**Case Study #4: Hypertension & Cardiovascular Disease**

Group names: Natalie Brandenburg, Ian Frazier, Julia Miller, Katia Zogg

**I. Understanding the Disease and Pathophysiology**

**1. Define blood pressure and explain how it is measured.**

Blood pressure is the force exerted upon the blood vessels as blood circulates throughout the body. The systolic pressure is the pressure in the blood vessels when the heart’s ventricles are contracting whereas the diastolic pressure is the blood pressure exerted when the heart’s ventricles are fully relaxed. It can be determined via cardiac output and total peripheral resistance. Blood pressure is measured using a sphymomanometer.

**2. How is blood pressure normally regulated in the body**?

Blood pressure is normally regulated by “the sympathetic nervous system, the renin-angiotensin-aldosterone system (RAAS), and renal function” (Nelms, 2016, p.295).

**3. What causes essential hypertension?**

Essential Hypertension is “idiopathic” meaning there is no known cause.

**4. What are the symptoms of hypertension?**

Symptoms of hypertension include: elevated blood pressure, excessive secretion of vasopressin or increased angiotensinogen (causes vasoconstriction), elevated cholesterol and elevated blood sugar.

**5. How is hypertension diagnosed?**

Hypertension is diagnosed based upon risk factors, comorbidities, laboratory tests (urinalysis, blood glucose, hematocrit, and lipid panel...calcium), history and physical examination, electrocardiogram, urinary/albumin/creatinine ratio, the assessment of target organ damage, and after revealing identifiable causes of hypertension.

**6. List the risk factors for developing hypertension.**

The risk factors for developing hypertension include: hypertension, obesity, dyslipidemia, diabetes mellitus, smoking, family history, age, insufficient physical activity, and microalbuminuria.

**7. What risk factors does Mrs. Sanders currently have?**

C.S.’s individual risk factors include: history of smoking, hypertension, having a history of insufficient activity (until more recently), having a family history of uncontrolled HTN, and dyslipidemia (high LDL and cholesterol).

**8. Hypertension is classified in stages based on the risk of developing CVD. Complete the following table of hypertension classification.**

(Joint National Committee, 2004)

|  |  |
| --- | --- |
|  | **Blood Pressure mmHg** |
| **Category** | **Systolic BP** |  | **Diastolic BP** |
| Normal | <120 | and | <80 |
| Prehypertension | 130–139 | or | 85–89 |
| Stage 1 Hypertension | 140-159 | or | 90-99 |
| Stage 2 Hypertension | >160 | or | >100 |

**9. How is hypertension treated?**

Hypertension is treated via weight loss, increasing physical activity, committing to

nutrition therapy, and pharmacological interventions such as diuretics or ACE

inhibitors.

**10. Dr. Thornton indicated in his note that he will “rule out metabolic syndrome.” What is metabolic syndrome?**

Metabolic syndrome includes having 3 of the following risk factors: abdominal obesity, elevated triacylglycerides, low HDL cholesterol, insulin resistance, and HTN.

**11. What factors found in the medical and social history are pertinent for determining Mrs. Sander’s CHD risk category?**

Factors C.S. has that link her to the risk of getting CHD include: family Hx of uncontrolled

hypertension (her mother), a past of increased glucose, elevated cholesterol, elevated LDL, low HDL, a Hx of smoking and inactivity, an unhealthy diet, and high blood pressure.

**12. What progression of her disease might Mrs. Sanders experience?**

If C.S.’s disease progresses it could affect major organs like her brain, heart and kidneys. Hypertension can lead to a stroke, heart disease, heart failure, myocardial infarction and kidney failure.

Since hypertension is a cardiovascular condition C.S. could be at a potential risk for all other cardiovascular diseases.

C.S. may experience an obstruction of blood flow due to the build-up of atherosclerosis. This could lead to MI or a stroke.  C.S. might also experience kidney failure from hypertension damaging the vessels in the kidney.

