Personal Drugs

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**First Diagnosis: Primary Hyperlipidemia**

A 38 year old African American male patient returns to a follow up visit for his high cholesterol levels from routine blood work required by his employer for a new insurance program. His physical assessment was unremarkable with heart sounds S1, S2, no murmurs, rubs, or gallops. Lung sounds were clear in all fields with no adventitious findings. He is alert and oriented times three and has no neurological deficient. The remainder of assessment was also normal with vital signs of a blood pressure 128/79 mmHg, heart rate 68 bpm, respirations 14 breaths per minute, pulse oximetry 99% on room air, temperature 97.9˚F, and patient denies any pain. The patient’s lab work included a complete blood count, complete metabolic panel, liver profile, and lipid profile. All lab values were normal except for his low-density lipoprotein (LDL) level of 178 mg/dL, total cholesterol of 250 mg/dL, and triglycerides 225mg/dL. Subsequently a C reactive protein level was drawn and resulted as 3.8 mg/dl. The patient states that his father was put on a cholesterol and high blood pressure medication after a heart attack when he was 60 years of age. He has no past medical history and cannot remember the last time he has seen a doctor. The patient smokes a half pack of cigarettes a day and is approximately 10 pounds overweight. He states that he drinks occasionally and only has two to three drinks each occasion.

**I. Definition of Diagnosis**

 Hyperlipidemia is an elevated level of lipids in a person’s bloodstream. Lipids are fatty substances used by the body and include cholesterol, cholesterol esters, phospholipids, and triglycerides. Chylomicrons, very low-density lipoproteins (VLDL), intermediate-density lipoproteins (IDL), low-density lipoproteins (LDL), and high-density lipoproteins (HDL) are the major classes of lipoproteins that carry the lipids in the blood (Elsevier, 2012). Elevation of these lipids and lipoproteins in the blood is caused by a heterogeneous group of disorders in which primary hyperlipidemia is likely genetically based but the genetic defects are only known in a small amount of patients (Elsevier, 2012).

**II. Therapeutic Objectives**

 The goal for treatment of hyperlipidemia is to lower and maintain the patients LDL level < 100 mg/dL, total cholesterol < 200 mg/dL, triglycerides < 150 mg/dL, and keep the HDL level ≥ 60 mg/dL. To reach and maintain these goals, patients should be initiated on therapeutic lifestyle changes and be started on cholesterol lowering medication if necessary (National Heart, Lung, and Blood Institute [NHLBI], 2001). The overall therapeutic objective is to lower patients risk for coronary heart disease, myocardial infarction, and stroke (American Heart Association, 2013). Below in table one is classifications for cholesterol management.

Table 1

 *Classification of LDL, Total, HDL, and Triglyceride Cholesterol (mg/dL)*

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| Lab Values | Interpretation | LabValues | Interpretation |
| **LDL**< 100100-129130-159160-189≥ 190 | OptimalNear optimal/above optimalBorderline highHighVery High | **Total**< 200200-239≥240 | DesirableBorderline highHigh |
| **HDL**< 40≥ 60 | LowHigh | **Triglycerides**< 150150-199200-499≥ 500 | NormalBorderline highHighVery high |

*Note.* Values from (NHLBI, 2004)

**III. Effective Drug Groups**

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| --- | --- | --- | --- |
| Drug Classification | Efficacy | Safety | Suitability  |
| Statinsfluvastatin (Lescol®), atorvastatin (Lipitor®), pravastatin (Pravachol®), lovastatin (Altoprev®, Mevacor®), pitavastatin (Livalo®), simvastatin (Zocor®), rosuvastatin (Crestor®) (CalOptima, 2012) | *Pharmacodynamics:* Inhibitor of 3-hydroxy-3-methylglutary coenzyme A (HMG-CoA) reductase, the rate-limiting enzyme in cholesterol synthesis (Lexi-Comp, 2013)*Pharmacokinetics:* Absorption: varies from 40% to 75%. Metabolism: Hepatic Excretion : mostly in bile, 5-20% in the urine (Katzung, Masters, & Trevor, 2012)

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 | *Side Effects:*Common: headache, dyspepsia, abdominal pain, diarrhea, nausea, insomnia, fatigue, flatulence, sinusitis, myalgia, CK elevation, ALT/AST elevation, coenzyme Q10 levels decrease, glucose increase, cognitive impairment(Epocrates, 2013)Serious: myopathy, rhabdomyolysis, acute renal failure, hepatotoxicity, pancreatitis, hypersensitivity reaction, angioedema, lupus, erythematosus, polymyalgia rheumatic, dermatomyositis, vasculitis, thrombocytopenia, leukopenia, hemolytic anemia, photosensitivity, toxic epidermal necrolysis, erythema multiforme, Stevens-Johnson syndrome  (Epocrates, 2013) | *Contraindications:* Hypersensitivity, pregnancy, breastfeeding, CK>10x ULN, myopathy, AST or ALT >3x ULN, elevated LFT’s, hepatic disease.*Caution with:* Alcohol abuse, pts.>65 yo, female pts., renal impairment, hepatic disease, diabetes mellitus, hypothyroidism, stroke within 6 months (Epocrates, 2013) |
| Bile Acid Sequestrantscolesevelam (Welchol®), colestipol (Colestid®), cholestyramine (Questran®) (CalOptima, 2012) | *Pharmacodynamics:* Binds with bile acid to form an insoluble complex that is eliminated in feces. Only good for isolated increases in LDL.(Lexi-Comp, 2013)*Pharmacokinetics:* Absorption: NoneMetabolism: NoneExcretion: Feces(Lexi-Comp, 2013) | *Side Effects:*Common: constipation, dyspepsia, URI sx., nausea, headache, fatigue, asthenia, influenza- like sx., hypoglycemia (DMII use), HTN, vomiting, myalgia, hypertriglyceridemia (Epocrates, 2013)Serious: hypersensitivity reaction, rash, oral blister, esophageal obstruction, fecal impaction, dysphagia, pancreatitis(Epocrates, 2013) | *Contraindications:* hypersensitivity to drug or class, GI obstruction, pancreatitis, triglycerides > 500 mg/dL(Epocrates, 2013)*Caution with:* triglycerides of 300-500 mg/dL, GI motility disorder, GI obstruction risk, major GI surgery history, dysphagia, fat-soluble vitamin deficiency risk, phenylalanine-containing forms (Epocrates, 2013) |
| Sterol Absorption Inhibitorezetimibe (Zetia®) (CalOptima, 2012) | *Pharmacodynamics:*Inhibits absorption of cholesterol at the brush of the small intestine via the sterol transporter, Niemann-Pick C1-Like1. Decreases total cholesterol, LDLs, ApoB, and triglycerides while increasing HDL cholesterol. (Lexi-Comp, 2013)*Pharmacokinetics:* Protein binding: . 90% to plasma proteinsMetabolism: undergoes glucuronide conjugation in the small intestine and liverExcretion: mostly in feces, some in urine(Lexi-Comp, 2013) | *Side Effects:*Common: URI, diarrhea, nasopharyngitis, arthralgia, sinusitis, myalgia, extremity pain, fatigue, back pain, influenza(Epocrates, 2013)Serious: hypersensitivity rxn, anaphylaxis, angioedema, erythema multiforme, pancreatitis, rhabdomyolysis, depression(Epocrates, 2013)  | *Contraindications:* hypersensitivity to drug*Caution with:* hepatic impairment(Epocrates, 2013) |
| Fibratesgemfibrozil (Lopid®), fenofibrate (Tricor®, Triglide®, Lipofen®), fenofibrate micronized (Antara®, Lofibra®), fenofibric acid (Trilipix®) (CalOptima, 2012) | *Pharmacodynamics:*Fibrates function primary as ligands for the nuclear transcription receptor, PPAR-α. Decreases VLDL levels and total plasma triglycerides by as much as 30%-60%, with a modest increase in HDLs in some patients(Lexi-Comp, 2013)*Pharmacokinetics:* Absorption: increase when taken with mealsProtein binding: >90%Metabolism: undergoes inactivation by glucuronidation hepatically or renally Excretion: mostly urine, some feces(Lexi-Comp, 2013)  | *Side Effects:*Common: LFTs elevated, headache, back pain, respiratory infection, extremity pain, nausea, dizziness, arthralgia, diarrhea, dyspepsia, nasopharyngitis, pain, sinusitis, myalgia, constipation, fatigue, muscle spasms(Epocrates, 2013) Serious: hepatitis, cirrhosis, cholelithiasis, pancreatitis, myositis, myopathy, rhabdomyolysis, hypersensitivity reaction, Stevens-Johnson syndrome, toxic epidermal necrolysis, thrombocytopenia, agranulocytosis, thromboembolism, HDL-C decrease(Epocrates, 2013)  | *Contraindications:* hypersensitivity to drug or class, renal impairment (severe), hepatic disease (active), elevated LFTs, primary biliary cirrhosis, gallbladder disease, breast feeding(Epocrates, 2013)*Caution with:* elderly, renal impairment, concurrent nephrotoxic agents, diabetes mellitus, hypothyroidism (Epocrates, 2013)  |
| NiacinNiacin IR (Niacin®), niacin ER (Niaspan®), niacin SR (Slo-niacin®) | *Pharmacodynamics:* component of two coenzymes which is necessary for tissue respiration, lipid metabolism, and glycogenolysis.(Lexi-comp, 2013)*Pharmacokinetics:* Absorption: Rapid and extensive (60% to 76%)Metabolism: extensive first-pass effectsExcretion: Urine 60% to 88% (Lexi-Comp, 2013) | *Side Effects:*Common: flushing , pruritus, hyperpigmentation, orthostatic hypotension, dyspepsia, vomiting, diarrhea, peptic ulcer, jaundice, abnormal LFTs, xeroderma, glucose tolerance decreased, hyperuricemia, gout, toxic amblyopia, headache, macular edema (Epocrates, 2013)Serious: hepatotoxicity, hepatic necrosis, peptic ulcer, arrhythmias, hypersensitivity reaction, anaphylaxis (Epocrates, 2013) | *Contraindications:* hypersensitivity to drug or class, active peptic ulcer, arterial bleeding, active hepatic disease, elevated LFTs(Epocrates, 2013)*Caution with:* hepatic disease history, biliary disease history, peptic ulcer disease history, alcohol abuse, diabetes mellitus, diabetes mellitus risk, gout, unstable angina, acute MI, renal impairment, hypophosphatemia, surgery (Epocrates, 2013) |

