Case 14: Inflammatory Bowel Disease: Crohn's Disease

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I. Understanding the Disease and Pathophysiology

1. What is inflammatory bowel disease? What does current medical literature indicate regarding its etiology?

Inflammatory bowel disease is an illness that causes chronic inflammation and disruption of normal functioning in parts of the gastrointestinal tract, most commonly in the ileum and large intestine. This is attributed to abnormal immune responses. Exact triggers of this type of disease are unknown, but developments are believed to originate from genetic and environmental factors (Rolfes, Pinna, & Whitney, 2012).

2. Mr. Sims was initially diagnosed with ulcerative colitis and then diagnosed with Crohn's. How could this happen? What are the similarities and differences between Crohn's disease and ulcerative colitis?

Both diseases share similar signs and symptoms, but Mr. Sims' signs and symptoms most represented ulcerative colitis. He was suffering from frequent, urgent bowel movements and fever which are more significant in ulcerative colitis. Both diseases may contribute to weight loss, increased risk of intestinal cancer, diarrhea, bloody stools, fever, weakness, fatigue, and abdominal pain and discomfort. Crohn's disease usually affects the ileum and/or colon and is characterized by intestinal lesions and deep fissuring, separated by normal tissue, creating a cobblestone appearance. Fistulas are common and cancer risk is increased. The location of ulcerative colitis is restricted to the colon and rectum—where it begins. Ulcers are visible, and the colon appears inflamed and reddened. Fistulas do not usually occur. The mucosa and submucosa are the primary intestinal layers damaged. The risk of cancer is substantially increased in patients with ulcerative colitis. The risk of malnutrition is much higher in Crohn's disease due to the areas typically most affected by illness being the only sites for absorption of numerous nutrients. Diet has to be watched closely and may require more manipulation in Crohn's patients compared to ulcerative colitis sufferers (Mayo Clinic, 2012; Rolfes, Pinna, & Whitney, 2012).

3. What does a CDAI score of 400 indicate? What does a classification of severe-fulminant disease indicate?

A CDAI score of ≥400 means severe activity of Crohn's disease in a patient. Scores between 150 and 400 indicate mild activity, and scores below 150 are interpreted as disease remission (Tzivras et al., 2006). Classifications of mild-moderate, moderate-severe, and severe fulminant, and remission exist for Crohn's. Severe-fulminant disease is characterized by severe symptoms that are persistent despite of steroidal treatment or high fever presenting people, on-going vomiting, signs of intestinal blockage, tenderness of the abdomen, muscle wasting and profound weight loss, or signs of an abscess (Accordant Health Services, 2010).

4. What did you find in Mr. Sim's history and physical that is consistent with his diagnosis of Crohn's? Explain.

He has lost a significant amount of weight (almost 30 pounds) from his usual body weight over the last six months due to frequent bowel movements and malabsorption of nutrients. He has been suffering fever, abdominal pain, and diarrhea that have become more severe and frequent since September, and it is now December. This is due to increased

inflammation, exacerbation of illness, caused by possible ulcerations, fissures, fistulas, intestinal matting, and strictures or obstructions. Mr. Sim's is suffering from distention (abdominal bloating) and extreme abdominal tenderness with rebound (pain upon removal of pressure from abdomen) and guarding (tensing of abdominal wall muscles to guard inflamed muscles) (Rolfes, Pinna, & Whitney, 2012).

5. Crohn's patients often have extraintestinal symptoms of the disease. What are some examples of these symptoms? Is there evidence of these in his history and physical?

Other organ systems may be affected by people with Crohn's disease. Inflammation of the uveitis and/or sclera (parts of the eye) may occur, leading to photophobia and/or episcleritis, respectively. Seronegative spondyloarthropathy, a rheumatologic disease in some Crohn's patients, causes inflammation of joints or muscle insertions. The skin, blood, and endocrine system may also be involved; skin lesions, blood clots, and autoimmune hemolytic anemia may develop. A deformity called clubbing that affects the hands and fingers may occur as a result of Crohn's. Osteoporoses may be caused by Crohn's disease, and, finally, neurological complications such as seizures, stroke, myopathy, peripheral neuropathy, headache, and depression may arise (News Medical, n.d.).

