Type I Diabetes Case Study: Questions

Shannon Edwards

I. Understanding the Diagnosis and Pathophysiology

1. What are the current thoughts regarding the etiology of type I 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?

Type 1 Diabetes is the pancreatic beta-cell destruction process that can be brought on by genetic, environmental or autoimmune complications. The genetic predisposition to T1DM is the result of the combination of human leukocyte antigen coded genes for disease susceptibility offset by genes that are related to disease resistance. Genetic factors that confer susceptibility or protection remain unclear, so it is not uncommon that she has T1DM, but no one else in her family does. Other problems can arise with T1DM diagnosis due to the decrease in amylin production, like celiac disease. Since her sister was diagnosed with celiac, her parents should have her checked for possible T1DM risks.

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

The standard diagnostic criteria for T1DM are A1C greater than or equal to 6.5, FPG greater than or equal to 126, 2 hours PG greater than or equal to 200 during OGTT (75g glucose load), random plasma glucose load greater than or equal to 200 with classic hyperglycemic symptoms. You can also test for autoantibodies and the existence of C-peptide. Rachel’s A1C and glucose levels are outside of normal range (elevated), has the presence of autoantibodies and has decreased C-peptide levels, all indicating T1DM.

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

Some factors that will play a part in distinguishing between T1DM and T2DM diagnosis in Rachel, would be her weight and height related to her BMI in the fact that she is within normal range. Rachel’s symptoms of polydipsia, polyphagia and polyuria, as well as her increase in weight loss are also signs and symptoms that will help determine. As far as lab results are concerned, the physician can test for auto-antibodies in the blood stream. The presences of these declare an autoimmune state in which certain antigens are in the process of destroying pancreatic b-cells. Lastly, Rachel’s C-peptide levels are very low indicating that there is little to no insulin production in the pancreas.

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
Since the pancreatic b-cells that secrete insulin are in the process of destruction, the body cannot appropriately take up glucose from exogenous sources properly. The body then automatically thinks it does not have the proper intake to supply fuel for activity, resulting in increased hunger. If the body is unable to use glucose for food, it will then switch to other tissues and macronutrients, consequently causing weight loss and possible DKA. The kidneys simultaneously want to rid the body of excessive glucose that is in the blood, resulting in an increase in polydipsia and polyuria. Fatigue is caused by the insufficient glucose uptake for energy in the cells, causing the body to lack 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?

Complications with diabetic ketoacidosis are brought on by a severe disturbance in CHO, protein and fat intake. The body’s inability to properly take up glucose from the blood consequently results in the metabolization of fats for energy and fuel, where ketones are formed. The increased fatty acid breakdown will cause an overproduction of byproducts, acetoacetic acid and 3-b-hydroxybutyric acid, which in turn causes the acidosis state. When the ketones are overproduced, they spill over into the urine. DKA is then characterized by an increase in glucose levels (greater than or equal to 250) and ketones in the blood and urine. Rachel was in fact in this state due to her symptoms of polyuria, polydipsia, dehydration and fatigue. Diabetic Ketoacidosis can also be caused by an illness (Rachel experiencing strep) and uncontrolled insulin therapy. DKA can lead to hypokalemia, hypoglycemia, coma, and even death.

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: 7u 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 fast acting insulin that has an onset of 15-30 minutes. This type of insulin peaks at 0.5-2.5 hours and has the duration of 5 hours or less. Lantus (or glargine) is long lasting basal insulin, which has an onset of 1.5 hours, where its duration can last up to 24 hours. Rachel’s case is different from their friends, who probably suffer from T2DM. Oral insulin’s are used to affect endogenous and exogenous insulin and are not used on T1DM individuals. Rachel cannot produce insulin at all because of the destruction to the beta-cells in the pancreas, so she needs straight insulin injections to better control her BG.

7. Rachel’s physician explains to Rachel and her parents the 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.
Once the hyperglycemic state, ketoacidosis, and metabolic acidosis has been corrected, endogenous insulin levels will recover and be “more normal”. This state is called the honeymoon state, where exogenous insulin needs are greatly decreased, mirroring a close to normal glucose/insulin state. These levels can last up to 1 year or more and are easily attainable. It is inevitable that the beta-cells will be fully destroyed and her exogenous insulin needs will rise, causing her insulin dosages to increase over the years.

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?

