Case Study 26: COPD

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**I. Understanding the Disease and Pathophysiology**

*1. Mrs. Bernhardt was diagnosed with stage 1 emphysema/COPD five years ago. What criteria are used to classify this staging?*

Multiple markers are used to determine standards for stages of COPD. These markers are FEV1 and FEV1/FVC. FEV1 is the forced expiratory volume of air in 1 second. FEV1/FVC measures the amount of a person’s vital lung capacity that they can expel in the first second of an expiration.

Markers for stage one are an FEV1/FVC of more than 70% a normal FEV1/FVC and an FEV1 above 80% of normal.

*2. COPD includes two distinct diagnoses. Outline the similarities and differences between emphysema and chronic bronchitis.*

Emphysema and chronic bronchitis usually occur together in patients with chronic obstructive pulmonary disease (COPD). Chronic bronchitis is inflammation of the lining of the bronchial tubes, while emphysema is the destruction of the alveoli sacs. Both of these conditions are a result of exposure to cigarette smoke. Repeated exposure to pollutants such as cigarette smoke cause an inflammatory response that decreases cilia function, increases phagocytosis and suppressed the amounts of immunoglobulin A (IgA). This causes edema of the bronchioles while the airway walls become thickened. Cilia are unable to clean the mucus from the airways and in result are the symptoms of COPD. Emphysema is specifically caused by the destruction of actual lung tissues. This is the distinguishing factor between the two conditions of chronic bronchitis and emphysema. As a result of emphysema, the lungs experience decreased forced expiratory volume (FEV) and air becomes trapped in the lungs. Patients experience dyspnea and extreme fatigue. These two conditions ultimately have the same consequences of a lack of oxygen but are caused by different parts of the lungs.

*3. What risk factors does Mrs. Bernhardt have for this disease.*

The primary risk factor for COPD is smoking. Other risk factors include air pollution, second-hand smoke, history of childhood infections, and occupational exposure to certain industrial pollutants (726). Additionally, low body weight has been shown to be a risk factor for the development of COPD.

Mrs. Bernhardt ceased smoking cigarettes a year ago, but prior to that she had been smoking a pack of cigarettes daily for 46 years. Bronchitis and upper respiratory infections during winter months as an adult would not be considered a risk factor, but rather a probable result of smoking. Mrs. Bernhardt has some family history - mother and 2 aunts - who both died of lung cancer. Family history is not a major risk factor with COPD, but smoking is the leading cause of lung cancer, and it is possible that these family members were smokers (National Institute of Health, n.d.). Mrs. Bernhardt may have been exposed to second-hand smoke, especially as a child.

National Institute of Health. (n.d.). *Lung cancer.* Retrieved from http://www.nlm.nih.gov/medlineplus/lungcancer.html

4. *a) Identify symptoms described in the MD’s history and physical that are consistent with Mrs. Bernhardt’s diagnosis. Then describe the pathophysiology that may be responsible for each symptom.*

Mrs. Bernhardt has a previous diagnosis of stage 1 emphysema five years ago but comes in today with a more exacerbated chronic obstructive pulmonary disease. She states that she is hardly able to do anything without getting short of breath. Small things like taking a shower and getting dressed now require the help of her husband. She feels as if she is always gasping for air and states that she is coughing up a lot of phlegm that is dark greenish-brown. She is often confused in the morning and has a hard time getting motivated in the morning. The shortness of breath and gasping for air is caused by the inflammation of the bronchiole tubes and the damage to the alveoli sacs. The mucus is a result of the damage to the cilia and its inability to sweep away mucus. Instead it builds up in the lungs and can cause an infection, which explains the green mucus.

*b) Now identify at least four features of the physician’s physical examination consistent with her admitting diagnosis. Describe the pathophysiology that might be responsible for each physical finding.*

In the doctor’s examination he observed decreased breath sounds, prolonged expiration with wheezing, rhonchi, and using accessory muscles at rest. The dysfunctional alveoli sacs cause decreased breath sounds and prolonged expiration with wheezing. The air is not able to escape from the lungs, which results in prolonged expiration. The inflammation of the bronchioles specifically causes the wheezing sound. The use of accessory muscles is necessary in order for the lungs to push the air out. The muscles of the lungs are compromised so the surrounding muscles must pick up their slack in order for the person to breathe. This inflammation causes the narrowing of the airways and produces the rattling sounds, rhonchi, observed by the doctor.