6. Which laboratory values are consistent with an exacerbation of his Crohn's disease? Identify and explain.

His albumin value is low which was caused by malnutrition, inflammation, and improper absorption and digestion of protein. Total protein is low due to malabsorption and improper digestion. Prealbumin is low due to malnutrition. Transferrin is low due to iron deficiency because of malabsorption and improper digestion of protein. This increases total iron-binding capacity, and therefore drops transferrin saturation. C-reactive protein is high because of inflammation. Osmolality lab value is low because of Mr. Sim's dehydration from the frequent diarrhea. Alk phos is high possibly because of bile duct obstruction and/or increased bone cell activity (osteoporosis). HDL-C lab is low because cholesterol levels temporarily fall during acute illness; HDL should be measured after waiting at least six weeks after any illness. Lab values of hemoglobin and ferritin are low, and ZPP is high due to iron deficiency caused by malabsorption of protein. ESR value is high due to inflammation (Lab Tests Online, 2012).

7. Is Mr. Sim's a likely candidate for short bowel syndrome? Define *short bowel syndrome*, and provide a rational for your answer.

Short bowel syndrome is the malabsorption syndrome that may take place after surgical resection of the small intestine. It occurs when the remaining intestine doesn't fully adapt to resection, and absorption is insufficient for nutritional needs being met. Matt will be a likely candidate for short bowel syndrome if his diet is not closely watched. The removal of part of his ileum my decrease his absorption of B_{12} and bile acid which can result in exacerbation of fat malabsorption, and the colon walls are irritated by unabsorbed bile acids which may make diarrhea worse (Rolfes, Pinna, & Whitney, 2012).

. **8.** What type of adaptation can the small intestine make after resection?

After resection, the small intestine can undergo a process that increases absorption. Growth of intestinal tissue begins soon after oral intakes follow surgery because of the

introduction of nutrients and gastrointestinal secretions in the lumen. Full adaptation may take several years. The section of the remaining intestine develops taller villi, crypts that are deeper, and increases in length and diameter. The absorptive surface area of the remaining intestine is dramatically increased by these changes, allowing for many patients to return to a normal diet following resection if adaptation sufficiently compensates for the removal of damaged intestine (Rolfes, Pinna, & Whitney, 2012).

9. For what classic symptoms of short bowel syndrome should Mr. Sim's health care team monitor?

They should especially monitor signs and symptoms of short bowel syndrome including frequency and severity of diarrhea, dehydration, electrolyte balance, osteopenia, abdominal pain and bloating, fever, weight loss, symptoms of malnutrition, food tolerance, adherence to diet, and lab values affected by Crohn's.

10. Mr. Sims is being evaluated for participation in a clinical trial with the new drug called Teduglutide (ALX-0600). What is this drug, and how might it help Mr. Sims?

Teduglutide contains GLP-2, a natural protein that helps maintain the health of the intestinal lining. It promotes normal growth and repair by increasing the depth of crypt and villi height which allows for less reliance on parenteral nutrition for SBS patients. This drug may help him by increasing his intestinal absorptive capacity and therefore reducing his chance of developing SBS (European Medicines Agency, 2012).

II. Understanding the Nutrition Therapy

11. What are the potential nutritional consequences of Crohn's disease?

Potential nutritional consequences may include protein, iron, folate, calcium, fat, magnesium, zinc, vitamins A, D, E, K, $B_{12,}$ and other vitamin and mineral deficiencies due to malabsorption. Supplementations are usually required. Weight loss, growth failure, muscle wasting, and dehydration may be consequences. Enteral and/or parenteral feeding may be necessary on occasion or for life. Lactose may not be tolerated. Diet must consist of small meals and be altered and closely monitored for life (except during remission) (Rolfes, Pinna, & Whitney, 2012).

12. Mr. Sims has had a 200-cm resection of his jejunum and proximal ileum. How long is the small intestine, and how significant is this resection?

The normal length of the small intestine in an adult is approximately 400 cm. As long as the terminal ileum remains intact, resection of large sections of jejunum is tolerated well. It is when 100 or more centimeters of the terminal ileum is resected that major malabsorptive problems, severe diarrhea, and malnutrition occur (Jeejeebhoy, 2002).

