Sodexo Dietetic Internships

Disease Specific Pre-rotation Assignment – Parenteral Nutrition

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Part 1: Medical Abbreviations and Terminology, Medications, Procedures and Pathophysiology

In your own words, briefly describe the following terms, medications, procedures and pathophysiology:

1. **Describe the Glasgow Coma Scale and APACHE II scoring system. What would the scores tell you about a critically ill patient?**

   The Glasgow Coma Scale is used to assess the level of severity of a brain injury and prognosis in patients in a coma. The scores range between 3-15, with scores of 3-8 usually associated with a coma. A score of 3 has the worst prognosis while a score of 15 has the best; scores above 8 tend to have a good chance of recovery, and scores between 3 and 5 are potentially fatal. For adults, the patient is given points assigned to particular criteria in the categories of eye-opening response, verbal response, and motor response. Similarly, for children there are age-appropriate criteria. These scores tell us the level of illness and likely outcomes for a critically ill patient, and what kind of interventions would be best in their particular condition[1].

   The APACHE II scoring system is an intensive care prognostic scoring model, which has shown to be an accurate measurement of the severity of illness and the outcome in critical care patients. Its system includes the Glasgow score, along with 11 other physiological variables like mean arterial pressure, acid-base balance, and certain lab values. This score also factors in age and any other chronic health issues, to determine the total APACHE II score out of 71. This score predicts the likeliness for survival in these ICU patients, and can also be used as benchmark data to compare the outcomes among groups of critically ill patients with similar illness severity[2].

2. **Describe the similarities and differences between non-tunneled catheters, tunneled catheters, PICCs and implanted ports. For what type of patient and or circumstances would each be appropriate to use?**

   Non-tunneled catheters, or percutaneous central catheters, are most common in acute care, when the need for access is of short duration, around 5-7 days. They enter the subclavian, jugular, or femoral with the tip of the catheter sitting close to the heart. This type of access can have up to 5 lumens, is cheaper to place, easy to remove, and easily exchanged with a guidewire. However, there is an increased risk of infection and can usually only be used in the hospital setting, as careful attention must be paid to avoid complications[3].

   PICCs are used for short- or moderate-term central PN infusions, either in the hospital or at home. They are inserted into a vein in the antecubital area of the arm and guided into the subclavian vein with the catheter tip entering the superior vena cava, and can be placed by trained medical personnel

other than a surgeon. PICCs are cost-effective and convenient to place, however they can more easily become occluded, mispositioned, or dislodged[3]. They are often used is someone needs to go home on PN for a relatively short period of time.

Tunneled catheters are a form of long-term central access, which can be single- or multi-lumened. They are placed in the cephalic, subclavian, or internal jugular vein and fed into the superior vena cava. With this type of access, a subcutaneous tunnel is created so that the catheter exits the skin away from its venous entry so that it may be cared for more easily by the patient using it for long-term infusion while in the hospital or at home. Additionally, they have a needleless connector and a disinfection cap for ease of use. Tunneled catheters are best used in patients that have a planned extended or unlimited time frame in which PN will be used, as their chance for infection is greatly diminished and there is a decreased risk of dislodgement. They also allow the patient to cover them easily with their clothing[3].

Implanted ports are surgically implanted under the skin in the anterior chest into the subclavian, jugular, or peripheral vessels, where a catheter would normally exit at the end of a subcutaneous tunnel. Instead, these are covered by the skin, but requires a special needle to access the entrance port, which can be single- or double-lumened. This can also be used for long-term access in the hospital or at home, and is great for patients who are concerned about their body image with an external catheter. It also provides ease of self-care, has a low rate of infection, and has no routine site care when it is not being used[3]. They are often used for those who need intermittent IV therapy such as chemotherapy.

