2 Types:
1. Non-Selective
   - Ex. Propanolol (inderal), nadolol (cogard), Pindolol (visken)
   - Has the capacity to affect both B1 receptor sites (found in the heart) and B2 receptor sites (found in the lungs)
   - May cause respiratory side effects (bronchospasm and bronchoconstriction) because of its action on B2 receptor sites
2. Selective
   - Ex. Mitropolol (Lopressor), Atenolol (Tenormin)
   - Affects only the B1 receptor sites on the heart and do not cause respiratory side effects

Special Nursing Considerations:

- Always check client for bradypnea or respiratory distress prior to giving non-selective beta blockers
- Look out for common side effects such as Bradypnea, Lethargy, GI disturbances, Hypotension and Depression, Impotence and decreased libido
- Inform client that Beta Blockers may take several weeks before it can take effect
- Avoid abrupt withdrawal of the medication. May cause sudden hypotension and even death. Dose must be tapered for 2 to 3 weeks prior to complete withdrawal.
- Can cause Lidocaine Toxicity
- The ability of Theophylline to cause Bronchodilation may be altered by non-selective beta-blockers
- NSAIDS if taken together with B-blockers causes water retention decreasing its anti-hypertensive capability

ACE INHIBITORS

- Given when the first line hypertensive drugs (Beta Blockers and Diuretics) are ineffective
- Can be given together with diuretics and beta blockers to increase efficiency
Prototype Drugs:
- Captopril
- Enalapril
- Benazepril
- Fosinopril
- Lisinopril
- Ramipiril

**Mechanism of Action:**
Inhibit the Angiotensin Converting Enzyme from converting Angiotensin I to Angiotensin II thus inhibiting the rennin angiotensin aldosterone mechanism

Causes peripheral vasodilation thus decreasing peripheral vascular resistance.

Decreases Aldosterone levels in the body thus sodium and water are not reabsorbed leading to decreased blood volume and cardiac output.

**Common Side Effects:**
1. Dry Cough – results from excessive release of Bradykinins together with ACE therapy
2. Skin Rashes
3. Hypotension
4. Hyperkalemia

**Nursing Consideration:**
1. Monitor client with side effects
2. Check client if pregnant. Cannot be given to pregnant mothers because bradykinin causes closure of the ductus arteriosus leading to fetal demise.
3. Presence of Food may decrease absorption
4. Monitor serum electrolyte levels for hyperkalemia. Avoid high doses of potassium supplements and potassium sparing diuretics. Monitor for development of serious cardiac arrhythmias

**ANGIOTENSIN II RECEPTOR BLOCKERS (ARBs)**
- Given when client cannot tolerate the side effects of ACE inhibitors
- Given in a once a day dosage
- Effects are similar to ACE inhibitors but are not known to increase bradykinin levels

**Prototype Drugs:**
- Losartan
- Candesartan
- Irbesartan
- Olmesartan
- Valsartan
- Telmisartan

**Mechanism of Action:**
Block the receptor sites of Angiotensin II thus preventing the RAA mechanism

Effects similar to that of ACE inhibitors

**Note:**
- NSAIDS decrease the antihypertensive capability of ARBs
- Rifampicin may increase the metabolism of ARBS decreasing its effectiveness

**RENNIN INHIBITORS**
Prototype Drug: Aliskiren

**Mechanism of Action:**
Effectively reduces blood pressure by inhibiting rennin, thus, acting earlier in the RAA mechanism than ARBS and ACE inhibitors do.

**Note:**
- as effective as ARBS and ACE inhibitors in preventing hypertension
- Can cause dry cough but not as severe as ACE inhibitors do
- Can be used in combination with other anti-hypertensive medications such as ARBS, ACE inhibitors, Calcium Channel Blockers and Diuretics
- Can cause severe hyperkalemia when given together with ARBS and ACE inhibitors. Monitor serum electrolyte levels for potassium and monitor for the development of major cardiac arrhythmias.