13. What nutrients are normally digested and absorbed in the portion of the small intestine that has been resected?

Specific to his resection, nutrients of digestive and absorptive concern include calcium, folate, fat soluble vitamins, free fatty acids, monoglycerides, B_{12} (small amount), sodium (small amount), and water (moderate amount) (Jeejeebhoy, 2002).

III. Nutrition Assessment

A. Evaluation of Weight/Body Composition

14. Evaluate Mr. Sims's anthropometric data by evaluating UBW and BMI. Interpret your calculations.

Mr. Sims's UBW is 167 lbs. He currently weighs 140 lbs, which means he is now at 84% of his UBW. Percentages of UBW within the range of 75-84% mean risk of moderate malnutrition. His BMI equals 21; healthy weight usually falls between a BMI range of 18.5-25, but in this case, Matt's current BMI masks his recent, significant weight loss. Rate and amount of weight loss is highly significant in determining health status. More than ten percent involuntary weight loss within six months places an adult at risk for PEM; Matt has lost 16% of his usual weight over the last six months (Rolfes, Pinna, & Whitney, 2012).

B. Calculation of Nutrient Requirements

15. Calculate Mr. Sim's energy requirements. Compare the Harris-Benedict, Mifflin-St. Jeor, and Ireton-Jones equations.

Rolfes, Pinna, and Whitney (2012) provided the following equations:

Harris-Benedict
Men: RMR = 66.5 + [13.75 x weight (kg)] + [5.003 x height (cm)] – [6.755 x age (years)]
Matt: RMR = 1587 kcal
TDE = RMR x IF x AF (1.3 injury factor for surgery and an activity factor of 1.5 for normal activity)
Energy needs (kcal/day) = 3100 kcal

Mifflin-St. Jeor
Men: RMR = [9.99 x weight (kg)] + [6.25 x height (cm)] – [4.92 x age (years)] + 5
Matt: RMR = 1568 kcal
Energy needs (kcal/day) = 3060 kcal

Ireton-Jones
Energy needs (kcal/day) = 1925 + [5 x wt (kg)] – [10 x age (yr)] + [281 x sex] + [292 x trauma] + [851 x burn]
Energy needs (kcal/day) = 2468

16. Which numbers would you use as a goal for Mr. Sim's nutrition support? Explain.

I would use the higher caloric intake of 3100 kcal if he resumes normal physical activity within at least 24 hours after his surgery, because his body will need the extra energy to heal and because he is 16% below his UBW.

17. What would you estimate Mr. Sim's protein requirements to be?

Using his usual body weight (because it falls within a healthy BMI range and is the ideal weight for him to get back to) to determine his protein energy requirement in a healthy condition equals 61 g/day. Considering his recent surgery and illness, Mr. Sims needs a doubled intake of protein per day. Therefore, he needs approximately 122 g/day of protein (Rolfes, Pinna, & Whitney, 2012).

C. Intake Domain

18. Based on your evaluation of Mr. Sim's nutritional history, taking into consideration his current hospital course, and from all information gathered within the intake domain, list possible nutrition problems.

According to his recent dietary intake, Mr. Sims is deficient in vegetables, fruits, protein, and dairy, although dairy should be consumed in small, spaced out servings. I'm estimating his caloric intake is around 1800 kcal/day, not nearly enough, considering his current hospital course. He needs about six times more protein to meet his RDA of 122 g/day (Rolfes, Pinna, & Whitney, 2012). He takes a multivitamin daily but is still likely deficient in the vitamins and minerals he needs because of intestinal malabsorption; the multivitamin should be continued along with alteration in diet. He needs to consume a diet containing approximately 3100 kcal/day including high calorie, nutrient dense foods. Fluid intake should approximately be doubled. Less soda, more water, and more nutritious beverages should be consumed. Oral intake of caloric needs will ensue after complete, then possibly along with, enteral/parenteral nutrition, until complete oral intake can be tolerated by the entire digestive system again.

