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Case Study #14 Presentation

I. Understanding the Diagnosis and Pathophysiology

1. *What are the current thoughts regarding the etiology of type 1 diabetes mellitus (T1DM)? No one else in Rachel's family has diabetes – is this unusual? Are there any other findings in her family medical history that would be important to note?*

Diabetes mellitus is not a single disease. In fact, it is a diverse group of disorders that differ in their origin and severity. However, all forms of diabetes mellitus share a common characteristic of hyperglycemia resulting from defects in insulin production, insulin action, or both. Of all diagnosed diabetic cases, type 1 diabetes mellitus accounts for 5 to 10% (Nelms, 2011, 482). Type 1 is considered an autoimmune disease. In most cases, it is the body's inability to produce insulin. This is due to the autoimmune destruction of the beta cells in the pancreas. Destruction rates vary but tend to be faster in infants and children. With little to no insulin being produced, glucose tends to build up in the blood instead of being transported to the cells. This means that the body will not be able to use the glucose for energy. Onset typically occurs during childhood but can occur at any age. The first sign of T1DM tends to be ketoacidosis, which is defined as acid-base imbalance caused by an increased concentration of ketones in the blood. This is evidenced by biochemical lab values. Autoantibodies, which are the cause of the destruction of the pancreatic β cells, are present in 85-89% of T1DM diagnoses. The cause of β cell destruction lacks sufficient research, yet recognized contributing factors to this disease are multiple genetic predispositions and unidentified environmental stimuli (Nelms 483). There are numerous contributing factors for

developing T1DM other than genetics, which makes it not unusual for Rachel to be the only person in her family that has been diagnosed with T1DM. After looking over her family medical history it is important to note that her sister has celiac disease and her mother has hyperthyroidism. Both of these conditions are autoimmune disorders, which have a predisposition for T1DM. Also, with celiac disease, it is often thought to be a genetic disorder and current research shows celiac disease and T1DM can occur together and share genetics.

(Khardori, Romesh. 2014)
(Wisse, Brent. 2014)

2. *What are the standard diagnostic criteria for T1DM? Which are found in Rachel's medical record?*

Standard diagnostic criteria for diabetes mellitus are symptoms of diabetes such as polyuria, polydipsia, and unexplained weight loss. Along with glucose concentration levels greater than or equal to 200 mg/dL should be of concern. Upon admittance to the ER, Rachel had a serum glucose of 724 mg/dL, which is well above normal standings. Other diagnostic criteria include a fasting plasma glucose concentration of greater than or equal to 126 mg/dL, or a two hour postprandial glucose level of greater than or equal to 200 mg/dL during an oral glucose tolerance test. Along with the fasting blood glucose test a hemoglobin A1c measure of 6.5% or higher is indicative of T1DM. (Nelms, 2011, 485). All of these standards are found in Rachel's medical record, which means she meets the criteria for the diagnosis of diabetes mellitus.

3. *Using the information from Rachel's medical record, identify the factors that would allow the physician to distinguish between T1DM and T2DM.*

According to the information from Rachel's medical record, the physician should be able to distinguish that she is T1DM instead of T2DM. The factors that conclude this include her high glucose levels, indicating hyperglycemia. From her medical record, one of Rachel's chief complaints was that she has been really thirsty – thirstier than she has ever been in her whole life. She also indicated that she has increased urination throughout the day and night. Increased thirst and urination are very common symptoms when it comes to T1DM. Also, her C-peptide levels are extremely low. Low to non-existent levels indicate little to no insulin levels in the body. This too confirms her diagnosis of T1DM because with T2DM C-peptide levels remain normal or become elevated.

4. *Describe the metabolic events that led to Rachel's symptoms and subsequent admission to the ER (polyuria, polydipsia, polyphagia, fatigue, and weight loss), integrating the pathophysiology of T1DM into your discussion.*

Rachel is insulin deficient and has hyperglycemia. It is a result of increased hepatic glucose output and decreased glucose uptake. The hyperglycemia has caused osmotic diuresis leading to polyuria. With the symptom of excessive urination, dehydration can occur and results in increased thirst; polydipsia. Along with her complaint of her increased feeling of hunger, which is a symptom called polyphagia (Nelms, 2011, 472). She also has a high amount of fatty acids in her blood forcing the body to use stored fat as energy. This process could have led to her symptoms of polyphagia. Having high amounts of amino acids in the blood could have increased the rate of protein degradation leading to muscle wasting, fatigue, and possible weight loss. When glucose can no longer enter the cells, plasma glucose levels rise and cells will begin to starve. Excess glucose is then lost

in the urine because the kidneys can only get rid of so much glucose from the blood at a specific rate. This results in polyuria or frequent urination. Because urine is lost, this leads to polydipsia, or her excessive thirst due to dehydration. Polyphagia sets in as a result of this loss of significant energy. Fatigue then sets in, because the cells no longer have the energy.

