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### Cardiovascular Case Study #1

#### **Understanding the Disease and Pathophysiology**

- 1) Define blood pressure.
  - The amount of pressure exerted on the walls of the blood vessels by circulating blood, measured in millimeters of mercury (mmHg).
- 2) How is blood pressure normally regulated in the body?
  - Mean arterial pressure (MAP) is regulated by the sympathetic nervous system, the renin-angiotensin system, and the renal system.
  - The sympathetic nervous system influences heart rate by stimulating the SA and AV nodes to release acetylcholine, slowing the heart rate. The heart rate then impacts cardiac output (heart rate x stroke volume), which directly influences MAP.
  - Vasoconstriction decreases the radius of the blood vessels, thus increasing MAP. Vasoconstriction is caused by the sympathetic nervous system, epinephrine, vasopressin, and angiotensin II.
  - A greater stroke volume results in increased MAP. Vasopressin, or antidiuretic hormone (ADH), and the renin-angiotensin-aldosterone system controls blood volume through sodium and water balance.
  - Baroreceptors are pressure sensors in the circulatory system that alter cardiac output and total peripheral resistance to monitor blood pressure.
- 3) What causes essential hypertension?
  - The etiology of essential hypertension is unknown, however, it is likely due to lifestyle factors such as diet, exercise, smoking, stress, and obesity.
  - Cigarette smoking impairs endothelial relaxation and vasodilation
  - Adrenal disorders can cause excessive secretion of epinephrine and norepinephrine which increase BP by causing vasoconstriction.
  - Neurological disease could influence the functioning of the sympathetic and parasympathetic nervous systems, resulting in poor control of heart rate and blood vessel radius.
- 4) What are the symptoms of hypertension?
  - Hypertension has very few signs and symptoms. A common early sign, however, is vision problems.
- 5) How is hypertension diagnosed?
  - Hypertension is diagnosed by measuring systolic and diastolic blood pressure using a Sphygmomanometer.
  - An individual is diagnosed as hypertensive if the systolic pressure  $\geq 140$  or the diastolic pressure  $\geq 90$ .
- 6) List the risk factors for developing hypertension.
  - Lifestyle factors influencing hypertension include diet, exercise, smoking, stress, and obesity.
  - Risk factors for all CVD include hypertension, obesity, dyslipidemia, diabetes mellitus, cigarette smoking, physical inactivity, microalbuminuria, age, and family history.
  - Possible causes of hypertension include sleep apnea, chronic kidney disease, primary aldosteronism, renovascular disease, Cushing's syndrome, pheochromocytoma, coarctation of aorta, and thyroid/parathyroid disease.
- 7) What risk factors does Mrs. Anderson currently have?

- Family history of cardiovascular disease.
- Hypertension Stage 2.
- Smoker.
- Abnormal fasting lipid profile; high cholesterol.

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

Category	Blood Pressure (mm Hg)		
	Systolic BP		Diastolic BP
Normal	< 120	and	< 80
Prehypertension	120-139	or	80-89
Hypertension Stage 1	140-159	or	90-99
Hypertension Stage 2	≥ 160	or	≥ 100

9) Given these criteria, which category would Mrs. Anderson’s admitting blood pressure reading place her in?

- Hypertension Stage 2.

10) How is hypertension treated?

- Hypertension is mainly treated through lifestyle change and medication.
- Lifestyle changes may include reduced weight, increased physical activity, and an altered diet.
- Medications can impact either cardiac output or peripheral resistance.

11) Dr. Thornton indicated in his admitting note that he will “rule out metabolic syndrome.” What is metabolic syndrome?

- Metabolic syndrome is a collection of risks associated with CVD. Criteria for diagnosis includes three of the five risk factors.
- Risk factors include abdominal obesity, high triglycerides, low HDL-cholesterol, hypertension, and insulin resistance.

12) What factors found in the medical and social history are pertinent for determining Mrs. Anderson’s CHD risk category?

- Other diseases/illnesses; physical activity level; diet; family hx

13) What progression of her disease might Mrs. Anderson experience?

- Hypertension is correlated with many other diseases, including congestive heart failure, kidney failure, myocardial infarction, stroke, aneurysm, and overall CVD morbidity/mortality.

### **Understanding the Nutrition Therapy**

14) What are the most recent recommendations for nutrition therapy in hypertension? Explain the history of and rationale for the DASH diet.