3. What is phlebitis and how is it related to parenteral nutrition? How can it be prevented?

Phlebitis is the inflammation of a vein, often caused by peripheral parenteral nutrition and the hypertonic fluids administered. This method of feeding should only be used for a short duration, as these veins can become easily irritated, especially due to the high osmolality of parenteral solutions. So, to avoid this issue, fluids with an osmolality of above 900 mOsm/L should not be administered as the high content of foreign objects in the veins will increase irritation. The addition of potassium into parenteral solutions can also cause burning in the insertion area. Frequent rotation of catheter sites and careful choice of catheter type and size can help minimize this complication, along with using total nutrient admixture formulas rather than dextrose/amino acid mixtures with separate lipids. The best way to avoid phlebitis in peripheral parenteral nutrition, though, is to keep the area of insertion sterile and limit movement of the catheter to avoid irritation and infection[4].

4. Explain the relationship between parenteral nutrition and hepatic steatosis. What can be done to minimize the risk of it developing?

Hepatic steatosis is the accumulation of fat in the liver, often caused in parenteral nutrition due to overfeeding, where the excess dextrose or glucose is converted to triglycerides in the liver. It may also be caused by high concentrations of glucose and amino acids promoting fat deposition by stimulating insulin release. Other components of dextrose-based TPN that are thought to play a part in the

pathogenesis of hepatic steatosis include the induction of carnitine deficiency, an essential fatty acid that has a role in the oxidation of fatty acids, impaired hepatic drug oxidation, and the absence of an uncharacterized, water-soluble 'protective factor' that is present in the normal diet, but not included in TPN. In order to minimize the risk of fat accumulation in the liver, modifications to TPN solutions to tailor the energy intake to a patients needs with balanced glucose, amino acid, and lipid solutions in the best solution[5]. Using a cyclic feeding schedule may also help decrease the risk of developing hepatic steatosis.

5. Describe the differences between the body's response to starvation versus metabolic stress.

The body has differences in responses to starvation versus metabolic stress due to the energy stores used in these conditions. In 'simple starvation' the body slows the release of insulin and increases the release of glucagon and catecholamine which leads to the hydrolysis of triglycerides in adipose tissue and the release of fatty acids and glycerol to use as energy in the organs and muscles. The glucose needs of the brain are met initially by glycogenolysis and later from gluconeogenesis, however as insulin levels decrease even further, the liver depends on a continuous supply of precursor amino acids, glycerol, and lactate to continue the gluconeogenesis process. Once protein catabolism begins, the body's metabolic rate decreases and the glucose demand by the brain is lowered due to it adapting to using ketones as fuel. During all of these processes, considerable changes in body composition take place, including the loss of fat mass and overall body mass[6].

When the body is undergoing metabolic stress starvation, as in the case of trauma, sepsis, or critical illness, the body's normal conservation of protein is overridden by the neuroendocrine and cytokine effects of injury. The metabolic rate rises rather than decreasing and protein catabolism increases to meet the demands of tissue repair and gluconeogenesis. Hyperglycemia and glucose intolerance are often found, and ketosis in minimal. Fluid retention may be seen in these patients as well[6].

6. What are the ebb phase and flow phase as related to the stress response?

As related to the stress response of the body, the ebb phase is the early phase in shock which is marked by a decreased metabolic rate, which is then followed by the catabolic flow phase. The ebb phase develops within the first few hours of stress/injury (24-48 hours), and is characterized by the reconstruction of the body's normal tissue perfusion and efforts to protect homeostasis. There is a decrease in total body energy and nitrogen excretion, and an increase in the production of endocrine hormones such as catecholamines and cortisol. Body temperature declines along with oxygen consumption, as a means of conserving energy[7].

Following this, the flow phase of the stress response begins and can last for many days. However, too long in the flow phase can cause bodily damage. In this catabolic phase, which can be described as an 'all or nothing' phase, the body needs enough substrates to cover the prevention of bleeding and infection. So, adipose, skin, and muscle tissue are broken down in order to provide for the healing response and maintain critical organ function. There is an increase in energy expenditure and oxygen consumption, and an increase in caloric needs as this trauma can cause complications such as

hyperglycemia, hyperproteinemia, and immunosuppression. After the metabolic response to stress has stopped, an anabolic phase begins to help rebuild the tissues lost and regain normal bodily functioning[7].