D. Clinical Domain

19. Identify any significant laboratory measurements from both his hematology and his chemistry labs.

This question was fully answered in number six: His albumin value is low which was caused by malnutrition, inflammation, and improper absorption and digestion of protein. Total protein is low due to malabsorption and improper digestion. Prealbumin is low due to malnutrition. Transferrin is low due to iron deficiency because of malabsorption and improper digestion of protein. This increases total iron-binding capacity, and therefore drops transferrin saturation. C-reactive protein is high because of inflammation. Osmolality lab value is low because of Mr. Sim's dehydration from the frequent diarrhea. Alk phos is high possibly because of bile duct obstruction and/or increased bone cell activity (osteoporosis). HDL-C lab is low because cholesterol levels temporarily fall during acute illness; HDL should be measured after waiting at least six weeks after any illness. Lab values of hemoglobin and ferritin are low, and ZPP is high due to iron deficiency caused by malabsorption of protein. ESR value is high due to inflammation (Lab Tests Online, 2012).

20. Based on your evaluation of Mr. Sim's clinical data, and taking into consideration his current hospital course, list the nutrition problems within the clinical domain.

Nutrition related problems revealed within the clinical domain include protein and iron deficiency, dehydration, electrolyte imbalance, bile duct obstruction, increase of bone cell

activity, malnutrition, improper absorption and digestion of protein, inflammation, acute illness, and low HDL cholesterol (Lab Tests Online, 2012).

E. Behavioral-Environmental Domain

21. From the information gathered within the behavioral-environmental domain, list possible nutrition problems using the diagnostic term.

Self-monitoring deficit (NB-1.4)
Limited adherence to nutrition-related recommendations (NB-1.6)
Poor nutrition quality of life (NB-2.5)

IV. Nutrition Diagnosis

22. Select two high priority nutrition problems and complete the PES statement for each.

Involuntary protein deficiency related to exacerbation of Crohn's disease which results in part from protein malabsorption as evidenced by clinical lab values of albumin, total protein, transferrin, hemoglobin, ferritin, and ZPP outside of normal ranges (Lab Tests Online, 2012).

Involuntary dehydration related to exacerbation of Crohn's disease which results in part from inadequate fluid reabsorption and unabsorbed nutrients in the intestines and possible increase in intestinal secretions as evidenced by low osmolality lab value (Rolfes, Pinna, & Whitney, 2012).

V. Nutrition Intervention

23. The surgeon notes that Mr. Sims probably will not resume eating by mouth for at least 7-10 days. What information would the nutrition support team evaluate in deciding the route for nutrition support?

Information to be evaluated when deciding Mr. Sims's route for nutrition support would include where and how much intestinal resection took place, nutrition status, GI functionality, possibility of paralytic ileus, upper GI motility, physical ability to eat, appetite, hydration status, presence of gastrointestinal obstructions and fistulas, nutrient requirements, presence of intractable vomiting or diarrhea, and enteral nutrition tolerance (Rolfes, Pinna, & Whitney, 2012).

24. The members of the nutrition support team note that his serum phosphorus and serum magnesium are at the low end of the normal range. Why might that be of concern?

Serum phosphorus and serum magnesium at the low end of the normal range are indicative of low body stores, malnutrition, malabsorption of nutrients, steatorrhea, electrolyte imbalance, and dehydration from diarrhea. Low levels cause an imbalance with calcium and potassium. A number of metabolic abnormalities and clinical consequences involving enzyme function, steps associated with DNA and RNA, cellular energy metabolism, membrane stabilization, nerve conduction, ion transport, and calcium channel activity, may result from inadequate serum magnesium. Hypophosphataemia may clinically alter bone and mineral metabolism and may manifest disorders of the skeletal muscle, cardiac, respiratory, haematological, and central nervous systems (Weisinger & Bellorín-Font, 1998).

25. What is refeeding syndrome? Is Mr. Sim's at risk for this syndrome? How can it be prevented?

Refeeding syndrome is characterized by hyperglycemia and electrolyte and fluid imbalances. This sometimes happens in extremely malnourished patients who are aggressively fed parenterally, or by other means, after surgery. These effects happen, because infusions of dextrose increase levels of insulin circulating, which encourage anabolic processes that cause losses of potassium, phosphate, and magnesium from the blood. Fluid retention and changes in organ systems that can be life-threatening may result from electrolyte depletion. Other possible consequences are heart failure and respiratory failure. Mr. Sims is definitely at risk for this syndrome, because he suffers from the two highest risk factors: chronic malnutrition and substantial weight loss. This syndrome can be prevented by beginning parenteral feedings slowing and closely monitoring electrolyte levels and levels of glucose in patients receiving nutrition support who are malnourished.