- Weight loss and reduced sodium and alcohol intake, in addition to smoking cessation and increased physical activity.
- In the 1990s, the DASH studies found that blood pressures could be decreased by consuming a diet that is low in saturated fat, cholesterol, and total fat, and that emphasized fruits and vegetables.

15) What is the rationale for sodium restriction in treatment of hypertension?

- Studies, such as INTERSALT, have found a relationship between urinary sodium excretion and systolic BP.

16) What are the Therapeutic Lifestyle Changes? Outline the major components of the nutrition therapy interventions?

- The TLC diet was developed as a strategy to treat and prevent AS. Major components include modifications of fat and cholesterol, increased fiber intake, decreased sodium intake, increased stanol esters. Dietary recommendations are to accompany increased PA and weight loss.

- TLC diet prescribes:
  - Saturated fat < 7% total kcal
  - Cholesterol < 200 mg/day
  - 10-25 g. soluble fiber daily
  - 2 g. plant stanols/sterols daily

17) The most recent recommendations suggest the therapeutic use of stanol esters. What are they, and what is the rationale for their use?

- Stanol esters are found in plants and have a structure similar to cholesterol. When esterified to a stanol ester or sterol ester, they can assist in lowering serum cholesterol and LDL levels.

**Nutrition Assessment**

**Evaluation of Weight/Body Composition**

18) Calculate Mrs. Anderson’s body mass index (BMI).

- Height = 5’ 6” = 66” = 1.68 m
- Weight = 160 lbs = 73 kg
- BMI =  $73 / 2.82 = 26$

19) What are the health implications of this number?

- Mrs. Anderson’s BMI classifies her as overweight.

**Calculation of Nutrient Requirements**

20) Calculate Mrs. Anderson’s resting and total energy needs. Identify the formula/calculation method you used and explain your rationale for using it.

- To calculate Mrs. Anderson’s EER, I will average the recommendations yielded by three equations. I selected 1.6 for the PAL because Mrs. Anderson is maintaining regular physical activity and spends most of her time in the home completing a variety of tasks.
- Mifflin: 2158
- Harris Benedict: 2258
- Quick Estimate: 2686
- Average: 2367 kcal/day

21) How many calories per day would you recommend for Mrs. Anderson?

- Mrs. Anderson’s ideal body weight is between 52 kg (114 lbs) and 70 kg (155 lbs). I would like to see Mrs. Anderson lose 2 pounds per month until she reaches a weight of 150 pounds (this goal weight is supported by the evidence that a weight loss of 5 kg will reduce both systolic and diastolic blood pressure). To lose 2 pounds per month I would put Mrs. Anderson at a 250 kcal/day deficit, yielding a daily caloric intake of 2100 kcal.

22) Determine the appropriate percentages of total kilocalories from carbohydrate, protein, and lipid.

- Carbohydrate = 45-65%
- Protein = 15-25%
- Fat = 25-35%

**Intake Domain**

23) Using a computer dietary analysis program or food composition table, compare Mrs. Anderson’s “usual” dietary intake to her prescribed diet (DASH/TLC diet).

Food Item	K (> 4700 mg)	Na (< 2400)	Mg (500 mg)	Ca (< 1240 mg)	Total Fat (105-152 g)	Sat. Fat (< 16 g)	Chol (< 200 mg)	Fiber (10-25 g)
Coffee (3 c/day)	348	15	21	15	0.15	0	0	0
Oatmeal	94	72	35	98	1.8	0.3	0	2.3
Margarine	5	90	0	1	6.65	1.2	0	0

Sugar	0	0	0	0	0	0	0	0
2% low-fat milk	182	59	16	143	1.98	0	8	0
Orange juice	443	5	27	27	0.3	0.03	0	0.7
Glazed donut	75	290	14	34	14	4	22	1.6
Canned tomato soup	277	667	17	16	0.7	0.2	0	1.5
Saltine crackers	24	167	4	3	1.3	0.3	0	0.4
Diet cola	28	28	4	11	0.1	0	0	0
12 oz bottle regular beer	92	11	21	14	0	0	0	0
Baked chicken	131	514	14	4	0.2	0.07	23	0
Baked potato w/ salt	926	422	48	26	0.2	0.06	0	3.8
Butter	3	82	0	3	11.5	7.2	31	0
Pepper	1	0	0	0	0	0	0	0
Carrots	195	42	7	20	0.2	0.02	0	1.7
Salad	116	4	7	16	0.1	0	0	1
Ranch dressing	14	287	0	8	15.5	2.3	8	0.1
Ice cream	164	50	19	72	7.2	4.4	22	0.8
Total	3118	2805	254	511	61.88	20.08	114	13.9

24) What nutrients in Mrs. Anderson's diet are of major concerns to you?