Part 2: Review of MNT

Answer the following questions below in your own words. Do not copy and paste textbook information. The answers don't need to be exhaustive. Focus on what would be important for a dietitian to know.

1. **Describe three-in-one parenteral nutrition solutions, also called Total Nutrient Admixtures (TNA). What are the advantages and disadvantages of these types of solutions?**

   Three-in-one parenteral nutrition is a PN solution with is comprised of all three macronutrients - where proteins and carbohydrates are combined together with a stable intravenous fat emulsion, or IVFE's. These solutions maintain their stability by having polar and nonpolar regions on the same fat molecule, which evenly disperses them within the water phase. However, they may become unstable and unsuitable for administration if the surface charge becomes less negative, causing the fat molecules to aggregate into larger fat globules due to things like changes in pH or the addition of electrolyte salts[8].

   The advantages of using Total Nutrient Admixtures include it requiring minimal administration manipulation and that all the components are aseptically compounded, leading to decreased risk of catheter contamination and patient infections. It is infused at slower rates due to the IVFE, so it has better fat clearance than a separated mixture. It also is more financially efficient, as less equipment is required for administration and is more convenient for the pharmacy due to the assistance of a machine to help produce the solution. It also allows for the nurses to spend less time focusing on administration and monitoring the patient. However, TNA and has its disadvantages, including the risk of instability described above. On top of this, with IVFE, the risk of catheter occlusion is greater so a larger pore size filter is necessary, so there is less microbial elimination. Lastly, these mixtures are limited in terms of the additives that can be used and due to their milky appearance, it is difficult to see any potential particulate matter in the solution[9].

2. **What is cyclic PN? What are the advantages? What factors need to be taken into consideration before changing a patient from continuous to cyclic PN?**

   Cyclic PN is the infusion of a parenteral solution to a patient in periods of 8-12 hours, usually at night, so that the patient may have a break of 12 to 16 hours per day, which can greatly improve quality of life. The solutions used in cyclic PN are generally more concentrated to supply a greater amount of energy and nutrients over a shorter amount of time than continuous PN. Through this method administration time may be decreased for medical procedures or therapies, or ADL's such as bathing or ambulation[3].

Certain considerations must be taken before changing a patient's from continuous to cyclic PN, however, such as the benefit to the patient and long term goals of infusion, such as receiving PN long term at home. The stability of the patient is the main consideration, as this method of administration can increase the risk for hyperglycemia and hypoglycemia, so it should not be attempted if glucose intolerance or fluid tolerance are problems. In addition, monitoring is important in patients less than three years of age, or those that are malnourished, hemodynamically unstable, or mechanically vented[10].

3. **What are the primary differences between peripheral and central PN? What is the maximum osmolarity recommended for PPN and why is this important?**

The primary difference between peripheral and central PN is the placement of the catheter, either into a large, high blood flow vein for central parenteral nutrition, or into a small vein, typically in the hand or forearm, in peripheral parenteral nutrition. The placement is dependent on the osmolarity of the PN solution, as the maximum osmolarity for PPN is 800 to 900 mOsm/kg. Central placement, however, can have a greater osmolarity due to the use of higher caloric PN formulation. The use of peripheral parenteral nutrition is limited, as it is meant to be a short-term therapy and has a minimum effect on nutritional status due to limited choices in type and amount of fluids. Central access, on the other hand, can be used in the long-term and supply total parenteral nutrition of a complete, balanced formulation. Lastly, central access must be placed by surgeon in the case of tunneled catheters or implantable ports, or by trained nurses for PICC lines, where peripheral access can be placed by many non-surgical personnel[3].