*5. Mrs. Bernhardt’s medical record indicates previous pulmonary function tests as follows: baseline FEV1=0.7 L, FVC=1.5 L, FEV1/FVC= 46%. Define FEV, FVC, and FEV/FVC, and indicate how they are used in the diagnosis of COPD. How can these measurements be used in treating COPD?*

FEV: forced expiratory volume, this is the amount of air Mrs. Bernhardt expels in an expiration over a given period of time. Standardly, this is one second. (727)

FVC: forced vital capacity, this is the amount of air Mrs. Bernhardt can breathe into her lungs. It is measured by the volume of her entire exhale.

FEV/FVC is a proportion that shows how much of the forced vital capacity is expelled in the first second of an exhale.

These values are used to place patients into different stages of COPD and can show the progression and severity of disease. Different or more intense treatments may be suggested at different stages of disease. As these numbers go down, it indicates that the patient is having a harder time breathing normally.

*6. Look at Mrs. Bernhardt’s arterial blood gas values from the day she was admitted*.

*a) Why would arterial blood gases (ABGs) be drawn for this patient?*

Arterial blood gases are drawn for Mrs. Bernhardt because of her lack of breath and other symptoms observed by the doctor. These values will help in the diagnosis of COPD and help in identifying the severity of the disease.

*b) Define each of the following and interpret Mrs. Bernhardt’s values:*

pH: 7.29 which is considered respiratory acidosis. This is a result of CO2 & HCO3 imbalances and the alveoli’s inability to exchange carbon dioxide and oxygen.

pCO2: 50.9 which is high from a normal range of 35-45. This is a result of the alveoli’s inability to correctly exchange CO2 with O2.

SO2: 92%. Oxygen saturation of the blood should be at or above 95%, hemoglobin is not able to bind with enough oxygen because there is not enough present in the blood stream.

HCO3: 29.6 which is high of a normal range of 24-28. This high bicarbonate level corresponds with the acidosis.

Brookside Associates. (n.d.) *Military obstetrics & gynecology laboratory*. Retrieved from

<http://www.brooksidepress.org/Products/Military_OBGYN/Lab/ABG.htm>

*c) Mrs. Bernhardt was placed on oxygen therapy. What lab values tell you the therapy is working?*

Many of her lab values have returned to in normal ranges. Her pH is now 7.4 as a result of CO2 and O2 levels returning to normal at 29.8 CO2 and 18 O2. Also, HCO3 (24.7) level has returned to a normal range. Although her oxygen saturation is still low, this may take a little more time to return to normal.

*7. Mrs. Bernhardt has quit smoking. Shouldn’t her condition now improve? Explain.*

Mrs. Bernhardt’s chart reports that she has COPD characterized by emphysema, which is caused by destruction of alveoli (726). While Mrs. Bernhardt has removed the biggest risk factor of COPD, there is already significant damage present. The destruction of the alveoli in her lungs is not reversible. However, Mrs. Bernhardt’s condition should not progress swiftly, as she has eliminated smoking from her lifestyle and does not present with additional major risk factors.

*8. What is a respiratory quotient? How is this figure related to nutritional intake and respiratory status?*

Respiratory quotient is defined as “a [dimensionless number](http://en.wikipedia.org/wiki/Dimensionless_quantity) used in calculations of [basal metabolic rate](http://en.wikipedia.org/wiki/Basal_metabolic_rate) (BMR) when estimated from carbon dioxide production.” Therefore respiratory quotient is an important determination of how well your calories are being used as energy. Your body needs the exchange of oxygen and carbon dioxide in order to metabolize the nutrients and calories being brought into your body. If your respiratory quotient is low, you become at risk for not using your calories efficiently.

**II. Understanding Nutrition Therapy**

*9. What are the most common nutritional concerns for someone with COPD? Why is the patient diagnosed with COPD at higher risk for malnutrition?*

Common nutritional concerns for someone with COPD mainly include unintended weight loss and malnutrition due to inadequate nutrient intake. Low intake can be related to symptoms of dyspnea, fatigue and early satiety (729). Additionally, the force it takes for lungs to expand during breathes is increased, which requires more calories. During exacerbations of COPD, patient need an additional increase in calories and protein needs. On average, a person needs about 1.2 grams of protein for every kg of body weight, where someone with COPD may need 1.7 grams of protein per kg of body weight.