**CALCIUM CHANNEL BLOCKERS**
- Also used as an anti-arrhythmic and anti-anginal medication
- Used when the first line drugs for hypertension is ineffective
- Has an intrinsic natriuretic effect, thus, it no longer needs to be paired with a diuretic
- Has short half lives usually given 3 times a day to maintain good control over hypertension except for Amlodipine
- Also referred to as “Very-Nice-Drugs” standing for its 3 prototype drugs:
  - Verapamil
  - Nifedipine
  - Diltiazem (use of diltiazem is often better since it has greater negative inotropic effects than other CCBs)
  - Amlodipine
Mechanism of Action:
The influx of calcium into the myocardium allows contraction of the myocardium and levels of calcium keeps the muscular tone of the blood vessels.

This medication prevents the inward movement of calcium in the heart and smooth muscles of the musculature of the blood vessels. This causes VASODILATION and decreased myocardial contractility ( - inotropic effect)

Drug to Drug Interaction:
1. Calcium salts and Vitamin D may decrease effectivity of CCBs
2. CCBs can cause digoxin toxicity
3. Furosemide if given together with Diltiazem can crystallize
4. Diltiazem increases risk for digoxin toxicity
5. Verapamil decreases Lithium affectiveness

Side Effects:
Dizziness, fatigue, head ache as a result of severe vasodilation and decreased BP.
Constipation is seen on 10% of clients taking Verapamil

Note:
-thiazide diuretics may not be effective in clients with poor renal function (creatinine clearance of less than 50mL/min). Loop diuretics may be prescribed for such clients
-Administered orally
-has the capacity to decrease blood pressure in standing, sitting or lying positions and is less likely associated with orthostatic hypotension unless your client is severely dehydrated
-Can cause paradoxical effects of lowering urine volume in clients with diabetes insipidus
-Can cause HYPOKALEMIA in clients whoa re taking corticosteroids

Side Effects:
1. Hypokalemia and Hypomagnesemia due to its ability to excrete serum electrolytes
2. Hyperurecemia because thiazide diuretics compete with uric acid in their excretion on the kidneys
3. Lithium toxicity- due to increased sodium excretion
4. Hyperglycemia: may increase blood glucose levels; increase insulin dose

2. Loop Diuretics
-acts promptly even to clients with poor renal function, and to clients who have not responded to thiazide diuretics and other forms of diuretics
-Produces the largest amount of urine output
Prototype Drugs:
- Bumetamide
- Furosemide (Lasix)
- Torsemide
-Bumetamide is 40x more active than Furosemide (Lasix)

Mechanism of Action
Affects the Loop of Henle which results to the excretion of sodium, water, potassium, chloride and magnesium. This leads to decreased blood volume thus decreasing cardiac output and blood pressure.

Side Effects:
1. Hyponatremia
2. Hypokalemia
3. Hypomagnesemia
4. Hyperuricemia
5. Gout
6. Postural Hypotension
7. Dehydration
8. Syncope

Note:
- Risk for ototoxicity in clients taking Aminoglycosides
- Reduces the hypoglycemic effect of Oral Antidiabetic Medications resulting in Hyperglycemia
- Increased risk of Lithium toxicity associated with excessive excretion of Sodium
- Increased risk of Digitalis toxicity associated with excessive excretion of Potassium

3. **Potassium-Sparing Diuretics**
- Do not promote the excretion of potassium in the urine
- Used to treat hypertension and or congestive heart failure but is not as effective as other diuretics since it has a lesser diuretic effect
- Used together with loop diuretics that would potentially lower serum potassium levels to severely dangerous low levels
  - Prototype Drugs: Amiloride, Spironolactone, Triamterene

**Mechanism of Action:**
- acts on the distal tubules of the kidney producing urinary excretion of water, sodium, chloride and calcium
- decreased excretion of potassium
- reduction of blood pressure while increasing potassium level

**Side Effects:** HYPERKALEMIA

**NURSING RESPONSIBILITY WHEN GIVING DIURETICS:**

D – daily weight
I – Input and Output
U – Urine Output
R – Response of BP
E – Electrolyes
T – Take Pulse
I – Ischemic Attacks
C – Complications (nocturia)

