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Case Study 2

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Type 1 Diabetes Mellitus with Diabetic Ketoacidosis

1. There are precipitating factors for diabetic ketoacidosis. List seven possible factors.
   1. Precipitating factors for diabetic ketoacidosis occur during illness, being insulin deficient, during an infection, emotional stress, having a fever, nausea, or vomiting, or missing an insulin dose. Type 1 diabetics are typically at a higher risk than those with type 2 diabetes. (Nelms, 2011, pg. 496).
2. Describe metabolic events that led to symptoms associated with DKA.
   1. Metabolic events that led to symptoms associated with DKA occur when the patient has an insufficient amount of insulin. When the insulin is not available, glucose is produced by gluconeogenesis and lipolysis in order to avoid starvation. Ketones are a byproduct of lipolysis and begin to build up in the bloodstream along with glucose. This causes osmotic diuresis in the body, which results in dehydration and electrolyte imbalances. As fluid is lost, the blood becomes concentrated causing hyperglycemia. (Nelms, 2011, pg. 496).
3. Assess Susan’s physical examination. What is consistent diabetic ketoacidosis? Give the physiological rationale for each that you identify.
   1. Based on Susan’s physical examination, her tired appearance, sunken eyes, dry ears and mucous membranes in the nose, dry skin with poor turgor, Kussmaul’s respirations, and lethargic and irritable neurological symptoms are all consistent with DKA. Most of the symptoms are due to the dehydration that Susan is experiencing as a direct result of the DKA. Severe dehydration will cause her to be tired, nauseous, and lethargic. The dry skin, mucous membranes, ears, sunken eyes, and poor skin turgor are also attributed to the dehydration. This dehydration also impacts the nerve impulses to the heart and brain, thus explaining the tachycardia and Kussmaul’s respirations. She is also experiencing lethargy and irritability because her neurological functions are depleted of the glucose sources necessary for normal functioning. (Nelms, 2011, pg. 496).
4. Examine Susan’s biochemical indices both in the chemistry section and in her ABG report. Which are consistent with DKA? Why?
   1. Susan’s biochemical lab results indicate that her potassium, chloride, PO4, osmolality, and BUN levels are all high. These values are all consistent with the dehydration present from the DKA. Her CO2 levels are low which is a symptom of DKA because of her difficulty breathing. Susan’s urine test was positive for ketones and glucose, further supporting the DKA diagnosis. Susan’s blood glucose levels were 475 mg/dL upon admission as compared with the normal blood glucose level of 250 mg/dL. Finally, Susan’s elevated creatinine levels are indicative of kidney issues. All of the above biochemical indices are consistent with her DKA diagnosis. (Nelms, 2011, pg. 483).
5. If Susan’s symptoms were left untreated, what would happen?
   1. If Susan’s symptoms were left untreated, she would suffer from severely high blood serum levels, eventually becoming fatal leading to coma, brain swelling, and even death due to the severe disruption of all metabolic processes. (American Diabetes Association, 2014).
6. Assuming Susan’s SMBG records are correct, what events seem to have precipitated the development of DKA?
   1. Based on Susan’s SMBG report, her levels appeared normal until the beginning of her menstrual period. Once her period began, her levels spiked after her volleyball tournament and remained high on her birthday. It is likely that her period altered her blood glucose levels and her high physical activity level and probable consumption of high glycemic foods ultimately exacerbated her condition.
7. What, if anything, could Susan have done to avoid DKA?
   1. To avoid DKA, Susan could have more effectively monitored her blood glucose levels and increased her insulin dosage for her volleyball tournament. She also could have expected to consume simple carbohydrates on her birthday and more accurately monitored her blood glucose on this day.
8. While Susan is being stabilized, Tagamet is being given IV piggyback. What does “IV piggyback” mean? What is Tagamet and why is it being prescribed?
   1. An IV piggyback is the, “intermittent delivery of an additional fluid or medication through the primary IV line from a second source of fluid with a secondary set of IV tubing” (Medical Dictionary, 2015). Tagamet is also known as cimetidine. Cimetidine is often used to treat peptic ulcers, GERD, and control excessive stomach acid production, but may also help with DKA by helping to stabilize her low blood pH levels. (Miller-Keane, 2003), (MedlinePlus, 2010).
9. Define “intensive” insulin therapy. Define “conventional” insulin therapy.
