Case 31 Nutrition Support in Sepsis and Morbid Obesity

Julia Araiza, Cecilia Olmos, XXXXX, XXXXX, XXXXX

California State University, Los Angeles

NTRS 415B

**CASE STUDY**

**PI:** CM is a 37 YOWM (year-old white male) with probable sepsis admitted to the MICU from the ER on February 23rd.

**CC:** CLM experienced flu-like symptoms over past 48 hours became acutely short of breath.

**HPI**: CM status post RYGB (Roux-en-Y gastric bypass) surgery 4 months ago (November 01) with a successful 100 lb. weight loss.  In the past 48 hours, he experienced flu-like symptoms, followed by acute short of breath and admitted to the MICU with probable sepsis. Admitting physician initiated sepsis bundle orders. Feeding tube was inserted and nutrition consult was ordered. Medical records indicate code full (means that every intervention possible to keep patient alive; this may even entail being put on long-term life support.)  CM is on mechanical ventilation.  Day one (2/24): MD reviewed labs.  No other record of subsequent days indicated in case study.

**PMH:** Obesity of 250+ lbs of weight since the age 15 and has continued to gain weight since adolescence. His highest weight peaked at 425 lbs, had RYGB 4 months ago after losing 24 lbs (401 lbs). Over the past 10 years, CM has suffered from T2DM (Type 2 Diabetes Mellitus), HTN (hypertension), hyperlipidemia (high triglyceride and cholesterol in blood) and osteoarthritis. He had a total R (right) knee replacement 3 years ago. Medication: Lovastatin 60 mg/day (previously on Lantus and metformin - off diabetes medications for 2 months).

**FH:** Father: T2DM, CAD (Coronary Artery Disease), HTN, COPD (chronic obstructive pulmonary disease). Mother: T2DM, CAD, osteoporosis.

**SH:** CM is single, has no children, and lives with a roommate. Occupation: Office manager for a real estate office. Previous alcohol use:  2-3 beers /week, has not had alcohol since bariatric surgery (11/01).

**PE:** Vital Signs: Temp 102.5, Pulse 98, Resp rate 23, BP 135/90, Height 5’-10”, Weight 325 lbs. Heart: Elevated rate, regular rhythm, normal heart; diminished distal pulses. No gallop and no friction rub. HEENT (Head, Eye, Ear, Nose, and Throat): normal head, eyes – PERRLA (Pupils Equal, Round & Reactive to Light and Accommodations), clear ears, normal nose, dry mucous membranes without exudates or lesions in throat. Chest/Lungs: Respiration rapid with rales. Peripheral vascular: diminished pulses bilaterally. Abdomen: Morbidly obese, soft, rash present under skinfolds. Extremities: Ecchymosis (discoloration of the skin resulting from bleeding underneath), abrasions, petechiae (small red or purple spot caused by bleeding into the skin) on lower extremities, 2+ pitting edema (swelling). Skin: Warm, pale, dry to touch. Genitalia: Normally developed 37 yo male.

**ASSESSMENT:** CM is a 37 YOWM transferred from ER with severe sepsis, pneumonia. Maintain current mechanical ventilation; cultures pending but will continue Vancomycin and Zosyn. Sedation with Versed and fentanyl. Initiate enteral feeding per nutrition consult.

**HOSPITAL COURSE:** CM was admitted February 23rdwith a diagnosis of sepsis and pneumonia. His current medication is Lovastatin 60 mg/day. CM was prescribed upon admission, medications primarily for bacterial infection, sedation, hydration, sedation and pain control. Zosyn (Piperacillin-tazobactam) 4.5 g in dextrose 100 mL IVPB and Vancomycin 2 g in sodium chloride IVPB. Versed, Norepinephrine 4 mcg/min; Dopamine 5 mcg/kg/min; epinephrine 1 mcg/min is ordered and is to be given if SBP (systolic blood pressure) <90 or MAP (mean arterial pressure) <65. Normal saline 500 mL bolus until CVP (central venous pressure) 8-12, then continue at 150 mL. The following labs were ordered for CM to rule out sepsis. On February 23rd: Chemistry Panel: Potassium (mEg/L), Carbon dioxide(CO2, mEg/L), Glucose (mg/dL), Phosphate, inorganic (mg/dL), Bilirubin, direct (mg/dL), Protein, total (g/dL), Albumin (g/dL), Prealbumin (mg/dL), Ammonia (NH3, mmol/L), ALT (U/L), AST (U/L), CPK (U/L), C-reactive protein (mg/dL), Fibrinogen (mg/dL), Lactate (mEq/L), Cholesterol (mg/dL), HDL-C (mg/dL), VLDL (mg/dL), LDL (mg/dL), LDL/HDL ratio, Triglycerfdes (mg/dL), HbA1c (%). Hematology: WBC (X 103/mm3), Hemoglobin (Hgb, g/dL), Hematocrit (Hct, %), Transferrin (mg/dL), Ferritin (mg/mL), Urinalysis: Protein (mg/dL), Glucose (mg/dL), Ketones, Prot chk, Bac.