26. Mr. Sims was started on parenteral nutrition postoperatively. Initially, he was prescribed to receive 200-g dextrose/L, 42.5-g amino acids/L, 30-g lipid/L. His parenteral nutrition was initiated at 50 cc/hr with a goal rate of 85 cc/hr. Do you agree with the team's decision to initiate parenteral nutrition? Will this meet his estimated nutritional needs? Explain. Calculate pro (g); CHO (g); lipid (g); and total kcal from his PN.

Yes, I agree with the team's decision to initiate parenteral nutrition. Mr. Sims just underwent intestinal resection, is malnourished, and his gut needs time to heal and rest before the reintroduction of food into the digestive system. I don't think this prescription will fully meet his nutritional needs, at least based off my calculations from the handout received in class I used to determine requirements. If he is only receiving one liter/day of this prescription, it is not enough calories. It only contains 1240. Mr. Sims's BMR alone is 1587 kcal, according to Harris-Benedict. This is what I calculated for his needs:

A. Energy Requirements
TDE = 3100 (Harris-Benedict, calculated in question 15)

B. Protein Requirement
1.2g/kg = 1.2 g protein x 76 kg (weight) = 91
91 x 4 = 400 kcal (leaving 3100 – 400 = 2700 kcal to be provided by dextrose and lipid)
1000 ml or 1 L of 9% amino acids = 90 g protein or 360 kcal protein needs

C. Fluid Requirements
30 ml/kg = 30 ml fluid x 76 kg = 2300 ml fluid needs

D. Kcal to be provided by intravenous lipid
3100 x .08 = 248 kcal lipid/day or 248 x 7 = 1740 kcal/week IV lipid
2700 kcal (dextrose and lipid) – 248 kcal lipid = 2450 kcal divided by 3.4 kcal or 721 g dextrose

3 bottles of 20% lipid will yield 1800 kcal/week

E. Glucose Tolerance
76 kg x 5 mg CHO/kg/min x 1.44 = 547 grams dextrose = 2188 kcal

1 bottle (1000 ml) D60W at 50 cc/hr = 2448 kcal
Intravenous lipid/day = 248 kcal
1 bottle (1000 ml) 9% amino acids/day = 90 g protein = 360 kcal
3056 total kcal would be provided by this prescription

27. 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).

For the first PES statement, the ideal goal is to get abnormal lab values caused by protein deficiency back to normal levels. The intervention will consist of increasing Mr. Sims's intake of dietary protein to approximately 122 g/day until exacerbation of Crohn's subsides and digestion and absorption returns to normal (remission).

For the second PES statement, the ideal goal is to increase his osmolality level to within the normal range. The intervention will consist of parenteral nutrition until osmolality lab value returns to normal, intestinal fluid absorption becomes adequate, and severity of illness ceases.

VI. Nutrition Monitoring and Evaluation

28. Indirect calorimetry revealed the following information.

Measure	**MR. Sim's Data**
Oxygen consumption (mL/min)	295
CO_2 production (mL/min)	261
RQ	0.88
RMR	2022

What does this information tell you about Mr. Sims?

His oxygen consumption is high. The normal measure is 250 mL/min. This is due to his high metabolic rate induced by Crohn's disease. Also, his carbon dioxide production is high due to his increased metabolic rate. Normal CO_2 production is 200 m/L. Mr. Sims's respiratory quotient value falls within the normal range (0.7-1.0) The RQ is the ratio of the volume of carbon dioxide produced by metabolism of tissue to the volume of oxygen consumption in the same tissue metabolism. His RMR is 2022, according to indirect calorimetry. In a state of complete rest, this is a measure of the calories released per kg of body weight in a certain amount of time, in this case, per day (Farlex, 2012). Indirect calorimetry revealed that his RMR is in fact higher than the Harris-Benedict and Mifflin-St. Jeor equations estimated.

29. Would you make any changes in his prescribed nutrition support? What should be monitored to ensure adequacy of his nutrition support? Explain.

