**Case Study #17: Adult Type 2 Diabetes Mellitus: Transition to Insulin**

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**I. Understanding the Diagnosis and Pathophysiology**

**1. What are the standard diagnostic criteria for T2DM? Which are found in Mitch’s medical record?**

The standard diagnostic criteria for T2DM include: A1c > 6.5% using standardized laboratory measures, fasting plasma glucose > 126 mg/dL (7.0 mmol/L), or symptoms of diabetes plus random plasma glucose concentration > 200 mg/dL (11.1 mmol/L) during an oral glucose tolerance test. (Nelms et al, 2016, p. 481).

M.F.’s medical record contains elevated HbA1c at 15.2%, elevated plasma glucose of 1524 mg/dL on 4/12 and 475 mg/dL on 4/13 (seen in his laboratory results), and elevated glucose in his urine.

**2. Mitch was previously diagnosed with T2DM. He admits that he often does not take his medications. What type of medications are metformin and glyburide? Describe their mechanisms as well as their potential side effects/drug-nutrient interactions.**

Metformin is a Biguanide, and Glyburide is a second generation Sulfonylurea agent.

Metformin’s mechanism is to decrease the production of hepatic glucose and increase insulin uptake in the muscles. Whereas, Glyburide’s mechanism is simply to stimulate insulin secretion.

Metformin’s potential side effects include: transient diarrhea, nausea, bloating, anorexia, flatulence, and lactic acidosis. Potential drug-nutrient interactions are: decrease in the absorption of folate and vitamin B12, alcohol should be avoided, and Metformin should be taken with meals to prevent GI stress.

Glyburides’ potential side effects include: hypoglycemia and weight gain. In terms of drug-nutrient interactions, alcohol should be avoided.

**3. What other medications does Mitch take? List their mechanisms and potential side effects/drug-nutrient interactions.**

Patient M.F. also takes Dyazide once daily and Lipitor 20 mg daily.

Dyazide, also known as Triamterene, is used to treat hypertension. One side effect is that it causes an increase in urine depletion and decreases blood volume. Other side effects may be dizziness, light-headedness, diarrhea, and stomach ache. When taking it, one should avoid natural licorice and excessive potassium intake (bananas, honeydew, oranges…).

Lipitor is used to lower bad cholesterol (LDL) and increase good cholesterol (HDL). Potential side effects/drug-nutrient interactions include: nausea, dyspepsia, abdominal pain, constipation, diarrhea, and flatulence. While taking lipitor, one should avoid grapefruit, alcohol, and high-fat/cholesterol meals.

**4. Describe the metabolic events that led to Mitch’s symptoms and subsequent admission to the ER with the diagnosis of uncontrolled T2DM with HHS.**

M.F.’s symptoms were onset by his vomiting and lack of taking his diabetes medication. Not taking his diabetes medication resulted in not enough insulin being produced and uptaken within his muscles. The combination of high blood glucose and severe dehydration led to him getting HHS. Signs before admission included drowsiness and confused behavior or “progressive decline in level of consciousness”.

**5. HHS and DKA are the common metabolic complications associated with diabetes. Discuss each of these clinical emergencies. Describe the information in Mitch’s chart that supports the diagnosis of HHS.**

**HHS** stands for Hyperglycemic hyperosmolar syndrome. HHS occurs when there is extremely high blood glucose (prolonged hyperglycemia) and severe dehydration. This condition is characterized by plasma glucose levels >250-600 mg/dL, serum osmolarity >330-380 mOsm/kg, and a small amount of ketones in the urine and serum. Symptoms of HHS include polyuria, polydipsia, polyphagia, fever, slow progress, and weight loss. As blood sugar increases, the body attempts to decrease it by increasing fluid output resulting in dehydration. According to the American Diabetes Association, severe dehydration can lead to seizures, coma and eventually death. To prevent, there should be slow rehydration and adequate monitoring.

**DKA** stands for Diabetic Ketoacidosis. DKA is when the blood contains high levels of ketones. Laboratory findings in DKA include plasma glucose levels between 600-1200 mg/dL, arterial pH between 6.8-7.3 serum osmolarity at 300-320 mOsm/kg and ketones within the urine and serum. The condition may occur when the body is unable to produce enough insulin. Because the body is unable to access glucose, its preferred source of energy, fat is broken down producing ketones. Causes other than inadequate insulin include: infections, acute illnesses, pump malfunction, drug abuse, and pregnancy. To be controlled, IV fluids must be administered along with insulin and the control of the pt’s serum lytes.