Upon admission, NPO (no oral intake food or drink). Orders for feeding tube inserted and enteral feeding initiated per nutrition consult. Initiated Sepsis Bundle Orders: Central line placement; arterial line placement – arterial line care per protocol. Feeding tube inserted and nutritional consult ordered. Maintain current mechanical ventilation: cultures pending on day 1 of admission but will continue vancomycin and Zosyn. Sedation with Versed and fentanyl. Initiate enteral feeding per nutrition consult. CM’s prognosis depends on the stage of sepsis and his health status prior to admission. No indication that CM progressed to septic shock was documented. This will decrease his risk of death. He is also relatively young, which increases his chance of survival (Davis, 2015).

**THEORETICAL DISCUSSION OF DISEASE PROCESSES (ES):**

Sepsis is defined as an immunosuppressive process that prevents an adequate response to infection.  Systemic inflammatory response syndrome (SIRS) is an additional classification of this condition not necessarily caused by an infectious process. SIRS may occur after major surgery or trauma, or with other conditions such as myocardial infarction (page 691).

Sepsis is caused by an inappropriate immune response to an infection and is a life threatening condition which is a major cause of death globally.  Our immune system is very efficient at destroying bacteria or other microbes that enter our body.  However, in sepsis, the immune system goes into overdrive and releases chemicals into the blood in order to fight infection which triggers widespread inflammation that can ravage the entire body (Recknagel et al., 2012).

People who are most likely to develop a septic response to an infection are the elderly, neutropenic (those who have low levels of white blood cells), or those that are immunocompromised.  Usually the infection is bacterial, but other things such as infections of fungi, viruses, and protozoa can also trigger sepsis. The infection can be limited to one area or can be blood-borne, but as soon as sepsis is triggered, the damage it causes is widespread and life threatening.

At first sepsis often has the typical symptom of systemic infections as seen in fever, tachycardia, tachypnea, and an elevated white blood cell count.  However, in sepsis instead of the symptoms lessening and disappearing, the inflammatory forces spread beyond the infected region. The spread starts as pro-inflammatory signal molecules enter the bloodstream in large numbers. As they move into the vascular system, these molecules cause damage the endothelium that lines the blood vessels. The orderly passage of gases, nutrients, and fluids through the capillary walls is disrupted and organs become hypoxic. (Shapiro et al., 2010). If the sepsis does not stop, organ failure will occur, and now the sepsis is referred to as severe sepsis.  This increased the chances that the patient will die.  In the cases where the circulatory system fails causing the arterial wall muscles to no longer contract sufficiently to maintain adequate blood pressure. Now the patient is in septic shock, and the chance of surviving declines further (Shapiro et al., 2010).

Systemic Inflammatory Response Syndrome (SIRS) is the systemic meltdown that occurs in sepsis and is a syndrome in itself. It can be caused by many things such as noninfectious insults such as pancreatitis, trauma, or burns. SIRS is called sepsis when it is triggered by an infection.  In an attempt to control or remove the primary source of infection, sepsis, unlike other types of SIRS must be treated with antibiotics.

**FINAL NUTRITIONAL CARE PLAN:**

CM is: 5’10” Present weight: 325# UBW: 425# %UBW: 76% IBW: 166# %IBW: 196% BMI: 46.6 kg/m2. Recent weight change is severe, but intentional due to the gastric bypass surgery. He is classified as morbidly obese Class III. Visceral protein status: serum albumin: 1.9 g/dL is low indicative of acute infection, surgery or stress, prealbumin 11 mg/dL is low indicative of severe nutrient deficiency. No diet history is recorded other than NPO at admission from emergency room since the patient is sedated and intubated, thus unable to speak.

Nutritional diagnoses: PES #1: Increased energy expenditure related to septic state as evidenced by patient under severe stress, elevated WBC count of 23.5, high CRP of 5.8 and elevated fibrinogen of 525. PES #2: Inadequate protein-energy intake related to septic state and malnutrition as evidenced by ⇩ serum albumin of 1.9, ⇩ prealbumin of 11 and ⇩ total protein of 5.8. PES #3: Impaired nutrient utilization related to malabsorption and restriction of micronutrients as evidenced by status post Roux-en-Y bypass surgery.

Evaluation of laboratory findings: His chemistry panel indicated many critical values. Elevated C-reactive protein (5.8mg/dL), measures general levels of inflammation in the body. High levels of CRP are caused by infections and many long-term diseases. Used to detect or monitor significant inflammation in an individual who is suspected of having an acute condition, such as a serious bacterial infection like sepsis. Fibrinogen is an acute-phase reactant protein. Elevated fibrinogen (525 mg/dL) is associated with acute inflammatory reactions and acute infection such as pneumonia. Elevated CPK (220 U/L) can be associated with pulmonary infarction or injury to the lungs. Elevated lactate (4.2 mEq/L) quantifies the degree of tissue hypoxemia associated with shock or localized vascular occlusion. Increased levels can be an indication of shock and tissue ischemia. Elevated white blood count (23.5 mm3) helps fight infections. A high white blood cell count can be due to anemia, infections, and most often those caused by bacteria or physical stress. Elevated glucose levels (185 mg/dL) can be an indication of stress or uncontrolled diabetes.