5. *Describe the metabolic events that result in the signs and symptoms associated with DKA. Was Rachel in this state when she was admitted? What precipitating factors may lead to DKA?*

Diabetic ketoacidosis (DKA), is a severe form of hyperglycemia. It is a life threatening condition that demands prompt medical attention. DKA typically occurs more often in individuals with T1DM (Nelms, 2011, 496). The condition is a complex disordered metabolic state characterized by hyperglycemia, ketoacidosis, and ketonuria. The development of DKA occurs slowly. The most common symptoms of DKA is the increase in polydipsia and polyuria, which occur early within the condition. Other signs and symptoms include increased thirst, high blood glucose, fatigue, increased urination, high levels of ketones in the urine, and nausea. A metabolic event that results with these symptoms is physiological stress, such as infection. Dehydration and electrolyte imbalance occur when glucose and ketones build up. Rachel was in this state when she was admitted into the ER. She was experiencing fatigue and weakness due to the fact that she fainted just moments before at her soccer practice. She has also been experiencing increased thirst and urination. Precipitating factors for ketoacidosis include lack of blood glucose self-monitoring, severe illness/infection, insulin omitted, increased insulin needs with growth spurts, and inappropriately stored insulin. (Hamdy, Osama, 2014)

6. *Rachel will be started on a combination of Apidra prior to meals and snacks with glargine given in the a.m. and p.m. Describe the onset, peak, and duration for each of these types of insulin. Her discharge dosages are as follows: 7 u glargine with Apidra prior to each meal or snack – 1:15 insulin:carbohydrate ratio. Rachel's parents want to know why she cannot take oral medications for her diabetes like some of their friends do. What would you tell them?*

Apidra is a man made type of insulin. It's onset takes 15 minutes, with a peak within 30 to 90 minutes. The overall duration of Apidra lasts 3 to 5 hours. Glargine is a type of insulin that lowers blood glucose levels. It's onset takes 2 to 4 hours and does not have a peak, Glargine has a duration of 20 to 24 hours (Nelms, 2011, 488). In discussing this information with Rachel's parents, I would explain that oral medication will not benefit Rachel and her diagnosis of T1DM. Their friends most likely have T2DM, which can be managed by taking oral medications. The best option for Rachel's health is to perform insulin injections. Administering injections will allow the insulin dosage to go straight into her bloodstream.

7. *Rachel's physician explains to Rachel and her parents that Rachel's insulin dose may change due to something called a honeymoon phase. Explain what this is and how it might affect her insulin requirements.*

The honeymoon phase occurs in individuals with type 1 diabetes mellitus. It refers to the period of time shortly following the diagnosis of diabetes. In this time, the pancreas is still able to produce enough insulin to reduce insulin needs, along with aiding blood glucose needs. This occurs due to the remaining insulin-producing β cells that have not been affected by the autoimmune response. This means that the cells produce insulin in varying amounts but will only be temporary. This will affect her insulin requirements in that she will require more insulin. Her needs will increase due to the destruction of her β cells. Recommendations during this phase

include taking regular insulin injections. Without these injections, her risk for diabetic ketoacidosis increase; a serious complication that produces high levels of blood acids called ketones.

(Diabetic Ketoacidosis, n.d.)
(Honeymoon Phase, n.d.)

8. *How does physical activity affect blood glucose levels? Rachel is a soccer player and usually plays daily. What recommendations will you make to Rachel to assist with managing her glucose during exercise and athletic events?*

During physical activity there is an increased need for glucose to provide energy to the muscles. Rachel's blood glucose may drop during or after physical activity. It is essential for her to monitor her levels. Hypoglycemia and hyperglycemia are acute risk factors of physical activity and are also important for her to consider (Nelms, 2011, 495). I would recommend that she monitor her levels before, during, and after physical activity. Carbohydrates should be increased and/or insulin adjustments should be made. I would advise Rachel to incorporate an additional 15 grams of carbohydrates into her diet for every hour of moderate physical activity performed. However, for more strenuous activities, 30 grams of carbohydrates for every hour of physical activity should be consumed (Nelms, 2011, 495). If her blood glucose is high prior to physical activity, she should not participate in the activity. This is because the physical activity could worsen her blood glucose levels and take it out of normal range. Having a pre-exercise snack will aid in raising her blood glucose. That way she wouldn't have to sit out of a practice or game. I would also recommend to Rachel that it's a smart idea to also carry a snack high in carbohydrates with her for emergencies.