Based on information found in M.F.’s chart, DKA can be seen in his various lab and assessment results. When first reviewing his appearance, based upon his lack of skin turgor, Kussmaul breathing, and dry skin, he must have DKA. An elevated hematocrit also points towards dehydration as the volume of blood has decreased. Although on 4/12 he had elevated plasma glucose of 1524 mg/dL (way over the 600 mark!) pointing more towards DKA, on 4/13 it decreased to 475 into the range for HHS. His lab results for BUN, creatinine serum, and urine glucose were also elevated. When examining his laboratory results, his osmolarity on 4/13 was 304 mOsm/kg in the range for DKA. The use of Dyazide has been found to increase the depletion of urine which could have also contributed to his dehydration and increased concentration. His vomiting also resulted in the loss of acid and fluids which increased dehydration further. He could also be suffering from an electrolyte deficit as he has only been sipping water since he vomited (lab results show decreased Na+ and K+). One of the most important findings includes the elevated presence of ketones in his urinalysis not common to HHS. These symptoms, signs, and laboratory results point towards DKA.

**6. HHS is often associated with dehydration. After reading Mitch’s chart, list the data that are consistent with dehydration. What factors in Mitch’s history may have contributed to his dehydration?**

* Super High glucose levels
* High Osmolality levels
* Really High BUN levels
* Confusion
* Low sodium levels
* Cloudy, amber appearance of urine
* High specific gravity
* Low pH
* Dry mouth
* Drowsy state

M.F. is taking Dyazide for his HTN, but this drug is also used for edema. With his low water intake normally and his very low water intake because of the vomiting he has been dehydrated. Drinking alcohol 3 - 4 drinks per week could have also lead him to dehydration. M.F. was also sweating from the fever, which is more fluid loss.

**7. Assess Mitch’s intake/output record for the first 24 hours of his admission. What does this tell you? Assuming that Mitch tells you that his usual weight is 228 lbs, can you estimate the volume of his dehydration?**

* The I/O report indicates that M.F. is severely dehydrated since his output of fluid is about half of the input through IV. M.F. took in a total of 4,335mL/kg/hr and only 2,195mL/kg/hr came out.
* M.F.’s usual weight is 228 lbs and entered the hospital at 214 (he lost 14 lbs).
* 14 lbs / 228 = 6.14% loss
* To convert to volume we need to convert his lbs to kg
* 228/2.2=103.6kg, so 103.6kg \* 6.14% loss = 6.36kg = 6.36 L lost from dehydration

**8. Mitch was started on normal saline with potassium as well as an insulin drip. Why are these fluids a component of his rehydration and correction of his HHS?**

M.F. was given the insulin drip to help glucose enter his the cells, instead of having a lot go out through his urine. Need to get his BG level back down to a normal range so that he can start to feel better and correct the hyperglycemia. The saline and potassium is given to correct the dehydration. Since M.F. lost a lot electrolytes, adding potassium to the saline drip will help restore the electrolytes in his body since potassium helps regulate the amount of water in and out of the cells within the body. Combining the insulin and potassium together will ensure that glucose and potassium will get into the cell but not overload the cell. Potassium likes glucose.

**9. Describe insulin therapy that was started for Mitch. What is Lispro? What is glargine? How likely is it that Mitch will need to continue insulin therapy?**

Lispro is a short-acting insulin that is given to type 2 DM patients who cannot control their diabetes. Glargine, which is a long-acting insulin, is given to type 2 DM patients when they cannot control their diabetes. Lispro was started with .5 u every 2 hours until blood glucose is in a more normal range of 150-200. From there the Lispro will be used every time M.F. eats a bolus for food w/ ICR 1:15. Glargine started at 9pm at 19u once per day and has given M.F. a base level of insulin throughout the day.