   1. Conventional or standard insulin therapy follows a constant dose of basal insulin combined with short or rapid-acting bolus insulin. This is also referred to as a mixed dose. Conventional therapy requires the individual to synchronize insulin administration with their food intake in order to avoid hypoglycemia. Flexible or intensive insulin therapy requires multiple daily injections of bolus insulin before meals in addition to basal insulin once or twice daily. Insulin can be adjusted to correspond to food intake, replicating normal insulin secretion. This allows for adjustment of insulin doses in response to hyperglycemia, variable carbohydrate intake, or alteration in usual physical activity. (Nelms, 2011, pg. 487-488).
10. List the microvascular and neurologic complications associated with T1DM.
    1. Long-term complications of hyperglycemia result in microvascular complications such as nephropathy and chronic kidney disease because of the changes in the structure of the blood vessels of the glomerulus. Other microvascular complications include retinopathy due to the damage to the blood vessels and the highly vascularized structure of the eye. Long-term complications of hyperglycemia results in neurologic complications such as impared sensation or pain in the feet or hands, slow digestion of food in the stomach, carpal tunnel syndrome, and other nerve problems due to the accumulation of abnormal substances such as sorbitol and glycated proteins that recult in cellular damage further disrupting the normal nervous system pathways. (Nelms, 2011, pg. 496-497).
11. What are the advantages of intensive insulin therapy?
    1. The advantage of intensive insulin therapy is the flexibility it provides. Intensive insulin therapy allows patients to adjust insulin dose in response to hyperglycemia, variable carbohydrate intake, or alteration in physical activity. It also has been shown to delay onset and slow the progression of complications such as retinopathy, nephropathy, and neuropathy in patients with T1DM. (Nelms, 2011, 489).
12. What are the risks of intensive insulin therapy?
    1. The risks of intensive insulin therapy include low blood sugar and weight gain. Any change in daily routine may cause a drop in blood sugar with tight blood sugar levels. Intensive insulin therapy may also cause weight gain because when you use insulin to lower blood sugar, the sugar enters the cells in the body instead of being excreted in the urine. The unused sugar will turn into fat, which may lead to weight gain. (Mayo Clinic, 2014).
13. What are some of the key characteristics of candidates for intensive insulin therapy?
    1. Intensive insulin therapy may not be recommended for children, older adults, if individuals suffer from frequent or severe spells of hypoglycemia, or for patients with heart disease, blood vessel disease, or severe diabetes complications. It is recommended for those seeking flexibility in their insulin regimen and those willing to comply with the exercise and meal planning for therapy. (Mayo Clinic, 2014).
14. Explain how an insulin pump works. Is Susan a candidate for an insulin pump?
    1. Insulin pumps are about the size of a pager that administer regular or rapid acting insulin through flexible tubing and are attached to the individual through an infusion set. Continuous subcutaneous insulin infusion allows for the creation of variable and adjustable insulin dosing to meet specific individual insulin needs. Susan’s active lifestyle and strong compliance with her therapy, she makes an excellent candidate for the insulin pump. (Nelms, 2011, 489).
15. How would you describe CHO counting to Susan and her family?
    1. I would begin by explaining the benefits of CHO counting to Susan and her family and describe the ease at which it can be done. I would then begin to explain that the carbohydrates are split into six categories: fruits, vegetables, starches, milk/dairy, protein, and fat. I would explain that one serving of CHO is equal to about 15 grams of carbohydrate. She can then calculate her total number of servings of CHO based off of her energy requirements of the day. I would then go through the division of her total servings of CHO through the six categories with her. Once I show her how to divide the CHO servings throughout the food groups and meals/snacks, I would show her how to read the carbohydrate amount on food labels. I would work to explain to her the strong correlation between carbohydrates, her diabetes, physical activity, blood glucose levels, and food choices on her insulin levels.
16. How is CHO counting used with intensive insulin therapy?
    1. CHO counting is used with intensive insulin therapy through matching the food intake and carbohydrate consumption with insulin dosage to meet target blood glucose levels. Insulin doses may be adjusted based off of the CHO counting.
17. Estimate Susan’s energy requirements using the Harris-Benedict equation.
    1. REE = 655 + 9.6 (wt.) + 1.85 (ht.) – 4.7 (age)
    2. Weight = 115#/2.2 kg = 52.27 kg
    3. Height = 63 in. x 2.54 cm = 160 cm
    4. REE = 655 + 9.6 (52.27 kg) + 1.85 (160cm) – 4.7 (16 years)
    5. Physical activity factor = 1.59 for very active
    6. REE = 1377 kcal x 1.59 = 2190 kcal/day
    7. **Estimated Energy Requirement = 2100-2200 kcal/day**
18. Using the 1-week food diary from Susan, calculate the average CHO usually consumed each meal and snack.

