NATIONAL CENTER FOR CASE STUDY TEACHING IN SCIENCE

A Rough Semester: What's Wrong with Katie?

by
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Part I – To the Health Center

Katie Robinson returned to her dorm room after another long day as a college sophomore. Things seemed to have been getting tougher the last few weeks, Katie thought, but she attributed this to her heavy course load that included anatomy, chemistry, physiology and microbiology courses required by her health science program. Noticing Katie was going to bed earlier and sleeping later than usual, her roommate Jasmine asked her if everything was alright. "Yeah, I'm fine," she replied. "I'm just stressed. After midterms are over, I'll feel better. I just wish there were more hours in the day."

Midterms came and went and her condition did not improve, so Katie decided to make an appointment at the on-campus health center. Jennifer, the health center's nurse practitioner on duty, took Katie's history.

Patient History

Chief complaint: flu-like symptoms with headache and fatigue.

History of patient illness: This 20 year-old white female, a college sophomore, presented at the on-campus health center with flu-like symptoms that began three weeks prior. She also describes a rash under her arm that won't go away, likely from playing weekly intramural tennis matches at the university. The symptoms do not appear to be related to stress as she successfully concluded her midterms over a week ago. She also complains of "tired eyes" due to studying endlessly for her midterms. She has not tried any remedies, other than rest, to alleviate the symptoms.

Past medical history: Patient has been in good health for most of her life. She denies any surgery or hospital stays; she has only taken prescription drugs (hydrocodone) when she had her wisdom teeth removed as an outpatient procedure two years ago.

Family history: Patient's mother has beaten breast cancer six years ago and is now cancer free. Patient's father suffered a stroke, according to patient, "when I was really little." Patient's younger brother was diagnosed with diabetes mellitus five years ago. Maternal grandmother died (age 97) of Alzheimer's disease when patient was in high school.

Physical examination: Patient was awake and oriented at time of examination. Height was 162 cm; weight was 62 kg. Vital signs were recorded and are shown in Table 1. Arterial pulses were within normal limits. The heart rate was regular with no evidence of murmur or abnormal heart sounds. Head and neck exam were normal, no swollen lymph nodes. Lungs were clear of any abnormal sounds on auscultation. She stated she does not smoke or drink and does not have diabetes. She does not know her cholesterol level.

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Table 1. Katie's vital signs recorded at the on-campus health center.

	Katie	*Normal*
Systolic blood pressure (mmHg)	140	120
Diastolic blood pressure (mmHg)	90	80
Oral temperature (°C)	38.3	36.6–37.3
Heart rate (beats per minute)	81	60–80
Respiratory rate (breaths per minute)	18	12–20
Oxygen saturation (%)	97	95–100

Questions

1. What are the red flags in Katie's physical exam and history?

2. Given the red flags you've identified, what are some possible diagnoses?

3. What are common causes for the above diagnoses?

4. What questions would you like to ask her to confirm your diagnoses?

5. How would you treat her symptoms if you were the clinician at the on-campus health center?

Part II – A Second Visit

Katie was counseled by the on-campus health center on common home remedies for mild hypertension, told to drink plenty of water and take over-the-counter acetaminophen for the flu-like symptoms of headache and fever. She was given documentation to miss class for one day to rest.

A week later, Katie's symptoms still had not resolved and, besides the struggle of attending her classes while feeling ill, she was spending most of the day in bed. Jasmine knocked on her bedroom door and asked, "Still not feeling any better?"

Katie replied, "No, I still don't feel right and I've been doing exactly what the health center told me: get plenty of rest, take two of these pills every six hours and drink plenty of clear liquids. I've been really thirsty so it's been easy to drink a lot of fluids. In fact, I've been drinking so much water that I get up at least three times every night to go the bathroom. And every time I go, it burns…you know, down there."

"What are you going to do?" Jasmine inquired.

"My mom texted me this morning and said I should go back to the health center to get a more thorough exam. I guess I'll try to schedule an appointment tomorrow. I just hope, with this being flu season and all, I'm able to get an appointment."

Luckily, Katie was able to get an appointment at the health center the next morning and Jennifer again performed a physical exam.