**SYMPATHOLYTICS**
Includes several type of drugs that reduce blood pressure by inhibiting or blocking the sympathetic nervous system. They are classified according to the site or mechanism of action:

a. **Centrally-acting Sympathetic nervous system Inhibitors**
Prototype Medications: Clonidine Hydrochloride
Methyldopa

**MOA:** Inhibits sympathetic vasomotor centers, decreasing sympathetic outflow to the heart, kidneys and peripheral vasculature
-This decreases Peripheral Vascular Resistance and Heart Rate

b. **Alpha-adrenergic Blockers**
Prototype Drugs: Doxazosin, Terazosin Prazosin

**MOA:** Acts on peripheral vasculature to promote vasodilation

c. **Mixed Alpha and Beta Adrenergic Blockers**
Prototype Drugs: Carvedilol, Labetalol

**MOA:** blocks the effects of epinephrine on both Alpha and Beta adrenergic receptors

**VASODILATING AGENTS**
- seldom used alone for the treatment of hypertension
- immediately acts to dilate the blood vessels causing decreased peripheral vascular resistance

**MOA:** Relaxes the smooth muscle of the blood vessels causing dilation

**Adverse Reactions:** Produce reactions related to the SNS’s compensatory mechanism to decreased BP like: palpitation, angina, edema, fatigue, head ache

**Prototype Drugs:** 1. Diazoxide
2. Hydralazine
3. Minoxidil
4. Nitroprusside

**ANTI-ANGINALS**

Angina Pectoris is a symptom characterized by a crushing pain in the heart. It is different from that of Heart Attack (Myocardial Infarction) since an infarction means that a tissue of the heart dies due to inadequate oxygen supply.

Although pain is the most common symptom of angina, medications to address angina is not focused on how to relieve pain but is addressed on decreasing cardiac workload and increasing cardiac O2 supply and decreasing its O2 demand.

**NITRATES**
- the drug of choice in relieving acute angina
- Prototype drugs: Nitroglycerine
  Amyl Nitrate
  Isosorbide dinitrate
  Isosorbide mononitrate

- Nitrates are the drug of choice for acute angina because of its fst action; slow acting nitrates such as transdermal patches of nitrates are used to prevent chronic angina
Nitrates can be given in many ways:
- Sublingually
- Buccally
- Lingual aerosols (sprayed under the tongue)
- Chewable tablets
- Inhalation (Amyl nitrate)
- Intravenously
- Skin Patches (gradual release of nitrate in to the body, affected by its location, surface area of the skin and the circulation of the skin)

Nitrates are absorbed almost immediately because of the rich blood supply in the mouth

Mechanism of Action
- relaxes the smooth muscles of the veins and at times the arteries : lesser blood returns to the heart, lesser cardiac workload
- Lesser blood goes to the ventricles, thus it decreases ventricular wall tension decreasing O₂ demand of the heart
- Dilates the arterioles (where PVR is greatest) causing decreased peripheral vascular resistance

Drug Interactions:
1. Alcohol and nitrates can cause severe hypotensive reactions
2. Sildenafil citrate (Viagra) together with nitrates can cause hypotensive reactions
3. Other antihypertensives may cause orthostatic hypotension when given together with

Adverse Reactions:
-most common adverse reaction is HEADACHE which results from severe vasodilation of the blood vessels of the head. Once dosage is reduced, symptoms gradually disappear

Nursing Interventions:
1. Always check for Blood Pressure and apical pulse prior to giving dose
2. Have client lie down after taking dose. May cause hypotension and dizziness
3. For the treatment of acute cases of Angina, nitroglycerine may be taken in 3 successive doses, in 5 minutes interval. If pain does not subside after 3 doses, rush client to the emergency department
4. Store nitroglycerine in dark, cool places. Nitroglycerine is sensitive to light
5. Replace nitroglycerine every three months
6. If using transdermal patch, wipe of excess nitroglycerine over the skin before reapplying another transdermal patch
7. For maintenance dose, take dose regularly and have it ready and accessible at all times in preparation for acute attacks
8. Instruct client to change positions slowly. Marked Orthostatic hypotension is a side effect of the medication
9. Avoid alcohol and other medications that may cause compounding hypotension (e.g. Sildenafil citrate)
10. Avoid giving beta blockers or CCBs on acute attacks, Nitroglycerine is the drug of choice
11. Remove transdermal patches during defibrillation. Aluminum backing of the patch may explode with electric current

