NUT 116BL
Winter 2015

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Section: _____

Major Case Study: Enteral and Parenteral Nutrition
Due 2/13/15
60 points

Mr. R, a 35 yo drug user, is hospitalized after a motor vehicle accident (MVA). He is currently suffering from a severe concussion and lapses of consciousness, a broken jaw, multiple broken bones, and possible internal injuries. He had not eaten anything for several days PTA because he was overdosing on drugs. Enteral feeding has been recommended in order to improve his nutritional status and given his decreased level of alertness. The patient will be bedridden until his mental status improves. A nasogastric feeding tube has been inserted and the physician has asked for your recommendation regarding the type of formula and amounts of kcal/protein needed for this patient.

Ht: 5'11" Current wt: 156 # UBW: 167 # Serum albumin: 3.0 mg/dL

1. Write 1 PES statement for this patient. (2 pts)

Inadequate protein-energy intake r/t MVA and drug abuse AEB multiple broken bones, broken jaw,possible internal injuries and a current weight lower than usual and ideal body weight(NI-2.1)

2. Is the nasogastric feeding route appropriate for this patient? Why or why not? (3 pts)

The nasogastric feeding route is not appropriate for this patient because he is currently experiencing lapses of consciousness. During one of these moments of unconsciousness the patient is at risk for aspiration. Also, he might have esophagus or stomach anomalies, obstructions or inadequate GI functions because of broken bones and possible internal injuries. A nasoduodenal tube would be the best option because it passes the stomach and goes straight to the small intestines where nutrients can be absorbed and not cause regurgitation. However, if Mr. R cannot tolerate the nasoduodenal route either, then we would move the tube further down to the jejunum and use the nasojejunal route

3. What daily intake of kcals, protein, and fluids would you recommend for this patient and why? Show calculations for estimated needs, give recommendations as kcal/d, g protein/d, ml fluid/d. (6 pts)

Mifflin-St. Jeor Equation: REE for males: 10 (weight kg) + 6.25 (height cm) – 5 (age) + 5 (NTP pg. 60)
Mr. R REE based on Actual Body weight
Weight: 156 #/ 2.2# = **70.91 kg**
Height: 5'11 = 71 in x 2.54 cm = **180.34 cm**
IBW: 106 + (11 x 6)=172 +/- 10%= 78.18kg +/- 10%
Serum albumin= lower than normal range (3.5-5.0)
%IBW = 70.91kg/78.18kg = 90.7%
% weight lost = 70.91-75.91/75.91 *100% = 6.6%
BMI = kg/m^2

BMI = 70.91kg/((1.8034m)^2)
70.91kg/3.2523m^2 = 21.80 kg/m^2

REE=10(70.9) + 6.25(180.34) - 5(35) + 5
REE=1666.125 x IF x AF
REE=1666.125 x 1.2-1.4 (skeletal trauma) x 1.2 (bed rest)=**2400-2800 kcal/d**
(MSJ)
Protein= 1.2-1.5 g/kg/day= 70.9(1.2) to 70.9(1.5)= **85-106 g protein/d**
Fluid= 1mL/kcal= **2400-2800 ml fluid/d**

4. Based on the needs of this patient, describe three desirable characteristics for the type of formula you would recommend. Give one example of an appropriate enteral formula meeting these characteristics. Use Appendix C2 in NTP text or the formulary provided on the UCD SmartSite. (4 pts)

The ideal formal would have a **slightly high protein content** due to the trauma this patient is experiencing and his already low serum albumin levels. Since he has been given a nasogastric tube, the formula can have **complete proteins**, and they do not need to be hydrolyzed. If the tube were to be placed in his duodenum the proteins would need to be hydrolyzed. He also does not need to have any fiber restrictions or a low residue formula because there is no issues that would require bowel rest. Lastly it would have **added immune support** to help fight off any possibility of infections. It can be also be **fiberenriched** because there is no GI dysfunction to worry about. He has no fluid restrictions and therefore does not need any fluid restricted formulas.The kcal content of the formula also needs to be high enough to prevent any more weight loss, and help his wounds to heal. A good example is **Jevity 1.2** considering all the factors above

5. a) Based on the enteral formula you selected in question 3 above, what daily total volume of formula would meet Mr. R's estimated kcal and protein needs? Show calculations. (3 pts)