> *History of patient illness:* Patient returned to the on-campus health center due to persisting flu-like symptoms. Patient was seen in this office eight days prior for similar symptoms. New symptoms include frequent urination with burning. Patient denies weakness, numbness, difficulty speaking or walking, syncope or seizures. When asked about diet and appetite, she admits to eating "lots" of leftover Halloween candy in the last week.
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> *Physical examination:* Patient was awake and oriented at time of examination. Height and weight did not change significantly from previous exam. Vital signs were recorded and are shown in Table 2. Arterial pulses were within normal limits. The heart rate was tachycardic and regular with no evidence of murmur or abnormal heart sounds. Head and neck, lymph nodes and lung exams were all normal. Patient denies drinking and smoking since last office visit.

Table 2. Katie's vital signs recorded at the on-campus health center during her second appointment.

	Katie	*Normal*
Systolic blood pressure (mmHg)	155	120
Diastolic blood pressure (mmHg)	92	80
Oral temperature (°C)	38.7	36.6–37.3
Heart rate (beats per minute)	96	60–80
Respiratory rate (breaths per minute)	22	12–20
Oxygen saturation (%)	97	95–100

Question

1. Based on this new information, identify at least three clinical tests that could elucidate the cause of Katie's illness. Describe what each test might detect.

Part III – Blood Work and Urinalysis Screen

Jennifer decided it would be best to draw a sample of Katie's blood for a metabolic panel and complete blood count (CBC). A urine specimen was also collected for a urinalysis screen. The results of these tests are shown on the next page. Using Katie's urine specimen, the test strips (glucose, pH, hemoglobin) and refractometer provided, complete the chart by filling in the blank boxes.

Questions

1. Using terminology of the kidney (filtration, reabsorption, secretion, excretion), explain how glucose and protein are each processed in the normal kidney.

2. Which of the results from Katie's blood and urine test seem abnormal? If there are abnormalities, what do they indicate?

3. What might glucose in the urine indicate about blood glucose levels?

4. What might occur in the kidney that would cause the presence of protein in the urine? The following link may be helpful: <https://www.niddk.nih.gov/health-information/kidney-disease/glomerular-diseases>.

5. How does glucose and protein in the urine lead to the excessive urine output Katie was experiencing at night?

6. What other symptom does Katie have that also indicates glucose in the urine?

7. What disease or condition do you think Katie may be dealing with? What clinical test(s) would confirm your diagnosis?

Table 3. Katie's test results.

Patient Name	Sex	Age	Date	Patient ID
Robinson, Katherine	F	20	11/09/16	7548987672

Physician Name
University Health Center

	RESULT			REFERENCE RANGE
	ABNORMAL	NORMAL	UNITS	
CHEM-SCREEN PANEL				
Glucose, Serum	H 145		mg/dL	80-120
BUN		20	mg/dL	5-26
Creatinine, Serum		1.1	mg/dL	0.5-1.5
BUN/Creatinine Ratio		20		8-27
Sodium, Serum		141	mmol/L	135-148
Potassium, Serum		4.4	mmol/L	3.5-5.5
Choride, Serum		100	mmol/L	96-109
Carbin Dioxide, Total		27	mmol/L	20-32
Calcium, Serum		10.4	mg/dL	8.5-10.6
Protein, Total, Serum		7.3	g/dL	6.0-8.5
Albumin, Serum		4.8	g/dL	3.5-5.5
Globulin, Serum		2.5	g/dL	1.5-4.5
A/G Ratio		1.9		1.1-2.5
Billirubin, Total		1.1	mg/dL	0.1-1.2
Alkaline Phosphatase, Serum		79	IU/L	25-150
LIPIDS				
Cholesterol, Total			mg/dL	100-199
Triglycerides	H 225		mg/dL	15-150
HDL Cholesterol	L 32		mg/dL	>40
VLDL Cholesterol	H 46		mg/dL	5-40
LDL Cholesterol	H 185		mg/dL	0-99
CBC WITH DIFFERENTIAL				
White Blood Cell (WBC) Count	H 12.68		x10E3/uL	4.0-10.5
Red Blood Cell (RBC) Count		4.35	x10E6/uL	4.1-5.6
Hemoglobin		14.5	g/dL	12.5-17.0
Hematocrit		41.7	%	36.0-50.0
Platelets		210	x10E3/uL	140-415
Neutrophils	H 79		%	40-74
Lymphs		16.5	%	14-46
Monocytes		4	%	4-13
Eos		0.4	%	0-7
Basos		0.1	%	0-3
URINALYSIS				
Glucose			Pos/neg	Negative
Protein	Positive			Trace or None
Ketones	36		mg/dL	Small: <20 Moderate: 30-40 Large: >80
Specific Gravity			-	1.001-1.030
pH			-	4.8-7.5
Hemoglobin			Pos/neg	Negative
Leukocyte esterase	Positive		Pos/neg	Negative

Part IV – Glucose Tolerance Test

After seeing the results from Katie's blood and urine tests, Jennifer decided that a glucose tolerance test would be best to confirm Katie's diabetes diagnosis. The results of a test for sexually transmitted diseases wouldn't be available for a few days; however, Katie denies any sexual contact in the previous twelve months.