BETA- ADRENERGIC ANTAGONIST / BETA BLOCKERS
(please refer to notes on Ant-hypertensives)

CALCIUM-CHANNEL BLOCKERS
(please refer to notes on Anti-hypertensives)

ANTI-ARYRHYTHMICS

- NORMAL CONDUCTION SYSTEM OF THE HEART:
  - The normal pacemaker of the heart is the SA node that fires impulses that travel through the AV node to the Bundle of His to the Purkinje Fibers and Left and Right Bundle Branches.
  - In cases when the SA node fails to perform its function as the pacemaker of the heart, the heart has the capacity to utilize other parts of the conductive system to generate the impulse and be the pacemaker.
  - However, the farther the pacemaker from the SA node, the smaller is its intrinsic capability to fire impulses (e.g. AV node = 40-60bpm)
  - Any damage to the conduction system can lead to a change in the normal rhythmicity of the heart
  - Any deviation from the normal rhythm of lubbs and dubbs can be considered arrhythmia
Phases of the Action Potential in the Heart

**Phase 0**: Sodium ions slowly bind to their receptor sites and enter the cells.

**Phase 1 and 2**: Sodium levels outside the cell and inside the cell equalizes.

**Phase 3**: Potassium binds in their receptor sites and slowly goes out from the cell.

**Phase 4**: Potassium completely leaves the cell.

Examples of Arrhythmias:
- Atrial Flutter
- Sinus Tachycardia
- Sinus Bradycardia
- Atrial Fibrillation
- Paroxysmal Atrial Tachycardia (Supraventricular Tachycardia)
- Ventricular Flutter
- Ventricular Fibrillation
- AV nodal Blocks
- Premature Atrial Contractions
- Premature Ventricular Contractions

**CLASS I: SODIUM CHANNEL BLOCKERS**

Subdivided into: IA, IB and IC

**I-A**: blocks atrial and ventricular arrhythmias by prolonging Phase 0 of the sodium potassium pump.
- Action potential becomes prolonged
- Usually given in sustained released tablets

Prototype drugs: Disopyramide phosphate
- Procainamide HCl
- Quinidine sulfate (has the capacity to cross the BBB)

**Drug Interactions**:
1. Disopyramide should not be taken together with Macrolides. It causes increased QT interval leading to arrhythmias
2. Avoid giving 2 anti-arrhythmic together, it causes arrhythmia
3. Quinidine may increase digoxin toxicity
4. Rifampin, Phenobarbital and Phenytoin (Dilantin) may decrease the effect of Disopyramide phosphate

**Nursing Interventions**:
1. Do not crush or chew sustained-release tablets
2. Use IV forms to treat Acute attacks

**I-B**: Treat Acute ventricular arrhythmias by preventing the influx of sodium during phase 0.
- Affects only the Purkinje fibers and the myocardium of the ventricles

Prototype drugs: Lidocaine (usually IV)
- Mexilitine
- Tocainide

- Lidocaine and Mexilitine easily binds to blood plasma.
- It is the unbounded part that takes effect as an anti-arrhythmic
- Rifampin cause decreased effects of I-B
- Lidocaine therapeutic levels: 2-5 mcg/mL

**Adverse Reactions**:
- Drowsiness, light-headedness, paresthesia, sensory disturbances, hypotension, bradycardia, seizures (lidocaine overdose)

**Nursing Intervention**:
1. SEIZURE PRECAUTION: in cases of seizures due to lidocaine toxicity

**I-C**: used to treat severe ventricular arrhythmias by reducing the inward movement of Sodium in the cells of the Purkinje Fibers and ventricular myocardial cells.
- It also decreases the conduction of impulses as well as the excitability and automaticity in the AV nodes, Purkinje fibers and intraventricular Myocardim

Prototype drugs: Flecainide acetate
- Propafenone HCl
- Moricizine (contains all IA, IB and IC properties)