Yes, he needs over twice as much protein to account for his high metabolic rate right now, and for healing. Dextrose should be more than double as well, according to my calculations. Amount of lipids is okay. His weight and clinical lab values, as well as abnormal signs and symptoms, should be closely monitored while receiving parenteral feedings. Not paying attention to the adequacy of his nutrition support could lead to severe malnutrition, dehydration, further illness, preventable weight loss, and could even cause death.

30. What should the nutrition support team monitor daily? What should be monitored weekly? Explain your answers.

Every 4-8 hours, body temperature, including vital signs, should be checked. Catheter site should be inspected for signs of inflammation or infection. The rate of pump infusion and the appearance of tubing and parenteral solution should be checked. Blood glucose level need to be measured every 4-8 hours until stabilization occurs; it can be checked daily after that. Parenteral solution and tubing need to be replaced daily. Weight changes should be monitored every day. Fluid intake and output have to be recorded daily, along with measures of BUN, serum creatinine, and serum electrolytes, until stabilized. Weekly reassess nutrition status and check laboratory values to monitor chemistry of blood (Rolfes, Pinna, & Whitney, 2012).

31. Mr. Sim's serum glucose increased to 145 mg/dL. Why do think this level is now abnormal? What should be done about it?

He was admitted with a glucose lab value of 82 which is at the low end of the normal range, 70-110. His value of 145 most likely reveals that he is getting too much dextrose in his parenteral feedings. His next parenteral feeding should contain less dextrose so that his blood glucose is allowed to drop back within the normal range.

32. Evaluate the following 24-hour urine data: 24-hour urinary nitrogen for 12/20: 18.4 grams. By using the daily nursing record that records the amount of PN received, calculate Mr. Sim's nitrogen balance on postoperative day 4. How would you interpret this information? Should you be concerned? Are there problems with the accuracy of Nitrogen balance studies?

42.5 (amino acids g) / 6.25 (constant)– 18.4 (UUN) + 3 (factor) = - 8.6

Mr. Sims's nitrogen balance is negative. He is not getting enough protein in his diet for maintenance. His protein intake should be increased to an amount that would give him a positive nitrogen balance to allow for healing from exacerbation of Crohn's and resection. Healing cannot take place in negative N balance (California State University, Northridge, 2012). During negative nitrogen status, the body breaks down muscle and other body proteins for energy (Rolfes, Pinna, & Whitney, 2012). Yes, problems exist with nitrogen balance studies. Urinary urea nitrogen, on average represents 80 to 90% of total urea nitrogen, but the variability can range from 12 to 112% (Konstantinides, Konstantindes, Li, Myaya, & Cerra, 1991).

33. On post-op day 10, Mr. Sim's team notes that he has had bowel sounds for the previous 48 hours and had his first bowel movement. The nutrition support team recommends consideration

of an oral diet. What should Mr. Sims be allowed to try first? What would you monitor for tolerance? If successful, when can the parenteral nutrition be weaned?

First, he will be allowed to try clear liquids including pulp free fruit juices, sodas, and clear broths. Small amounts are administered to begin with to determine tolerance. Later feedings recommend lactose free, low fat foods and beverages. For tolerance, gastrointestinal symptoms such as nausea, vomiting, diarrhea, or bloating will be monitored. Parenteral feedings may be discontinued when about two-thirds to three-fourths of nutrient needs can be met enterally. It may take up to several weeks in some cases after terminating parenteral nutrition to transition to a complete oral diet (Rolfes, Pinna, & Whitney, 2012).

34. What would be the primary nutrition concerns as Mr. Sims prepares for rehabilitation after his discharge? Be sure to address his need for supplementation of any vitamins and minerals. Identify two nutritional outcomes with specific measures for evaluation.

The primary nutrition concerns include hypermetabolism, negative nitrogen balance, insulin resistance, and hyperglycemia. He should continue to take his multivitamin daily and a nitrogen supplement if his protein intake doesn't increase right away. He may also need Vitamin $B_{12,}$ fat soluble vitamin, and electrolyte supplementation. Mr. Sims needs to keep a strict watch on his dietary intake to be sure he his getting adequate nourishment for healing and then maintenance of normal health (Rolfes, Pinna, & Whitney, 2012). Dehydration and fluid loss is one significant nutritional outcome that can be measured frequently by determining any weight loss. A nutritional outcome of pain and/or abdominal discomfort may mean the proper diet is not being followed or exacerbation of illness.

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