A patient diagnosed with COPD is at significantly increased risk of malnutrition. Malnutrition occurs in 24-35% of patients with COPD, particularly patients with emphysema (727). This is due to the increased resting energy expenditure required by the increased effort it takes for a patient to breathe. Additionally, someone living with COPD may feel tired more easily and may not feel like eating, leading to reduced nutrient intake. This also can lead to vitamin and mineral deficiencies. Deficiencies in antioxidant vitamins, specifically vitamins C, A, E, and beta-carotene are concerning because they contribute to respiratory health (729).

A special concern for patients with COPD is the balance between carbohydrates, lipids, and protein. Compared to fat and protein, metabolized carbohydrate yields the greatest amount of CO2, which may be overwhelming for the respiratory system (729). Formula’s with a higher fat content and lower carbohydrate content may be used to help a client regain weight and adequate nutrient levels.

*10. Is there a specific nutrition therapy prescribed for these patients?*

Patients with COPD generally have higher resting energy expenditures and therefore need to consume adequate nutritional intake. Without increasing their caloric needs they are at risk for weight loss and malnutrition. It is important for COPD patients to make sure they are taking in an adequate amount of calories.

However, for those who are overweight, they need to decrease their caloric slightly in order to lose some weight. Being overweight with COPD puts extra strain on the lungs and surrounding muscles to supply oxygen to the body. COPD is generally a result of smoking for many years and many patients continue to smoke. In order to lessen their symptoms cutting back and eventually quitting smoking is very important.

Florian, Ilaria. (2009) ***Nutrition and COPD - dietary considerations for better breathing.* Retrieved from**<http://www.todaysdietitian.com/newarchives/td_020909p54.shtml>

**III. Nutrition Assessment**

*11. Calculate Mrs. Bernhardt’s %UBW and BMI. Does either of these values indicate she is at nutritional risk? How would her 1+ bilateral pitting edema effect evaluation of her weight?*

Mrs. Bernhardt’s usual body weight is between 145 and 150 lbs. She is currently 119 lbs. Her % usual body weight is calculated below:

119/145 = 0.82 = 82%

119/150 = 0.79 = 79%

Mrs. Bernhardt is between 79-82% of her usual body weight of 145-150 lbs. This is a significant weight loss, and I would like to investigate more about when it happened. She reported this was her usual weight about 5 years ago, but if it has happened since her diagnosis I would be much more worried than I am about a 20-25 lb weight loss over five years. I believe that it has probably been more recent and am concerned due to the fact that she may be malnourished and that weight loss and malnutrition, as well as a low BMI, have been associated with increased mortality in people with COPD (730). Mrs. Bernhardt’s BMI is calculated below:

BMI = weight in kg/(height in m)(height in m)

119lbs x 1 kg/2.2lbs = 54.1 kg

63 inches x 0.0254m/1 inch = 1.6 m

54.1/(1.6)(1.6) = 21.13 kg/m2

Mrs. Bernhardt has a healthy, normal BMI. Her BMI alone does not indicate that she is in any nutritional danger, but we know from the interview with Mrs. Bernhardt that she is not eating very often and has experienced weight loss to a significant degree.

Additionally, Mrs. Bernhardt seems to be experiencing evidence of edema. The water retention would artificially bump up Mrs. Bernhardt’s weight, causing a higher %UBW and BMI. The extent to which this was happening would have to be evaluated to determine approximately how much water weight she was believed to be carrying, which could be subtracted from her weight and recalculated for an estimated BMI. Depending on the extent of Mrs. Bernhardt’s edema, she may be at more nutritional risk than initially perceived.

*12. Calculate arm muscle area using the anthropometric data for mid-arm muscle circumference (MAC) and triceps skinfold (TSF). How would this data be interpreted?*

[(19.05 – 3.14 x 1.5)2 / 4 x 3.14] -6.5  = 9.9

This AMA value of 9.9 indicates that her muscle mass is severely wasted away.

*13. Calculate Mrs. Bernhardt’s energy and protein requirements. What activity and stress factors would you use? What is your rational?*

Using the Mifflin St. Jeor equation, Mrs. Bernhardt’s resting metabolic rate is calculated below:

10(weight in kg) + 6.25(height in cm) - 5(age in years) - 161 =

10(54kg) + 6.25(160cm) – 5(62) – 161 = 1,040 kcal

Thorsdottir and Gunnarsdottir found that energy needs can be up to 156% above basal energy expenditure, and that protein intake of 1.2 to 1.7 grams/kg of body weight were necessary in patients who were experiencing exacerbations of their COPD (729). These numbers are used below to calculate Mrs. Bernhardt’s needs due to the fact that she also needs an increased amount of kcals to potentially gain some weight back.