M.F.’s blood sugar has been so high for so long because he did not take his medication (metformin and Glyburide) regularly so he will be on this new treatment for a while. One thing that M.F. has going for himself is that he still is making insulin. His C-peptide levels are at 1.10 so if he changed his ways with 1) taking the medication correctly and following the doctors orders and 2) losing weight and eating healthier and exercising he could possibly get off the insulin and move back to the pills or even no medication at all.

**II. Understanding the Nutrition Therapy**

**10. Mitch was NPO when admitted to the hospital. What does this mean? What are the signs that will alert the RD and physician that Mitch may be ready to eat?**

NPO means that M.F. cannot have anything by mouth at this time. All meds and nourishments need to be administered by IV. This is because when M.F. was admitted he said that he had been vomiting. To ensure M.F. does not continue vomiting and gets more dehydrated, he is on an IV. He will also be kept on NPO so that his blood glucose levels decrease to a normal level. By keeping M.F. on NPO and giving him the IV fluid his BUN and creatinine levels should decrease and I/O balance should go back to normal. This will indicate M.F. is hydrated and has the correct electrolyte inbalance and his kidneys are not working overtime to keep him going.

**11. Outline the basic principles for Mitch’s nutrition therapy to assist in control of his DM.**

The overall goal of nutrition therapy for M.F. includes: A1c <7%, blood pressure <140/80 mgHg, LDL cholesterol <100mg/dL, triglycerides <150mg/dL, HDL cholesterol >40mg/dL, achieve and maintain weight loss goals, delay or prevent DM complications, address individual nutrition needs, maintain pleasurable eating, provide practical tools and guidelines for day-to-day meal planning and DM management.

* M.F. stated he has only received diabetes education from his physician, but has not seen anyone for diabetes teaching
* Will educate M.F. on sources of CHO and will emphasize CHO from vegetables, fruits, grains, legumes, low-fat dairy
* Focus will be on CHO counting and spreading out CHO consistently throughout the day for each meal and/or snack
* Will emphasize that CHO is the major macronutrient that has an influence on post-meal blood glucose variations and pre-meal insulin requirements
* Will emphasize nutrient density and high fiber foods
* Will emphasize substituting unsaturated fats for saturated and trans fats
* Will emphasize choosing lean proteins and/or meat alternatives
* Will educate on reducing energy intake while maintaining a healthful eating pattern to promote weight loss
* Will coordinate eating schedule with prescribed medications
* Will address his individual needs and will facilitate practical guidelines to follow while still maintaining pleasure of eating
* Nutrition therapy principles will help M.F. achieve and maintain glycemic, lipid, and blood pressure goals

**III. Nutrition Assessment**

**12. Assess Mitch’s weight and BMI. What would be a healthy weight range for Mitch?**

M.F.’s BMI is: [(214lbs)/(69inches2)] x 703 = 31.6 kg/m2, which is mildly obese

(BMI range for obese is 30 kg/m2 - 34.99 kg/m2)

Ideal body weight: 106lbs + 6lbs per inch over 5 feet

 106 + 6(9) = 160 lbs +/- 10%

 -10% = 144 lbs

 +10% = 176 lbs

A healthy weight range for M.F. would be between 144-176 lbs

**13. Identify and discuss any abnormal laboratory values measured upon his admission. How did they change after hydration and initial treatment of his HHS?**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test** | **Ref. Range** | **4/12 1780** | **4/13 1522** | **Change after hydration and initial Tx** |
| **Sodium (mEg/L)** | 136-145 | 132 | 134 | Upon admission sodium levels were low due to dehydration and vomitting. Sodium levels increased after hydration and initial Tx, but are not within normal range. |
| **BUN (mg/dL)** | 8-18 | 31 | 20 | BUN levels increase with dehydration. BUN levels decreased after hydration and initial Tx, but are not within normal range.  |
| **Creatinine serum (mg/dL)** | 0.6-1.2 | 1.9 | 1.3 | Creatinine levels increase with dehydration. Creatinine levels decreased after hydration and initial Tx, but are not within normal range.  |
| **Glucose (mg/dL)** | 70-110 | 1524 | 475 | Extrememley high glucse levels upon admission. Glucose levels have decreased significanly after hydration and initial Tx, but are still very high.  |
| **Phosphate, inorganic (mg/dL)** | 2.3-4.7 | 1.8 | 2.1 | Phosphate levels were low upon admission (<2.3mg/dL is hypophosphatemia). Levels increased after hydration and initial Tx, but is still <2.3 mg/dL. |
| **Osmolality (mmol/kg/H20)** | 285-295 | 360 | 304 | Osmolality increases with dehydration and hyperglycemia. Osmolality measures solute concentration. High osmolality upon admission. Levels have decreased after hydration and initial Tx, but are not within normal range.  |