Elevated HbA1c (6.8%) provides an accurate long-term index of the patient's average blood glucose level. CM has a past medical history of diabetes and after surgery, he discontinued his diabetes medication. Urinalysis indicated positive results in protein, glucose, ketones can possibly be related to his poor utilization of glucose for energy. His past medical history of hyperlipidemia is indicated with decreased HDL-C level (32 mg/dL), elevated values of cholesterol (320 mg/dL), VLDL (45 mg/dL), LDL (232 mg/dL), triglycerides (232 mg/dL) and an LDL/HDL ratio (7.5).

Acidosis indicated by abnormal values: Elevated potassium (5.8 mEg/L) when the body responds to trauma by aldosterone, increasing potassium excretion. Elevated CO2 (31 mEg/L) is the mark of type II respiratory failure due to inadequate alveolar ventilation. Elevated phosphate, inorganic (2.2 mg/dL) when the pH is reduced, phosphates are driven out of the cell and into the bloodstream as part of a buffering system. Elevated NH3 (35 mmol/L) indicates ineffective metabolism and elimination of ammonia.

Sepsis is indicated by inflammatory response causing many organs to dysfunction. Lab values confirm sepsis diagnosis for CM and the effect on organs. Possible liver involvement indicated in elevated ALT U/L (37) would indicate liver rather than red blood cell hemolysis as a source of jaundice. Sepsis can cause an increased level in blood of unconjugated (indirect) bilirubin (0.7 mg/dL) as an indication of liver function and hemolytic anemia. An increased level of AST (38 U/L) points to multiple trauma and acute hemolytic anemia. Hematology results correlate the suspicion of hemolytic anemia with a low hemoglobin (12.5 g/dL), low hematocrit percentage of (38%). Ferritin (14 mg/mL) is the most sensitive test to determine iron-deficiency anemia. Elevated transferrin (385 mg/dL) evaluates the blood's ability to bind and transport iron and is a reflection of iron stores.

Critically ill, post bariatric surgery patients have increased energy needs and protein requirements. His low total protein (5.8 g/dL) indicated severe nutrient deficiency. Low albumin status (1.9 g/dL) can be associated with malnutrition and probable liver dysfunction (albumin synthesis). Low level of prealbumin (11 mg/dL) also indicates severe nutrient deficiency when correlated with his restrictive intake and malabsorption as a result of his surgery.

Review of medications and food/nutrient interactions: CM was prescribed upon admission, medications primarily for bacterial infection, sedation, hydration, sedation and pain control. Zosyn (Piperacillin-tazobactam) 4.5 g in dextrose 100 mL IVPB and Vancomycin 2 g in sodium chloride IVPB is used to treat a wide variety of bacterial infections. Versed affects the CNS (central nervous system) as a depressant and used for sedation. Fentanyl treats moderate to severe chronic pain. Norepinephrine 4 mcg/min; Dopamine 5 mcg/kg/min; epinephrine 1 mcg/min is ordered and is to be given if SBP (systolic blood pressure) <90 or MAP (mean arterial pressure) <65. Normal saline 500 mL bolus until CVP (central venous pressure) 8-12, then continue at 150 mL/hr is a sterile, nonpyrogenic solution for fluid and electrolyte replenishment intravenous administration. His current medication of Lovastatin 60 mg/day lowers high cholesterol and triglyceride levels in the blood is continued.

It is important to note that CM admission information did not indicate he was taking any vitamin/mineral supplements. Due to the restrictive and malabsorption associated with the Roux-en-Y, CM is at a high risk for micronutrient deficiency is required to take supplemental vitamins compared to the gastric sleeve which is restrictive only. Vitamins of concern include vitamin D, thiamin, B12, and folate. There is also a risk of deficiency of all of the fat-soluble vitamins and for mineral deficiencies, with iron deficiency a particular problem. Up to 49% of bariatric surgery patients are iron deficient (Marshall, 2003). Upon review, there are no drug interactions indicated with current medications.

Evaluation of physical or clinical findings: There is an acute postoperative risk of sepsis in bariatric surgeries of 5% due to anastomotic leak (breakdown of the surgical site of the bypass (Marshall et al., 2003). If not detected early, it will lead to intra-abdominal sepsis and a prolonged postoperative course.  CM is 4 months post op Roux –en-Y. No additional labs were obtained to compare to his initial labs in the case study.