**IV. Effective Drug Classification: Statins**

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| Drug Name | Efficacy | Safety | Suitability | Cost |
| fluvastatin (Lescol®) | *Onset of action:* Peak effect: maximal LDL-C reductions achieved within 4 weeks*Protein Binding:* > 98%*Metabolism:* to inactive and active metabolites (oxidative metabolism via CYP2C9 [75%], 2C8 [~5%], and 3A4 [~20%] isoenzymes); active forms do not circulate systemically; extensive (saturable) first-pass hepatic extraction *Bioavailability:* absolute: capsule: 24%; extended release tablet: 29%*Half-life:* capsule: <3 hours; extended release tablet: 9 hours*Excretion:* feces (90%); urine (5%)(Lexi-Comp, 2013) | **Substrate** of CYP2C9 (minor), CYP2D6 (minor), CYP3A4 (minor), SLCO1B1; **Inhibits** CYP1A2 (weak), CYP2C8 (weak), CYP2C9, (moderate), CYP2D6 (weak), CYP3A4 (weak)*Drug Interactions:* *Avoid use with* Fusidic Acid; Gemfibrozil; Pimozide; Red Yeast Rice*Fluvastatin may increase the levels/effects of:* Aripiprazole; Carvedilol; CYP2C9 Subtrates; Daptomycin; Lomitapide; Pazopanib; Pimozide; Trabectedin; Vitamin K Antagonists*The levels of Fluvastatin may be increased by:*  Amiodarone; Benzafibrate; Colchicine; Cyclosporine (systemic); Cyproterone; Eltrombopag; Fenofibrate; Fenofibric Acid; Gemfibrozil; Mifepristone; Niacin; Niacinamide; Red Yeast Rice*Fluvastatin may decrease the levels/effects of:* Lanthanum*The levels of Fluvastatin may be decreased by:* Antacids; Cholestyramine Resin; Etravirine; Fosphenytoin; Peginterferon Alfa-2b; Phenytoin; Rifamycin Derivatives(Lexi-Comp, 2013) | - Avoid excessive ethanol consumption (due to potential hepatic effects)- Food reduces rate but not the extent of absorption. Red yeast rice contains an estimated 2.4 mg lovastatin per 600 mg rice. - Monitor baseline CPK; baseline LFTs and repeat when clinically indicated thereafter. Patients with elevated transaminase levels should have a second test and frequent monitoring until values normalize.- Take as directed. Do not chew, crush, or dissolve extended release tablets; swallow whole. Periodic laboratory testing will be needed to evaluate response. (Lexi-Comp, 2013) | Lescol (capsules): 20 mg (30): $117.59; 40 mg (30): $109.19Lescol XL (extended release): 80 mg (30): $145.99  |
| atorvastatin (Lipitor®) | *Onset of action:* Initial changes: 3-5 days; Maximal reduction in plasma cholesterol and triglycerides: 2 weeks*Protein binding:* ≥ 98%*Metabolism:* Hepatic; forms active ortho- and parahydroxylated derivates and an inactive beta-oxidation product*Bioavailability:* ~14% (parent drug); ~30% (parent drug and equipotent metabolites)*Half-life:* Parent drug 14 hours; Equipotent metabolites: 20-30 hours*Peak:* 1-2 hours*Excretion:* Bile; urine (<2% as unchanged drug)(Lexi-Comp, 2013) | **Substrate** of CYP3A4 (major), P-glycoprotein, SLCO1B1; **Inhibits** CYP3A4 (weak), glycoprotein*Drug Interactions:**Avoid use with:* Bosutinib; Conivaptan; Cyclosporine (systemic); Fusidic Acid; Gemfibrozil; Pimozide; Posaconazole; Red Yeast Rice; Silodosin; Telaprevir; Tipranavir; Topotecan; Vincristine (Liposomal)*Atorvastatin may increase the levels/effects of:* Aliskiren; Ariprazole; Bosutinib; Daptomycin; Digoxin; Diltiazem; Everolimus; Ketoconazole (systemic); Lomitapide; Midazolam; Pazopanib; P-glycoprotien/ABCB1 Substrates; Pimozide; Prucalopride; Rivaroxaban; Silodosin; Topotecan; Trabectedin; Verapamil; Vinncristine (Liposomal)*Atorvastatin may be increased by:* Amiodarone; Bezafibrate; Boceprevir; Cobicistat; Colchicine; Conivaptan; Cyclosporine (systemic); CYP3A4 Inhibitors (Strong); CYP3A4 (Moderate); Cyproterone; Danazol; Dasatinib; Fenofibrate; Fenofibric Acid; Fluconazole; Fusidic Acid; Gemfibrozil; Grapefruit juice; Itraconazole; Ivacaftor; Ketoconazole (systemic); Macrolide Antibiotics; Mifepristone; Niacin; Niacinamide; P-glycoprotein / ABCB1 Inhibitors; Posaconazole; Protease Inhibitors; Quinine; Red Yeast Rice; Sildenafil; Telaprevir; Tipranavir; Verapamil; Voriconazole*Atorvastatin may decrease the levels/effects of:* Dabigatran Etexilate; Lanthanum*Atorvastatin may be decreased by:* Antacids; Bexarotene (systemic); Bile Acid Sequestrants; Bosentan; CYP3A4 Inducers (Strong); Deferasirox; Efavirenz; Etravirine; Fosphenytoin; P-glycoprotein / ABCB1 Inducers; Phenytoin; Rifamycin Derivatives; St. Johns Wort; Tocilizumab(Lexi-Comp, 2013) | -Avoid excessive ethanol consumption.-Avoid concurrent intake of large quantities of grapefruit juice (>1 quart/day) Red yeast rice contains an estimated 2.4 mg lovastatin per 600 mg rice- St. Johns Wort may decrease atorvastatin levels.- Monitor baseline CPK; baseline LFTs and repeat when clinically indicated thereafter. Patients with elevated transaminase levels should have a second test and frequent monitoring until values normalize.- Take as directed. Report unusual muscle cramping, or weakness, yellowing of the skin or eyes, easy bruising or bleeding, or unusual fatigue. (Lexi-Comp, 2013) | Atorvastatin calcium (tablets): 10mg (30): $99.99; 20 mg (30): $129.99; 40 mg (30): $129.99; 80 mg (30): $129.99Lipitor (tablets): 10 mg (30): $119.99; 20 mg (30): $164.99; 40 mg (30); $166.99; 80 mg (30): $164.99(Lexi-Comp, 2013) |
| pravastatin (Pravachol®) | *Onset of action:* Several days; Peak effect: 4 weeks.*Absorption:* Average absorption 34%*Protein binding:* 50%*Metabolism:* Hepatic multiple metabolites*Bioavailability:* 17%*Half-Life:* 77 hours (including all metabolites)*Peak:* 1-1.5 hours*Excretion:* Mostly feces, some in urine(Lexi-Comp, 2013) | **Substrate** of CYP3A4 (minor), P-glycoprotein, SLCO1b1; **Inhibits** CYP2C9 (weak), CYP2D6 (weak), CYP3A4 (weak)*Avoid use with:* Fusidic Acid; Gemfibrozil; Pimozide; Red Yeast Rice*Pravastatin may increase the levels/effects of:* Ariprazole; Cyclosporine (systemic); Daptomycin; Lomitapide; Paroxetine; Pazopanib; Pimozide; Trabectedin; Vitamin K Antagonist*Pravastatin may be increase by:* Benafibrate; Boceprevir; Colchicine; Cyclosporine (systemic); Darunavir; Eltrombopag; Fenobibrate; Fenofibric Acid; Fusidic Acid; Gemfibrozil; Itraconazole; Niacin; Niacinamide; P-glycoprotein / ABCB1 Inhibitors; Red Yeast Rice*Pravastatin may decrease the levels/effects of:* Lanthanum*Pravastatin may be deceased by:* Antacids; Bile Acid Sequestrants; Efavirenz; Fosphenytoin; Nelfinavir; P-glycoprotein / ABCB1 Inducers; Phenytoin; Rifamycin Derivatives; Saquinavir(Lexi-Comp, 2013) | -Avoid excessive ethanol consumption.-Red yeast rice contains an estimated 2.4 mg lovastatin per 600 mg rice- St. Johns Wort may decrease pravastatin.- Monitor baseline CPK; baseline LFTs and repeat when clinically indicated thereafter. Patients with elevated transaminase levels should have a second test and frequent monitoring until values normalize.- Take as directed. Take same time each day with or without food. Report unusual muscle cramping, or weakness, yellowing of the skin or eyes, easy bruising or bleeding, or unusual fatigue.(Lexi-Comp, 2013) | Pravachol (Tablets): 10 mg (30): $139.99; 20 mg (30): $121.99; 40 mg (30): $172.98; 80 mg (30): $191.66Pravastatin Sodium (Tablets): 10 mg (30): $18.99; 20 mg (30): $27.99; 40 mg (30): $25.99; 80 mg (30): $119.99(Lexi-Comp, 2013) |
| lovastatin (Altoprev®, Mevacor®) | *Onset of action:* LDL-cholesterol reduction in 3 days*Absorption:* 30%; increased with extended release tablet when taken in the fasting state*Protein binding:* > 95%*Metabolism:* Hepatic; extensive first-pass effect*Bioavailability:* Increased with extended release tablets*Half-life:* 1.1-1.7 hours*Peak:* Immediate release: 2-4 hours; extended release: 12-14 hours*Excretion:* Mostly feces, some in urine(Lexi-Comp, 2013) | **Substrate** of CYP3A4 (major), P-glycoprotein; **Inhibits** CYP2C9 (weak), CYP3A4 (weak)*Avoid use with:*Boceprevir; Cyclosporine (systemic); CYP3A4 Inhibitors (Strong); Erythromycin (systemic); Fusidic Acid; Gemfibrozil; Lomitapide; Mifepristone; Pimozide; Protease Inhibitors; Red Yeast Rice; Telaprevir*Lovastatin may increase the levels/effects of:* Aripiprazole; Daptomycin; Diltiazem; Pazopanib; Pimozide; Trabectedin; Vitamin K Antagonists*Lovastatin may be increased by: Amiodarone; Bezafibrate; Boceprevir; Colchicine; Cyclosporine (systemic); CYP3A4 Inhibitors (Moderate); CYP3A4 Inhibitors (Strong); Cyproterone; Danazol; Dasatinib; Diltiazem; Dronedarone; Erythromycin (systemic); Fenofibrate; Fenofibric Acid; Gemfibrozil; Grape Fruit Juice; Ivacaftor; Lomitapide; Macrolide Antibiotics; Mifepristone; Niacin; Niacinamide; P-glycoprotein / ABCB1 Inhibitors; Protease Inhibitors; Quinine; Ranolazine; Red Yeast Rice; Sildenafil; Telaprevir; Ticagrelor; Verapamil**Lovastatin may decrease the levels/effects of:*  Lanthanum*Lovastatin may be decreased by:* Antacids; Bosentan; CYP3A4 Inducers (Strong); Deferasirox; Efavirine; Fosphenytoin; P-glycoprotein / ABCB1 Inducers; Phenytoin; Rifamycin Derivatives; St. Johns Wort; Tocilizumab(Lexi-Comp, 2013) | - Avoid excessive ethanol consumption.- Food decreases the bioavailability of lovastatin extended release tablets and increases the bioavailability of immediate release tablets.-Avoid concurrent intake of large quantities of grapefruit juice (>1 quart/day) Red yeast rice contains an estimated 2.4 mg lovastatin per 600 mg rice- St. Johns Wort may decrease lovastatin levels- Monitor baseline CPK; baseline LFTs and repeat when clinically indicated thereafter. Patients with elevated transaminase levels should have a second test and frequent monitoring until values normalize.- Take as directed. Take with food at evening meal.- Report unusual muscle cramping, or weakness, yellowing of the skin or eyes, easy bruising or bleeding, or unusual fatigue.(Lexi-Comp, 2013)  | Altoprev (extended release tablet): 20 mg (30): $399.98; 60 mg (30): $427.99Lovastatin (Tablet): 10 mg (45): $47.99; 20 mg (30): $22.99; 40 mg (30): $35.99Mevacor (Tablet): 40 mg (30): $146.00(Lexi-Comp, 2013) |
| pitavastatin (Livalo®) | *Protein binding:* >99%*Metabolism:* Hepatic, via UGT1A3 and UGT 2B7; minimal metabolism via CYP2C9 and CYP2C8 *Bioavailability:* 51%*Half-life:* ~12 hours*Peak:* ~1 hour*Excretion:* Mostly feces, some in urine(Lexi-comp, 2013) | **Substrate** of SLOCO1B1, UGT1A3, UGT2B7*Avoid use with:* Cyclosporine (systemic); Fusidic Acid; Gemfibrozil; Red Yeast Rice*Pitavastatin may increase the levels/effects of:* Daptomycin; Pazopanib; trabectedin; Vitamin K Antagonist*Pitavastatin may be increased by:* Atazanavir; Bezafibrate; Colchicine; Cyclosporine (systemic); Danazol; Eltrombopag; Fenofibrate; Fenofibric Acid; Fusidic Acid; Gemfibrozil; Macrolide Antibiotics; Niacin; Niacinamide; Red Yeast Rice; Rifamycin Derivatives; Sildenafil*Pitavastatin may decrease the levels/effects of:* Lanthanum*Pitavastatin may be decreased by:* Antacids; Bosentan; St Johns Wort(Lexi-Comp, 2013) | - Avoid excessive ethanol consumption.- Red yeast rice contains an estimated 2.4 mg lovastatin per 600 mg rice- Take as directed with or without food. - Monitor baseline CPK; baseline LFTs and repeat when clinically indicated thereafter. Patients with elevated transaminase levels should have a second test and frequent monitoring until values normalize.- Report unusual muscle cramping, or weakness, yellowing of the skin or eyes, easy bruising or bleeding, or unusual fatigue.(Lexi-Comp, 2013) | Livalo (Tablet): 1 mg (30): $158.00(Epocrates, 2013)  |
| simvastatin (Zocor®) | *Onset of action:* >3 days; Peak effect: 2 weeks*Absorption:* 85%*Protein binding:* ~95%*Metabolism:* Hepatic via CYP3A4; extensive first-pass effect*Bioavailability:* <5%*Half-life:* Unknown*Peak:* 1.3-2.4 hours*Excretion:* Mostly feces, some in urine(Lexi-Comp, 2013) | **Substrate** of CYP 3A4 (major), SLCO1B1; **Inhibits** CYP2C8 (weak), CYP2C9 (weak), CYP2D6 (weak)*Avoid use with:* Boceprevir; Cyclosporine (systemic); CYP3A4 Inhibitors (Strong); Erythromycin (systemic); Fusidic Acid; Gemfibrozil; Mifepristone; Protease Inhibitors; Red Yeast Rice; Telaprevir*Simvastatin may increase the levels/effects of:* Ariprazole; Daptomycin; Diltiazem; Pazopanib; trabectedin; Vitamin K Antagonists *Simvastatin may be increase by:* Amiodarone; Amlodipine; Bezafibrate; Boceprevir; Colchicine; Cyclosporine (systemic); CYP3A4 Inhibitors (Moderate); CYP3A4 Inhibitors (Strong); Cyproterone; Danazol; Dasatinib; Diltiazem; Dronedarone; Eltrombopag; Erythromycin (systemic); Fenofibrate; Fenofibric acid; Fluconazole; Fusidic Acid; Gemfibrozil; Grape Fruit Juice; Green Tea; Imatinib; Ivacaftor; Lomitapide; Macrolide Antibiotics; Mifepristone; Niacin; Niacinamide; Protease Inhibitors; Quinine; Ranolazine; Red Yeast Rice; Sildenafil; Telaprevir; Ticagrelor; Verapamil*Simvastatin may decrease the levels/effects of:* Lanthanum*Simvastatin may be decrease by:* Antacids; Bosentan; CYP3A4 Inducers (Strong); Deferasirox; Efavirenz; Etravirine; Fosphenytoin; Phenytoin; Rifamycin Derivatives; St. Johns Wort; Tocilizumab(Lexi-Comp, 2013) | - Avoid excessive ethanol consumption.- Avoid concurrent intake of large quantities of grapefruit juice (>1 quart/day) Red yeast rice contains an estimated 2.4 mg lovastatin per 600 mg rice-Avoid St Johns Wort- Monitor baseline CPK; baseline LFTs and repeat when clinically indicated thereafter. Patients with elevated transaminase levels should have a second test and frequent monitoring until values normalize.- Take as directed at the same time each day in the evening, with or without food. - Report unusual muscle cramping, or weakness, yellowing of the skin or eyes, easy bruising or bleeding, or unusual fatigue.(Lexi-Comp, 2013) | Simvastatin (Tablet): 5 mg (30): $17.99; 10 mg (30): $19.99; 20 mg (30): $27.99; 40 mg (30): $27.99; 80 mg (30): $35.99Zocor (Tablets): 5 mg (30): $77.30; 10 mg (30): $100.99; 20 mg (30): $173.99; 40 mg (90): $465.99; 80 mg (30): $178.99(Lexi-Comp, 2013) |
| rosuvastatin (Crestor®) | *Onset of action:* Within 1 week; maximal at 4 weeks*Protein binding:* 88%*Metabolism:* Hepatic (10%), via CYP2C9*Bioavailability:* 20%; high first-pass extraction by liver*Half-life:* 19 hours*Peak:* 3-5 hours*Excretion:* Feces, primarily as unchanged drug(Lexi-Comp, 2013) | **Substrate** of CYP2C9 (minor), SLOCO1B1*Avoid use with:* Fusidic Acid; Gemfibrozil; Red Yeast Rice*Rosuvastatin may increase the levels/effects of:* Daptomycin; Pazopanib; Trabectedin; Vitamin K Antagonists*Rosuvastatin may be increased by:* Amiodarone; Bezafibrate; Colchicine; Cyclosporine (systemic); Dronedarone; Eltrombopag; Fenofibrate; Fenofibric Acid; Fusidic Acid; Gemfibrozil; Itraconazole; Niacin; Niacinamide; Protease Inhibitors; Red yeast Rice*Rosuvastatin may decrease the levels/effects of:* Lanthanum*Rosuvastatin may be decreased by:* Antacids(Lexi-Comp, 2013)   | - Avoid excessive ethanol consumption. - Red yeast rice contains an estimated 2.4 mg lovastatin per 600 mg rice- Monitor baseline CPK; baseline LFTs and repeat when clinically indicated thereafter. Patients with elevated transaminase levels should have a second test and frequent monitoring until values normalize.- Take as prescribed. Take at the same time each day, with or without food. -Report unusual muscle cramping, or weakness, yellowing of the skin or eyes, easy bruising or bleeding, or unusual fatigue.(Lexi-Comp, 2013)  | Crestor (Tablets): 5 mg (30): $154.99; 10 mg (30): $154.99; 20 mg (30): $155.98; 30 mg (30): 155.99(Lexi-Comp, 2013) |