9. *Rachel's blood glucose records indicate that her levels have been consistently high when she wakes in the morning before breakfast. Describe the dawn phenomenon. Is Rachel experiencing this? How might it be prevented?*

The dawn phenomenon, also referred to as the dawn effect, is an increase in blood glucose in the early morning, most likely due to increased glucose production in the liver after an overnight fast (Nelms, 2011, 472). As an individual sleeps, a natural overnight release of hormones occur, which increases insulin resistance and results in the rise of blood glucose. Essentially, the increased need for insulin at dawn causes a rise in an individual's fasting blood glucose levels. Another explanation for the phenomenon is that there was insufficient insulin the night before, insufficient dosages, or a snack consumed right before bedtime. Given Rachel's higher glucose levels in the morning hours, I do think that she is experiencing this phenomenon. There are a few things that Rachel and her parents can do to help prevent this from happening. Avoiding carbohydrates before bed, adjusting her medication or insulin dosages, or to adjust the time of when she takes her medication or insulin to right before she goes to bed. (Castro, Regina. 2014).

II. Understanding the Nutrition Therapy

10. *The MD ordered a consistent carbohydrate-controlled diet when Rachel begins to eat. Explain the rationale for monitoring carbohydrate in diabetes nutrition therapy.*

The American Diabetes Association (ADA), states that monitoring carbohydrates remains a significant approach in realizing glycemic control. They also stated that setting a limit for the amount of carbohydrates consumed will aid in managing blood glucose levels (Nelms, 2011, 493). This is important because if a diabetic individual consumes more carbohydrates that their insulin supply can handle, their

blood glucose level will rise. The visa versa is also true. Since Rachel has been diagnosed with T1DM, she will need to monitor her carbohydrate intake during meals and snacks. If proper monitoring of carbohydrate intake is executed, it will become easier for her to determine the appropriate insulin dosage needed. If appropriate carbohydrate and insulin intake is executed, Rachel's blood glucose levels should remain within normal and healthy standings.

11. *Outline the basic principles for Rachel's nutrition therapy to assist in control of her T1DM.*

The basic principles for Rachel's nutrition therapy to assist in controlling her T1DM would be to attain and maintain optimal metabolic outcomes that include glucose levels at a normal range, lipid or lipoprotein profile that reduces risk for macrovascular disease, and blood pressure levels that reduce risk for vascular disease. Other goals would be to prevent and treat chronic complications by modifying nutrient intake and lifestyle as appropriate for the patient, as well as enhancing health through food choices and physical activity, and addressing the individual nutritional needs with regard to personal and cultural preferences and lifestyles (Nelms, 2011). Nutrition therapy for Rachel is solely aimed at avoiding hyperglycemia and retarding the development of complications associated with T1DM.

III. Nutrition Assessment

12. *Assess Rachel's ht/age; wt/age; ht/wt; and BMI. What is her desirable weight?*

a. Rachel's height is 5', or 60in, which puts her at about the 50th percentile for her height/age on the CDC growth charts.

b. Rachel's weight is 82 lbs which puts her at about the 25th percentile for her weight/age; this is on the lower end according to the CDC growth charts.

d. BMI:
BMI = Weight (lbs) / [Height (in) x Height (in)] x 703
BMI = 82 lbs/ [60 in x 60 in] x 703
BMI = 82 lbs/ 3600 in x 703
BMI = 0.023 x 703
BMI = 16.01

Rachel's BMI puts her at about the 20th percentile for her age according to the CDC BMI charts. Anywhere between the 5th-85th percentiles is considered normal for children (Nelms, 2011, pg. 47).

Rachel's desirable weight based on the CDC growth charts for weight/age would be about 90 lbs to put her in the 50th percentile. This puts her at 91% of her ideal body weight.

13. *Identify any abnormal laboratory values measured upon her admission. Explain how they may be related to her newly diagnosed T1DM.*

Upon Rachel's admission her abnormal lab values were sodium were low along with low phosphate values which is consistent with the diagnosis of T1DM. With diabetes, there is an increase in urination as a result of excess glucose in the blood. This increase in urination results in an overall fluid loss which explains why her sodium values are low. Her glucose level is 683 mg/dL upon admission and the normal range is typically below 200 mg/dL. This is also extremely consistent with T1DM. Her high osmolality values are consistent with diabetes because of the hypovolemia due to the diabetes diagnosis. The HbA1c measures the plasma glucose concentration therefore the diabetes diagnosis explains the high HbA1c levels. The abnormal levels of C-peptide, ICA, GADA, and IAA are all indicative of T1DM because each are found in those with diabetes. The C-peptide can show how much insulin is being produced because it is released when the disulfide bond is broken between the insulin chains. The ICA, IAA, and GADA are all present in

majority of cases of T1DM. Finally, the proteins, glucose, ketones, prot chk found in the urinalysis are all evidence of diabetes because with diabetics, there is an increased production of keto acid which causes pH to fall and ketone bodies to be secreted in the urine. This also explains the acidic pH of the urine. (Nelms, 2011, pg. 483-485).