- Potassium—too low
- Sodium—too high
- Magnesium—too low
- Total fat—too low
- Saturated fat—too high

25) From the information gathered within the intake domain, list possible nutrition problems using the diagnostic term.

- Inappropriate lipid intake RT food selections with high saturated fat and low intake of unsaturated fat AEB diet Hx.
- Inadequate mineral intake RT selection of nutrient poor foods AEB diet Hx.

**Clinical Domain**

26) 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 (tests provide information related to a disease or condition).

Parameter	Normal Value	Pt.'s Value	Reason for Abnormality	Nutrition Implication
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Glucose	70-110 mg/dL	92	WNL	n/a
BUN	8-18 mg/dL	20	High	Possible decreased kidney function
Creatinine	0.6-1.2 mg/dL	0.9	WNL	n/a
Total Cholesterol	120-199 mg/dL	270	High	Risk for AS/HTN
HDL-Chol	> 55 mg/dL (w)	30	Low	Risk for AS/HTN
LDL-Chol	< 130 mg/dL	210	High	Risk for AS/HTN
Apo A	101-199 mg/dL (w)	75	Low	Risk for AS/HTN
Apo B	60-126 mg/dL (w)	140	High	Risk for plaque build up
Triglycerides	35-135 mg/dL (w)	150	High	Risk for AS/HTN

27) Interpret Mrs. Anderson's risk of CAD based on her lipid profile.

- All of Mrs. Anderson's lipid levels suggest a high risk for CAD. Overall TG and cholesterol is high, and HDL-cholesterol is low.

28) What is the significance of apolipoprotein A and apolipoprotein B in determining a person's risk of CAD?

- Apolipoproteins A and B can be correlated with the type and amount of serum cholesterol, and are thought by some to be better indicators of the risks proposed by cholesterol levels.

29) Indicate the pharmacological differences among the antihypertensive agents listed below:

Medication	Mechanism of Action	Nutritional Implications
Diuretics	Decrease blood volume by increasing urinary output	Hypokalemia, hyperlipidemia, hpertriglyceridemia, hypercholesterolemia, glucose intolerance, N/V, anorexia, dry mouth, constipation
Beta-blockers	Blocks beta-receptors in heart to decrease HR and cardiac output	Nausea, diarrhea, upset stomach, dry mouth
Calcium-channel blockers	Affect movement of calcium to relax blood vessels	Edema, nausea, heartburn
ACE inhibitors	Vasodilators; act on production of angiotensin II and inhibits degradation of bradykinin	None
Angiotensin II receptor blockers	Acts on rennin-angiotensin system	Increased serum potassium
Alpha-adrenergic blockers	Block vascular muscle response to sympathetic stimulation; reduce stroke volume	N/V, diarrhea, dry mouth

30) What are the most common nutritional implications of taking hydrochlorothiazide?

- Hypokalemia, hyperlipidemia, hpertriglyceridemia, hypercholesterolemia, glucose intolerance, N/V, anorexia, dry mouth, constipation

31) Mrs. Anderson'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?

- Zocor will reduce Mrs. Anderson's total-C, LDL-C, Apo B, and TG, and increase her HDL-C.

32) How does an ACE inhibitor work to lower blood pressure?

- ACE inhibitors act on the renin-angiotensin system by interfering with the production of angiotensin II from angiotensin I.

- 33) How does HMGCoA reductase inhibitor work to lower serum lipid?
- HMGCoA reductase inhibitors catalyze the conversion of HMGCoA to mevalonate, assisting with this rate-limiting step of cholesterol synthesis.
- 34) What other classes or medications can be used to treat hypercholesterolemia?
- Statins
  - Niacin (nicotinic acid)
  - Bile acid sequestrants
  - Cholesterol absorption inhibitors
  - Fibric acid derivatives (University of Maryland)
- 35) What are the pertinent drug-nutrient interactions and medical side effects for ACE inhibitors and HMGCoA?
- Increased serum potassium
  - Increased serum lithium levels
  - Effectiveness may be reduced by non-steroidal anti-inflammatory drugs (MedicineNet)
- 36) From the information gathered within the clinical domain, list possible nutrition problems using the diagnostic term.
- Dyslipidemia RT regular consumption of high-fat meals AEB blood test results.