Energy requirements: EER: (18-22 kcal/kg IBW) = 18\*75.45 kg = 1358, 22\*75.45kg = 1358-1660 kcal Protein requirements: EPR: (1.5 - 2.0 g/kg IBW for Class III morbid obesity per ASPEN guidelines) = 1.5\*75.45= 113 g, 2.0\*75.45 = 151 g 113 -151g. of protein = 452 -604 kcal of protein. Nelms lists possible predictive equation for permissive underfeeding for critically ill obese patients Table 22.6 page 671 lists 18-22 kcal/kg and 1.5-2.5 g protein/kg of IBW (Nelms, et al., 2016). Fluid requirements: 1.01 mL/kg/hr = 1.01mL\*75.45 kg \* 22 hours for ICU patients = 1676 mL in addition to IV piggy back 250 mL = 1676 + 250 = ~1700 mL/22 hour. Diet order: 1358 – 1660 kcal total, 113 – 151 g (452 – 604 kcal) of protein, 197 g (788 kcal) of CHO, and 17g (153 kcal) of fat with 1700mL of fluid. Continuous enteral tube feeding will be used. Our case study did not indicate any I/O record, residual volumes, nausea, vomiting, stool frequency and consistency following the initiation of enteral feeding. Diet Therapy: Escott Stump (2015) recommends branched-chain amino acids (BCAAs) are useful for energy because they do not need to be metabolized to glucose. Enteral nutrition should be initiated within 48 hours of admission and average intake actually delivered within the first week should be at least 60-70% of total estimated energy requirements as determined by the patient’s assessment. (Academy of Nutrition and Dietetics, 2013) A continuous feed would be best for CM because a continuous feed with a slower advancement and will be better tolerated with his bowel reconstruction and allow for a more stabilized blood glucose Permissive underfeeding is accepted for patients with a BMI > 30 because metabolic rate is not markedly increased in most patients with critical illness, weight gain during nutrition support in critical illness is caused by fat, and risk of infections increase with hyperglycemia (Jeejeebhoy, 2004). It is important to not overfeed because excess calories causes hyperglycemia, hepatic steatosis, and excess CO2 production which can exacerbate respiratory insufficiency and prolong weaning from mechanical ventilation. This is very important to prevent due to his already high CO2 levels. It is also recommended that patients with a BMI >30, who are severely malnourished, and who are septic be kept on hypocaloric energy requirements. Aggressive protein provision is also recommended for patients who are metabolically stressed. This is to spare protein in their muscle mass and to help enhance healing. Initiate diet order of 113 – 151g (452 – 604 kcal) of protein, 197g (788 kcal) of CHO, and 17g (153 kcal) of fat, total of 1358 – 1660 kcals with 1700mL of fluid.

**ADIME**

Date/Time: May 15, 2015

***Assessment***

CM is a 37 YOWM (year-old white male) with probable sepsis admitted to the MICU from the ER on February 23rd. CM experienced flu-like symptoms over past 48 hours became acutely short of breath. 5’10” Current Weight: 325# BMI: 46.7 (morbidly obese, Class III); UBW: 425#, % UBW: 76.47% IBW166# %IBW:196%; Adjusted body weight for obesity: 205.75

Pt labs confirm diagnosis of sepsis / bacterial infection, along with indications of malnutrition and uncontrolled diabetes. ⇧ C-reactive protein (5.8mg/dL), ⇧ Fibrinogen (525 mg/dL) ⇧ CPK (220 U/L) ⇧ Lactate (4.2 mEq/L) ⇧ WBC (23.5 mm3) ⇧ glucose (185 mg/dL), ⇧HbA1c (6.8%), ⇩ HDL-C level (32 mg/dL), ⇧ Cholesterol (320 mg/dL), ⇧VLDL (45 mg/dL), ⇧ LDL (232 mg/dL), ⇧ Triglycerides (232 mg/dL) ⇧ LDL/HDL ratio (7.5), ⇧Potassium (5.8 mEg/L), ⇧CO2, (31 mEg/L) ⇧Phosphate, inorganic (2.2 mg/dL) ⇧ NH3, (35 mmol/L) ⇧ALT U/L (37) ⇧ (indirect) bilirubin. (0.7 mg/dL) ⇧AST (38 U/L) ⇩ HGB (12.5 g/dL), ⇩ HCT (38%). ⇩Ferritin (14 mg/mL) ⇧ Transferrin (385 mg/dL), ⇩ total protein (5.8 g/dL) ⇩ albumin (1.9 g/dL) ⇩ prealbumin (11 mg/dL) Urinalysis + protein, +glucose, + ketones.

Medications primarily for bacterial infection, sedation, hydration, sedation and pain control. Zosyn (Piperacillin-tazobactam) 4.5 g in dextrose 100 mL IVPB, Vancomycin 2 g in sodium chloride IVPB, Versed, Fentanyl, Norepinephrine 4 mcg/min; Dopamine 5 mcg/kg/min; epinephrine 1 mcg/min, Normal saline 500 mL, and Lovastatin 60 mg/day.

Physical Assessment:HEENT: Obese neck, no adenopathy, no JVD appreciated, RIJ, (right internal jugular), CVC in place. Neck: WNL Heart: Regular rate, regular rhythm, no M/R/G appreciated. Lungs: Coarse breath sounds bilaterally with scattered rhonchi R> L; no wheezes or crackles. Abdomen: Morbidly obese, soft, non-distended, no organomegaly, bowel sounds present. Extremities: Good radial pulses bilaterally. Neurologic: Intubated, sedated, pupils equal and reactive to light. GI: Active bowel sounds. I/O +1430 mL. Skin

WNL. Warm and dry to touch. Ecchymosis, abrasions, petechiae on lower extremities, 2+ pitting edema. Rashes under skinfolds. Current Diet: NPO. Feeding tube inserted.

EER; EPR; Fluid requirements: EER: (18-22 kcal/kg IBW) = 18\*75.45 kg = 1358, 22\*75.45kg = 1358-1660 kcal EPR: (1.5 - 2.0 g/kg IBW for Class III morbid obesity per ASPEN guidelines) = 1.5\*75.45= 113 g, 2.0\*75.45 = 151 g 113 -151g. of protein = 452 -604 kcal of protein. Nelms lists possible predictive equation for permissive underfeeding for critically ill obese patients Table 22.6 page 671 lists 18-22 kcal/kg and 1.5-2.5 g protein/kg of IBW (Nelms, et al., 2016).