It has been shown that an increase in physical activity for diabetic individuals is an integral part of the treatment plan, increasing insulin sensitivity, reducing cardiovascular risk factors and helping with weight control. For T1DM patients, increases in insulin sensitivity vary and is not always the case. Since Rachel partakes in a more intense form of exercise, that probably lasts around 2 hours, she needs to partake in frequent blood glucose monitoring before, during and after practices and games. She could fall into a hyperglycemic and/or ketosis state due to the excessive glucose and fuel breakdown encouraged by the liver during intense activity. She could also experience a hypoglycemic state due to increased insulin sensitivity.

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 is a condition in which the blood glucose levels are higher in the morning than they are throughout the night. This is due to the liver breaking down glycogen stores thinking the body is in a fasting state. The amount of insulin required to normalize blood glucose levels during the night is less in the predawn period (from 1:00 – 3:00 am) than at dawn (4:00 – 8:00 am). Given Rachel’s higher glucose levels in the morning, I do think that she is experiencing this situation and this situation can be prevented by not administering an insulin that peaks around 1-3am. She must be careful of the rebound hyperglycemia that can take place post hypoglycemia. During hypo, the body secretes hormones like glucagon and epinephrine, to increase glucose secretion in the liver. This will in turn raise blood glucose levels in the blood. She wants to be careful not to administer more insulin to avoid over use and unregulated hypoglycemia.

II. Understanding the Nutrition Therapy

10. The MD ordered a consistent carbohydrate-controlled diet when Rachel begins to eat. Explain the rationale for monitoring carbohydrates in diabetes nutrition therapy.
The physician’s rationale for ordering a consistent carbohydrate-controlled diet was specifically to monitor Rachel’s rate of glucose removal under particular insulin dosages. Everyone is different in how they react to insulin removal, especially when they have a higher or lower ISF due to factors revolving around Rachel’s active lifestyle, lower body weight and age. During nutrition therapy, if patients are administered the same controlled CHO amounts, the hospital staff and physician will be in a better position to address Rachel’s insulin needs for controlled diabetic education and lifestyle changes when she returns home. Thus, education needs to be specifically suited for her lifestyle, to ensure success and to ease the initial overwhelming process of insulin therapy. For this to occur, the physician will make nutrition therapy decisions based on Rachel’s insulin:CHO ratio and insulin sensitive factor.

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

Utilize SMBG at least 8 times per day, especially pre and post meals/snacks, and monitoring before and after practices and exercise to get better control of glucose patterns, including multiple injections with the use of an insulin pump. Her insulin needs to consist of half basal and half rapid acting (before meals). Make sure to pay close attention to insulin:CHO ratios to avoid hypo- or hyperglycemia. If glucose exceeds 240mg/dl regularly, make sure to check for ketones. Rachel needs to be monitoring CHO intake which can provide diet flexibility and improve compliance. This will ensure that she is meeting her insulin needs and maintaining consistency throughout ADL and practice/games. Her intake needs to consist of 3c. milk, 34g oil, 2c. fruit, 3.5c vegetables, 7oz. meat and beans and 9oz. of grains, and an increase in fiber rich foods. Her diet needs to include 50% of her calories to carbohydrates, 18% to protein and 25% to fat. Fat intake needs to also include >7% SFA, no trans fats and increased intake of omega-3 polyunsaturated fatty acids. The nutrition requirements listed above will help her maintain glucose levels, weight and aid in the defense against additional health risks created from diabetes like CVD.

### III. Nutrition Assessment

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

Rachel’s wt/age is right on the 25th%tile line and ht/age is right on the 50th%tile line, where the weight needs to increase. Judging from the low weight, her current BMI is in the 10th-25th%tile which is too low for her as well. For her to be within normal weight range (50th%tile for her age) she would need to increase her current weight by 12#, putting her at 94#.

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

Sodium: This is due to her poor dietary intake and decreased cellular uptake.
Phosphate (inorganic mg/dL): This decrease is closely associated with disturbed intake, distribution or renal function.\(^1\)

Osmolality (mmol/kg/H\(_2\)O): This increase is a direct reflection on her dehydrated state, diabetic ketone increase and major uncontrolled diabetic physiological state.

HbA\(_{1c}\) (%): This is increased due to the amount of glucose in her blood. Hemoglobin becomes glycolated when there is an excessive amount of glucose in the blood, thus increasing the % A1C.