14. *Determine Rachel's energy and protein requirements. Be sure to explain what standards you used to make this estimation.*

Rachel's energy requirements:
EER for Females 9 through 18 Years:

1. EER = 135.3 - 30.8 x Age + PA x (10.0 x wt + 934 x ht) +25
2. EER = 135.3 - 30.8 x 12 + 1.31 x (10.0 x 37.3 + 934 x 1.524) + 25
3. EER = 135.3 - 30.8 x 12 +1.31 x (1796.41) + 25
4. EER = 2144 kcals

Rachel's energy requirements are 2100-2200 kcals/day using the EER for females 9 through 18 years with an active physical activity level. (Nelms, 2011, pg. 242).

Rachel's protein requirements:
Protein requirements for diabetic patients is 15-20% of daily kilocalories from animal and vegetable protein sources. (Nelms, 2011, pg. 490).

Protein = 2144 kcal x 15% = 321.6 kcal
= 2144 kcal x 20% = 428.8 kcal

Protein = 321.6 kcal/ 4 kcal/g = 80.4 grams
= 428.8 kcal/ 4 kcal/g = 107.2 grams

Rachel's protein requirements are 80.4 - 107.2 grams of protein per day.

IV. Nutrition Diagnosis

15. *Prioritize two nutrition problems and complete the PES statement for each.*

1. **N.C. 2.2 -** Altered nutrition related laboratory values in sodium, glucose, phosphate, osmolality, HbA1c, c-peptide, ICA, GADA, IAA related to new T1DM diagnosis as evidenced by laboratory results.
2. **N.B. 1.1** - Food and nutrition related knowledge deficit related to lifestyle changes required for T1DM as evidenced by changes required for the new diagnosis.

(eNCPT, 2014).

16. *Determine Rachel's initial nutrition prescription using her diet record from home as a guideline, as well as your assessment of her energy requirements.*

a. Nutrition recommendations for total fat, saturated fat, cholesterol, fiber, vitamins, and minerals are for individuals with diabetes as for the general population. She needs 2100-2200 kcals per day and 80-107 grams of protein per day to reach her 15-20% protein needs per day. Rachel should consume about 210-315 grams of carbohydrate per day to meet her daily needs of 40-60% carbohydrate. Rachel should also consume 58-81 grams of fat per day to meet her daily needs of 25-35% fat per day. Based off of her diet history, it appears that Rachel will need to be introduced to a wider variety of fruits and vegetables. Her parents report that she is a picky eater so she will need to become familiar with all types of fruits and vegetables to determine a couple that she truly likes. If she is noncompliant with new fruits and vegetables, supplementation might be considered. She should also increase her variations of protein other than just chicken and fish by incorporating foods such as eggs or nuts. Rachel is active but may still want to limit her intake of ice cream, chips, and cookies.

17. *What is an insulin to carbohydrate ratio? Rachel's physician ordered her ICR to start at 1:15. If her usual breakfast is 2 Pop-tarts and 8oz. skim milk, how much Apidra should she take to cover the carbohydrate in this meal?*

An insulin to carbohydrate ratio is a mechanism for determining insulin dosage based on carbohydrate intake. Typically, 1 unit of rapid-acting insulin is taken for every 10-15 grams of carbohydrate (Nelms, 2011, pg. 493). Rachel's prescription is one unit of insulin for every 15 grams of carbohydrate. One Pop-tart pastry has 35g of carbohydrate and 8oz. of skim milk has about 12g of carbohydrate. This is a total of 82g of carbohydrate for Rachel's usual breakfast. This is about 5.5 doses of Apidra in order to cover the carbohydrates in this meal.

35g + 35g + 12g = 82 g CHO

82g/15g = 5.5 doses

(Poptarts Nutrition, 2014).

18. *Dr. Cho set Rachel's fasting blood glucose goal at 90-180 mg/dL. If her total daily insulin dose is 33 u and her fasting a.m. blood glucose is 240 mg/dL, what would her correction dose be?*

a. One unit of rapid-acting insulin is given for every 50mg/dL that blood glucose rises above 150mg/dL. According to the correction factor, if blood glucose is 201-250, 2 units of insulin are added. Therefore, in order to correct her a.m. blood glucose, 2 units of insulin must be given.