Fluid requirements 1.01 mL/kg/hr = 1.01mL\*75.45 kg \* 22 hours for ICU patients = 1676 mL in addition to IV piggy back 250 mL = 1676 + 250 = ~1700 mL/22 hour.

Adjusted Weight for Obesity: ABW = IBW + 0.25 (actual body weight - IBW) 166# + 0.25(325# - 166#) = 166# + 0.25(159#) = 166# + 39.75# = ABW = 205.75# = ~ ABW = 206#

***Diagnosis***:

1. Increased energy expenditure related to septic state as evidenced by patient under severe stress, elevated WBC count of 23.5, high CRP of 5.8 and elevated fibrinogen (525 mg/dL).
2. Inadequate protein-energy intake related to septic state and malnutrition as evidenced by ⇩ serum albumin of 1.9, ⇩ prealbumin of 11 and ⇩ total protein of 5.8 .
3. Impaired nutrient utilization related to malabsorption and restriction of micronutrients as evidenced by status post Roux-en-Y bypass surgery.

***Intervention:***

* Start continuous enteral tube feeding on osmolite at 20 mL/hr and increase as tolerated by 10-20 mL every 8 – 12 hours until goal rate of 77.27 mL/hr to provide 1500 kcal (197.5 g of CHO, 140g of protein, 17g of fat). ICU patient continuous feed over 22 hours.
* Use of aseptic techniques for feedings and meals will be essential because of infection risk.
* Once CM is discharged and not sedated, educational material on food safety will be given to reduce any new infection risks because he is more susceptible to foodborne illness.
* Once CM is discharged, he is to continue high protein post bariatric diet. At his stage of recovery post Roux-en-Y, protein needs are first addressed in feedings.
* Repeat labs, review for improved values compared to initial labs: Basic metabolic panel, hepatic function panel, CBC, EDIF, platelets, urinalysis.
* Glucose levels to return to normal levels of >70-110mg/dL to decrease uncontrolled diabetes.

***Monitoring/Evaluation***

* Reevaluate enteral feeding needs once weaned off of ventilator and ability to self-feed and meet the recommendations.
* At discharge, CM will have increased knowledge of aseptic techniques and foodborne illness.
* Once discharged, patient will improve oral intake of protein sources from dairy products, meat groups, and protein shakes to meet daily protein needs of 1.5 g/kg/day.
* Labs (C-reactive protein, fibrinogen & CPK) will be evaluated for normal level maintenance and for prevention of future infection.
* CM blood glucose levels will have improved.

***Signatures (& names)***

Julia Araiza

Waka Banchi

Silvia Martinez

Kanako Miyoshi

Cecilia Olmos

REFERENCES

Davis, C. (2015, February 9). Sepsis Symptoms, Causes, Treatment - What is the prognosis (outcome) with sepsis? - MedicineNet. Retrieved May 12, 2015, from <http://www.medicinenet.com/sepsis/page7.htm>

Escott Stump, S. (2015). *Nutrition and Diagnosis-Related Care,* 8th ed. Philadelphia: Wolters Kluwer.

Jeejeebhoy, KN. (2004). Permissive underfeeding of the critically ill patient. *Nutr Clin Pract.:* 19(5):477–80.

Marshall SJ, et al. (2003). Roux-en-Y gastric bypass leak complications, *Arch Surg.* 2003;138:520-524.

 Mogensen, KM, (2010). Nutritions Support Therapy for the bariatric surgery patient, *Weight Management Matters,* Winter 2010.

Pagana, KD; Pagana, TJ, (2013). Mosby's Manual of Diagnostic and Laboratory Tests. Elsevier Health Sciences. Kindle Edition.

Port, A. M., & Apovian, C. (2010). Metabolic support of the obese intensive care unit patient: a current perspective. Current Opinion in Clinical Nutrition and Metabolic Care, 13(2), 184–191. doi:10.1097/MCO.0b013e328335f1e6.

Nelms, M. (2016). Nutrition therapy and pathophysiology (Third ed.). Boston, MA: Cengage Learning.

Recknagel P, et al. (2012). Liver Dysfunction and Phosphatidylinositol-3-Kinase Signaling in Early Sepsis: Experimental Studies in Rodent Models of Peritonitis. Retrieved July 22, 2013 from [http://www.plosmedicine.org/article/info%3Adoi%2F10.1371%2Fjournal.pmed.1001338](http://www.plosmedicine.org/article/info%3Adoi/10.1371/journal.pmed.1001338).

Shapiro NI, et al. (2010). Sepsis syndromes. In: Marx, J, et al. (eds), *Rosen’s Emergency Medicine : Concepts and Clinical Practice*, 7th ed. Philadelphia: Mosby/Elsevier, Ch. 136

**Q&A**

1. Which of the following is NOT a symptom of Sepsis?

    A)   High fever

    B)   Tachycardia

    C)   Tachypnea

    D)   **Hypoglycemia\***

*(answer D)*

    2. All of the following are tests commonly used for inflammation EXCEPT?

    A)  C-reactive protein

    B)  Fibrinogen

    C) **HcG\***

    D)  CPK

*(answer C)*

**QUESTIONS**

***1.*** Sepsis is an uncontrolled inflammatory response to infection or trauma. It is the 10th leading cause of death in the United States. SIRS (systemic inflammatory response syndrome) is an additional classification of sepsis not necessarily caused by an infectious process. SIRS may occur after major surgery or trauma.