**V. Drug of Choice: Simvastatin (Zocor®)**

 The initial treatment of hyperlipidemia in any patient is to implement therapeutic lifestyle changes. The ATP III guidelines by the NHLBI uses a patients risk category, which takes into account a person’s risk factors and 10-year risk of coronary heart disease. These should be used to guide treatment and determine when drug therapy should be considered (NHLBI, 2001). Statin drugs have the most supportive evidence for use of primary prevention, especially in patients that are considered at high risk (Last, Ference, & Falleroni, 2011). The ATP III guidelines do not make a recommendation for the classification of drug, or the specific drug in a classification when starting therapy. The guideline from the National Institute for Health and Clinical Excellence however does make a recommendation to use Simvastatin 40 mg daily for the initial treatment of primary prevention (Last, Ference, & Falleroni, 2011).

Thus this patient will be started on simvastatin 40 mg oral once a day. He will need to follow up at 6 – 8 weeks after the initiation of the medication (Lexi-Comp, 2013). Before starting any patient on statins a baseline CPK and liver function tests (LFTs) should be drawn. If any patient has symptoms or complaints suggestive of myopathy during the course of treatment with simvastatin than a recheck of their CPK and LFTs should be done immediately and treatment should be discontinued if the CPK is markedly elevated or if there is an increase of ALT/AST levels greater than three times the normal level (Lexi-Comp, 2013).

 The patient should be instructed on the side effects and when to notify a health care provider. The main side effects of concern for simvastatin are myopathy and increased liver enzymes. The absolute contraindication for prescribing simvastatin is patients with active or chronic liver disease and the relative contraindication is the concomitant use of certain drugs (NHLBI, 2001). An advanced practice nurse (APN) may prescribe simvastatin in the state of Ohio (Ohio Board of Nursing, 2011).

**Second Diagnosis: Stage One Hypertension**

 A 54 year old Hispanic female is at a follow-up appointment after having been seen in the emergency department (ED) for a headache and high blood pressure. The patient has been taking her blood pressure at home and keeping a log. She states that she takes her blood pressures every morning before she starts her day. Her vital signs in the office are a blood pressure of 150/92 mm/Hg, respirations 14 breaths per minute, heart rate 82 bpm, temperature of 97.9 F˚, and no complaints of pain. When the APN reviews the log, the patient’s systolic blood pressure is consistently between 143 mmHg and 158 mmHg and diastolic blood pressure was between 85 mmHg and 96 mmHg. Blood work that was drawn in the ED was all normal including a complete blood count, renal and electrolyte profile, and liver enzymes. She also had a head CT scan that was read as normal. The patient has not seen a health care provider for some time because she did not have insurance. She is currently working at Target and just received health insurance the month prior to this appointment. The patient denies tobacco, alcohol, or illicit drug use. The patient has a past medical history of an appendectomy at the age of 18 and headaches that have been getting more frequent the last several months.

**I. Definition of Diagnosis**

 Hypertension is classified based on the level of the systolic and diastolic blood pressure. A single high blood pressure reading is not diagnostic of hypertension. There must be more than one documented increased blood pressure with at least 5 minutes apart with the patient sitting and comfortable. The blood pressure should be confirmed by an elevated reading in the contralateral arm to make the diagnosis of hypertension (NHLBI, 2003). Stage one hypertension is having a systolic blood pressure of 140 – 159 mm/Hg or a diastolic blood pressure of 90 – 99 mm/Hg. The other classifications are shown in table two below.

Table 2

*Classification of Blood Pressure*

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| Category | Systolic  | Diastolic |
| Normal | <120 | <80 |
| Prehypertension | 120 - 139 | 80 - 89 |
| Stage 1 Hypertension | 140 - 159 | 90 - 99 |
| Stage 2 Hypertension | ≥160 | ≥100 |

 *Note.* Information from the National Heart, Lung, and Blood Institute (2003)

**II. Therapeutic Objective**

 The treatment goal of hypertension is to lower a person’s blood pressure less than 140/90 mm/Hg. For patients with diabetes or chronic kidney disease the goal is to keep the patient’s blood pressure <130/80 mm/Hg. The therapeutic objective for lowering and maintaining a patient’s blood pressure is a reduction in the risk for cardiovascular disease, stroke, chronic kidney disease, peripheral arterial disease, and retinopathy (NHLBI, 2003).