(2400kcal)/(1.2kcal/mL)=2000mL of formula per day
(2000mL formula/d)/(24 hrs)=83.33mL/hr=85mL/hr
(85mL/hr) x (24hrs/d)= **2040 mL/d of formula to meet kcal and protein needs**
(2.04L/d) x (55g/L)=112.2g protein/d
(2040mL) x (1.2kcal/mL)=2448kcal/d
The protein level is slightly above what was calculated for Mr. R's needs. However, since he is severely injured it would be beneficial to increase the amount of protein. If he beings to gain weight and heal the amount can be lowered or the formula can be changed to one without additional protein.

b) What would be the hourly rate for delivery of this tube feeding as a continuous 24hr infusion? Show calculations. (1 pt)

(2400kcal)/(1.2kcal/mL)=2000mL of formula per day
(2000mL formula/d)/(24 hrs)=83.33mL/hr=**85mL/hr**
The hourly rate for delivery would be 85 mL every hour, which is rounded up from his actual needs(83.33mL/hr).

c) Is this volume of tube feeding adequate to meet his fluid needs? If not, indicate what else is needed and how it would be added to the current tube feeding. Show calculations. (4 pts)

85ml x24 hour =2040 ml
2040 mL of formula x 81% free water= 1652.4 mL of free water
2400mL needed/d-1652mL formula/d= 748mL of additional fluid needed
Fluid flush every 6 hours (4x a day)= 748ml/4=187ml every 6 hours
This is not adequate to meet his fluid needs. He would need 748mL of additional fluids. This could be
obtained through free water flushes. The tube can be **flushed with 187mL of free water every 6 hours**.

6. Give 3 blood values that you would monitor for this patient and the reasons why. (6 pts)

Prealbumin: I would monitor prealbumin to ensure the pt is improving nutritionally and his intake is adequate. It responds to acute changes and can be a quick indicator of malnutrition. Prealbumin levelsrespond to short term modifications and they can be monitored to ensure the pt is receiving ideal amounts of macronutrients. Checking for prealbumin is also important to monitor inflammation and infections. Any low levels can indicate malnutrition and inflammation

Electrolytes: How are the magnesium, potassium, phosphorous
Enteral fed patients can have issues with their electrolyte balances. Electorlytes need to be monitored in Mr. R to make sure that he is not having refeeding syndrome. Refeeding syndrome can occur in malnourished patients and are suddenly refed, leading to electrolyte imbalances: hypophosphatemia, hypokalemia, and hypomagnesemia. There are more side effects of refeeding syndrome, like hyperglycemia, sodium retention, arrhythmias, and heart failure, which is why these electrolytes need to be monitored. Hypophosphatemia causes phosphate to shift into the cells, hypokalemia can occur if the potassium intake is less than the required amount, and hypomagnesemia can occur from extracellular magnesium deficiency if inadequate amounts are present in the formula..

C-reactive protein: C-reactive protein should also be monitored to assess his degree of inflammation since this is a positive acute phase protein, which means that that the liver will produce c- reactive protein in great amounts as an inflammatory signal. It has been found that as the c-reactive protein levels increase, there is an increase in nutritional risk during stress, illness, and trauma. Since he is suffering from the multiple broken bones, he is suffering a traumatic incident that is causing c-reactive protein to increase. Making sure that the c-reactive protein levels diminish overtime, along with an increase in the negative acute phase proteins such as prealbumin, will signify that he is responding to the treatment well and is starting to heal. It should be noted that c-reactive protein and prealbumin will also be good indicators of an infection given he develops one due to aspiration of food or a bacterial infection from a lack of intestinal mucosa integrity.

7. Give one urine value that you would monitor and the rationale for monitoring it. (2 pts)

Urine Specific Gravity: This should be monitored to ensure the pt is receiving enough fluid and is not dehydrated. Since he is not able to drink water on his own it is crucial he is receiving

free water flushes in the appropriate amounts. If his urine is too concentrated then the amount of free water will need to increase. If the specific gravity is too high, it can indicate dehydration, hyperglycemia, or diarrhea. If the specific gravity is too low, it can indicate that the patient is getting too much fluid. This will help us see if he has any kidney problems and whether we need to exchange the formula that caters to the needs for renal patients.