**Drug Interactions**:
1. Can cause digoxin toxicity
2. Can increase the serum concentration of beta blockers
3. Theophylline effectiveness may be decreased

**Nursing Responsibilities**
1. Always check for possibility of digoxin toxicity for clients taking cardiac glycosides
2. Do not give to clients with structural Heart Defects
3. Administer with food to prevent gastric irritation

**CLASS II – BETA BLOCKERS / BETA ADRENERGIC ANTAGONISTS**

*Please refer to noted in anti-hypertensives*

**CLASS III – AMIODARONE**
- Treats Atrial Fibrillation, Atrial Flutter and other ventricular arrhythmias by blocking potassium channels in
the myocardium preventing potassium from going out of the cell (Prolongation of phase 3 of the Na-K pump)

**Prototype drugs**: Amiodarone
  
  Dofetilide
  
  Ibutilide

**Drug Interactions**:
1. Amiodarone can cause digitalis toxicity
2. Ibutilide if given within 4 hours added with other forms of anti-arrhythmic can trigger an arrhythmia
3. Avoid rapid administration of IV Amiodarone: may predispose to severe Hypotension

**CLASS IV – CALCIUM CHANNEL BLOCKERS**

*(please refer to notes on anti-hypertensives)*

**ADENOSINE**
- an anti-arrhythmic not classified under any of the classes
- indicated for acute treatment of Re-entry Tachycardias
- depresses the pacemaker activity of the SA node, reducing HR and the ability of the AV node to conduct impulses from atria to ventricles

**Common Nursing Interventions when giving Anti-Arrhythmics**:
1. It is important to take the drug exactly as prescribed. You may use an alarm clock if the medication needs to be taken at odd hours
2. Take pulse before each dose. Withhold dose if pulse rate is less than 60 beats per minute
3. Instruct client to avoid activities that require mental alertness. Medication can cause dizziness
4. Spare activities throughout the day and take adequate rest periods
5. Instruct client not to stop taking medication on his own

**CARDIAC STIMULANTS / INOTROPIC DRUGS**

Influence the contractility of muscular tissue resulting to increased heart contraction

**CARDIAC GLYCOSIDES**
- group of drug derived from digitalis, a substance that occurs naturally from the foxglove plant

**Prototype drug**: Digoxin

**Mechanism of Action:**
- (+ INOTROPIC): boosts intracellular calcium at the cell membrane causing the heart to pump more effectively
- (- CHRONOTROPIC AND DROMOTROPIC): blocks the reuptake of norepinephrine and epinephrine on the cells slowing the conduction and automaticity of the heart

**Indication**: Congestive Heart Filure, Atrial Fibrillation and Atrial Flutter

**Note**:
- Serum therapeutic levels for digoxin: 0.5-2.0 ng/dL
- Older adults and clients with kidney failure may be more prone o developing digitalis toxicity
- Hypokalemia predisposes client to developing Digitalis toxicity

**Dosage is different among age groups**

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<thead>
<tr>
<th></th>
<th>LOADING</th>
<th>MAINTENANCE</th>
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<tbody>
<tr>
<td>INFANTS</td>
<td>0.02-0.04 mg/kg q 8hrs in 24hrs</td>
<td>0.012 mg/kg q 12 hrs</td>
</tr>
<tr>
<td>ADULTS</td>
<td>0.5 – 1.0 mg divided doses within 24 hrs</td>
<td>0.125 – 0.25 mg daily</td>
</tr>
<tr>
<td>GERIATRICS</td>
<td>0.5 – 1.0 mg divided doses within 24 hrs</td>
<td>0.0625 – 0.125 mg daily</td>
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**Signs of Toxicity**:
- Nausea, Anorexia, Vomiting, Diarrhea, Bradycardia and Blurring of Vision

**Antidote to toxicity**: DIGIBIND, DIGOXIN IMMUNE FAB

**Nursing Interventions**:
1. Monitor serum potassium level prior to initiating therapy
2. Monitor for signs and symptoms of adverse reaction
3. Be careful in giving to clients with hepatic and renal damage
4. Anti-arythmic medications can increase the risk of digitalis toxicity
5. Hold administration if BP is less than 90/60 mmHg or pulse rate is less than 60 bpm
6. IM injections are painful and absorption is erratic
7. Antacids can decrease digitalis absorption
8. Assess for hypothyroidism. Clients who have Hypothyroidism are more prone to developing toxicity
9. IV digitalis can be administered bolus or can be titrated with D5W. 1 ml of digoxin can be mixed with 4 ml of D5W

**ANTI-LIPIDEMICS**

Are used to lower abnormally high levels of lipids such as cholesterol, triglycerides and phospholipids.