4. **What are the indications for the use of PN? What are the contraindications?**

The indications for the use of PN are[11]:

- A non-functioning gut, making enteral nutrition administration impossible
- A non-accessible gut due to anatomical reasons, etc
- Enteral feeding is unsafe or not likely to be effective due to particular diseases or conditions

The contraindications for the use of PN are[11]:

- A functional GI tract, that is able to adequately absorb macro and micronutrients
- Administration is expected for less than 5 days in patients without severe malnutrition
- Inability to obtain venous access
- Prognosis does not justify aggressive nutrition support
- The patient is hemodynamically unstable
- The risks of PN outweigh the benefits

5. **How quickly can an essential fatty acid deficiency occur in a patient receiving PN without lipids? How much lipid needs to be provided and how often in order to prevent this?**

An essential fatty acid deficiency (EFAD) in a patient receiving PN without lipids can occur within 1 to 3 weeks from the beginning of administration. While incidence is low, several potential complications

with IVFE use can occur, and lead to a deficiency in linoleic and alpha-linoleic fatty acids, both of which cannot be synthesized by the body and are considered essential. This deficiency can lead to issues like scaly dermatitis, alopecia, fatty liver, and anemia. These fatty acids can be sourced through lipolysis of adipose tissue, but when a hypertonic dextrose is infused, insulin is secreted which decreases lipolysis and can lead to EFAD. To avoid this, 1% to 2% of daily energy requirements should be derived from linoleic acid and 0.5% from alpha-linoleic. This is about 250 mL of 20% IVFE or 500 mL 10% IVFE administered over 8-10 hours, twice a week, or 500 mL of a 20% IVFE, once a week. In patients that are intolerant to IVFE, a trial of topical or oral oils may be given[8].

Part 3: Case Study

Minerva McGonagall https://en.wikipedia.org/wiki/Hogwarts_staff#Minerva_McGonagall is a 70-year-old professor at the Hogwarts School of Witchcraft and Wizardry. https://en.wikipedia.org/wiki/Hogwarts Professor McGonagall denies smoking, but drinks an occasional glass of wine or mead at The Three Broomsticks, a local pub in the village of Hogsmeade. She was admitted to the hospital after several days of worsening abdominal pain and nausea, for which over-the-counter antacids provided no relief. Professor McGonagall is 66" and weighs 180#. She thinks she might have lost a few pounds over the past few days. She hasn't been eating well since her symptoms started.

Past medical history: Hyperlipidemia

Past surgical history: Appendectomy during childhood, right knee surgery 1 year ago.

Social history: Never married and has no children. She lives at Hogwarts and has a very strong support system from Professor Dumbledore, the other faculty, staff, and house elves.

Medications at home: Lipitor

Labs - drawn in the ER: Na 141, K 3.8, Mg 1.8, GLU 138, BUN 19, CREAT 0.9, ALB 3.6, TG 103, Ca 8.4, Phos 3.7

Physician ordered diet: NPO

Professor McGonagall underwent several tests, including an abdominal series, which showed a high-grade small bowel obstruction. She was taken to surgery where an exploratory laparotomy and lysis of adhesions were conducted. Postoperatively, she received IV fluids and had a NG tube to continuous suction. On postop day 6, Professor McGonagall was referred for the initiation of PN due to the delayed return of her bowel function and prolonged postop ileus.

Her weight was now 170#. She continued to receive IV fluids at 100ml/hr, and had approximately 1700ml/day drainage from the NG tube. A triple-lumen catheter was inserted into the superior vena cava and placement was confirmed by x-ray.

Case Study Questions:

1. **Calculate Professor McGonagall's IBW, %UBW and BMI.**

IBW: 100 + 6(5) = 130# = 58.97 kg

%UBW: 77.11/81.65 = 94.4% UBW

BMI: 77.11/1.68^2 = 27.3 [overweight]

2. **Assess her protein, kcal and fluid needs. Use EAL/ASPEN guidelines to assess the patient and show your calculations and the predictive equation used.**

   Kcal = 25-30 kcal/kg = 1927 - 2313 kcal/day = 2100 kcal/day

   Protein = 1.5 g/kg = 115 g/day

   Fluid = 30-40 mL/kg = 2310 - 3080 mL/day = 2695 mL/day

3. **Write a PES statement for Professor McGonagall.**

   Altered GI function (NC-1.4) *related to* high-grade small bowel obstruction *as evidenced by* abdominal series test showing SBO, several days of abdominal pain and nausea, and indication for NPO.