1,040 kcals x 1.56 = 1,622 kcals

1.7 grams protein/kg x 54.1 = 92 grams

I would estimate that Mrs. Bernhardt needs about 1,600-1,650 kcals daily and between 90 and 95 grams of protein daily.

*14. Using Mrs. Bernhardt’s nutrition history and 24-hour recall as a reference, does she have an adequate oral intake? Explain.*

Mrs. Bernhardt takes in a very minimal amount of calories each day. She states that in the last 24-hours she has consumed ½ c coffee with nondairy creamer, few sips of orange juice, ½ c oatmeal with 1 tsp sugar, ¾ c chicken noodle soup, 2 saltine crackers, ½ c coffee with nondairy creamer and approximately 32 oz. of Pepsi throughout the day. From this and her statement about her usually daily intake we see that she eat very minimal calories. This is because she doesn’t have much of an appetite anymore. Lunch is typically her biggest meal of the day even though she still eats small portions. Her lack of appetite and inadequate intake cause her to be near the range of underweight.

*15. Evaluate Mrs. Bernhardt’s laboratory values. Identify those that are abnormal. Which of these may be used to assess her nutritional status.*

Mrs. Bernhardt’s total protein, albumin, hematocrit, and hemoglobin can be used to assess her nutritional status. Mrs. Bernhardt’s low total protein and albumin indicate probably malnutrition. Her low hematocrit and hemoglobin are markers for anemia.

Additional lab values that are of concern are her pH, which was low, a high PCO2, low O2 saturation, and high CO2 content. This suggests that she is not getting enough oxygen and that oxygen therapy is not working as is.

*16. Why may Mrs. Bernhardt be at risk for anemia? Do her laboratory values indicate that she is anemic?*

Mrs. Bernhardt is at risk for anemia because her red blood cell count and hemoglobin count are both low. Her RBC count is 4, a normal range is 4.2-5.4 for females and her hemoglobin count is 11.5, a normal range is 12-15 for females. We can see that she is only slightly under the normal range and there still is time to make improvements before an actual diagnosis is made that she is anemic.

*17. What factors can you identify from her nutrition interview that probably contribute to her difficulty in eating?*

Mrs. Bernhardt reports that she has a poor appetite. Additionally, she says “I fill up so quickly - after just a few bites.” Early satiety is a side effect of COPD and is related to inadequate nutrition (729). Increased coughing can make it hard to eat, and Mrs. Bernhardt reports that she find food to be unappetizing as of late. COPD and increased effort needed for breathing can leave a patient exhausted. By the time Mrs. Bernhardt would finish preparing a meal she may be nearly too tired to enjoy it. Finally, Mrs. Bernhardt uses dentures, but they appear to be improperly fitting, possibly due to weight loss.

**IV. Nutrition Diagnosis**

*18. Select two high-priority nutrition problems and complete the PES statement for each.*

Inadequate oral intake (NI-2.1; 10639) related to low caloric intake as evidence by 24-hour recall and usual dietary intake.

Unintended weight loss (NC3.2-; 10765) related to loss of appetite as evidence by patients statement of food not tasting good anymore.

**V. Nutrition Intervention**

*19. What is the current recommendation on the appropriate mix of calories from carbohydrate, protein, and lipid for this patient?*

Too many carbohydrates in the diet can be harmful for the patient with COPD because they have the greatest amount of CO2 let off during metabolism when compared to the other macronutrients (729). For this reason, it is recommended that a higher percentage of calories come from protein and fat than normal. About 20% of calories should come from protein, with as much as 50% coming from fat due to its low amount of CO2 released as it is metabolized (729). About 30% of calories can come from carbohydrates. Unfortunately, there are some potential side effects of a high lipid diet, such as delayed gastric emptying, abdominal discomfort, bloating, or early satiety (729).

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

Inadequate oral intake: advise client to increase caloric intake by 600 kcals per day.

Unintended weight loss: advise client to try more flavorful foods and use new spices and flavorings.