The risk for developing coronary artery disease is high when these lipids are abnormally high

**BILE-SEQUESTRATING DRUGS**
- lows LOW DENSITY LIPOPROTEINS that don’t respond to diet changes
- Prototype drugs: Cholestyramine
  - Colevelam
  - Colestepol Hydrochloride

- do not get absorbed in the GI tract rather stays in the intestines for 5 hours and combines with bile acids and are excreted in the feces

**Mechanism of action:**
- combines with bile acids in the intestines to form an insoluble compound that is then excreted in the feces. The decreasing level of bile acid in the gall bladder triggers the liver to synthesize more bile acids that requires cholesterol.
- since there are no available bile acids, lipids are not emulsified thus are not absorbed in the GIT, helping the lowering of lipids in the body

**Drug interactions:**
1. may cause digoxin toxicity
2. may decrease absorption of Propanolol, Furosemide, Penicillin G, Hydrochlorothiazide and gemfibrozil
3. May reduce absorption of lipid soluble vitamins

**Adverse Reactions:**
1. gall stones

2. Anorexia and Vomiting
3. Inflammation of the gallbladder
4. Feecal Impaction

Nursing responsibilities:
1. Give other drugs 1 hr before or 4-6 hrs after giving cholestyramine
2. If severe constipation occurs, reduce dosage
3. Monitor serum lipid levels
4. Avoid taking dry form of the medication, can cause esophageal irritation or severe constipation
5. Mix powder forms of the medication with 120-180 ml of water. Sprinkle powder over preferred beverage then let it stand for a few minutes then stir
6. Maintain proper diet
7. Increase fluid intake to prevent constipation

**FIBRIC ACID DERIVATIVES**
- Fibric acid is produced by fungi that is used to reduce high triglyceride levels and to a lesser extent low density lipoproteins

**Mechanism of Action:**
- not fully understood but are believed to reduce cholesterol formation, mobilize cholesterol from tissues, excrete cholesterol and decrease synthesis of triglycerides

**Prototype drugs:** Fenofibrate, Gemfibrozil

Gemfibrozil has 2 other effects:
- increases High density lipoprotein (good cholesterol)
- It increases the serum’s capacity to dissolve additional cholesterol

**Drug Interactions:**
1. can increase bleeding tendencies for clients receiving anti-coagulants

**Adverse Reactions:**
- GI irritation, headache, dizziness, thrombocytopenia, nausea, vomiting, diarrhea and constipation

**HMG-CoA REDUCTASE INHIBITORS**
- Also known as 3-hydroxy-3-methylglutaryl coenzyme reductase inhibitors (statins)
- lower low density lipoproteins by interfering with the production of cholesterol
Prototype drugs: Atorvastatin calcium  
Fluvastatin sodium  
Lovastatin  
Pravastatin sodium  
Simvastatin

Drug Interactions:
1. can cause muscle wasting if combined with anti-infectives
2. may increase bleeding tendencies in clients who are taking warfarin
3. should be taken an hour before or 4 hrs after bile acid sequestrants

Adverse Reaction:
1. Muscle wasting  
2. Arthralgia  
3. Myalgia  
4. Muscle cramps  
5. Nausea and vomiting  
6. Abdominal pain  
7. Flatulence  
8. Constipation

Nicotinic Acid (Niacin)
- A water soluble vitamin that decreases triglyceride levels and apolipoprotein B-100 levels and increases High Density Lipoprotein levels
- Commonly used with other lipidemics in order to achieve ideal LDL level associated with type IV hyperlipidemia