**14. Determine Mitch’s energy and protein requirements for weight maintenance. What energy and protein intakes would you recommend to assist with weight loss?**

**Energy Requirements (using Mifflin St. Jeor):**

Weight in kg: 214 lbs/2.2 = 97.3 kg

Height in cm: 69 inches x 2.54 = 175.3 cm

10(wt) + 6.25(ht) -5(age) + 5

10(97.3) + 6.25 (175.3) -5(53) + 5 = 1808 kcals

1808 multiplied by an activity factor of 1.2 for sedentary individuals = **2170kcals**

**For weight loss, do a deficit of 500-750 kcals:**

2170 - 500 = 1670 kcals

2170 - 750 = 1420 kcals

Energy range for weight loss should be beween 1500-1800 kcals/day for men

M.F. energy range for weight loss: **1420-1670 kcals per day**

**CHO:**

Start with national guidelines of 45% of total kcal, <10% being simple sugars

Focus on nutrient density and high fiber

45% of total kcal:

 (45% x 1420 kcal)/4 = 159.75 g CHO

 (45% x 1670 kcal)/4 = 187.875 g CHO

CHO range between **160 - 188 grams of CHO** depending on total kcals per day

**Fat:**

Start with national guidelines of <30% of total kcals

Substitute trans fat and saturated fat with unsaturated fat

(30% x 1420)/9 = 47.33 g fat

(30% x 1670)/9 = 55.67 g fat

Fat range between **47 - 56 grams of fat** depending on total kcals per day

**Protein 25% of total kcal:**

(25% x 1420)/4= 88.75 g protein

(25% x 1670)/4= 104.375 g protein

Protein intake should be between **89-104 grams per day** depending on total kcals per day

I would recommend 1420-1670 kcals per day for weight loss.

I would recommend 160-188 grams of CHO per day, 89-104 grams of protein per day, and 47-56 grams of fat per day.

**IV. Nutrition Diagnosis**

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

Self-monitoring deficit related to noncompliance as evidenced by acute hyperglycemia and HHS.

Food- and nutrition-related knowledge deficit related to nutrition guidelines for diabetes as evidenced by carbohdrate intake per 24-hour recall and HbA1c.

**V. Nutrition Intervention**

**16. Determine Mitch’s initial CHO prescription using his diet history as well as your assessment of his energy requirements.**

**Mitch’s initial CHO prescription**

Coffee + Half and half = 0 CHO

Bagel + cream cheese + 2-3 cups of coffee = 60 gm + 4 gm + 0 gm =64 gm

Jimmy John’s sandwich = 68 gm

Chips = 45 gm

Diet soda = 0 gm

Grilled chicken or beef = 0 gm

Salad = varies

Potatoes = 60 gm

or

Rice = 60 gm

Chinese, Mexican, Indian, or Thai = unknown choices and portions

**Total CHO = 237**

**Assessment of his energy requirements**

Based on Mitch’s energy level and need to lose weight his energy requirement would be between 1420-1670 kcals per day (see above under question 14). He is currently getting around 240 CHO/day. Based on his energy requirements his CHO should be between 160 - 188 grams per day. Taking the mean of these two numbers his CHO should be ~175 gm/day, spread out throughout the day.

The total choices of carbohydrates per day will be ~12 choices

175/15 = ~12 CHO choices per day

175gm CHO/3 meals=58 gm CHO at each meal

Subtracting 15gm from each meal for snacks gives a meal plan as follows:

43-58 gm CHO at meal times

0-15 gm CHO at snack times

**Example:**

Breakfast = 3-4 choices

Snack = 1 choice

Lunch = 3-4 choices

Snack= 1 choice

Dinner = 3-4 choices

Snack = 1 choice

**17. Identify two initial nutrition goals to assist with weight loss.**

The first nutrition goal would be to lose weight by eating between between 1420-1670 kcals per day. This means M.F. needs to create a 500-750 kcals per day defict. This can be accomplished with a combination of diet and excercise.