4. **Make recommendations for the final PN solution to meet the patient's needs. Complete the following chart and show your calculations as well.**

   2100 kcal 115 g pro 2695 mL fluid

   AA: 115 g AA x 4 kcal/g = 460 kcal AA

   Fat: 2100 x .30 = 630 kcal ILE
   630/2 kcal/mL = 315 mL 20% ILE

   Dextrose: 2100 - 460 - 630 = 1010 kcal dextrose
   1010 / 3.4 kcal/g = 297 g D

   2695 x C = 115 g AA → 115/2695 = 4.3% AA
   2695 x C = 297 c D → 297/2695 = 11% D

   2695 D 11% = 330 g D / 77.11 kg = 4.28 g/kg / 1.44 = 2.97mg/kg/min
   315 mL 20% IVFE / 5 mL/g = 63 g fat
   63 g / 77.11 kg = 0.82 g/kg lipids

   2695 mL AA 4.3%, D 11% + 315 mL 20% IVFE
   (2100 kcal, 115 g pro, 297 g D, 2.97 mg/kg/min, 0.82 g/kg lipids)

Macros	Grams	Kcals	Percent
Amino Acids	115	460	4.3%
Dextrose	297	1010	11%
Lipids	70	630	
Total kcals		2100	
Total volume and rate: 2695 mL / 24 hrs = 112 mL/hr			

5. **Write a Care Plan including intervention and monitoring for Professor McGonagall. Make sure to include labs and other indicators that you will monitor to ensure that she is tolerating the PN solution.**

   Intervention:

   - Initiate PN at goal rate
   - Maintain all labs WNL
   - Avoid overfeeding and refeeding
   - Maintain weight
   - Avoid the onset of infection

   Monitoring and evaluation:

   - Monitor fluid and labs including CBC, BMP, phos, mg
   - Monitor osmolality to prevent dehydration
   - Monitor plasma glucose and TGs, watch for hyperglycemia or hypoglycemia
   - Watch for indications of advancement to enteral feeding
   - Monitor weight, blood pressure, pulse, and respiratory rate
   - Monitor hepatic enzymes and bilirubin for indications of liver damage

6. **When you follow up on Professor McGonagall two days later, you find that her triglyceride level has increased to 510 mg/dL. Is this a cause for concern? Why or why not? Would you make any changes to her PN formula based on this lab value?**

   A TG level of 510 mg/dL is cause for concern, especially with the Minerva's history of hyperlipidemia. Triglycerides this high are a sign of overfeeding, providing excessive amounts of dextrose, or infusing the IVFE's at too rapid of a rate. A TG level this high may cause an increased risk for instability in hemodynamics, impair the body's immune response, or increase the risk for liver or pancreas damage. In order to lower TG levels, I would try adjusting the dextrose infusion first, and if this did not work, I would consider holding lipids until serum TG levels have decreased to less than 400 mg/dL[8].

7. **What is the maximum amount of carbohydrate in mg/kg/min tolerated by a stressed patient? Non-stressed patient?**

A stressed patient can tolerate a maximum of 4 mg/kg/min. A non-stressed patient can tolerate up to 7 mg/kg/min[12].

8. **What is Propofol? If Professor McGonagall was receiving Propofol, how would that change your PN recommendations?**

   Propofol is a parenterally administered anesthetic which slows the activity of the brain and the nervous system, which is used for sedation of intubated and/or mechanically vented patients. It provides 1.1 kcal/mL and is an emulsion lipid, so its use will alter the estimated needs of a patient. Based on the amount of Propofol received, the calories from it need to be accounted for in the total estimated calorie needs, and the lipid emulsion may be skipped altogether with the parenteral formula readjusted to meet the total energy needs[3].

9. **What signs would you look for to indicate that the patient may be ready to transition from PN to either enteral nutrition or a po diet?**

   The first sign I would look for to indicate that the patient may be ready to transition to enteral or oral feeding is the functionality of the GI tract, showing signs of positive bowel sounds or passing a BM/flatus, along with the return of appetite.

References

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