**III. Effective Drug Groups**

|  |  |  |  |
| --- | --- | --- | --- |
| Drug Classification | Efficacy | Safety | Suitability  |
| Angiotensin Converting Enzyme Inhibitors (ACE-I)benazepril (Lotensin®), captopril (Capoten®), enalapril (Vasotec®), fosinopril (Monopril®), lisinopril (Prinivil®, Zesteril®), moexipril (Univasc®), quinapril (Accupril®), ramipril (Altace®), trandolapril (Mavik®)(CalOptima, 2012) | *Pharmacodynamics:*Prevents angiotension I to angiotensionII, a potent vasoconstrictor. *Pharmacokinetics:*Absorption: Widely varies between medications. Food may alter some medications significantly.Metabolism: Widely varies between medications from not metabolized to metabolized extensively.Excretion: Mainly urine, some feces.(Lexi-Comp, 2013) | *Side Effects:*Varies slightly between medications.Common: dizziness, BUN and creatine elevation, headache, diarrhea, hypotension, upper respritory infection, cough, fatigue, abdominal pain, hyperkalemia, photosensitivity, hyperuricemiaSerious: anaphylactiod reaction, angioedema head/neck, hypotension, hyperkalemia, renal impairment/failure, hepatotoxicity, neutropenia, agranulocytosis, pancreatitis, Stevens-Johnson syndrome, SIADH(Epocrates, 2013) | *Contraindications:* hypersensitivity, history of ACE-I angioedema, history of angioedema, pregnancy*Caution with:* renal artery stenosis, severe CHF, renal impairment, volume depletion, hyponatremia, risk for hyperkalemia, hypotension, elderly patients, black patients, aortic stenosis, hypertrophic cardiomyopathy, CAD, cerebrovascular disease, collagen vascular disease, dialysis with high-flux membranes, LDL apheresis with dextran, antigen desensitization treatment(Epocrates, 2013) |
| Angiotensin – II Receptor Blockers (ARB)azilsartan (Edarbi®), candesartan (Atacand®), eprosartan (Teveten®), irbesartan (Avapro®), losartan (Cozaar®), olmesartan (Benicar®), telmisartan (Micardis®), valsartan (Diovan®)(CalOptima, 2012)  | *Pharmacodynamics:*Blocks the vasoconstrictor and aldosterone-secreting effects of angiotensin II by selectively and competitively blocking angiotensin II receptor sites. *Pharmacokinetics:* Absorption: Not listedMetabolism: Varies among medications, mostly hepatic, some in the gut.Excretion: Most in feces, some in urine.(Lexi-Comp, 2013) | *Side Effects:*Varies slightly between medications.Common: upper respiratory infection, dizziness, fatigue, musculoskeletal pain, dyspepsia, diarrhea, chest pain, anemia, cough, BUN and creatine elevation, ALT and AST elevationSerious: angioedema, anaphylaxis, hypotension, hyperkalemia, renal impairment/failure, rhabdomyolysis, hepatitis(Epocrates, 2013) | *Contraindications:*Hypersensitivity, pregnancy*Caution with:* renal artery stenosis, renal impairment, hepatic impairment, volume depletion(Epocrates, 2013) |
| Direct Renin Inhibitors (DRI)aliskiren (Tekturna®)(CalOptima, 2012)  | *Pharmacodynamics:*Blocks the conversion of angiotensinogen to angiotensin I.*Pharmacokinetics:* Absorption: Poor, decreased by high-fat meals.Metabolism: UnknownExcretion: Mostly in urine, some in feces(Lexi-Comp, 2103)  | *Side Effects:*Common: diarrhea, GERD, hyperkalemia, BUN elevationSerious: anaphylaxis, angioedema head/neck, hypotension, hyperkalemia, nephrolithiasis, Stevens-Johnson Syndrome, toxic epidermal necrolysis (Epocrates, 2013) | *Contraindications:*Hypersensitivity, pregnancy *Caution with:* renal impairment, renal artery stenosis, history of renal disease, volume depletion, hyponatremia(Epocrates, 2013) |
| Aldosterone Antagonistseplerenone (Inspra®), spironolactone (Aldactone®)(CalOptima, 2012) | *Pharmacodynamics:*Competes with aldosterone for receptor sites in the distal tubules, increasing sodium chloride and water excretion while conserving potassium and hydrogen ions. *Pharmacokinetics:*Absorption: Not listedMetabolism: Primarily hepatic Excretion: Urine and feces(Lexi-Comp, 2013) | *Side Effects:*eplerenone has fewer adverse reactions then spironolactone.Common: nausea, headache, abdominal pain, diarrhea, confusion, gynecomastia, sexual dysfunction, menstrual irregularities, fever, rash, hyperkalemia, metabolic acidosis, hyperuricemiaSerious: hyperkalemia, agranulocytosis, anaphylaxis, hepatotoxicity, renal failure, Stevens-Johnson Syndrome, toxic epidermal necrolysis, rash with eosinophilia and systemic symptoms(Epocrates, 2013)  | *Contraindications:*Hypersensitivity to class, anuria, renal impairment, hyperkalemia*Caution with:* hepatic impairment, renal impairment, hyponatremia, diabetes mellitus, elderly patients(Epocrates, 2013) |
| Alpha-Blockersdoxazosin (Cardura®), prazosin (Minipress®), terazosin (Hytrin®)(CalOptima, 2012) | *Pharmacodynamics:*Competitively inhibits postsynaptic alpha-adrenergic receptors which results in vasodilatation of veins and arterioles and a decrease in total peripheral resistance and blood pressure.*Pharmacokinetics:* Absorption: terazosin- rapid and completeMetabolism: extensively hepaticExcretion: Mainly feces, some in urine(Lexi-Comp, 2013) | *Side Effects:*Common: dizziness, headache, fatigue/malaise, somnolence, edema, rhinitis, dyspnea, palpitations, chest pain, nausea, diarrhea, xerostomia, blurred vision, polyuria, hypotensionSerious: hypotension, syncope, arrhythmias, intraoperative floppy iris syndrome, priapism(Epocrates, 2013)  | *Contraindications:*Hypersensitivity to class*Caution with:* elderly patients, hypotension, hepatic impairment, cataract surgery |
| Alpha-Beta Blockerscarvedilol (Coreg®), labetalol (Trandate®)(CalOptima, 2012)  | *Pharmacodynamics:*Non-selective beta-adrenoreceptor and alpha-adrenergic blocking activity *Pharmacokinetics:* Absorption: rapid and extensive to completeMetabolism: hepatic, primarily via glucurnide conjunction; extensive first-pass effectExcretion: Urine(Lexi-Comp, 2013) | *Side Effects:*Common: orthostatic hypotension, dizziness, paresthesia, nausea/vomiting, BUN and creatine elevation, fatigue, dyspepsia, rhinitis, headache, ejaculatory dysfunction, dyspnea, edemaSerious: CHF, bradycardia, syncope, heart block, angina exacerbation if stopped abruptly, MI if stopped abruptly, ventricular arrhythmias, Raynaud phenomenon, bronchospasm, lupus erythematosus, hepatotoxicity, hypersensitivity reaction, anaphylactiod reaction, intraoperative floppy iris syndrome(Epocrates, 2013) | *Contraindications:*Hypersensitivity to drug class, sinus bradycardia, 2nd or 3rd degree heart block, heart failure that is uncompensated, cardiogenic shock, sick sinus syndrome without pace maker, bronchial asthma, avoid abrupt withdrawal *Caution with:* peripheral vascular disease, bronchospastic disease, major surgery, diabetes mellitus, thyroid disorder, WPW syndrome, hepatic impairment, renal impairment, pheochromocytoma, myasthenia gravis, elderly patients(Epocrates, 2013)  |
| Beta-Blockers (BB)acebutalol (Sectral®), atenolol (Tenormin®), betaxolol (Kerlone®), bisoprolol (Zebeta®), metoprolol (Lopressor®), metoprolol XL (Toprol XL®), nadolol (Corgard®), nebivolol (Bystolic®), penbutalol (Visken®), propranolol (Inderal®), timolol (Blocadren®)(CalOptima, 2012)  | *Pharmacodynamics:*Selective beta-blockers blocks response to beta-1 adrenergic stimulation and may block beta-2 adrenergic response at high doses. Non-Selective beta-blockers blocks response to beta-1 and beta-2 adrenergic stimulation. *Pharmacokinetics:*Absorption: Selective – rapid and from ~50% to complete. Non-selective – Varies from 30% to rapid and complete. Food may decrease absorption in some medications.Metabolism: Selective – Hepatic from minimal to extensive with significant first pass effect. Non-selective – hepatic, some with significant first pass effect. nadolol is not metabolized.Excretion: mostly all by urine, few by feces and urine.(Lexi-Comp, 2013) | *Side Effects:*Varies between medications. List represents most common.Common: fatigue, dizziness, headache, constipation, diarrhea, dyspepsia, nausea, dyspnea, insomnia, urinary frequency, chest pain, edema, depression, rash, arthralgia/myalgia, visual disturbancesSerious: CHF, bradycardia, heart block, angina exacerbation if stopped abruptly, MI if stopped abruptly, ventricular arrhythmia if stopped abruptly, Raynaud phenomenon, bronchospasms, hypersensitivity reaction, lupus erythematous(Epocrates, 2013) | *Contraindications:*Hypersensitivity to class, sinus bradycardia, 2nd or 3rd degree heart block, uncompensated heart failure, cardiogenic shock, sick sinus syndrome without pacemaker, bronchial asthma, avoid abrupt withdrawal*Caution with:* peripheral vascular disease, bronchospastic disease, major surgery, diabetes mellitus, thyroid disease, WPW syndrome, phenochromocytoma, renal impairment, pregnancy 2nd or 3rd trimester, breastfeeding, myasthenia gravis, elderly patients(Epocrates, 2013) |
| Calcium-Channel Blockers (CCB)amlodipine (Norvasc®), diltiazem (Cardizem®), diltiazem SR (Cardizem LA®), felodipine SR (Plendil®), isradipine (DynaCirc®), nicardipine (Cardene®), nifedipine SR (Cardene SR®, Nifedical XL®, Nifediac CC®), verapamil (Calan®, Isoptin®), verapamil SR (Calan SR®, Isoptin SR®)(CalOptima, 2012)  | *Pharmacodynamics:*Inhibits calcium ion from entering the “slow channels” or select voltage-sensitive areas of vascular smooth muscle and myocardium during depolarization, producing a relaxation of coronary vascular smooth muscle and coronary vasodilatation.*Pharmacokinetics:* Absorption: highly absorbed, some completelyMetabolism: hepatic, many with extensive first pass eliminationExcretion: mostly urine, some feces(Lexi-Comp, 2013)  | *Side Effects:*Varies between medications. Common: peripheral edema, headache, dizziness, asthenia, orthostatic hypotension, dyspepsia, constipation, rash, bradycardia, 1st degree AV block, ALT/AST elevationSerious: bradycardia, AV block, arrhythmias, hypotension, syncope, cardiac failure, CHF, hepatic injury, erythema multiforme, exfoliative dermatitis, exanthematous pustulosis(Epocrates, 2013)  | *Contraindications:*Hypersensitivity to class, sick sinus syndrome, 2nd or 3rd degree block, hypotension, acute MI with pulmonary congestion*Caution with:* CHF, cardiac conduction defects, left ventricular dysfunction, hepatic impairment, renal impairment(Epocrates, 2013) |
| Centrally-Acting Adrenergicsclonidine (Catapress®), clonidine transdermal (Catapress TTS®), guanfacine (Tenex®), methyldopa (Aldomet®)(CalOptima, 2012)  | *Pharmacodynamics:*Stimulates alpha-2 edrenoceptors in the brain stem, thus activating an inhibitor neuron, resulting in reduced sympathetic out flow from the CNS, producing a decrease in peripheral resistance, renal vascular resistance, heart rate, and blood pressure. *Pharmacokinetics:* Absorption: varies on each medication.Metabolism: hepatic, methyldopa – intestinal and hepatic.Excretion: urine (Lexi-Comp, 2013) | *Side Effects:*Guanfacine – Common: rash, vomiting, nausea Serious: neprhrolithiasisCommon: xerostomia, drowsiness, constipation, sedation, hypotension, bradycardia, fever, weakness, nausea/vomiting, fatigue, nervousness, agitation, sexual dysfunction, headache, withdrawal symtoms.Methyldopa only- pancreatitis, black tongue, hyperprolactinemia, bone marrow depression, hemolytic anemia, hepatic impairment, myocarditis, pericarditisSerious: Clonidine – hypotension bradycardia, AV block, syncope, tachycardia, depression, hypersensitivity reaction, angioedema, withdrawal if stopped abruptly, rebound HTN if stopped abruptly.Methyldopa – myocarditis, hemolytic anemia, thrombocytopenia, hepatic necrosis, leukopenia, bradycardia, pancreatitis (Epocrates, 2013) | *Contraindications:*Hypersensitivity to class, avoid abrupt withdrawalMethyldopa only – hepatitis, cirrhosis, *Caution with:* elderly patients, cardiovascular disease, recent MI, CADClonidine only – cardiac conduction disturbances, hemodynamically unstable, renal impairment, depression, cerebrovascular disease(Epocrates, 2013) |
| DiureticsLoop Diureticsbumetanide (Bumex®), torsemide (Demadex®), furosemide (Lasix®), spironolactone (Aldactone®)Thiazide Diureticsindapamide (Lozol®), hydrochlorothiazide (HCTZ) (Microzide®), metolazone (Zaroxolyn®), chlorthalidone (Thalitone®)Potassium sparing Diureticsamiloride HCL (Midamor®), triamterene (Dyrenium®), (CalOptima, 2012)  | *Pharmacodynamics:* Loops - Inhibits reabsorption of sodium and chloride in the ascending loop of Henle and distal renal tubules.Thiazides – Inhibits sodium reabsorption in the distal tubules.Potassium sparing – Blocks epithelial sodium channels in the late distal convoluted tubule and collecting duct which inhibits sodium reabsorption from the lumen. *Pharmacokinetics:* LoopsAbsorption: rapidMetabolism: hepaticExcretion: urine and fecesThiazidesAbsorption: from 50% to 80%Metabolism: hepatic, HCTZ – not metabolizedExcretion: urine and some feces.Potassium sparingAbsorption: ~15% to 25%, triamterene – unreliableMetabolism: no active metabolitesExcretion: urine and feces(Lexi-Comp, 2013) | *Side Effects:*Varies slightly between diuretic class and medications in the same class. Amiloride has minimal adverse reactions compared to the others.Common: headache, urinary frequency, dizziness, rhinitis, asthenia, diarrhea, ECG abnormalities, cough, hypokalemia, hyperglycemia, hyperuricemia, photosensitivity, orthostatic hypotension, muscle cramps, sexual dysfunction, hyperlipidemia, abdominal painSerious: hypokalemia, electrolyte imbalance, metabolic alkalosis, hypovolemia, azotemia, ECG abnormalities, arrhythmias, thrombosis, ototoxicity, GI bleeding, SLE exacerbation, thrombocytopenia, Stevens-Johnson Syndrome, toxic epidermal necrolysis, pancreatitis , renal failure, leucopenia, aplastic anemia, hemolytic anemia, interstitial nephritis, necrotizing angiitis (Epocrates, 2013) | *Contraindications:*Hypersensitivity to class or components, hypersensitivity to sulfonamides, anuria, hypersensitivity to sulfonylureas (torsemide), electrolyte imbalance*Caution with:* hypersensitivity to sulfonamides, concurrent ototoxic agents, elderly patients, gestational HTN, hearing impaired, renal impairment, hepatic impairment, diabetes mellitus, acute MI, arrhythmias, SLE, gout, history of pancreatitis, volume depletion, seizure disorder, (Epocrates, 2013) |