***2.*** The metabolic alterations that occur as a result of sepsis and the systemic inflammatory response include changes in carbohydrate, protein, and lipid metabolism. A combination of pro-inflammatory cytokine release, imbalance of coagulation factors, altered cellular metabolism, hypoperfusion and hypotension direct the physiological changes that occur with sepsis and SIRS. In carbohydrate metabolism, proinflammatory cytokines (IL-2, TNF, and interferon-y) and catabolic hormones (glucagon, catecholamines, and cortisol) are released. Glycogenolysis and gluconeogenesis due to a limited supply of glucose and increased demand for glucose occurs. The increase in glucose production, as well as insulin resistance, results in hyperglycemia even if the patient has no history of diabetes. Protein breakdown and synthesis accelerate while uptake of amino acids by the muscle declines. The liver increases its production of acute-phase proteins (CRP, fibrinogen), and this leads to a decrease in synthesis of other proteins, such as albumin and prealbumin (hepatic reprioritization). If no adaptation occurs, lethal depletion can occur. Alterations in lipid metabolism include an increase in lipolysis impairing transportation within cells, causes an accumulation of lactate and pyruvate, resulting in serum hyperlipidemia.

***3.*** Roux-en-Y is a restrictive-malabsorptive procedure. The size of the stomach is surgically reduced and bypasses part of the stomach and small intestine connecting to the jejunum. Nutritional risks include loss of lean body mass, malabsorption of micronutrients such as calcium and iron, and inadequate intake of all nutrients. These can possibly lead to malnutrition or to a specific nutrient deficiency if the patient is non-compliant with taking their supplemental vitamin and minerals.

***4.*** This patient is currently sedated, intubated and on mechanical ventilation after he presented to the emergency room complaining of shortness of breath. Since this patient was diagnosed with sepsis, it is important to initiate tube feeding to avoid catabolism that will occur with the increased needs that develop with sepsis and SIRS. Enteral feeding was ordered since the gut still works after bypass surgery.

***5.*** The difference in Roux-en-Y patients from patients with a complete stomach is the risk of intolerance for a nasogastric tube feeding due to the size of the pouch. Another consideration is to check his laboratory results to see if he is deficient in any protein requirements because of the sepsis.

***6.*** Refeeding is a metabolic alterations that may occur during nutritional repletion of starved patients. Roux-en-Y rapid weight loss due to bariatric surgery places him at high risk for refeeding syndrome.

***7.*** Ht: 5’10”, Wt: 325#; BMI: 46.6 (morbidly obese) IBW: 166#, %IBW: 196%; UBW: 425#, %UBW: 76%. His highest weight was 425# before surgery. He lost 24# prior to the surgery and lost 100# after surgery. This is 19% weight loss over four months, which would usually indicate severe malnutrition, but rapid weight loss was intentional and typical in Roux-en-Y gastric bypass patients.

***8.*** Patient reported flu-like symptoms which can indicate an infection. His complaint of shortness of breath, Temp. 102.5, HR 98, respiratory rate 23 and 2+ pitting edema were indications of the inflammatory response to sepsis, which was confirmed with laboratory results. Fluid can cause the rapid respirations with rales.