The patient, Mr. R, is now 5 days s/p his MVA. He did not tolerate the enteral feedings well (diarrhea and pain) and now has been diagnosed with acute pancreatitis. The MD has ordered a nutrition consult for evaluation of parenteral nutrition (PN) support. For the purposes of answering questions 7-12, assume that your current estimated kcal and protein needs for Mr. R are: 2600 kcal/day and 110 g protein/day.

8. Write a PES statement. (2 pts)

Altered GI function**(NC-1.4)** r/t acute pancreatitis AEB diarrhea and pain from intolerance of enteral feedings

9. Which type of PN support do you recommend – central or peripheral? Justify your answer. (2 pts)

I would recommend **central** PN support because of the high energy needs. With central access the high osmolality can be diluted quickly. Peripheral parenteral nutrition is limited to 800-900 mOsm/kg to protect against thrombophlebitis. I would further recommend a PICC line because it can be the safest and does not require surgery. Since the pt is already experiencing multiple traumas it would be best to keep him out of surgery if possible.

10. Calculate the amount of a 10% lipid emulsion that is needed to provide around 20% of Mr. R's total kcal needs. Show calculations. (2 pts)

20% of 2600kcal= (.2) x (2600)=520kcal
10% lipid emulsion=1.1kcal/mL
520kcal/1.1kcal/mL=**472.72 mL**
For this requirement a **500mL bag** would be used.
(500mL) x (1.1kcal/mL)=550kcal from lipids

11. The MD wants the dextrose and amino acid solution to be a total volume of 2 L/day. (The volume of lipid emulsion is separate from this 2 L.)

a) Determine the final amino acid concentration of this solution, which would supply 110 g protein/day. Show calculations. (2 pts)

(110g protein/2000mL) x 100%=**5.5% AA concentration**

b) Determine the remaining kcals to be provided as CHO. Express your answer as kcals from CHO and as grams of dextrose. Show calculations. (3 pts)

(110g protein) x (4kcal/gm)=440kcal from protein + 550kcal from lipids = 990kcal
2600 total kcal-990kcal=**1610kcal from CHO**
(1610kcal)/(3.4kcal/gm CHO)= **473.5 grams of dextrose**

c) Determine the final dextrose concentration of the solution. Show calculations. (2 pts)

(473.5g CHO)/2000mL) x 100%=**23.7% CHO concentration**

d) If the PN solution had to be made from a starting stock solution of $D_{50}W$ (500 g dextrose in 1 L of water), what volume of this stock $D_{50}W$ would be needed to provide the grams of dextrose that you calculated in question 9b above? Show calculations. (2 pts)

500g/1000mL=473.5g/XmL
X=**948mL of $D_{50}W$ stock**

e) Compare the grams of dextrose to be provided in this solution with the maximum glucose infusion rate for Mr. R of 5 mg/kg BW/min. Would you make any changes to the PN solution based on this information? Explain your rationale. If so, how would you change it? (2 pts)

5 mg/kg BW/min
(5mg) x (70.9kg)= 354.5 mg of dextrose/min
(354.5mg dextrose/min) x (60min/hr) x (24hr/d) x (1g/1000mg)= **510.5 g/d of glucose max**
The current PN solution is providing 473.5 grams of dextrose in a day.
(473.5g dextrose/d) x (hr/60min) x (d/24hrs) x (1000mg/1g) / (70.9kg)= **4.6 mg/kg BW/min**
I would not make any changes to the PN solution because the amount does not exceed the maximum infusion rate. However, I would make sure to monitor the patient, and if changes are needed in the future they should be made based on his current state