**II. Understanding the Nutrition Therapy**

**13. Briefly describe the DASH eating plan.**

DASH stands for Dietary Approaches to Stop Hypertension. The DASH diet places an emphasis on reducing sodium while increasing potassium, magnesium, calcium, and fiber. The diet should be rich in fruits, vegetables, grains, and low-fat dairy with reduced saturated and total fat. Lean protein, whole grains, nuts and seeds are important. As is reducing fats, oils, and sweets. Sodium intake should not be more than 2,400 mg a day, however 1,500 mg a day is best.

**14. Using the EAL, describe the association between sodium intake and blood pressure.**

When sodium levels are increased, blood pressure also increases. When sodium levels are decreased, blood pressure also decreases. Sodium intake and blood pressure mirror each other. Reducing sodium intake to less than 2,300 mg per day and further reduction to 1,600 mg per day may have a significant impact on lowering blood pressure, especially if combined with the DASH diet.

**15. Lifestyle modifications reduce blood pressure, enhance the efficacy of antihypertensive medication and decrease cardiovascular risk. List lifestyle modifications that have been shown to lower blood pressure.**

* The DASH diet (details above in question 13)
* Lower sodium intake to below 2,400 mg a day or preferably 1,500 mg a day
* Keep a healthy weight. Stay within a normal body mass index of 18.5-24.9 kg/m²
* Aim for 30 minutes of moderate aerobic physical activity most days.
* Limit alcohol, 2 drinks per day for men and 1 drink per day for women
* Quit smoking

**III. Nutrition Assessment**

**16. What are the health implications of Mrs. Sanders’s body mass index (BMI)?**

C.S. has a body mass index of 25.8 kg/m². Having a BMI between 25-29.9kg/m² is considered overweight. Being overweight increases one’s risk for type 2 diabetes, HTN, CHD, certain cancers, hepatobiliary disorders, sleep apnea, and lipid abnormalities. C.S already has stage 2 HTN, heart disease, and early COPD.

**17. Calculate Mrs. Sander’s resting and total energy needs.**

 Mifflin-St. Jeor Equation:

10\*weight + 6.25 \* height- 5\* age -161

( 10\* (160/2.2) + 6\* (66\*2.54) - 5\*54 -161= 1302 kcal resting energy

1302.04 \* 1.2=1562 kcal total energy

Since C.S. is walking 4-5 times a week for 30 minutes we want to multiply the resting energy needs by 1.2 to get total calories needed: 1562 kcal per day.  She has been maintaining weight loss for a year, but she needs to lose some more weight to get into the normal BMI range. A calorie deficit of 250 kcal will give her a new calorie intake of 1312 kcal per day assuming she stays on the exercise regimen.

**18. What nutrients in Mrs. Sander’s diet are of major concern to you?**

* Sugar and refined carbohydrates
* Butter
* Sodium
* Saturated fats
* Cholesterol
* Inadequate potassium, magnesium and calcium
* Inadequate fiber
* Inadequate mono and polyunsaturated fats
* None or very little water

**19. From the information gathered within the intake domain, list possible nutrition problems using the diagnostic terms.**

* Excessive energy intake
* Excessive sodium intake
* Excessive or inappropriate intake of fats
* Inadequate fiber, calcium, magnesium, or potassium intake

**20. Dr. Thornton ordered the following labs: fasting glucose, cholesterol, triglycerides, creatinine, and uric acid. He also ordered an EKG. In the following table, outline the indication for these tests (test provide information related to disease or condition).**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter**  | **Normal Value** | **Pt’s Value**  | **Reason for Abnormality**  | **Nutrition Implication**  |
| Glucose  | 70-110 mg/dL | 115 | Increased refined CHO intake | Pre-diabetes, diabetes |
| BUN | 8-18 mg/dL | 20 | Excess protein, dehydration | Kidney problem, can lead to high blood pressure or DM |
| Creatinine  | 0.6-1.2 mg/dL | 0.9 | No abnormality | Kidneys working fine |
| Total cholesterol | 120-199 mg/dL | 270 | High intake of animal protein and high fat intake | Heart disease, HTN, high cholesterol, could lead to CAD  |
| HDL-cholesterol | >55 mg/dL F>45 mg/dL M | 30 | Wrong Food intake, overweight | At risk for heart disease |
| LDL-cholesterol | <130 mg/dL | 210 | Consuming food high in cholesterol and saturated fats | Risk for stroke, heart disease, atherosclerosis |
| Apo A | 101-199 mg/dL F94-178 mg/dL M  | 75 | Low levels of HDL and High Cholesterol  | Risk of CVD, can lead to renal failure and DM |
| Apo B  | 60-126 mg/dL F63-133 mg/dL M  | 140 | High fat diet and high LDL | Risk of CVD, atherosclerosis,heart attack |
| Triglycerides  | 35-135 mg/dL F40-160 mg/dL M  | 150 | High fat diet, overweight, alcohol | Heart Attack, stroke, DM, could lead to CAD |