**IV. Effective Drug Classification: Thiazide Diuretics**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Drug Name | Efficacy | Safety | Suitability | Cost |
| indapamide (Lozol®) | *Absorption:* rapid and complete*Protein binding:* 71% to 79%*Metabolism:* extensively hepatic *Bioavailability:* 93%*Half-life:* Biphasic: 14 and 25 hours*Peak:* 2 hours*Excretion:* mostly urine, some feces(Lexi-Comp, 2013) | *Avoid use with:* Dofetilide*Indapamide may increase the levels/effects of:* ACE inhibitors; Allopurinol; Amifostine; Antihypertensives; Calcium salts; Carbamazepine; Dofetilide; Highest Risk QTc-Prolonging Agents; Multivitamins/Minerals; Oxcarbazepine; Porfimer; Rituximab; Sodium Phosphates; Topiramate; Toremifene; Vitamin D Analogs*Indapamide may be increased by:* Alcohol; Alfuzosin; Analgesics (opioid); Barbiturates; Beta-2 Agonists; Corticosteroids (orally inhaled & systemic); Herbs (Hypotensive Properties); Licorice; MAO Inhibits; Mifepristone; Pentoxifylline; Phosphodiesterase 5 Inhibitors; Prostacyclin Analogues*Indapamide may decrease the levels/effects of:* Antidiabetic Agents *Inapamide may be decreased by:* Bile Acid Sequestrants; Herbs (Hypertensive Properties); Methylphenidate; Nonsteroidal Anti Inflammatory Agents; Yohimbine(Lexi-Comp, 2013)  | - Avoid herbs with hyper and hypotensive properties.-Take as prescribed.Take early in the day. Monitor weigh on a regular basis.-Report weight gain, swelling of the ankles and hands.-Monitor blood pressure (orthostatic), serum electrolytes, hepatic function, renal function, and uric acid.(Lexi-Comp, 2013)  | Inapamide (tablets): 1.25 mg (90): $15.99; 2.5 mg (30): $13.99(Lexi-Comp, 2013) |
| hydrochlorothiazide (HCTZ) (Microzide®) | *Onset of action:* ~2 hours*Absorption:* ~50% to 80%*Protein binding:* 68%*Metabolism:* not metabolized*Half-life:* 5.6 – 14.8 hours*Peak:* 1 – 2.5 hours*Excretion:* Urine (as unchanged drug)(Lexi-Comp, 2013) | *Avoid use with:* Dofetilide*HCTZ may increase the levels/effects of:* ACE Inhibitors; Allopurinol; Amifostine; Antihypertensives; Benazepril; Calcium Salts; Carbamazepine; Dofetilide; Hypotensive Agents; Lithium; Multivitamins/Minerals (with ADEK, Folate, Iron); Oxcarbazapine; Porfimer; Rituximab; Sodium Phosphates; Topiramate; Toremifene; Valsartan; Vitamin D Analogs*HCTZ may be increased by:* Alcohol, Alfuzosin; Analgesics (opioids); Barbiturates; Beta-2 Agonists; Corticosteroids (orally inhaled & systemic); Herbs (Hypotensive properties); Licorice; MAO Inhibitor; Pentoxifylline; Phosphodiesterase 5 Inhibitors; Prostacyclin Analogues; Valsartan *HCTZ may decrease the levels/effects of:* Antidiabetic Agents*HCTZ may be decreased by:* Benazepril; Bile Acid Sequestrants; Herb (Hypertensive Properties); Methylpenidate; Nonsteroidal Anti-Inflammatory Agents; Yohimbine(Lexi-Comp, 2013)  | - Food may decrease peak serum levels. HCTZ may deplete potassium, sodium, and magnesium.- Avoid Herbs with hyper and hypotensive effects.- Take as prescribed. Take with meals early in the morning to avoid nocturia. Report palpitations, muscle cramping, or skin rash. - Patients may have to take a potassium supplement well on HCTZ.- Monitor weight, blood pressure, serum electrolytes, BUN and creatine.(Lexi-Comp, 2013)  | HCTZ (capsules): 12.5 mg (30): $14.99HCTZ (tablets): 12.5 mg (100): $27.99; 25 mg (100): $12.99: 50 mg (100): $15.99Microzide (capsules): 12.5 mg (30): $42.02(Lexi-Comp, 2013) |
| metolazone (Zaroxolyn®) | *Onset of action:* ~60 minutes*Absorption:* incomplete*Protein binding:* 95%*Half-life:* 20 hours*Excretion:* mostly urine, some bile(Lexi-Comp, 2013) | *Avoid use with:* Dofetilide*Metalazone may increase the levels/effects of:* ACE Inhibitors; Allopurinol; Amifostine; Antihypertensives; Calcium Salts; Carbamazepine; Dofetilide; Hypotensive Agents; Lithium; Multivitamins/Minerals (with ADEK, Folate, Iron); Oxcarbazapine; Porfimer; Rituximab; Sodium Phosphates; Topiramate; Toremifene; Vitamin D Analogs*Metolazone may be increased by:* Alcohol, Alfuzosin; Analgesics (opioids); Barbiturates; Beta-2 Agonists; Corticosteroids (orally inhaled & systemic); Herbs (Hypotensive properties); Licorice; MAO Inhibitor; Pentoxifylline; Phosphodiesterase 5 Inhibitors; Prostacyclin Analogues*Metolazone may decrease the levels/effects of:* Antidiabetic Agents*Metlazone may be decreased by:* Bile Acid Sequestrants; Herb (Hypertensive Properties); Methylpenidate; Nonsteroidal Anti-Inflammatory Agents; Yohimbine(Lexi-Comp, 2103) | - Avoid ethanol use. Avoid herbs with hyper, hypotensive properties.- Take as prescribed. Take after breakfast. Include bananas or orange juice in daily diet.- Report chest pain or palpitations, dizziness, headache, pain, weakness, skin rash, excessive fatigue, or swelling of extremities.- Monitor serum electrolytes, renal function, blood pressure (orthostatic)(Lexi-Comp, 2013) | Metolazone (tablets): 2.5 mg (30): $42.99; 5 mg (30): $42.99Zaroxolyn (tablets): 2.5 mg (30): $94.99; 5 mg (30): $88.99; 10 mg (30): $79.99(Lexi-Comp,2013) |
| chlorthalidone (Thalitone®) | *Onset of action:* Peak: 2 – 6 hours*Protein binding:* ~75%*Absorption:* 65%*Metabolism:* hepatic*Half-life:* 40 – 60 hours, may be prolonged with renal impairment*Excretion:* urine(Lexi-Comp, 2013)  | *Avoid use with:* Dofetilide*Chlorthalidone may increase the levels/effects of:* ACE Inhibitors; Allopurinol; Amifostine; Antihypertensives; Calcium Salts; Carbamazepine; Dofetilide; Hypotensive Agents; Lithium; Multivitamins/Minerals (with ADEK, Folate, Iron); Oxcarbazapine; Porfimer; Rituximab; Sodium Phosphates; Topiramate; Toremifene; Vitamin D Analogs*Chlorthalidone may be increased by:* Alcohol, Alfuzosin; Analgesics (opioids); Barbiturates; Beta-2 Agonists; Corticosteroids (orally inhaled & systemic); Herbs (Hypotensive properties); Licorice; MAO Inhibitor; Pentoxifylline; Phosphodiesterase 5 Inhibitors; Prostacyclin Analogues*Chlorthalidone may decrease the levels/effects of:* Antidiabetic Agents*Chlorthalidone may be decreased by:* Bile Acid Sequestrants; Herb (Hypertensive Properties); Methylpenidate; Nonsteroidal Anti-Inflammatory Agents; Yohimbine(Lexi-Comp, 2103) | - Avoid herbs with hyper, hypotensive properties.- Take once a day dose in the morning or last dose of the day early to avoid nocturia. Patient may need to be on a high potassium diet or potassium supplement. -Report muscle twitching, cramps, nausea/vomiting, confusion, numbness of extremities, loss of appetite, or GI distress, rash, chest pain, palpitations, respiratory difficulties, or unusual weigh loss. - Monitor weight, blood pressure, serum electrolytes, renal function(Lexi-Comp, 2013) | Chlorthalidone (tablets): 25 mg (90): $45.99; 50 mg (30): $26.99; 100 mg (30): $33.99Thalitone (tablets): 15 mg (30): $56.99(Lexi-Comp, 2013) |

**V. Drug of Choice**: **Chlorthalidone (Thalitone®)**

 The recommended treatment for most patients with stage one hypertension is a thiazide type diuretic. You may also consider using an ACE-I, ARB, BB, CCB, or a combination of medications to reach your treatment goal (NHLBI, 2003). Chlorthalidone has been supported by current evidence to be a safe and effective drug for the treatment of hypertension. There is debate on whether HCTZ or chlorthalidone is a better or more efficient drug for the treatment of hypertension. Clinical head to head studies of the two drugs have shown a favorable trend for chlorthalidone, but there is a lack of consistent clinical significance ( Neff & Nawarskas, 2010). Allen, Ivers, and Padwal (2012) conducted a review of the literature and stated that “chlorthalidone reduces systolic blood pressure better than HTCZ with equivalent doses with similar effects on potassium levels”. This can allow you to use lower doses of chlorthalidone and reduce the risk for side effects. Every patient with the diagnosis of hypertension should also be instructed on lifestyle modifications that will help with their blood pressure control. This includes weight reduction to a body mass index of 18.5 – 24.9 kg/m², healthy eating habits, dietary sodium reduction, increased physical activity, and moderation of alcohol consumption (NHLBI, 2003).

 This patient will be started on chlorthalidone 12.5 mg daily. She will need to follow up for a revisit in 2 – 4 weeks unless she has any issues or concerns after starting the medication, then follow up should be sooner. The patient’s serum electrolyte and renal panel should be checked periodically through the course of treatment on chlorthalidone (Lexi-Comp, 2013). She should be instructed to continue taking her blood pressure and keep a log; this is very helpful in optimizing her treatment. The medication should be taken in the morning or early in the day so that she does not have any night time disturbances. Chlorthalidone may cause sensitivity to light, anorexia, or GI distress. The patient should report any muscle twitching, cramps, nausea or vomiting, confusion, numbness of extremities, loss of appetite, GI distress, severe rash, red or itchy skin, chest pain, palpitations, respiratory difficulties or unusual weight loss (Lexi-Comp, 2103). An APN may prescribe chlorthalidone in the state of Ohio (Ohio Board of Nursing, 2011).

**Third Diagnosis: Community Acquired Methicillin-Resistant Staphylococcus Aureus (MRSA), Wound Infection**

 A 38 year old Caucasian male was seen at his family doctor’s office two days ago for swelling and redness of his right forearm. There was an area of redness approximately 3 cm by 3 cm with a small area of dark redness in the middle. The patient’s past medical history includes two orthopedic surgeries on his left knee. The patient does suffer from chronic left knee pain, but is otherwise healthy. All his vital signs in the office were normal. The patient was diagnosed with cellulitis and placed on Keflex. The patient has returned to his family doctor’s office because his forearm has gotten worse with increased redness, swelling, and an abscess formation. The redness covers the majority of the anterior forearm with 2 cm by 2 cm abscess formation centrally located that is intact without drainage. The patient’s vital signs this visit was normal except for a temperature of 100.5 and heart rate of 103. The patient has been admitted to the infectious disease group at the local hospital and is being evaluation by the APN. An incision and drainage of the abscess was performed, and a wound culture was taken and sent to the lab.

**I. Definition of Diagnosis**

 MRSA is a staph infection that is resistant to beta-lactam antibiotics (Centers for Disease Control and Prevention [CDC], 2010). Community acquired MRSA infections are serious soft skin infections that may include abscess formations, cellulitis, and necrotizing fasciitis. These infections can occur among healthy individuals without having any known risk factors, hospitalizations, or history of prior MRSA infections (McCance, Huether, Brashers, & Rote, 2010). The community acquired MRSA strains are different than the nosocomial acquired MRSA. Community acquired MRSA infections are generally more susceptible to antibiotic treatment then are the nosocomial strains, which allow for a wider range of antibiotic treatments (McCance, Huether, Brashers, & Rote, 2010).

**II. Therapeutic Objective**

 The therapeutic objective for treatment of MRSA is to receive treatment as soon as possible with incision and drainage of abscess if indicated and prescribing the appropriate antibiotics for the correct length of time. The goal is to prevent the infection from getting worse and to prevent the spread of the infection to other parts of the body or to other people (CDC, 2010). Instructions on preventative measures should be discussed with individuals who have a current MRSA infection, history of MRSA infections, or are at high risk for these infections. The prevention education should include good hand washing techniques, use of antiseptics and covering of cuts and abrasions, use of antibacterial soaps in the shower after contact sports, and avoidance of sharing towels and razors, and frequent towel washing (McCance, Huether, Brashers, & Rote, 2010).