C-peptide (ng/mL): C-peptide is released along with insulin, so when insulin secretion decreases, so does C-peptide.

Specific gravity: Her increase could determine excessive water loss, and fluid concentration (which she has a higher concentration due to the color.)

pH: Rachel’s blood pH is slightly acidic due to her increase in fatty acid metabolism. When the tissues cannot use glucose, they turn to fats, thus resulting in dangerously acidic levels and possible ketoacidosis complications.

ICA, GADA, IAA: These are all autoantibodies that increase in a T1DM state. These antibodies are the reason for the beta-cell destruction. The presence of them is one of the main determinants of T1DM.

Glucose (mg/dL): Elevated in the blood due to insulin resistance and decreased uptake into tissues.

Ketones: Increased amounts will indicate high glucose levels due to insulin resistance. When the tissues cannot take up glucose, the begin to breakdown fatty acids, increasing the level of ketones in the blood and urine.

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

Rachel’s energy requirements, given her activity level, are ~2,592 calories/day which includes 116g of protein/day (18%). This is within the required 15-20%, being on the higher side to meet her activity level needs. Her calorie requirements were obtained based on her ht, wt, age and activity level.

IV. Nutrition Diagnosis

15. Prioritize two nutrition problems and complete the PES statement for each.
NB 1.4 Self-monitoring deficit RT increased blood glucose levels AEB patient’s current state of polydipsia, polyuria, polyphagia, dehydration, electrolyte imbalance, significant weight loss, and ketoacidosis.

NC 3.2 Unintended weight loss RT insulin resistance and T1DM diagnosis AEB current weight of 82#'s and underweight BMI in the range of 10 – 25th%tile ranking on CDC growth charts.

V. Nutrition Intervention

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

Given that Rachel has a good ISF at 52 and participates in strenuous activity for 90 minutes/day, she would need roughly 55% of her calories to be carbohydrates (356g). Distributed throughout the day would be around 93g CHO per meal, one 30g snack after school and one 45g snack before practice. I think that this will help her maintain a good glucose level with her active lifestyle.

17. What is an insulin:CHO ratio (ICR)? 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?

ICR is based on the principle that 1 unit of rapid-acting insulin is needed to cover a particular amount of carbohydrates. The patient would use this set ratio to determine units to administer to control glucose in the blood. In Rachel’s case, the pop-tarts are ~72g and 8oz. of skim milk is ~12g of CHO, totaling 84g. If she is on a 1:15 ICR, she would need 5.5-6 u of insulin to cover the meal.

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

1700/33 = 52 ISF = 1:52 ratio

To correct the dose to get her down below 180 mg/dL, you would have to add 1.5 - 2 u of insulin to the total daily to decrease her BG in the morning to roughly 162 – 136mg/dL, which is within normal range.

VI. Nutrition Monitoring and Evaluation

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

Answer below...

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.

<table>
<thead>
<tr>
<th>Time</th>
<th>Diet</th>
<th>Grams of CHO</th>
<th>Exercise</th>
<th>BG (mg/dL)</th>
<th>What insulin dosage patient took</th>
<th>What you would recommend</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30 a.m.</td>
<td>2 Pop-Tarts 1 banana 16 oz skim milk with Ovaltine (2 tbsp)</td>
<td>135g</td>
<td></td>
<td>(Pre) 150</td>
<td>5 u Apidra</td>
<td>Her dosage amount needed to be around 7u.</td>
</tr>
<tr>
<td>10:30 a.m.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 noon</td>
<td>2 slices of pepperoni pizza 2 chocolate chip cookies Water</td>
<td>107g</td>
<td></td>
<td>(Pre) 180</td>
<td>6 u Apidra</td>
<td>Her pre-meal was a little high, so the increase in the morning would help, she was ok at 6-7u</td>
</tr>
<tr>
<td>2 p.m.</td>
<td>Granola Bar</td>
<td>22g</td>
<td>PE class – 30 minutes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4:30 p.m.</td>
<td>Apple</td>
<td>28g</td>
<td></td>
<td>(Pre) 110</td>
<td></td>
<td>This is fine, she was within normal limits</td>
</tr>
<tr>
<td>5-6:30 p.m.</td>
<td>16 oz Gatorade</td>
<td>30g</td>
<td>Soccer practice – 1.5 hours</td>
<td>(Pre) 140</td>
<td></td>
<td>Since the duration of her practice was 1.5 hours, she</td>
</tr>
<tr>
<td>Time</td>
<td>Meal</td>
<td>CHO Intake</td>
<td>Insulin Dose</td>
<td>Notes</td>
<td></td>
<td></td>
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<tr>
<td>6:30 p.m.</td>
<td>Chicken with broccoli stir-fry (1 c fried rice, 2 oz chicken, ½ c broccoli) Egg roll-1 2 c skim milk</td>
<td>89g</td>
<td>5 u Apidra</td>
<td>Her pre was a little low due to the amount of CHO eaten before practice. She should have taken 6u because of the amount of CHO eaten at dinner.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8:30 p.m.</td>
<td>2 c ice cream With 2 tbsp peanuts</td>
<td>60g</td>
<td>4 u Apidra</td>
<td>Her amount is sufficient for the CHO intake to pre</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:30 p.m.</td>
<td>Bed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Works Cited