***9.***

|  |  |  |
| --- | --- | --- |
| Ref. Range | 2/23 | Interpretation |
| Chemistry |
| Potassium (mEg/L) | 3.5- 5.5 | 5.8 !↑ | This is a critical value. Potassium is an electrolyte for cardiac function. Acidotic states tend to increase potassium levels. Body responds to trauma by aldosterone, increasing potassium excretion. |
| Carbon dioxide(CO2, mEg/L) | 23-30 | 31 !↑ | CO2 retention is the hallmark of type II respiratory failure. While in type I any degree of hypoxia is compensated for by hyperventilation (and a decrease in CO2), this mechanism fails in type II. Mechanical ventilation (through intubation). |
| Glucose (mg/dL) | 70-110 | 185 !↑ | Critical values: Adult male: < 50 and > 450 mg/ dL This test is a direct measurement of the blood glucose level. It is most commonly used in the evaluation of diabetic patients. |
| Phosphate, inorganic (mg/dL) | 2.3-4.7 | 2.2 !↓ | Acidosis: When the pH is reduced, phosphates are driven out of the cell and into the bloodstream as part of a buffering system. |
| Bilirubin, direct (mg/dL) | <0.3 | 0.7 !↑ | This test is used to evaluate liver function. It is a part of the evaluation of adult patients with hemolytic anemias.  Sepsis can cause an increased level in blood of unconjugated (indirect) bilirubin. |
| Protein, total (g/dL) | 6-8 | 5.8 !↓ | Low levels indicates severe nutrient deficiency. |
| Albumin (g/dL) | 3.5-5 | 1.9 !↓ | Malnutrition: Lack of amino acids available for building proteins contributes to this observation. Probably the liver dysfunction (albumin synthesis) associated with malnutrition also contributes to the low albumin levels.   |
| Prealbumin (mg/dL) | 16-35 | 11 !↓ | Low levels indicates severe nutrient deficiency. |
| Ammonia (NH3, mmol/L) | 9-33 | 35 !↑ | A significantly increased concentration of ammonia in the blood indicates that the body is not effectively metabolizing and eliminating ammonia but do not indicate the cause. |
| ALT (U/L) | 4-36 | 37 !↑ | This test is used to identify hepatocellular diseases of the liver. It is also an accurate monitor of improvement or worsening of these diseases. In jaundiced patients an abnormal alanine aminotransferase (ALT) will incriminate the liver rather than red blood cell (RBC) hemolysis as a source of the jaundice. |
| AST (U/L) | 0-35 | 38 !↑ | This test is used in the evaluation of patients with suspected hepatocellular diseases.  Increased levels can be an indication of multiple traumas, recent noncardiac surgery and acute hemolytic anemia |
| CPK (U/L) | 55-170 | 220 !↑ | This test is used to support the diagnosis of myocardial muscle injury (infarction). It can also indicate neurologic or skeletal muscle diseases. Because the CK-BB isoenzyme is found predominantly in the brain and lung, injury to either of these organs (e.g., cerebrovascular accident, pulmonary infarction) will be associated with elevated levels of this isoenzyme. |
| C-reactive protein (mg/dL) | <1.00 | 5.8 !↑ | A C-reactive protein (CRP) test is a blood test that measures the amount of a protein called C-reactive protein in your blood. C-reactive protein measures general levels of inflammation in your body. High levels of CRP are caused by infections and many long-term diseases.CRP may be used to detect or monitor significant inflammation in an individual who is suspected of having an acute condition, such as: a serious bacterial infection like sepsis. |
| Fibrinogen (mg/dL) | 160-145 | 525 !↑ | Values of < 100 mg/ dL can be associated with spontaneous bleeding.  Acute inflammatory reactions (e.g., rheumatoid arthritis [RA], glomerulonephritis), Trauma, acute infection such as pneumonia: Fibrinogen is an acute-phase reactant protein. Coronary heart disease (CHD), Stroke, Peripheral vascular disease, Cigarette smoking: Elevated fibrinogen levels are merely an observation with no known pathophysiology. |
| Lactate (mEq/L) | 0.3-2.3 | 4.2 !↑ | Measurement is helpful to document and quantify the degree of tissue hypoxemia associated with shock or localized vascular occlusion. It is also a measurement of the degree of success associated with treatment of those conditions. Increased levels can be an indication of shock and tissue ischemia. Byproduct of lipolysis that accumulates in the blood during the inflammatory response and is an indicator for tissue hypoxia; is a marker for metabolic stress |
| Cholesterol (mg/dL) | 120-199 | 320 !↑ | Cholesterol testing is used to determine the risk for coronary heart disease (CHD). It is also used for evaluation of hyperlipidemias. |
| HDL-C (mg/dL | >45 | 32 !↓ |
| VLDL (mg/dL) | 7-32 | 45 !↑ |
| LDL (mg/dL) | <130 | 232 !↑ |
| LDL/HDL ratio | <3.55 | 7.5 !↑ |
| Triglycerfdes (mg/dL) | 40-160 M | 245 !↑ | TGs identify the risk of developing coronary heart disease (CHD). This test is part of a lipid profile that includes the measurement of cholesterol and lipoproteins. This test is also performed on patients with suspected fat metabolism disorders. |
| HbA1c (%) | 3.9-5.2 | 6.8 !↑ | Normal findings: Nondiabetic adult/ child: 4%-5.9% Good diabetic control: < 7%.This test is used to diagnose and monitor diabetes treatment. It measures the amount of HbA1c in the blood and provides an accurate long-term index of the patient's average blood glucose level. |
| Hematology |
| WBC (X 103/mm3) | 4.8-11.8 | 23.5 !↑ | A WBC count is a test to measure the number of white blood cells (WBCs) in the blood.  WBCs help fight infections. They are also called leukocytes. A high white blood cell count can be due to anemia, Infections, most often those caused by bacteriaInflammatory disease (such as rheumatoid arthritis or allergy), Leukemia, Severe mental or physical stress. |
| Hemoglobin (Hgb, g/dL) | 14-17 M | 12.5!↓ | This test is a measure of the total amount of Hgb in the blood. It is used as a rapid indirect measurement of the red blood cell (RBC) count. It is repeated serially in patients with ongoing bleeding or as a routine part of the complete blood cell count (CBC). |
| Hematocrit (Hct, %) | 40-54 M | 38 !↓ | The Hct is an indirect measurement of red blood cell (RBC) number and volume. It is used as a rapid measurement of RBC count. It is repeated serially in patients with ongoing bleeding or as a routine part of the complete blood cell count. |
| Transferrin (mg/dL) | 215-365 M | 385 !↑ | Evaluation the blood's ability to bind and transport iron and are a reflection of iron stores. The TIBC measures the total amount of iron that can be bound by proteins in the blood. |
| Ferritin (mg/mL) | 20-300 M | 14 !↓ | This is the most sensitive test to determine iron-deficiency anemia. |
| Urinalysis |
| Protein (mg/dL) | Neg | + !↑ | Newly developing or increasing amounts of protein in your urine may be the earliest sign of diabetic kidney damage. |
| Glucose (mg/dL) | Neg | + !↑ | high d/t gluconeogenesis and glycogenolysis from inflammatory response (pt also has history of T2 diabetes) |
| Ketones | Neg | + !↑ | Ketones are a metabolic product produced when fat is metabolized. Ketones increase when there is insufficient insulin to use glucose for energy.  |
| Prot chk | Neg | + !↑ | A urine protein test is a screening test to look for the presence of proteins in the urine.  |
| Bact | 0 | + !↑ | Bacteria present |