Mechanism of action:
- Lowers triglyceride and apolipoprotein B-100 in an unknown manner but is thought to inhibit hepatic synthesis of lipoproteins that contain apolipoprotein B-100
- Mobilizes free fatty acids from adipose tissues
- Increases the excretion of sterols in the feces

Contraindicated in: Hypersensitivity to niacin  
Severe Hepatic Dysfunction  
Peptic Ulcer Disease

Drug Interactions:
1. Together with HMG-CoA reductase inhibitor can cause muscle wasting and weakness
2. A bile-sequestrating drug such as cholestyramine can bind with niacin and can cause decreased effectiveness

Nursing Responsibilities:
1. Monitor for possible effects of VASODILATION like marked hypotension, orthostatic hypotension, dizziness. Vasodilation is a common adverse reaction
2. Monitor liver function as medication can cause hepatotoxicity
3. Administer Aspirin to relieve flushing experienced by client
4. Note that time released niacin may prevent excessive flushing as a result of vasodilaton but may cause hepatic toxicity
5. Give drug with meals, contraindicated in peptic ulcer disease

Cholesterol Absorption Inhibitors
- Inhibit the absorption of cholesterol from the intestine
- Can be administered alone or as adjunctive therapy to diet for treatment of primary hypercholesterolemia
- Can be also used as adjunctive therapy to HMG-CoA reductase inhibitors
- Can also cause lowering of LDL and increasing the HDL

Prototype drug: Ezetimide

Drug Interactions:
1. Bile acid sequestrants decrease the effect of Ezetimide

Common Nursing Responsibilities when giving Anti-lipidemins:
1. Assess the patient’s cholesterol level and pruritus before therapy as appropriate
2. Monitor blood cholesterol levels before and periodically or every 4 weeks
3. Check CK levels especially if client complains of muscle pain
4. Monitor the patient for fat soluble vitamin deficiency
5. If severe constipation occurs, decrease dosage and implement independent interventions for constipation relief
6. Instruct a lipid-lowering diet as appropriate

Anti-coagulants
Anticoagulants are used to reduce the ability of the blood to clot

Major categories of Anti-coagulants:
1. Heparin
2. Antiplatelet drugs
3. Oral Anti-coagulants

HEPARIN AND HEPARIN DERIVATIVES
- prepared commercially from animal tissue
- an anti-thrombolytic agent used to prevent clot formation
- cannot dissolve existing clots
- administered parenterally because they are poorly absorbed in the GI tract
IM route is not recommended since it causes localized bleeding at the site of injection

Classified into:
- a. Unfractionated heparin – administered in a continuous IV infusion
- b. Low-molecular weight Heparin – drug of choice for Deep Vein Thrombosis and is usually given once a day SQ OD or BID

Mechanism of Action:
Prevents formation of thrombi by activating Anti-thrombin III, which in turns deactivate factors IXa, Xa and XIIa

Indications:
- a. Prevention and Treatment of Thromboemboli
- b. Treatment of Disseminated Intravascular Coagulation
- c. Prevention of thrombus formation in clients with atrial fibrillation
- d. Prevention of clotting in situations where the blood must circulate outside the human body (e.g. Hemodialysis)
- e. Orthopedic surgeries where the clotting mechanism of the body is increased

Drug Interactions:
- a. Oral Anticoagulants: Increased risk for bleeding
- b. NSAIDS, FeDextran, Clopidogrel, Cilostazol, Aspirin, Ticlopidine and Dipyridamole: Increased risk for bleeding
- c. Antihistamine, Digoxin, Pn G, Cephalosporins, Nitroglycerine, Quinidine, Nicotine, IV Penicillin: Antagonizes the effects of Heparin

ANTIDOTE: Protamine Sulfate

Side Effect: Bleeding, Bruising, Hematoma, Thrombocytopenia

Nursing Management:
1. Assess patient for bleeding and other adverse reactions
2. Monitor VS, including laboratory values foe Hgb, Hct, Platelet, PT, PTT. PTT should be maintained within 1 ½ to 2 ½ times the control value
3. Assess for any signs of bleeding such as bleeding gums, hematuria, melena and hematocritias and hematemesis
4. Keep Protamine Sulfate ready at all times
5. Maintain bleeding precautions
6. Administer IV solutions sing Infusion Pumps