#### **Behavioral-Environmental Domain**

- 37) What are some possible barriers to compliance?
- Mrs. Anderson complained that she found her low-sodium diet to be bland and unappetizing.

#### **Nutrition Diagnosis**

- 38) Select two high-priority nutrition problems and complete PES statements for each.
- Dyslipidemia RT regular consumption of high-fat meals AEB blood test results.
  - Excessive body weight RT overconsumption and inadequate physical activity AEB BMI.

#### **Nutrition Intervention**

- 39) Mrs. Anderson asks you, "A lot of my friends have lost weight and that Dr. Atkins diet. Would it be best for me to follow that for a while to get this weight off?" What can you tell Mrs. Anderson about the typical high-protein, low-carbohydrate approach to weight loss?
- Low carbohydrate diets are dangerous and not an effective approach to weight loss. Their popularity is due to the immediate loss of weight due to lost water weight. This weight often returns, however, and is not the loss of fat, as most people would like it to be. Additionally, starving your body of carbohydrates is dangerous and can negatively impact CNS function. Successful weight loss should result from the gradual deficit of energy input.
- 40) When you ask Mrs. Anderson how much weight she would like to lose, she tells you she would like to weigh 125 pounds, which is what she weighed for most of her adult life. Is this reasonable? What would you suggest as a goal for weight loss for Mrs. Anderson?
- As individuals age, their metabolism changes. Many individuals cannot achieve the same weight that they were at in their younger adult years. Mrs. Anderson's healthy weight is between 114 and 155 pounds, making the goal of 125 pounds unnecessary and unrealistic. I would recommend Mrs. Anderson's goal weight be 150 pounds.
- 41) How quickly should Mrs. Anderson lose this weight?
- Mrs. Anderson can achieve the goal of 150 pounds by losing 0.5 pounds per week. This can be accomplished by a 250 Calorie daily deficit.
- 42) 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).
- Lower T-chol to < 200 within 12 months through the use of an HMGCoA reductase inhibitor and the consumption of a diet low in saturated fat and cholesterol.

- Lower body weight to 150 pounds within 6 months through increased physical activity.
- 43) Identify the major sources of saturated fat and cholesterol in Mrs. Anderson's diet. What suggestions would you make for substitutions and/or other changes that would help Mrs. Anderson reach her medical nutrition therapy goals?
- The majority of Mrs. Anderson's saturated fats and cholesterol came from added butter/margarine and sweets (like donuts and ice cream). Some simple suggestions to help Mrs. Anderson control her lipid intake would be to use low fat spreads instead of butter and choose alternative sweets, such as sweet pretzels or sherbets.
- 44) Assuming that the foods in her 24-hour recall are typical of her eating pattern, outline necessary modifications you could use as a teaching tool.

Foods	Modification/Alternative	Rationale
Coffee (3 c/day)	Limit to 1 c/day	Caffeine should be consumed in moderation
Oatmeal (w/ margarine & sugar) or Frosted Mini-Wheats	Substitute fruit for sugar	Fruits will provide additional nutrients and add texture and sweetness
2% low-fat milk	Replace with skim	Skim milk contains less cholesterol than 2%
Orange juice	n/a	
Glazed donut	Toast with jelly	Provides a sweet taste with less fat and more nutrients
Canned tomato soup	Select low sodium variety	Sodium reduction will help lower BP
Saltine crackers	Select low sodium variety	Sodium reduction will help lower BP
Diet cola	Fruit juice	Will provide additional nutrients
12 oz bottle regular beer	Light beer	Decrease empty Kcal
Baked chicken	n/a	
Baked potato (w/ 1 T. butter, salt, & pepper)	Select margarine instead of butter	Less sat. fat
Carrots	n/a	
Salad w/ ranch-style dressing	Select low-fat ranch	Less sat. fat
Ice cream	Sherbet	Provide less fat and more nutrients

- 45) What would you want to reevaluate in 3 to 4 weeks at a follow-up appointment?
- Dietary intake
  - Blood work
  - Weight
  - Mrs. Anderson's attitude
- 46) Evaluate Mrs. Anderson's labs at 6 months and then at 9 months. Have the biochemical goals been met with the current regimen?
- BUN is still high
  - Cholesterol is moving in the right direction, but is still high
  - HDL levels are improving, but are still low
  - LDL is still high, but has improved
  - Apo A, Apo B, and TG have reached desirable ranges

## **References**

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