**21. Interpret Mrs. Sanders’s risk of CAD based on her lipid profile.**

C.S.’s  LDL levels are elevated (210 mg/dL) and her HDL levels are low (30mg/dL), which

indicates that she has dyslipidemia putting her at an increased risk for CAD.

**22. What is the significance of apolipoprotein A and apolipoprotein B in determining a**

**person’s risk of CAD?**

Apolipoprotein A is associated with high-density lipoprotien (HDL), while Apolipoprotein B is

associated with low-density lipoprotein (LDL). The risk for developing CAD increases with low levels of Apo A and high levels of Apo B.

**23. Indicate the pharmacological differences among the antihypertensive agents listed**

**below.**

|  |  |  |
| --- | --- | --- |
| **Medications**  | **Mechanism of Action**  | **Nutritional Side Effects and Contraindications**  |
| Diuretics  | Decrease blood volume by increasing urinary output; inhibit renal sodium and water reabsorption | ***Loop-***Hypokalemia, hyperuricemia, anorexia, N/V, diarrhea, constipation. Avoid natural licorice.***Thiazide-***Hypokalemia, hypercalcemia, anorexia, hyperglycemia. Avoid natural licorice.***Potassium sparing-***N/V, diarrhea. Avoid natural licorice; avoid excessive potassium intake.  |
| Beta-blockers  | **Beta-1-blockers**Block beta receptors in heart to decrease heart rate and cardiac output**Beta blockers, alpha activity**Block alpha-1 receptors in addition to beta-receptors to increase peripheral vasodilation**Beta blockers, intrinsic sympathomimetic** Possess intrinsic sympathomimetic activity  | Nausea, diarrhea. Calcium may interfere with absorption. Dry mouth, gas or bloating. May mask hypoglycemia.Increases weight; N/V, diarrhea. Dyspepsia, N/V, constipation, diarrhea, flatulence. May mask hypoglycemia. |
| Calcium-channel blockers | Affect the movement of calcium, cause blood vessels to relax; therefore, reduce vasoconstriction | Edema, nausea, heartburn. Contraindication: Heart failure or greater than first-degree heart block. Avoid natural licorice; limit caffeine; avoid or limit alcohol.  |
| ACE inhibitors  | Vasoconstriction that reduce BP by decreasing peripheral vascular resistance by interfering with the production of angiotensin II from angiotensin I and inhibiting degradation of bradykinin | Hypotension, especially in older patients. Can worsen renal function, hyperkalemia, dysgeusia. Cause dry, nonproductive cough, hyperkalemia. Contraindication: pregnancy. Avoid natural licorice; avoid salt substitutes. Side effects increased in African Americans.  |
| Angiotensin II receptor blockers  | Interfere with renin-angiotensin system without inhibiting degradation of bradykinin  | Nausea. May increase serum potassium; avoid salt substitutes. Avoid natural licorice; caution with grapefruit.  |
| Alpha-adrenergic blockers | Block the vascular muscle response to sympathetic stimulation; reduce stroke volume | N/V, diarrhea, constipation, mouth dryness. Avoid natural licorice.  |

**24. What are the most common nutritional implication of taking hydrochlorothiazide?**

Hydrochlorothiazide is a thiazide diuretic which works by inhibiting the reabsorption of sodium,

chloride and potassium (these drugs act in the distal tubule and ascending loop of Henle). These

drugs work to increase sodium, chloride and potassium excretion through the urine which can

cause an imbalance in electrolytes.