1. Krause’s Food and Nutrition Care Process


4. http://care.diabetesjournals.org/content/27/suppl_1/s36.full


6. https://www.bcm.edu/research/centers/childrens-nutrition-research-center/healthyeatingcalculator/eatingCal.html
A: Rachel was presented to the ER after she fainted at soccer practice. States she felt horrible, has been experiencing excessive thirst, urination. Patient recently had strep throat. Parents state that Rachel has lost weight recently and she states her clothes are loose. Patient weighed 90#'s (UBW) at fast care clinic during strep check. Patient states her appetite has increased slightly she believes due to soccer practice. Sister suffers from celiac disease. 

12 yo female  Admit Dx: acute-onset hyperglycemia, Type 1 Diabetes Mellitus
Admitted with dry mucous membranes without exudates or lesions
Ht: 60” Wt: 82#  BMI: 16  percentile range: 10-25th%tile (below normal)  BP: 122/77
Diet order: consistent-carbohydrate  B&L:70-80g D:85-95g S: 3-15g
Insulin order: Apidra 0.5 u Q 2 hrs until 150-200mg/dL, then increase using ICR 1:15  Glargine 6 u starting @2100
Labs (05/05): HbA1c – 14.6(high)  Glucose – 250(high)  C-peptide – 0.10(low)  ICA, GADA, IAA: +(present)
TEE: ~2592 kcal  Est protein: 116g (18% based on activity level)  CHO: 356g total daily (based on activity level)

D: NB 1.4 Self-monitoring deficit RT increased blood glucose levels AEB patient’s current state of polydipsia, polyuria, polyphagia, dehydration, electrolyte imbalance, significant weight loss, and ketoacidosis.

NC 3.2 Unintended weight loss RT insulin resistance and T1DM diagnosis AEB current weight of 82#'s and underweight BMI in the range of 10 – 25th%tile ranking on CDC growth charts.

I: ND 1.2.10832 Composition of carbohydrate modified diet to control blood glucose levels ensuring accurate and easy insulin therapy.

E 1.2 Priority modifications based on risk factors associated with inappropriate insulin use and detrimental glucose levels.

Go over with patient the importance of C 2.3 self-monitoring to confirm her knowledge based around T1DM and proper insulin use.

RC 1.4 Collaboration with insurance and pharmaceutical to set up insulin pump refills and administration.

E 2.3 nutrition education application of insulin pump, knowledge of CHO counting and proper dosage calculations to present self-efficacy in the patient, parents and healthcare team.

M&E: FH 1.2.2.3 Evaluate meal/snack patterns based around insulin therapy
FH 1.5.3.1 Total carbohydrate intake evaluation related to glucose levels
FH 2.1.1.1 General, healthful diet including fruits, vegetables, whole grains, fiber, low fat dairy and low SFA foods
FH 4.2.8 Increased self-efficacy based around insulin therapy and pump usage
FH 7.3.4 Physical activity duration is optimal based on proper CHO intake and insulin use
AD 1.1.2 Adequate weight gain and AD 1.1.5 increased BMI
Anthropometric and Labs evals: BD 1.5.2 proper casual glucose levels, BD 1.5.3 HgA1C is within normal range, BD 1.2.5. increased sodium, BD 1.12.3 specific gravity is within normal range
CS 2.3.1 total estimated carbohydrates are adequate for insulin dosage and vise versa

Signature:
Shannon Edwards