*21. What goals might you set for Mrs. Bernhardt as she is discharged and beginning pulmonary rehabilitation.*

I would set goals for Mrs. Bernhardt such as:

* Increased calorie intake.
* Increased meal frequency with smaller sizes to reduce early satiety and exhaustion from eating.
* Decreased carbohydrate intake with an increased lipid intake in response.

**VI. Nutrition Monitoring and Evaluation**

*22. You are now seeing Mrs. Bernhardt at her second visit to pulmonary rehabilitation. She provides you with the following information from her food record. Her weight is now 116 lbs. She explains adjustment to her medications and oxygen at home has been difficult, so she hasn’t felt like eating very much. When you talk with her, you find she is hungriest in the morning, and often by evening she is too tired to eat. She is having no specific intolerances, but she does tell you she hasn’t consumed any milk products because she thought they would cause more sputum to be produced.*

*A) Is she meeting her calorie and protein goals?*

Monday

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Calories | Carbs | Fats | Proteins |
| 1 c Coffee | 0 | 0 | 0 | 0 |
| 2 tbsp. nondairy creamer | 19 | 2 | 1 | 1 |
| ½ c orange | 30 | 7.5 | 0 | 0 |
| 1 poached egg | 75 | 0 | 5 | 7 |
| ½ slice toast | 40 | 7.5 | 1 | 3 |
| ¼ tuna salad sandwich (3 tbsp. tuna salad on 1 slice wheat bread) | 21 | 0 | 1 | 3 |
| 1 c Coffee | 0 | 0 | 0 | 0 |
| 2 tbsp. nondairy creamer | 19 | 2 | 1 | 1 |
| 1 c Cream of tomato soup | 80 | 15 | 1 | 3 |
| ½ slice toast | 40 | 7.5 | 1 | 3 |
| ½ banana | 30 | 7.5 | 0 | 0 |
| 36 oz. Pepsi | 486 | 122 | 0 | 0 |
| **Total** | **840 kcals** | **163.5g** | **11g** | **21g** |

Tuesday

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Calories | Carbs | Fats | Proteins |
| 1 c Coffee | 0 | 0 | 0 | 0 |
| 2 tbsp. nondairy creamer | 19 | 2 | 1 | 1 |
| ½ c orange juice | 60 | 15 | 0 | 0 |
| ½ c oatmeal | 80 | 15 | 1 | 3 |
| 2 tbsp. brown sugar |  |  |  |  |
| 1 fried chicken leg | 200 | 0 | 16 | 14 |
| ½ c mashed potatoes | 80 | 15 | 1 | 3 |
| 2 tbsp. gravy | 90 | 0 | 10 | 0 |
| 1 c Coffee | 0 | 0 | 0 | 0 |
| 2 tbsp. nondairy creamer | 19 | 2 | 1 | 1 |
| 2 oz. cheese | 100 | 0 | 8 | 7 |
| 8 saltine crackers | 160 | 30 | 2 | 6 |
| 1 can V8 juice (6 oz.) | 37.5 | 7.5 | 0 | 3 |
| 36 oz. Pepsi | 486 | 122 | 0 | 0 |
| **Total** | **1,332 kcals** | **208.5g** | **40g** | **38g** |

No, she is still not meeting her caloric goals or her goal for grams of protein per day.

*B) What would you tell her regarding the use of supplements and/or milk and sputum production?*

I would suggest taking a multivitamin to make up for some of the nutrients she is not taking in through her diet. As for sputum production, it isn’t increased when the patient drinks milk, it actually becomes thicker. The fat in the milk causes a reaction with the sputum and as a result it thickens and therefore is harder to expel from the body. The damaged cilia are unable to remove this thick mucus and it builds and causes the patient to cough excessively. I would recommend drinking low fat or skim milk occasionally but not in excess. This also goes for dairy products. If she is going to eat dairy or milk products, choose the low fat or no fat versions and eat them sparingly.

*C) Using information from her food diary as a teaching tool, identify three interventions you would propose for Mrs. Bernhardt to increase her calorie and protein intakes.*

I would advise Mrs. Bernhardt to eat more lean meats to increase her protein intake, add a protein source at dinner and/or breakfast, and work on eating all of the food she has in front of her rather than only part of her portions.

COPD Foundation (2012). *Milk products and mucous in COPD.* Retrieved from <http://blog.copdfoundation.org/milk-products-and-mucous-in-copd/>

Fit Day (n.d.) *Food journal*. Retrieved from <http://www.fitday.com/app/journal/foods#23SEP2014>