**III. Effective Drug Groups**

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| --- | --- | --- | --- |
| Drug Classification | Efficacy | Safety | Suitability  |
| Cephalosporins 5th Generation ceftaroline fosamil (Teflaro™)(Lexi-Comp, 2013; Sanford Guide, 2013) | *Pharmacodynamics:*Inhibits bacterial cell wall synthesis by binding to penicillin-binding protiens 1 through 3.*Pharmacokinetics:* Absorption: not listedMetabolism: undergoes rapid conversion to bioactive ceftaroline in plasma by phosphatase enzymeExcretion: urine and feces(Lexi-Comp, 2013) | *Side Effects:*Common: diarrhea, nausea, rash, constipation, vomiting, ALT/AST elevation, hypokalemia, phlebitisSerious: anaphylaxis, hypersensitivity reaction, C-Diff associated diarrhea, superinfection, hemolytic anemia(Epocrates, 2013)  | *Contraindications:*Hypersensitivity to class*Caution with:* hypersensitivity to beta-lactams, history of recent antibiotic-associated colitis (Epocrates, 2013) |
| Quinolonesmoxifloxacin (Avelox®), gemifloxacin (Factive®), gatifoxacin (Zymaxid®) (Lexi-Comp, 2013; Sanford Guide, 2013) | *Pharmacodynamics:*DNA gyrase inhibitor, and also inhibitors topoisomerase.*Pharmacokinetics:* Absorption: well absorbedMetabolism: Hepatic, degree varies with each medication.Excretion: urine and feces(Lexi-Comp, 2013)  | *Side Effects:*Common: nausea diarrhea, headache, dizziness, vomiting, constipationSerious: anaphylaxis, hypersensitivity reaction, phototoxicity, superinfection, C-Diff associated diarrhea, ICP increase, seizures, toxic psychosis, depression, suicidal ideation, skin reaction, vasculitis, serum sickness, pneumonitis, myelosuppression, blood dyscrasias, nephrotoxicity, hepatotoxicity, QT prolongation, torsades de point, peripheral neuropathy, tendon rupture, myasthenia gravis exacerbation(Epocrates, 2013)  | *Contraindications:*Hypersensitivity to class, prolonged QT interval, hypokalemia, hypomagnesemia, myasthenia gravis*Caution with:* proarrhythmic condition, female patients, patients less than 40 yrs. and patients greater than 60 yrs., kidney/heart/lung transplant, renal impairment, dehydration, CNS disorder, seizure disorder, seizure threshold lowered, history of recent antibiotic associated colitis(Epocrates, 2013)  |
| Sulfonamidessulfamethoxazole and trimthoxazole (Bactrim™, Septra®)(Lexi-Comp, 2013; Sanford Guide, 2013) | *Pharmacodynamics:*Interferes with bacterial folic acid synthesis and growth via inhibition of dihydrofolic acid formation from para-aminobenzoic acid*Pharmacokinetics:*Absorption: almost completely, 90%-100%Metabolism: SMX: N-acetylated and glucuronidated; TMP: Metabolized to oxide and hydroxylated metabolitesExcretion: urine(Lexi-Comp, 2013) | *Side Effects:*Common: nausea/vomiting, anorexia, rash, urticaria, hypersensitivity reaction, photosensitivity, diarrhea, dizziness, dyspepsia, headache, lethargySerious: Stevens-Johnson syndrome, toxic epidermal necrolysis, hepatic necrosis, agranulocytosis, aplastic anemia, blood dyscrasias, thrombocytopenia, hypersensitivity reaction, photosensitivity, hepatotoxicity, pancreatitis, interstitial nephritis, renal impairment/failure, pulmonary infiltrates, myelosuppression, methemoglobinemia, hyperkalemia, aseptic meningitis, seizures, lupus erythematosus, hypoglycemia, clostridium difficile assoc. diarrhea, rhabdomyolysis(Epocrates, 2013) | *Contraindications:*Hypersensitivity to class or component, hypersensitivity to sulfonamides, , patients <2 months, pregnancy near term, breastfeeding, hepatic impairment-significant, megaloblastic anemia, folate deficiency, G6PD deficiency*Caution with:*Elderly patients, hyperkalemia, hepatic impairment, renal impairment, bronchial asthma, thyroid disorder, porphyria, malabsorption, malnutrition, severe allergies, chronic alcohol use, history of recent antibiotic associated colitis (Epocrates, 2013) |
| Tetracyclinesdoxycycline (Adoxa®, Alodox®, Doryx®, Doxy 100™, Monodox®, Ocudox™, Oracea®, Oraxyl™, Periostat®, Vibramycin®), minocycline (Dynacin®, Minocin®, Solodyn®)(Lexi-Comp, 2013; Sanford Guide, 2013) | *Pharmacodynamics:*Inhibits bacterial protein synthesis by binding with the 30S and possibly the 50S ribosomal subunit(s) of susceptible bacteria.*Pharmacokinetics:*Absorption: Oral-almost completeMetabolism: doxycycline- Not hepatic; partially inactivated in GI tract by chelate formationminocycline- HepaticExcretion: urine and feces(Lexi-Comp, 2013) | *Side Effects:*Varies per medicationCommon: headache, nausea, dyspepsia, arthralgia, diarrhea, URI symptoms, rash, dysmenorrheal, photosensitivity, candidiasis, vulvovaginal, skin/tissue discoloration, BUN elevation,nausea, vomiting, diarrhea, anorexia, flatulence, abdominal discomfort, epigastric discomfort, lightheadedness, dizziness, vertigo, ataxia, drowsiness, headache, fatigue, tinnitus, rash, urticaria, candidiasis-oral or vulvovaginal, skin/tissue hyperpigmentationSerious:photosensitivity, superinfection, C-Diff. associated diarrhea, anaphylaxis, angioedema, lupus erythematosus, serum sickness-like reaction, vasculitis, pericarditis, hepatitis-autoimmune, hepatotoxicity, nephrotoxicity, esophagitis, esophageal ulcer, pancreatitis, erythema multiforme, Stevens-Johnson syndrome, toxic epidermal necrolysis, exfoliative dermatitis, thrombocytopenia, neutropenia, anemia-hemolytic, pseudotumor cerebri, Jarisch-Herxheimer reaction (Epocrates, 2013) | *Contraindications:*Hypersensitivity to class or components, pregnancy, patients < 8 yrs. of age *Caution with:* hepatic impairment, SLE, history of or risk of candidiasis, history of recent antibiotic associated colitis(Epocrates, 2013) |
| Oxazolidinonelinezolid (Zyvox®) (Lexi-Comp, 2013; Sanford Guide, 2013) | *Pharmacodynamics:*Inhibits bacterial protein synthesis by binding to bacterial 23S ribosomal RNA of the 50S subunit.*Pharmacokinetics:* Absorption: rapid and extensiveMetabolism: Hepatic via oxidation into to inactive metabolitesExcretion: mostly urine, some in feces(Lexi-Comp, 2013) | *Side Effects:*Common: diarrhea, headache, nausea, HTN, rash, vomiting, anemia, thrombocytopenia, fever, URISerious: superinfection, C-Diff associated diarrhea, anemia, leukopenia, pancytopenia, thrombocytopenia, lactic acidosis, peripheral neuropathy, optic neuropathy, vision loss, serotonin syndrome, anaphylaxis, Stevens-Johnson syndrome, seizures(Epocrates, 2013) | *Contraindications:*Hypersensitivity to class or component, avoid high tyramine-content foods*Caution with:* myelosuppression, thrombocytopenia, uncontrolled hypertension, pheochromocytoma, carcinoid syndrome, thyrotoxicosis, PKU, hepatic impairment, renal impairment, seizure history or risk for seizure, use > 28 days, history of recent antibiotic associated colitis(Epocartes, 2013) |
| StreptograminQuinupristin and dalfopristin (Synercid®)(Lexi-Comp, 2013; Sanford Guide, 2013) | *Pharmacodynamics:*Inhibits bacterial protein synthesis by binding to different sites on the 50S bacterial ribosomal subunit thereby inhibiting protein synthesis.*Pharmacokinetics:* Absorption: not listedMetabolism: to active metabolites via nonenzymatic reactionsExcretion: mostly feces, some in urine(Lexi-Comp, 2013) | *Side Effects:*Common: injection site reaction and/or pain, arthralgia/myalgia, nausea/vomiting, thrombocytopenia, rash, hyperbilirubinemia, LDH elevation, anemiaSerious: C-Diff associated diarrhea, superinfection, anaphylactiod reaction, angioedema(Epocrates, 2013) | *Contraindications:*Hypersensitivity to class or component*Caution with:* history of recent antibiotic associated colitis(Epocrates, 2013) |
| Glycylcyclinetigecycline (Tygacil®)(Lexi-Comp, 2013; Sanford Guide, 2013)  | *Pharmacodynamics:*Binds to the 30S ribosomal subunit of susceptible bacteria, thereby, inhibiting protein synthesis.*Pharmacokinetics:* Absorption: not listedMetabolism: Hepatic, via glucuronidation, N-acetylation, and epimerizationExcretion: feces and urine(Lexi-Comp, 2013) | *Side Effects:*Common: nausea/vomiting, diarrhea, injection site reaction, infection, fever, abdominal pain, thrombocytopenia, headache, LFT elevation, HTN, hypoproteinemia, anemia, pain, cough, leukocytosis, dizziness, abnormal hearing, peripheral edema, abscess, dyspepsia, dyspnea, constipation, asthenia, rash, diaphoresis, insomnia, BUN elevationSerious: anaphylaxis, sepsis, pseudotumor cerebri, C-Diff associated diarrhea, superinfection, tooth discoloration, photosensitivity, cholestasis, pancreatitis, anti-anabolic effects, thrombocytopenia (Epocrates, 2013)  | *Contraindications:*Hypersensitivity to class, hypersensitivity to tetracyclines, pregnancy, patients < 8 yrs. of age*Caution with:* hepatic impairment, intestinal perforation, history of recent antibiotic associated colitis(Epocrates, 2013) |
| Cyclic LipopeptideDaptomycin (Cubicin®) (Lexi-Comp, 2013; Sanford Guide, 2013) | *Pharmacodynamics:*Binds to components of the cell membrane of susceptible orgainsms and cuases rapid depolarization, inhibiting, intracellular synthesis of DNA, RNA, and protein.*Pharmacokinetics:* Absorption: not listedMetabolism: unknownExcretion: mostly urine, some in feces(Lexi-Comp, 2013) | *Side Effects:*Common: insomnia, pharyngolarygeal pain, CK elevation, chest pain, edema, abdominal pain, pruritus, HTN, headache, diarrhea, increased sweating, rash, abnormal LFTs, UTI, hypotension, dizziness, dyspnea, fungal infectionSerious: C-Diff associated diarrhea, superinfection, eosinophilic pneumonia, hypersensitivity reaction, anaphylaxis, skin reaction, thrombocytopenia, myopathy, rhabdomyolysis, peripheral neuropathy(Epocrates, 2013) | *Contraindications:*Hypersensitivity to class or component, CK > 10x ULN, CK > 5x ULN with myopathy *Caution with:* elderly patients, renal impairment, history of recent antibiotic associated colitis(Epocrates, 2013) |
| Glycopeptides vancomycin (Vancocin®), teicoplanin (Tagocid, Targocid), telavancin (Vibativ™)(Drug Bank, 2012; Sanford Guide, 2013)  | *Pharmacodynamics:*Inhibits bacterial cell wall synthesis by blocking glycopeptide polymerization through binding tightly to D-alanyl-D-alanine protion of cell wall precursor *Pharmacokinetics:* Absorption: poorMetabolism: Vancomycin – noneTeicoplanin – into two known metabolitesExcretion: urine and feces(Lexi-Comp, 2013) | *Side Effects:*Varies between medicationsCommon: red-man syndrome (vancomycin), hypotension, fever, nausea, chills, eosinophilia, rash, urticarial, phlebitis, tinnitus, dizziness/vertigo, elevated BUN/creatine, vomiting, flatulenceSerious: anaphylaxis, hypotension, thrombophlebitis, tissue necrosis (if extravasated), vasculitis, exfoliative dermatitis, Stevens-Johnson syndrome, toxic epidermal necrolysis, rash, interstitial nephritis, nephrotoxicity, ototoxicity, neutropenia, thrombocytopenia, superinfection, C-Diff associated diarrhea(Epocrates, 2013) | *Contraindications:*Hypersensitivity to class or components, telavancin - congenital or current QT prolongation, uncompensated heart failure, LVH*Caution with:* vancomycin - renal impairment, concurrent nephrotoxic agents, hearing impaired, concurrent ototoxic agents, elderly patients, history of recent antibiotic associated colitistelavancin – concurrent QT prolonging medication, CrCl < 50, concurrent nephrotoxic agents, CHF, HTN, diabetes mellitus, history of recent antibiotic associated colitis(Epocrates, 2013) |
| Miscellaneous Antibiotictrimethoprim (Primsol®) (Lexi-Comp, 2013; Sanford Guide, 2013) | *Pharmacodynamics:*Inhibits folic acid reduction to tetrahydrofolate, and thereby inhibits microbial growth.*Pharmacokinetics:* Absorption: readily and extensiveMetabolism: partially hepaticExcretion: urine(Lexi-Comp, 2013)  | *Side Effects:* Common: rash, pruritus, nausea, epigastric pain, vomiting, glossitis, taste changes, fever, hyperkalemia, hyponatremia, ALT/AST elevation, BUN/creatine elevation, photosensitivity, eosinophiliaSerious: thrombocytopenia, leukopenia, neutropenia, megaloblastic anemia, exfoliative dermatitis, Stevens-Johnsons syndrome, aseptic meningitis, toxic epidermal necrolysis, erythema multiforme, phototoxicity, anaphylaxis, cholestatic jaundice, C-Diff associated diarrhea(Epocrates, 2013)  | *Contraindications:*Hypersensitivity to class or components, megaloblastic anemia*Caution with:* folate deficiency, renal impairment, hepatic impairment, bone marrow depression history of recent antibiotic associated colitis(Epocrates, 2013) |
| Miscellaneous Antibioticnitrofurantoin (Furadantin®, Macrobid®, Macrodantin®)(Lexi-Comp, 2013; Sanford Guide, 2013) | *Pharmacodynamics:*Inhibits several bacterial enzyme systems including acetyl coenzyme A interfering with metabolism and possibly cell wall synthesis. *Pharmacokinetics:* Absorption: well absorbedMetabolism: body tissues (except plasma)Excretion: urine and feces(Lexi-Comp, 2013) | *Side Effects:*Common: nausea, vomiting, anorexia, abdominal pain, diarrhea, flatulence, asthenia, vertigo, nystagmus, dizziness, headache, drowsiness, confusion, depression, alopecia, yellow/brown urine, sialadenitis, fever, rash, pruritus, urticaria, arthralgia, chillsSerious: peripheral neuropathy, hemolytic anemia, megaloblastic enema, agranulocytosis, leukopenia, thrombocytopenia, pancreatitis, hepatitis, cholestatic jaundice, pulmonary hypersensitivity, interstitial pneumonitis, pulmonary fibrosis, cyanosis, ECG abnormalities, C-Diff associated diarrhea, optic neuritis, superinfection, pseudotumor cerebri, psychosis, exfoliative dermatitis, erythema multiforme, Stevens-Johnson syndrome, lupus erythematosus, angioedema, anaphylaxis, hypersensitivity reaction(Epocrates, 2013)  | *Contraindications:*Hypersensitivity to class or components, hepatic impairment, cholestatic jaundice, patient < 1 month of age, CrCl < 60, oliguria, anuria, pregnancy 38 – 42 weeks gestation, labor and delivery*Caution with:* peripheral neuropathy, anemia, diabetes mellitus, electrolyte abnormalities, G6PD deficiency, long-term use, history of recent antibiotic associated colitis(Epocrates, 2013) |