12. List three lab values that you would monitor for this patient and the reasons why. (6 pts)

Electrolytes: these values will be most
useful in determining his hydration status and again the risk for refeeding syndrome. His intolerance of enteral feedings was indicated by pain but also by diarrhea. As a result of the diarrhea, he likely experienced a great deal of fluid and consequently electrolyte loss. At the initiation of PN support, electrolytes are very important to monitor to note his tolerance of this feeding method but also to observe his recovery toward an adequate hydration status and electrolyte levels. With regards to the prevention of refeeding syndrome, magnesium, phosphorus and potassium are especially important to monitor as these
electrolytes are key cofactors in energy metabolism. These levels should be kept at a normal, adequate level to offset their potential storage depletion and usage in metabolizing the incoming nutrients from the parenteral formula.
Glucose: Mr. R has just been diagnosed with acute pancreatitis which implies some degree of maldigestion and malabsorption in patients not on PN support. However with the PN support he has been placed on, it is likely he will have a predigested formula delivered intravenously so there is a risk of abnormal blood glucose levels if he is not tolerating the formula, its osmolality or rate of delivery. If he has continuously elevated blood glucose levels, this indicates glucose intolerance and as a result, he may also become insulin resistant, potentially leading to the development of Type 2 Diabetes. However this would take a fairly significant amount of time to develop and continuous intolerance to any parenteral formula utilized in his nutritional treatment.

An additional reason to monitor blood glucose levels is to prevent refeeding syndrome. Because Mr. R had not eaten anything several days before hospital admission and he did not tolerate the enteral formula or method of support, he is not likely to have received adequate nutrition for approximately a week. Introducing a regular source of calories, in greater quantities than his body has been exposed to in the short term, can trigger refeeding syndrome which can have significant metabolic and systemic consequences, depending on the severity of the body's response to metabolize the incoming nutrients.

Lipids/Serum Triglycerides – It is important to monitor lipids to assess lipid clearance. While lipids are important in TPN in order for patients to receive their essential fatty acids, some patients may be at higher risk for developing hyperlipidemia, like diabetics. If patients experience decreased lipid clearance and an accumulation of fat, this can result in liver dysfunction, immune system problems, anemia, and cardiac dysfunction

13. Mr. R develops hyperglycemia while on PN support. Describe two actions you would recommend to help lower blood glucose and achieve metabolic control of the patient. (2 pts)

In order to lower Mr. R's blood glucose and achieve metabolic control, I would recommend **slowing the rate of infusion** so his body has time to react to the added glucose. If the rate is slower there will be tighter control of glucose in the blood stream. If that does not solve the problem I would recommend **adding insulin** to the solution in order to lower blood glucose. However, if the rate is slower than the patient will not be meeting his calorie goals so this should only be done for a short period of time. If this needs to be a longterm change than I would recommend decreasing the percentage of dextrose in the solution. It can be replaced with lipids or protein in order to meet calorie goals.

14. What is refeeding syndrome? Why is it important to monitor for refeeding syndrome in a severely malnourished patient who is started on PN? (4 pts)

Refeeding syndrome occurs when a patient who is undernourished or malnourished is given an increased amount of glucose, relative to their low intake, and goes into systemic shock in the process of metabolizing these nutrients, lowering already depleted stores of electrolytes and causing drastic fluid shifts between intra-and intercellular compartments. In malnourished individuals, storage and serum levels of electrolytes, especially magnesium, potassium and phosphorus are extremely low or nearly depleted. Additionally during starvation, the energy source is ketone bodies produced by the further metabolism of released free fatty acids to compensate for the starvation as well as the delayed rate of hepatic gluconeogenesis to preserve energy stores. Upon the refeeding of glucose, the energy source becomes glucose in place of ketone bodies and this requires an increased amount of magnesium,
potassium and phosphorus for its metabolism. This causes a large migration of these electrolytes from the serum into the cells to assist in the metabolism and because they carry a charge, fluid follows this migration. This causes a dramatic drop in blood volume, blood pressure and imposes a great burden on the heart to attempt to restore mean arterial pressure, thus increasing cardiac output. This increased cardiac output can be of such a great magnitude that cardiac failure results and possibly even death can follow. In PN patients it is likely they are malnourished to some extent if not extremely malnourished, especially those that were in this state prior to PN initiation as a result of long term inadequate intake, intolerance to enteral feedings, NPO status for several days prior to PN initiation such as Mr. R or generally present with signs and symptoms of

malnutrition. All of these factors indicate a high risk for refeeding syndrome and especially in PN patients, it is crucial to monitor serum electrolyte levels in response to PN feeding especially at the initiation of these feedings. To effectively prevent refeeding syndrome in general as well as in PN patients, feedings should start slowly and increase gradually as progression and tolerance are verified by serum electrolyte levels and patient's proper metabolism of glucose, free of extraneous symptoms indicating signs of refeeding syndrome. (NTP p. 92-93)