ORAL ANTICOAGULANTS (COUMADIN)
- most famous is COUMARIN COMPOUND WARFARIN SODIUM
- Drug of choice for thromboembolism that is usually given together with heparin. Warfarin can be started without Heparin for thromboembolism prevention
- Drug of Choice for Deep Vein Thrombosis usually given together with antiplatelet medications
- Takes about 48 hours or even 3 to four days to take effect because it counteracts the effects of vitamin K dependent clotting factors. These factors must at first be exhausted so that warfarin can take effect
- Frequent assessment of the PROTHROMBIN TIME must be done to determine therapeutic levels of warfarin
- ANTIDOTE: VITAMIN K1 (Phenytonadione)

Mechanism of Action:
- Alter the ability of the liver to synthesize vitaminK dependent clotting factors, including Prothrombin and Factors VII, IX and X

Drug Interactions:
- Drugs that are highly protein bounded potentiate the effects of warfarin (e.g. Acetaminophen, Amiodarone, Allopurinol, Ibuprofen, Isoniazid, Cephalosporins…etc.)
- Diet high in Vitamin K antagonizes the effects of Warfarin.
- Warfarin causes Phenytoin toxicity; Phenytoin may either increase or decrease the effects of warfarin
- Patients with alcohol intoxication are at greater risk for bleeding

Adverse reaction :
- MINOR BLEEDING, bleeding on GI tract, Bruises and Hematomas

Nursing Responsibilities:
- Monitor client for bleeding tendencies
- Monitor client’s PT level
- Assess patient’s stools for melena and other signs of bleeding
- Keep Vitamin K available
Maintain bleeding precautions
Instruct client to avoid activities that may result to bleeding
Give warfarin at night

ANT-PLATELET DRUGS

Prototype drugs
- Aspirin
- Clopidogrel
- Dipyridamole
- Sulfinpyrazone
- Ticlopidine

IV Anti-platelets
- EPTIFIBATIDE
- Tirofiban
- Abciximab

Mechanism of Action:
- Interferes with platelet activity in drug specific dose related manners:

A. STOPPING CLOT FORMATION
- ASPIRIN inhibits the production of prostaglandin needed for the production of Thromboxane A2 needed for blood clotting
- CLOPIDOGREL inhibits pla-let fibrinogen bindin

B. BLOCKING PLATELET FUNCTION
- IV antiplatelets inhibit Glycoprotein IIa- IIIb receptor (major receptors involved in platelet aggregation)
- DIPYRIDAMOLE increases adenosine (a known vasodilator and platelet aggregation inhibitor)
- TICLOPIDINE stops platelet aggregation on its early stages by stopping fibrinogen from binding with platelets

Drug Interactions:
- Antiplatelet drugs if taken with NSAIDS, Heparin and oral anticoagulants poses client for bleeding tendencies
- Aspirin causes Valproic acid and Methotrexate toxicity

THROMBOLYTIC DRUGS

Prototype drugs: Alteplase
Reteplase
Tenectplase
Urokinase
Streptokinase

Mechanism of Action:
- converts plasminogen to plasmin, which lysed thrombi, fibrinogen and other plasma proteins

Indication:
- thromboembolic disorders that may result to myocardial infarction, stroke, peripheral artery occlusion and is used to dissolve thrombi in atriovenous cannulas and in IV catheters to reestablish blood flow.

Drug Interaction:
- Oral anticoagulants and Heparin and Antiplatelets can increase the risk of clients to bleeding
- Aminocaproic acid can decrease the effectivity of Streptokinase

Nursing Responsibilities:
1. Monitor the patient for bleeding
2. Assess the patient’s underlying conditions before starting therapy
3. Check PT and PTT time of client
4. Monitor the patient’s vital signs before and after the procedure. Monitor client’s platelet count, hemoglobin and hematocrit level
5. Monitor client for internal bleeding by checking client’s stool and urine as well as emesis for presence of blood

Thrombolytic drugs are used to dissolve preexisting clots or thrombus commonly in an acute emergency situation

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