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| --- | --- | --- |
| **Meal** | **Day** | **Gram CHO** |
| Breakfast | Monday | 102 g |
|  | Tuesday | 102g |
|  | Wednesday | 87g |
|  | Thursday | 102g |
|  | Friday | 102g |
|  | Saturday | 117g |
|  | Sunday | 92g |
|  |  | **Average: 100.57g** |
| Lunch | Monday | 150g |
|  | Tuesday | 68g |
|  | Wednesday | 30g |
|  | Thursday | 72g |
|  | Friday | 150g |
|  | Saturday | 77g |
|  | Sunday | 77g |
|  |  | **Average: 89.14g** |
| Snack | Monday | 37g |
|  | Tuesday | 30g |
|  | Wednesday | 15g |
|  | Thursday | 30g |
|  | Friday | 42g |
|  | Saturday | 30g |
|  | Sunday | 30g |
|  |  | **Average:** **30.57g** |
| Dinner | Monday | 190g |
|  | Tuesday | 43g |
|  | Wednesday | 80g |
|  | Thursday | 109g |
|  | Friday | 84g |
|  | Saturday | 65g |
|  | Sunday | 60g |
|  |  | **Average**: **90.14g** |
| HS | Monday | 15g |
|  | Tuesday | 15g |
|  | Wednesday | 30g |
|  | Thursday | 15g |
|  | Friday | 15g |
|  | Saturday | 15g |
|  | Sunday | 15g |
|  |  | **Average: 17.14g** |

(Nelms, 2011, pg. A-110-123).

1. After you have calculated Susan’s usual CHO intake from her food record, develop a CHO-counting meal plan that she could use. Include menu ideas.
   1. Daily total:
      1. CHO = 45-55% total energy needs
         1. CHO = (2190 kcal) x (45-55%) = 985.5-1204.5 kcal
         2. CHO = (985.5-1204.5 kcal)/ (4g/kcal) = 246-301 g CHO
         3. CHO = (246-301g CHO/day)/(15g/serving) = 16-20 serving CHO/day

PRO = 15-20% total energy needs:

PRO = (2190 kcal) x (15-20%) = 328-438 kcal/day

PRO = (328-438 kcal)/ (4g/kcal) = 82-109 g PRO/day

FAT = 20-35% total energy needs:

FAT = (2190 kcal) x (20-35%) = 438-766 kcal/day

FAT = (428-766 kcal)/ (9g/kcal) = 47-85 g FAT/day

|  |  |  |
| --- | --- | --- |
| **Meal** | **Grams CHO** | **Menu Ideas** |
| Breakfast:  7:00am – 8:00am | 5 CHO Choices | 1 cup oatmeal (2 CHO)  1 banana (2 CHO)  1 cup skim milk (1 CHO)  1 tbsp. peanut butter |
| Lunch | 5 CHO Choices | 2 slices whole grain bread (2 CHO)  3 oz. deli meat  1 oz. cheese  1 apple (2 CHO)  1 cup chocolate milk (1 CHO) |
| Snack | 2 CHO Choices | 6 pita chips (1 CHO)  1 tbsp. hummus (1 CHO) |
| Dinner | 6 CHO Choices | 1 cup brown rice (3 CHO)  3 oz. chicken breast  ½ cup broccoli (1 CHO)  1 cup skim milk (1 CHO)  ½ cup asparagus (1 CHO) |
| HS | 2 CHO Choices | 1 cup ice cream (2 CHO) |

1. What will you tell Susan and her mother in regards to the use of stevia instead of artificial sweeteners or sugar?
   1. I would tell Susan and her mother that according to the Academy of Nutrition and Dietetics, the use of nonnutrive sweeteners is generally recognized as safe as long as they follow the current FDA guidelines and consume in moderation. (Academy of Nutrition and Dietetics, 2012).

References

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