An imbalance in electrolytes can cause hypokalemia, hypercalcemia, anorexia, and hyperglycemia.

Hypokalemia can cause muscle weakness, diminished deep tendon reflexes, shallow

respirations, cardiac dysrhythmias and arrest. Hypercalcemia can cause fatigue and weakness,

bone pain, confusion and cardiac dysrhythmias. Hyperglycemia can cause increased thirst, and

urination, vomiting, lethargy and dehydration.

**25. Mrs. Sander’s physician has decided to prescribe an ACE inhibitor and an HMGCoA**

**reductase inhibitor (Zocor). What changes can be expected in her lipid profile as a result of**

**taking these medications?**

Since ACE inhibitors are vasodilators they will have no impact on C.S.’s lipid profile. HMGCoA reductase inhibitors inhibit the enzyme HMGCoA reductase which has a role in cholesterol production, thus will have an impact in improving C.S.’s lipid profile.

**26. How does an ACE inhibitor lower blood pressure?**

ACE inhibitors are vasodilators. They work by blocking an enzyme called angiotensin-converting enzyme. This enzyme works by converting angiotensin I to angiotensin II. Angiotensin II causes narrowing of blood vessels and causes the adrenal cortex to secrete aldosterone. Aldosterone causes sodium and chloride to be reabsorbed resulting in increased blood volume and therefore blood pressure. Blocking this enzyme results in “vasodilation, a decrease in vasopressin release, and a resulting decrease in blood pressure.”

**27. How does an HMGCoa reductase inhibitor lower serum lipid?**

HMGCoA reductase inhibitors inhibit the enzyme HMGCoA reductase. This blocks the synthesis of cholesterol and lowers the amount of cholesterol in the blood. They also enhance LDL uptake.

**28. What other classes of medications can be used to treat hypercholesterolemia?**

* **Statins:** can decrease LDL and triglycerides; increase HDL slightly
* **Bile Acid Binding Resins:** can decrease LDL
* **Cholesterol Absorption Inhibitor:** can decrease LDL; decrease triglycerides slightly, increase HDL slightly
* **Combination Cholesterol Absorption Inhibitor and Statin:** can decrease LDL and triglycerides; increase HDL
* **Fibrates:** can decrease LDL and triglycerides; increase HDL
* **Niacin:** can decrease LDL and triglycerides; increase HDL
* **Combination Statin and Niacin:** can decrease LDL and triglycerides; increase HDL
* **Omega-3 fatty acids:** can decrease triglycerides; may increase HDL
* **Combination Statin and Calcium Channel Blocker:** can decrease LDL and triglycerides; lowers blood pressure
* **Injectable Medications:** can decreases LDL in individuals who have a genetic condition that causes very high LDL levels

**29. What are the pertinent drug-nutrient interactions and medical side effects for ACE inhibitors and HMGCoA reductase inhibitors?**

ACE inhibitors can lead to hypotension, especially in elderly patients. It can worsen renal function, hyperkalemia, dysgeusia. It can also cause a dry, nonproductive cough. Individuals taking it should avoid natural licorice and salt substitutes.

HMGCoA reductase inhibitors can cause nausea, dyspepsia, abdominal pain, constipation, diarrhea, and flatulence. Grapefruit interacts with HMGCoA reductase inhibitors by inhibiting an enzyme that helps metabolize the drug. This can increase the amount of the drug in the blood which can lead to toxicity.

**30. From the information gathered within the clinical domain, list possible nutrition problems using the diagnostic terms.**

Overweight (indicated by BMI of 25.8 kg/m2)

**31. What are some possible barriers to compliance?**

* Reluctance to follow a low sodium diet
* Reluctance to follow the DASH diet
* Making unhealthy choices at pizza restaurants and steakhouses
* Not having time for more physical activity
* Not understanding the associated risk of HTN
* Unwanted side effects from medication(s)

**IV. Nutrition Diagnosis**

**32. Select two nutrition problems and complete the PES statement for each.**

Excessive intake of sodium, trans fats, and saturated fats related to high consumption of energy dense, nutrient poor foods as evidenced by high blood pressure (160/100), high chol, high LDL, low HDL, and high LDL:HDL ratio.