**IV. Effective Drug Classification: I.V. Glycopeptides**

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| Drug Name | Efficacy | Safety | Suitability | Cost |
| Vancomycin (Vancocin®)  | *Protein binding:* ~50%*Half-life:* biphasic: Terminal*Peak:* I.V.: immediately*Metabolism:* none*Excretion:* urine (80% to 90% as unchanged drug)(Lexi-Comp, 2013) | *Avoid use with:* BCG; Gallium Nitrate*Vancomycin may increase the level/effects of:* Aminoglycosides; Colistimethate; Gallium Nitrate; Neuromuscular-Blocking Agents*Vancomycin may be increased by:* Nonsteriodal Anti-Inflammatory agents*Vancomycin may decrease the levels/effects of:* BCG; Sodium Picosulfate; Typhoid Vaccine *Vancomycin may be decreased by:* Bile Acid Sequestrants(Lexi-Comp, 2013) | - Patients should immediately report any chills; pain, swelling, or redness at infusion site; or respiratory difficulty. Patient should also report any rash or hives, fever, persistent GI disturbances, opportunistic infection, respiratory difficulty, change in urine output, chest pain palpitations, changes in hearing or a fullness in their ears.- Monitor periodic renal function tests, urinalysis, WBC; serum trough vancomycin concentrations in select patients.(Lexi-Comp, 2013) | Vancomycin (powder vial): 1g: $40.86; 500 mg: $24.50(Epocrates, 2013) |
| Telavancin (Vibativ®)  | *Protein binding:* ~90%; primarily to albumin*Half-life:* 6.6 – 9.6 hours*Metabolism:* unknown*Excretion:* mostly urine, < 1% in feces(Lexi-Comp, 2013) | *Avoid use with:* BCG*Telavancin may increase the levels/effects of:* Highest Risk and Moderate QTc-Prolonging Agents*Telavancin may be increased by:* Mifepristone*Telavancin may dcrease the levels/effects of:* BCG; Sodium Picosulfate; Tyhoid Vaccine(Lexi-Comp, 2013)  | **-** Patient should report any flushing, hives, itching, rash, persistent diarrhea, stomach cramping, pain, bloody stools, persistent naseua/vomiting, or unusual heartbeat.- Monitor renal function, pregnancy test before administering. - Telavancin may cause artificially increased clotting times (Lexi-Comp, 2013) | Telavancin: 750 mg dose approximately $180 a day(Estes, 2009) |

**V. Drug of Choice: I.V. Vancomycin**

Treatment of community acquired MRSA infections includes incision and drainage if indicated and can usually be treated with appropriate oral antibiotics on an outpatient basis (Lui et al., 2011). This patient has developed a more complicated MRSA infection with deeper soft skin involvement. The recommendations for complicated MRSA infection is hospitalization of the patient, surgical debridement if necessary, and treatment with I.V. Vancomycin or another more effective antibiotic that would be given with outpatient treatment. The recommendation for the length of treatment is seven to fourteen days and should be dependent on the patient’s clinical response to treatment (Lui et al., 2011). The dose for vancomycin for complicated skin and skin structure infections is 15 – 20 mg/kg/dose I.V. every 8 – 12 hours for the recommended seven to fourteen days (Lexi-Comp, 2013).

 The patient’s renal function tests, urinalysis, and white blood count should be done periodically as well as a serum trough vancomycin concentration in patients with prolonged courses of greater than three to five days (Lexi-Comp, 2013). Dosage adjustments may be required based on the patient’s serum trough level (Lui et al., 2011). Assessment of the patient’s culture and sensitivity test and history of the patient’s allergies should be done before administration of the first dose. It is imperative to closely monitor the infusion site for extravasation and to monitor the patient for hypotension, rash, neutropenia, nausea, vomiting, and auditory changes on a regular basis during therapy (Lexi-Comp, 2013). An APN may prescribe vancomycin in the state of Ohio that is physician initiated or with a physician consult and is listed in the APN’s standard care agreement with their collaborating physician (Ohio Board of Nursing, 2011).

**Fourth Diagnosis: Osteoarthritis**

 A 51 year old Caucasian male is being seen by the APN in the emergency department for right hand pain. The patient is a mechanic at a local auto repair shop and states that his right hand pain has been affecting his ability to do his job. He is right hand dominant and tells the APN that he usually has some degree of pain in his hands, but Tylenol and Motrin normally works well enough for him to do his job. On assessment the patient has Heberden’s nodes on the DIP joints of his first and second digits, and a Bouchard’s node on the PIP joint of his second digit on his right hand. The patient’s left hand is sore but there are no abnormalities with the finger joints. The patient’s radial pulses are 2+, cap refill is <3 in all fingers, and he is able to flex and extend all of his fingers but complains of 7/10 pain and stiffness in his right hand when doing so. The remainder of his vital signs was normal. Bilateral hand X-rays reveal joint changes in the phalanges of the right hand that are consistent with osteoarthritis and slight joint deteriorations of the phalanges of left hand as well. The patient has a medical history of hypertension and hyperlipidemia. His home medications include HCTZ daily, Lipitor daily, Tylenol as needed, and Motrin as needed.

**I. Definition of Diagnosis**

 Osteoarthritis is a joint disease in which there is deterioration of the cartilage and the underlying bone in the joint as well as bony overgrowth. It is characterized by pain and stiffness and commonly occurs in the knees, hips, and joints of the hands and spine. The cause of osteoarthritis is unknown and it is usually a gradual onset occurring in individuals over the age of 40 (CDC, 2011).

**II. Therapeutic Objective**

The objective for patients with osteoarthritis is to provide treatment to alleviate symptoms and increase function of the affected joint or joints. Pharmacologic and non-pharmacologic interventions are used to treat patients that have osteoarthritis. Currently there is no cure for this disease. Managing a patient’s osteoarthritis so they can function at the highest level possible is the goal for treatment (CDC, 2011).