***10.*** Net I/O for daily total for 24 hours (2/23 -2/24) +1430 mL after being put on IV hydration with saline (no TPN noted). He was probably dehydrated due to the sepsis and high temperature and edema. No stool, emesis output or other output was noted in Intake/Output table. (pg. 369 of case study).

***11.*** EER: (18-22 kcal/kg IBW) = 18\*75.45 kg = 1358, 22\*75.45kg = 1358-1660 kcal Protein requirements: EPR: (1.5 - 2.0 g/kg IBW for Class III morbid obesity per ASPEN guidelines) = 1.5\*75.45= 113 g, 2.0\*75.45 = 151 g 113 -151g. of protein = 452 -604 - 756 kcal of protein. Nelms lists possible predictive equation for permissive underfeeding for critically ill obese patients Table 22.6 page 671 lists 18-22 kcal/kg and 1.5-2.5 g protein/kg of IBW (Nelms, et al., 2016). Fluid requirements 1.01 mL/kg/hr = 1.01mL\*75.45 kg \* 22 hours for ICU patients = 1676 mL in addition to IV piggy back 250 mL = 1676 + 250 = ~1700 mL/22 hour. Diet order: 7 cans of Optimental ready-to-feed elemental formula Each 8 oz. can delivers 237 calories, 12.2 grams of protein, 6.7 grams of fat, 32.9 grams of carbohydrate and 198 mL of water. Diet Therapy: Optimental was chosen for CM since he is a bariatric patient and this formula is for the dietary management of patients with malabsorptive conditions or metabolic stress, and acute trauma. A continuous feed would be best for Mr. McKinley because a continuous feed with a slower advancement will be better tolerated with his bowel reconstruction and allow for a more stabilized blood glucose. 7 cans would deliver a total of 1659 kcal, 85.4 grams of protein, 230.3 grams of carbohydrate and 1386 mL of water. This diet order is appropriate as it is specially formulated with a high protein ratio and provides at least 100% of the RDI for 24 key vitamins and minerals. It also is formulated with a structured lipid system combines medium-chain triglycerides (MCTs) with eicosapentaenoic acid (EPA) for increased absorption of omega-3 fatty acids and contains elevated levels of antioxidants: vitamins C and E, and beta-carotene.

***12.*** Increased energy expenditure related to septic state as evidenced by patient under severe stress, elevated WBC count of 23.5, high CRP of 5.8 and elevated fibrinogen (525 mg/dL). Inadequate protein-energy intake related to septic state and malnutrition as evidenced by ⇩ serum albumin of 1.9, ⇩ prealbumin of 11 and ⇩ total protein of 5.8. Impaired nutrient utilization related to malabsorption and restriction of micronutrients as evidenced by status post Roux-en-Y bypass surgery (altered GI function).

***13.*** CM was admitted for sepsis, and labs indicate malnutrition which correspond to his acute illness and inflammatory response as noted by his elevated lab values. He is also status post bariatric surgery which brings CM to a malabsorptive state. His lack of supplementation with vitamins and minerals which is routine for Roux-en-Y patients has him at risk for nutrient deficiencies that could impact the outcome of his hospitalization.

***14.*** 20 mL/hour of Optimental and increase as tolerated by 10-20 mL every 8-12 hours until goal rate of 63 mL/hour (based on 22 hours per day for an ICU patient) is reached. Seven cans will provide a total of 1659 kcal, 85.4 grams of protein, 230.3 grams of carbohydrate and 1386 mL of water. This diet order is appropriate as it is specially formulated with a high protein ratio and provides at least 100% of the RDI for 24 key vitamins and minerals. It also is formulated with a structured lipid system combines medium-chain triglycerides (MCTs) with eicosapentaenoic acid (EPA) for increased absorption of omega-3 fatty acids and contains elevated levels of antioxidants: vitamins C and E, and beta-carotene.

***15.*** Review his daily intake-output, check his weight, hydration status, vital signs, bowel functions/sounds, Order repeat labs to see if there is an improvement in critical values.

***16.*** Post Roux-en-Y patients in ICU for sepsis may have some problems with the nutritional support therapy. Since he has a non-GI admission and his GI worked prior to admission (although altered with surgery) nasogastric tube feeding would be inserted into the pouch, if not tolerated, jejunal feeding may be better tolerated (Marshall, 2003).

 ***17.*** Refer to complete ADIME on pages 11 – 13.