Inadequate fiber, calcium, magnesium, potassium intake related to poor consumption of fiber, fruits, vegetables, grains, as evidenced by 24-hour recall.

**V. Nutrition Intervention**

**33. When you ask Mrs. Sanders how much weight she would like to lose, she tells you she would like to weight 125, which is what she weighed for most of her adult life. Is this reasonable? What would you suggest as a goal weight for Mrs. Sanders?**

Based on C.S.’s height, her IBW is 130lbs. If C.S. weighed 125 pounds she would be within a healthy BMI range.

Suggestions for C.S.:

* Get weight down so she has a healthy BMI and work from there
* If she loses just over 6 pounds she would be in a normal range
* I would work with her to develop a SMART goal. This way she could decide how she wants to lose the weight (exercise x times per week, eat more fruits and vegetables) and what is realistic and achievable. Then we could work on a time frame for completing her goal(s).

**34. How quickly should Mrs. Sanders lose weight?**

In general, a healthy weight loss goal is losing no more than 1-2 lbs per week and realistically losing 5-10% of the baseline weight within 6 months. C.S. could aim to lose around a ½ to 1 pound per week. We would work on her SMART goal to determine a realistic goal for her. Losing a pound a week would mean she would need to have a caloric deficit of around 500 calories each day. This could be a combination of exercise and calorie restriction.

**35. For each of the PES statements that you have written, establish an ideal goal (based on the signs and symptoms) and an appropriate intervention (based on the etiology).**

An ideal goal for C.S.’s blood pressure is <120/<80; and ideal goal for her chol is between 120-199 mg/dL; an ideal goal for her LDL is <130 mg/dL; ideal goal for her HDL is >55mg/dL; an ideal goal for her LDL/HDL ratio is <3.22. An appropriate intervention to decrease her high blood pressure, LDL, and LDL/HDL ratio and to increase her HDL would be to progress towards adopting the DASH eating plan (which will decrease sodium, trans fat, and saturated fat intake) and increasing physical activity.

An ideal goal for C.S.’s fiber, calcium, magnesium, and potassium intake is: 30 gm fiber, 1,240 mg calcium, 500 mg magnesium, and 4,700 mg potassium. An appropriate intervention to increase her intake of fiber, calcium, magnesium, and potassium would be to progress towards adopting the DASH eating plan.

**36. Identify the major sources of calcium, sodium, saturated fat, and cholesterol in Mrs. Sander’s diet. What suggestions would you make for substitutions and/or other changes that would help Mrs. Sanders reach her medical nutrition therapy goals?**

Major sources of calcium: low-fat (2%) milk, ice cream, spinach

Major sources of sodium: Campbell’s ® tomato bisque soup prepared with milk, saltines, ranch dressing, donut, seasoning with salt during meal preparation

Major sources of saturated fat: low-fat (2%) milk, margarine, butter, ice cream, donut

Major sources of cholesterol: chicken, butter, low-fat (2%) milk, ice cream

**Suggestions:**

* Use more spices and herbs for seasoning in place of salt
* Substitute homemade vinaigrette dressing for ranch dressing
* Replace saltines with low-sodium crackers
* Replace 2% milk with fat-free milk
* Replace orange juice with whole fruit
* Increase fruit intake
* Increase vegetable intake
* Increase dark green leafy vegetables
* Increase grain and grain product intake
* Increase nuts, seeds, and legume intake
* Decrease saturated fat intake
* Focus on unsaturated fats and oils
* Select lean meats, poultry, fish
* Meat preparation: roasted, broiled, or boiled instead of fried
* Remove skin from poultry
* Homemade soup or low-sodium soup instead of regular canned soup
* Water in place of soda
* Low fat sweets
* Limit alcohol consumption

**37. What would you want to reevaluate in three to four weeks at a follow-up appointment?**

I would want to re-evaluate her lipid profile to check for decreases in chol, LDL, HDL/LDL ratio, and to check for an increase in HDL. I would test for blood glucose to see if her risk of developing diabetes has decreased. I would have C.S. prepare for the follow-up appointment by doing a 3-5 day food record (with a weekend included) to see her progress in following the recommended DASH diet plan.