**III. Effective Drug Groups**

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| --- | --- | --- | --- |
| Drug Classification | Efficacy | Safety | Suitability  |
| Non-Narcotic AnalgesicsAcetaminophen (Tylenol®, Acephen, Cetafen®, Excedrin®, Feverall®, Mapap®, Ofirmev™, Q-Pap, Valorin) (Lexi-Comp, 2013) | *Pharmacodynamics:*Believed to inhibit the synthesis of prostaglandins in the central nervous system and work peripherally to block pain impulse generation.*Pharmacokinetics:* Absorption: Primarily in the small intestine, dependent on gastric emptying. Metabolism: primarilyhepatic, undergoes first pass metabolism.Excretion: urine(Lexi-Comp, 2013) | *Side Effects:*Common: nausea, rash, headacheSerious: anaphylaxis/anaphylactiod reaction, hepatotoxicity, renal tubular necrosis, analgesic-associated nephropathy, anemia, thrombocytopenia(Epocrates, 2013)  | *Contraindications:*Hypersensitivity to drug class/component*Caution with:* hepatic impairment, renal impairment, hypovolemia, PKU, malnutrition, chronic alcohol abuse(Epocrates, 2013) |
| Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)diclofenac (Cambia™, Cataflam®, Voltaren®-XR, Zipsor), diflunisal, etodolac, fenoprofen (Nalfon®), floctafenine, flurbiprofen, ibuprofen (Addaprin, Advil®, Caldolor®, I-Prin, Ibu, Midol®, Motrin®, NeoProfen®, Proprinal®, Ultraprin), indomethacin (Indocin®), ketoprofen, ketorolac, meclofenamate, mefenamic acid (Ponstel®), Meloxicam (Mobic®), nabumetone, naproxen (Aleve®, Anaprox®, EC-Naprosyn®, Mediproxen, Midol®, Naprelan®, Pamprin®), oxaprozin (Daypro®), piroxicam (Feldene®), sulindac (Clinoril®), tiaprofenic acid, tolmetin (Lexi-Comp, 2013) | *Pharmacodynamics:*Reversibly inhibits cyclooxygenase – 1 and 2 (COX – 1 and 2) enzymes, which result in decreased formation of prostaglandin precursors.*Pharmacokinetics:* Absorption: most are rapid and > 80%Metabolism: hepatic, the pathway differs between medications in this class, ibuprofen – via oxidation; meloxicam – via CYP2C9 and CYP3A4 (minor); ketoprofen – via – glucuronidation; ….etc.Excretion: urine and feces.(Lexi-Comp, 2013) | *Side Effects:*Common: dyspepsia, nausea, abdominal pain, constipation, headache, dizziness, drowsiness, rash, ALT/AST elevation, fluid retention, tinnitus, ecchymosis, dyspnea, photosensitivitySerious: GI bleed, GI perforation/ulcer, MI, stroke, thromboembolism, HTN, CHF, renal papillary necrosis, nephrotoxicity, hepatotoxicity, anaphylaxis/anaphylactiod reaction, bronchospasms, exfoliative dermatitis, Stevens-Johnson Syndrome, toxic epidermal necrolysis, thrombocytopenia, agranulocytosis, aplastic anemia, hemolytic anemia, leukopenia, angioedema(Epocrates, 2013)  | *Contraindications:*Hypersensitivity to class/component, ASA or NSAID – induced asthma or urticaria, aspirin triad, pregnancy 3rd trimester, CABG surgery periop use *Caution with:* cardiovascular disease, HTN, CHF, fluid retention, dehydration, PUD, history of GI bleed, coagulation disorder, hepatic impairment, renal impairment, asthma, sodium restriction, prolonged use, chronic alcohol use, smoking habit changes, elderly patients, debilitated patients(Epocrates, 2013)  |
| NSAID: COX-2 Selectivecelecoxib (Celebrex®)(Lexi-Comp, 2013)  | *Pharmacodynamics:*Inhibits prostaglandin synthesis by decreasing the activity of the activity of the enzyme, cyclooxygenase – 2 (COX – 2), which results in decreased formation of prostaglandin precursors.*Pharmacokinetics:* Absorption: not listedMetabolism: hepatic via CYP2C9Excretion: feces and urine(Lexi-Comp, 2013) | *Side Effects:*Common: headache, dyspepsia, URI, diarrhea, abdominal pain, nausea/vomiting, back pain, insomnia, rash, flatulence, peripheral edema, dizziness, ALT/AST elevation, BUN elevation, photosensitivitySerious: GI bleed, GI peroration/ulcer, stroke, thrombocytopenia, HTN, CHF, renal papillary necrosis, nephrotoxicity, hepatotoxicity, anaphylactiod reaction, bronchospasm, exfoliative dermatitis, Stevens-Johnson Syndrome, toxic epidermal necrolysis, erythema multiforme, anemia, blood dyscrasias (Epocrates, 2013)  | *Contraindications:*Hypersensitivity to class/component, hypersensitivity to sulfonamides, ASA or NSAID – induced asthma or urticaria, aspirin triad, pregnancy 3rd trimester, CABG surgery periop use*Caution with:* cardiovascular disease, HTN, CHF, fluid retention, history of GI bleed or ulcer, coagulation disorder, alcohol use, smoker, elderly or debilitated patients, hepatic impairment, poor CYP2C9 metabolizer, renal impairment, dehydration, asthma, prolonged use, systemic onset JRA(Epocrates, 2013) |
| Opioid AnalgesicsSchedule IIalfentanil (Alfenta®), codeine, fentanyl (Abstral®, Actiq®, Duragesic®, Fentora®, Lazanda®, Onsolis®, Subsys®), hydrocodone, hydromorphone (Dilaudid®, Exalgo®), levorphanol, meperidine (Demerol®), methadone (Dolophine®, Methadose®), morphine (Astramorph/PF™, Avinza®, Duramorph, Infumorph, Kadian®, MS Contin®), nalbuphine, oxycodone (Oxecta™, Oxycontin®, Roxicodone®), oxymorphone (Opana®), remifentanil (Ultiva®), sufentanil (Sufenta®), tapentadol (Nucynta®)Schedule IIIbuprenorphine (Buprenex®, Butrans®), paregoricSchedule IVbutorphanol, pentazocine (Talwin®), tramadol (ConZip™, Rybix™, Ryzolt™, Ultram®)(Lexi-Comp, 2013, Drug Enforcement Agency, 2012)  | *Pharmacodynamics:*Schedule II - Binds with stereospecific receptors at many sites within the CNS or opioid receptors in the CNS and increases pain threshold, alters pain perception, and inhibits ascending pain pathway.Schedule III – buprenorphine exerts its effect by binding to μ – opiate receptors in the CNS.Schedule IV – agonist of kappa opiate receptors and partial agonist of mu opiate receptors in the CNS, causing inhibition of ascending pain pathways, altering the perception of and response to pain. Tramadol effects μ – opiate receptors only.*Pharmacokinetics:*Absorption: Schedule II – varies on medication and route.Schedule III – buprenorphine – IM, SubQ: 30% - 40%.Schedule IV – rapid and well absorbed.Metabolism: Schedule II – hepatic, pathway varies with each medication.Schedule III – buprenorphine – primarly hepatic via N – dealkylation by CYP3A4.Schedule IV – hepatic, pentazocine – via oxidation and glucuronide, extensive fisrt-pass effect; tramadol – via demethylation, glucuronidation, and sulfation.Excretion: urine and feces(Lexi-Comp, 2013)  | *Side Effects:*Varies between medicationsCommon: somnolence, constipation, nausea/vomiting, dizziness, diaphoresis, dysphoria, euphoria, headache, edema, abdominal pain, pruritus, flushing, xerostomia, aesthesia, paresthesia, urinary retention, libido decrease, miosisSerious: respiratory depression, apnea, respiratory arrest, circulation depression, hypotension, shock, paralytic ileus, ICP increase, biliary spasm, bradycardia, anaphylaxis, dependency/abuse, withdrawal symptoms if stopped abruptly after prolonged use(Epocrates, 2013)  | *Contraindications:*Hypersensitivity to class/component, respiratory depression, acute or server asthma, paralytic ileus, GI obstruction, coma or impaired consciousness, circulatory shock, < 24 hours post op, labor and delivery, avoid abrupt withdrawal with prolonged use *Caution with:* elderly patients, renal impairment, hepatic impairment, pulmonary impairment, CNS depression, alcohol use, increased ICP, seizure disorder, hypovolemia, GI motility disorder, acute pancreatitis or biliary disease, prostatic hypertrophy, urethral stricture, history of substance abuse, history of mental illness(Epocrates, 2013) |

**IV. Effective Drug Classification: Schedule IV Opioid Analgesics**

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| Drug Name | Efficacy | Safety | Suitability | Cost |
| Butorphanol | *Onset of action:* I.M. – 5 – 10 minutes, I.V. - < 10 minutes*Absorption:* rapid and well absorbed*Protein binding:* 80%*Metabolism:* hepatic*Half-life:* 2.5 – 4 hours*Excretion:* Primarily urine(Lexi-Comp, 2013) | *Avoid use with:* Azelastine (Nasal); Paraldehyde*Butorphanol may increase the levels/effects of:* Alcohol; Alvimopan; Azelastine (Nasal), CNS Depressants; Desmorpression; Metyrosine; Mirtazapine; Paraldehyde; Pramipexole; Ropinirole; Rotigotine; Selective Serotonin Reuptake Inhibitors; Thiazide Diuretics; Zolpidem*Butorphanol may be increased by:* Amphetamines; Antipsychotic Agents (Phenothiazines); Droperidol; Hydroxyzine; Magnesium Sulfate; Perampanel; Sodium Oxybate; Succinylcholine*Butorphanol may decrease the levels/effects of:* Analgesics (Opioid); Pegvisomant*Butorphanol may be decreased by:* Ammonium Chloride; Mixed Agonist / Antagonist Opioids(Lexi-Comp, 2013) | - Avoid ethanol consumption.- Avoid valerian, St. John’s wort, kava kava, gotu kola (may increase CNS depression)- May cause physical and/or psychological dependence.- Increased risk for falls.- Monitor pain relief, mental status, and blood pressure- Discontinue slowly after prolonged use.(Lexi-Comp, 2013) | Butorphanol (solution): 10 mg/ml (2.5): $56.99(Lexi-Comp, 2013) |
| Pentazocine (Tawin®) | *Onset of action:* I.M., SubQ: 15 – 20 minutes, I.V.: 2 – 3 minutes*Protein binding:* 60%*Metabolism:* hepatic via oxidative and glucuronide conjugation pathways; extensive first-pass effect*Half-life:* 2 – 3 hours; prolonged with hepatic impairment*Excretion:* urine(Lexi-Comp, 2013) | *Avoid use with:* Azelastine (Nasal); Paraldehyde*Pentazocine may increase the levels/effects of:* Alcohol; Alvimopan; Azelastine (Nasal), CNS Depressants; Desmorpression; Metyrosine; Mirtazapine; Paraldehyde; Pramipexole; Ropinirole; Rotigotine; Selective Serotonin Reuptake Inhibitors; Thiazide Diuretics; Zolpidem*Pentazocine may be increased by:* Amphetamines; Antipsychotic Agents (Phenothiazines); Droperidol; Hydroxyzine; Magnesium Sulfate; Perampanel; Sodium Oxybate; Succinylcholine*Pentazocine may decrease the levels/effects of:* Analgesics (Opioid); Pegvisomant*Pentazocine may be decreased by:* Ammonium Chloride(Lexi-Comp, 2013) | - May cause physical and/or psychological dependence.- Increased risk for falls.- Monitor pain relief, mental status, and blood pressure- Discontinue slowly after prolonged use.(Lexi-Comp, 2013) | Talwin (solution): 30 mg/ml (10): $74.42(Lexi-Comp, 2013) |
| Tramadol (ConZip™, Rybix™, Ryzolt™, Ultram®) | *Onset of action:* immediate release: ~ 1 hour*Absorption:* rapid and complete; extended release is delayed*Protein binding:* 20%*Bioavailability:* 75%;extended release 70% - 95%*Half-life:* 6 – 9 hours; Zytram ~ 16 hours*Peak:* ~ 2 hours; extended release varies on brand*Excretion:* urine(Lexi-Comp, 2013) | *Avoid use with:* Azelastine (Nasal); Carbamazepine; Conivaptan; Paraldhyde*Tramadol may increase the levels/effects of:* Alcohol; Alvimopan; Azelastine (Nasal), Carbamazepine; CNS Depressants; Desmopressin; MAO Inhibitors; Metoclopramide; Metyrosine; Paraldehyde; Pramipexole; Ropinirole; Rotigotine; Selective Serotonin Reuptake Inhibitors; Serotonin Modulators; Thiazide Diuretics; Vitamin K Antagonists; Zolpidem*Tramadol may be increased by:* Amphetamines; Antipsychotic Agents (Phenothiazines); Antipsychotics; Conivaptan; CYP3A4 inhibitors (Moderate and strong); Dasatinib; Hydroxyzine; Ivacaftor; Magnesium Sulfate; Mifepristone; Perampanel; Selective Serotonin Reuptake Inhibitors; Sodium Oxybate; Succinylcholine; Tricyclic Antidepressants*Tramadol may decrease the levels/effects of:* Carbamazepine; Pegvisomant*Tramadol may be decreased by:* Ammonium Chloride; Antiemetics (5HT3 Antagonist); Carbamazepine; CYP2D6 Inhibitors (Moderate and strong); CYP3A4 Inducers (Strong); Deferasirox; Mixed Agonist / Antagonist Opioids; Tocilizumab(Lexi-Comp, 2013) | - Avoid ethanol use. Food may alter absorption of some brands of tramadol.- Avoid valerian, St. John’s wort, kava kava, and gotu kola; these may increase CNS depression.- Extended release tablets must be swallowed whole; do not break, chew or crush. Maintain adequate fluid hydration.- May cause physical and/or psychological dependence.- Monitor pain relief, respiratory rate, blood pressure, and pulse; signs of tolerance, abuse, or suicidal ideations.(Lexi-Comp, 2013) | Ryzolt (24 hour tablet): 200 mg (30): $213.98Tramadol HCL (24 hour tablet): 100 mg (30): $109.99; 200 mg (30): $145.99Ultram ER (24 hour tablet): 100 mg (30): $144.99; 200 mg (30): $224.99; 300 mg (30): $298.00Tramadol HCL (tablet): 50 mg (30): $16.99Ultram (tablet): 50 mg (30): $62.99(Lexi-Comp, 2013) |

**V. Drug of Choice: Tramadol**

 All patients with hand osteoarthritis should be referred to their primary care provider and/or an occupational or physical therapist for evaluation of their ability to perform activities of daily living. These patients also should be educated on joint protection techniques and thermal modalities as well as be provided assistive devices or splints when indicated. Although opioid analgesics are not recommended for hand osteoarthritis, the guidelines do recommend the use of tramadol for these patients. Tramadol may be used in monotherapy or in combination with topical capsaicin and topical or oral NSAIDs (Hochberg et al., 2012).

 Cepeda, Camargo, Zea, and Valencia (2009) conducted a meta-analysis on the use of tramadol in patients with osteoarthritis against a placebo. They concluded that tramadol was effective in decreasing pain intensity, produced symptom relief, and improved the function in patient with osteoarthritis, but that the benefits were small. Cepeda et al. (2009) also discussed the increased use of tramadol in patients with osteoarthritis because this drug does not cause GI bleeding or renal problems, and does not affect the articular cartilage. In their study one out of every five participants stated having a minor adverse effect and one in eight participants discontinued tramadol due to the adverse effects.

 This patient will be prescribed tramadol 50 mg orally, take one to two tablets every 4 – 6 hours, not to exceed 400 mg/day for moderate to severe pain. He should be instructed to only use tramadol for moderate to severe pain and to continue using oral NSAIDs for his mild to moderate pain. He should be instructed to follow up with his primary care provider for evaluation within two weeks. Tramadol may increase the levels/effects of thiazide diuretics, which the patient is taking HCTZ daily (Lexi-Comp, 2013). If there is any major changes in his urinary habits, signs or symptoms of dehydration, or any other concerns the patient should be instructed to stop taking the tramadol and follow up with his family care provider. Any patient taking tramadol should follow up for monitoring of pain relief, respiratory status, blood pressure, and pulse as well as signs of tolerance, abuse, or suicidal ideations. Tramadol may cause physical and/or psychological dependence and should be discontinued slowly after prolonged use (Lexi-Comp, 2013). An APN may prescribe tramadol in the state of Ohio (Ohio Board of Nursing, 2011).

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