In regards to his diet, he can swap out simple carbohydrates like his chips for fruit. He can also do this by adding whole grains to his diet. He can get his Jimmy John’s sandwich on a whole wheat roll and if his bagel for breakfast is made with white flour he can exchange it for whole wheat flour. His rice for dinner can be exchanged for brown rice. Complex carbohydrates have fiber and will help with satiety which can lower total calorie intake. He will need to be mindful of his portion sizes and should keep his rice and potato amounts to about one serving depending on his overall meal. Ordering a regular Jimmy Johns sandwich instead of a large (if he is doing this) would be helpful, or he could make a sandwich at home more often. A sandwich made at home could be made with two slices of bread, meat, mustard, mayonnaise, vegetables and a small piece of fruit. For breakfast he can have half a bagel with cream cheese or peanut butter and a serving of fresh fruit to be within 45 gm CHO/meal.

The second nutritional goal, based on M.F.’s usual intake for the past several months, would be to add fruits and vegetables to his diet. Fruits and vegetables are nutrient dense, low energy options that are high in fiber and water which can help him with satiety.

**18. Mitch also has hypertension and high cholesterol levels. Describe how your nutrition interventions for diabetes can include nutrition therapy for his other conditions.**

A diet high in fruits, vegetables, and whole grains are components of the DASH diet. The DASH diet aims to cut down on salt while increasing potassium, magnesium, calcium and fiber which can help lower blood pressure. Losing weight and having a normal body mass index of 18.5-24.9 kg/m² can also help lower blood pressure. A high fiber diet can help reduce LDL and total serum cholesterol levels. Obesity negatively affects dyslipidemia therefore losing weight and having a normal BMI can positively impact dyslipidemia.

**VI. Nutrition Monitoring and Evaluation**

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

**Assessment:** Age 53yo; male; Dx type 2 DM; HTN; hyperlipidemia; gout

Ht. 5'9; Wt. 214 lbs; UBW 214 lbs; %UBW 100%; BMI 31.6 kg/m²

Labs: Sodium: 132; BUN: 31; Creatinine serum: 1.9; Glucose: 1524; Phosphate, inorganic: 1.8; Osmolality: 360; Cholesterol: 205; Triglycerides: 185; HbA1c: 15.2; WBC: 13.5; Hematocrit:
57; Specific gravity: 1.045; pH: 5.0; Protein: 10; Glucose: +; Ketones: +; Prot chk: +

Meds: Glyburide 20 mg daily; metformin 500 mg/twice daily; Dyazide daily (hydrochlorothiazide 25 mg and triamterene 37.5 mg); Lipitor 20mg daily

GI: bowel sounds: present; stool color: lt brown; stool consistency: soft
Before admission pt. complained of vomiting but this has ceased upon admission

I/O: total intake 4/12 0701-4/13 0700: 4,335 mL; total output 4/12 0701-4/13 0700: 2,195

**Physical assessment:** Type 2 DM, acute hyperglycemia and HHS

Skin: Braden score: 20, no risk; skin condition: intact

EER: 2170 kcals/day (based on Mifflin St. Jeor \* activity factor of 1.2) with a deficit of 500- 750 kcal = 1670-1420 kcal/day; EPR: 89-104 grams per day (based on 25% of total calories); Fluid requirements: 2000-2500 mL after rehydration

Current diet: NPO then clear liquid then CHO controlled

**Diagnosis:** HHS as evidenced by abnormal lab values.
Patient admits to not consistently taking his medication and has a history of noncompliance.

**Intervention:** Treatment plan: patient will receive nutrition education for type 2 insulin dependent DM including understanding DM, checking BG, hyperglycemia, hypoglycemia, healthy eating, taking insulin, sick days, TDD, CHO counting, insulin-to-carbohydrate ratio, correction factors, and food label reading.

**Monitoring/Evaluation:** Will continue to monitor patient lab values. Patient will transition from NPO to a clear liquid diet and then consistent carbohydrate-controlled diet. Patient will receive diabetes education (see intervention).
He will get 2000-2500 mL of fluid after rehydration.

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