**38. Evaluate Mrs. Sander’s labs at six months and then at nine months. Describe the changes that have occurred.**

**Six Months**

* **BUN:** decreased from 20 to 18 (ref. range: 8-18)
* **Creatinine serum**: increased from 0.9 mg/dL to 1.1mg/dL (ref. range: 0.6-1.2)
* **Glucose**: decreased from 115mg/dL to 90mg/dL (ref. range: 70-110)
* **Cholesterol**: decreased from 270mg/dL to 230mg/dL (ref. range: 120-199)
* **HDL-C**: increased from 30mg/dL to 35 (ref. range: > 55 F, > 45 M)
* **LDL**: decreased from 210mg/dL to 169mg/dL (ref. range: <3.22 F, > 3.55 M)
* **Apo A**: increased from 75mg/dL to 100mg/dL (ref. range: 101-199 F, 94-178 M)
* **Apo B**: decreased from 140mg/dL to 120mg/dL (ref. range: 60-126 F, 63-133 M)
* **Triglycerides**: decreased from 150mg/dL to 130mg/dL (ref. range: 35-135 F, 40-160 M)

**Nine Months**

* **BUN:** increased from 18mg/dL to 22mg/Dl (ref. range: 8-18)
* **Creatinine serum**: no changes, stayed at 1.1mg/dL (ref. range: 0.6-1.2)
* **Glucose**: increased from 90mg/dL to 96mg/dL (ref. range: 70-110)
* **Cholesterol**: decreased from 230mg/dL to 210mg/dL (ref. range: 120-199)
* **HDL-C**: increased from 35mg/dL to 38mg/dL (ref. range: > 55 F, > 45 M)
* **LDL**: decreased from 169mg/dL to 147mg/dL (ref. range: <3.22 F, > 3.55 M)
* **Apo A**: increased from 100mg/dL to 110mg/dL (ref. range: 101-199 F, 94-178 M)
* **Apo B**: decreased from 120mg/dL to 115mg/dL (ref. range: 60-126 F, 63-133 M)
* **Triglycerides**: decreased from 130mg/dL to 1125mg/dL (ref. range: 35-135 F, 40-160 M)

References

Effects of High Blood Pressure (n.d.). *Centers for Disease Control and Prevention*. Retrieved October 9, 2018: <https://www.cdc.gov/bloodpressure/effects.htm>

Health Library (n.d.). Michigan Medicine University of Michigan. Retrieved October 20, 2018: https://www.uofmhealth.org/health-library

High Blood Pressure and Kidney Disease (September, 2014). *National Institute of Diabetes and Digestive and Kidney Diseases*. Retrieved October 9, 2018: <https://www.niddk.nih.gov/health-information/kidney-disease/high-blood-pressure>

HTN: Minerals (2007). *AND Evidence Analysis Library*. Retrieved October 6, 2018: https://www.andeal.org/topic.cfm?cat=2777&evidence\_summary\_id=250515&highlight=sodium%20and%20blood%20pressure&home=1

Joint National Committee. (August 2004).  *Prevention, Detection, Evaluation, and Treatment of High Blood Pressure* (The Seventh Report). Retrieved September 22, 2018 from  <https://www.nhlbi.nih.gov/files/docs/guidelines/jnc7full.pdf>

Mayo Clinic Staff (March 1, 2017). Atorvastatin (Oral Route). *Mayo Clinic.* Retrieved October 4, 2018 from <https://www.mayoclinic.org/drugs-supplements/atorvastatin-oral-route/description/drg-20067003>

Mayo Clinic Staff (September 22, 2015). Cholesterol Medications: Consider the Options. *Mayo Clinic.* Retrieved October 4, 2018 from https://www.mayoclinic.org/diseases-conditions/high-blood-cholesterol/in-depth/cholesterol-medications/art-20050958

Nelms, M.N., Sucher, K., Lacey, K., Habash, D., Nelms, R.G., Hansen-Petrik, M., … Wong, J. (2016). *Nutrition Therapy and Pathophysiology.* Boston, MA: Cengage Learning.