VI. Nutrition Monitoring and Evaluation

19. *Write an ADIME note for your initial nutrition assessment.*

a. Assessment -

i. 12 year-old female with newly diagnosed Type I Diabetes Mellitus upon hospital admission with a blood-glucose level of 724 mg/dL,

with a height of 5' (60in) and a weight of 82 lbs (37.3kg), prior weight of 90 lbs which is normal weight for the patient with a BMI of 16. Patient is at 91% of usual body weight. Patient is at 50th percentile for height/age and 25th percentile for weight/age. Her biochemical markers for the condition are low sodium levels, high glucose levels, low phosphate levels, high osmolality, high HbA1c, low C-peptide, high ICA, high GADA, and high IAA levels. Clinical diagnosis of T1DM. Estimated energy requirements of about 2100-2200 kcals/day, 80-107g of protein per day.

b. Diagnosis -
    i. Type I diabetes mellitus related to serum glucose levels as evidenced by abnormal laboratory results, unintended weight loss, frequent urination, increased thirst, and increased hunger.
    ii. N.C. 2.2 - Altered nutrition related laboratory values in sodium, glucose, phosphate, osmolality, HbA1c, c-peptide, ICA, GADA, IAA related to new T1DM diagnosis as evidenced by laboratory results.
    iii. N.B. 1.1 - Food and nutrition related knowledge deficit related to lifestyle changes required for T1DM as evidenced by changes required for the new diagnosis.
c. Intervention -
    i. Begin Apidra 0.5 u every 2 hours until glucose is 150-200 mg/dL. Progress Apidra using ICR 1:15. Continue glucose checks hourly. Once glucose levels have stabilized, provide caregivers and patient with nutrition education and instruction on carbohydrate counting, the exchange system, and meal planning.
d. Monitoring/Evaluation -
    i. Provide a food log to the patient in order to assist in the new dietary changes and to effectively teach carbohydrate counting.
    ii. Self-monitoring of blood glucose (SMBG) and A1C levels taken and recorded by the patient to be reviewed at the next session.
    iii. Reevaluation of laboratory results will be conducted at the next session to monitor glucose control. Original abnormalities will be monitored as well as total cholesterol, low-density lipoproteins, and triglycerides in order to monitor lipid profile and blood pressure.

(Nelms, 2011, pg. 493-495).

20. When Rachel comes back to the clinic, she brings the following food and blood glucose record with her.

a. Determine the amount of carbohydrates she is consuming at each meal.
b. Determine whether she is taking adequate amounts of Apidra for each meal according to her record.
c. Calculate a correction dose for her to use.

Time	Diet	Grams of CHO	Exercise	BG (mg/dL)	Insulin Dosage: What she took:	Insulin Dosage: What you would recommend:
7:30 am	2 Pop-tarts 1 banana 16 oz. skim milk with Ovaltine (2 tbsp)	35g + 35g + 15g + 29g = 143 g of CHO		(Pre) 150	5 u Apidra	143g/ 1 unit per 15g CHO = **9.5 units**
10:30 am						
12:00 pm	2 slices of pepperoni pizza 2 chocolate chip cookies Water	36g + 36g + 8g + 8g = 88g		(Pre) 180	6 u Apidra	88g/1 unit per 15g CHO= 5.8 + 1 correction unit = 6.8 units ~ **7 units**
2:00 pm	Granola bar	25 g	PE class - 30 min			25g/ 1 unit per 15g CHO = **2 units**
4:30 pm	Apple 6 saltines with 2 tbsp peanut butter	60g + 80g + 0g = 140 g		(Pre) 110		140g/1 unit per 15g CHO = **9 units**
5-6:30 pm	16 oz. Gatorade	28 g	Soccer practice - 1.5 hrs	(Pre) 140		28g/1 unit per 15g CHO = **2 units**
6:30 pm	Chicken with broccoli stir-fry (1 c fried rice, 2 oz. chicken, ½ c broccoli) Egg roll - 1 2 c skim milk	0g + 45g + 5g + 23g + 24g = 97g		(Pre) 80	5 u Apidra	97g/1 unit per 15g CHO = **6 units**
8:30 pm	2 c ice cream with 2 tbsp peanuts	68g + 5g = 73g		(Pre) 150	4 u Apidra	73g/1 unit per 15g CHO = **5 units**
10:30 pm	Bed					

(Calorie Counter, n.d.)
(Gatorade, 2014)
(Poptarts Nutrition, 2014)

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