Katie's blood was also drawn at these intervals to measure plasma C-peptide concentrations. Plasma C-peptide concentration normally matches plasma insulin concentration and is an indicator of how much insulin is produced by the pancreas. The results of Katie's glucose tolerance test and plasma C-peptide levels are shown below.

Table 4. Katie's test results from glucose tolerance test and plasma C-peptide levels.

Patient Name	Sex	Age	Date	Patient ID
Robinson, Katherine	F	20	11/09/16	7548987672

Physician Name
University Health Center

	RESULT ABNORMAL NORMAL	UNITS	REFERENCE RANGE
GLUCOSE TOLERANCE TEST			
Blood Glucose, Fasting	H 212	mg/dL	70-100
C-peptide, Fasting	H 7.8	ng/mL	1.4-2.6
Blood Glucose, 30 Min	H 324	mg/dL	<200
C-peptide, 30 Min	H 11.9	ng/mL	2-4.4
Blood Glucose, 60 Min	H 286	mg/dL	<200
C-peptide, 60 Min	H 9.6	ng/mL	3-5.2
Blood Glucose, 120 Min	H 241	mg/dL	<140
C-peptide, 120 Min	H 8.9	ng/mL	1.4-5.2
Hb A1C	H 6.5	%	4-5.6

Additionally, a culture of Katie's urine revealed pathogenic bacteria *(E. coli)* present in her urine sample.

Questions

1. What is the difference between type I and type II diabetes in terms of pancreatic insulin production?

2. What is the role of insulin injections in the treatment of type I and type II diabetes?

3. What type of diabetes does Katie have? What is your evidence?

4. Why is hemoglobin A1C (HbA1c) important in diagnosing diabetes mellitus?

Part V – A New Treatment

Six weeks later, Katie returned home from college on winter break and made an appointment with her family's physician, Dr. Sofia Ramos, to check on her blood sugar level. Since her last appointment at the student health center, Katie had been taking metformin, prescribed by the student health center, which lowers the body's own production of glucose by the liver. Further, she had been placed on a low carbohydrate diet, her urinary tract infection had cleared up after a two-week treatment of oral antibiotics, and her blood pressure had returned to normal. However, during her appointment at Dr. Ramos's office, her metabolic panel revealed her blood glucose level was still elevated.

Dr. Ramos, concerned about the ineffectiveness of the metformin she was prescribed, tells Katie that she would like to try a different treatment. Katie, remembering a commercial she saw on television about a new drug to treat type II diabetes, asked Dr. Ramos, "I saw an advertisement on TV about a drug that makes you pee out all the sugar in your blood. Do you know what I'm talking about?"

Dr. Ramos noticeably chuckled and nodded. "Yes, I think you mean canagliflozin. It has been shown to lower blood glucose levels in patients with type II diabetes. Unfortunately however, I don't think you are a good candidate for this drug."

Questions

1. What is the mechanism of action of canagliflozin?

2. Why does Dr. Ramos say Katie is not a candidate for canagliflozin?

3. What other drug(s) may Dr. Ramos prescribe to treat Katie's type II diabetes? What is the mechanism of each?

Part VI – Ongoing Monitoring

Just before returning to school for the spring semester, Katie made one more appointment with Dr. Ramos to evaluate the effectiveness of pioglitazone, the new drug she she had been prescribed at her previous visit. While in the office, Katie told Dr. Ramos that she began to feel like her old self again about two weeks ago. A final blood test showed Katie's blood glucose level in the normal range but her HbA1c was still elevated.

Questions

1. Is it concerning that Katie's HbA1c is still elevated? Why?

2. What would you expect her HbA1c levels to be when she visits Dr. Ramos again when the school year ends in May, assuming she continues on pioglitazone as prescribed?