Living the Sweet Life: An Internship in Endocrinology

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It's 8:00 AM on Monday morning and you're getting ready to start your day at Dr. Gupta's practice. Dr. Gupta is an endocrinologist and has been in the field for 20 years. You've been working with Dr. Gupta as an intern for the past three weeks and so far you've seen patients with Addison's disease, neonatal diabetes, and Hashimoto's disease, plus a few others. You check the calendar and see that there are three patients scheduled for this morning:
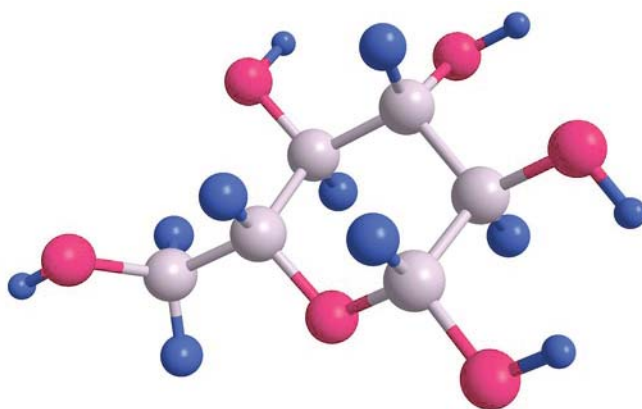
- Jorge Alvarez
- Janique Johnson
- Mary Smith

Figure 1. Molecule of glucose ($C_6H_{12}O_6$).

Part I – Jorge Alvarez

Jorge is a 45-year-old Latino/Hispanic male. He works as an accountant and has three daughters. Jorge has been a smoker for 20 years, but has been attempting to quit. His diet consists of about half home cooked foods and half fast-food items (he usually grabs a quick lunch from McDonald's, Arby's or Burger King when he's working), and is usually accompanied by sweet tea. He tries to exercise but his desk job keeps him pretty stationary during the day. He has, however, been taking walks on the weekends with his daughters. Over the past few months, Jorge has been extremely thirsty, has had some tingling in his legs, has been urinating frequently, and has felt extremely tired. He also has a sore on his leg that just does not seem to heal. His primary care physician ran some quick labs and referred him to Dr. Gupta. Some blood work and patient info is in his chart and details are listed below.

Test	Result	Normal Range
BMI (weight: 210 lbs Height: 5'8")	31.9	18.5–24.9
Triglycerides (mg/dl)	225	< 150
High-density Lipoprotein (mg/dl)	42	≥ 40
Low-density Lipoprotein (mg/dl)	95	< 100
Blood Pressure (mm Hg)	155/95	90–120/60–80
Pulse	90	60–100
Hematocrit (%)	40	36–50
Hemoglobin (g/100 ml blood)	12.4	11–14
Glucose (mg/dl)	178	75–105
Sodium (mmol/L)	140	135–145
Potassium (mmol/L)	4.5	3.5–5.0

Questions

1. What symptoms is Jorge experiencing?

2. Are any of his values on his chart outside normal ranges? If yes, which ones?

3. What additional information about Jorge's history would be useful in understanding his situation? Explain your answer.

4. What additional tests might assist in your understanding of your patient's situation? Explain your rationale for your choice(s).

"Living the Sweet Life" by Breanna N. Harris

Part I – Janique Johnson

Janique is a 12-year-old female. She is in the 7th grade and has been on the swim team for the past four years. She is a good student and is generally a happy child. Lately, however, Janique's mother has been worried about her daughter. Janique has been very irritable the past few months and at first Mrs. Johnson just chalked that up to her daughter becoming a teenager. But, in addition to the mood changes, Mrs. Johnson has noted a few other changes in her daughter—Janique is often too tired to attend swimming practice and has complained of feeling too weak to swim and of having headaches. Despite her decreased physical activity, Janique has been eating almost non-stop but has lost about 5lbs; she is also drinking more than usual and has been vomiting frequently. Janique saw her primary care physician, and after running some tests, he sent Janique to Dr. Gupta for follow-up. Some blood work and patient info is in her chart and details are listed below.

Test	Result	Normal Range
BMI (weight: 106 lbs Height: 5'4")	18.2	18.5–24.9
Triglycerides (mg/dl)	130	< 150
High-density Lipoprotein (mg/dl)	66	≥ 40
Low-density Lipoprotein (mg/dl)	85	< 100
Blood Pressure (mm Hg)	110/70	90–120/60–80
Pulse	60	60–100
Hematocrit (%)	45	36–50
Hemoglobin (g/100 ml blood)	12.8	11–14
Glucose (mg/dl)	130	75–105
Sodium (mmol/L)	142	135–145
Potassium (mmol/L)	4.6	3.5–5.0

Questions

1. What symptoms is Janique experiencing?

2. Are any of her values on her chart outside normal ranges? If yes, which ones?

3. What additional information about Janique's history would be useful in understanding her situation? Explain your answer.

4. What additional tests might assist in your understanding of your patient's situation? Explain your rationale for your choice(s).

Part I – Mary Smith

Mary is a 40-year-old female. Mary works for a pharmaceutical sales company and sits behind a desk for the majority of her day. Mary has not been feeling like herself lately and she's concerned. Mary has noticed a handful of symptoms: she has been tired and a little depressed, she's gained weight – especially around her belly, and she's noticed that her face feels fuller than usual. Additionally, her menstrual cycles have become irregular, at first she thought she was going through menopause, but then thought she's too young for that. And, she was embarrassed to mention this to her doctor, but she's noticed increased facial hair growth that she's been dealing with via waxing. Mary saw her primary care physician, and after running some tests, she sent Mary to Dr. Gupta for follow-up. Some blood work and patient info is in her chart and details are listed below.

Test	Result	Normal Range
BMI (weight: 215 lbs; Height: 5'7")	33.7	18.5–24.9
Triglycerides (mg/dl)	165	< 150
High-density Lipoprotein (mg/dl)	41	≥ 40
Low-density Lipoprotein (mg/dl)	82	< 100
Blood Pressure (mm Hg)	135/97	90–120/60–80
Pulse	88	60–100
Hematocrit (%)	42	36–50
Hemoglobin (g/100 ml blood)	13.6	11–14
Glucose (mg/dl)	115	75–105
Sodium (mmol/L)	147	135–145
Potassium (mmol/L)	3.3	3.5–5.0

Questions

1. What symptoms is Mary experiencing?

2. Are any of her values on her chart outside normal ranges? If yes, which ones?

3. What additional information about Mary's history would be useful in understanding her situation? Explain your answer.

4. What additional tests might assist in your understanding of your patient's situation? Explain your rationale for your choice(s).

Part II – Jorge Alvarez

Carefully inspect the test results below and use the information together with what you learned from Part I to diagnose the patient and answer the following questions.

Alvarez, J. Lab Results – Dr. Gupta, M.D.

Test	Result	Normal Range
Random blood sugar (mg/dl)	200	< 140
Fasting blood sugar (mg/dl)	155	75–105
GTT glucose at 2hr	225	< 200
Fasting morning cortisol (ug/dl)	25	5–23
Hemoglobin A1c %	8	< 6.5
c-peptide (ng/ml)	2.5	0.5 to 2
Antibodies against pancreas	normal	varies
Urinary glucose (ug/dl)	30	0–15
Urinary ketones (mg/dl)	20	Very little to none
T3 (ng/dl)	50	80–180
T4 (ug/dl)	5	4.6–12

Questions

5. Based on the data, is Jorge producing adequate insulin? How do you know?

6. Based on the data, what is your diagnosis for Jorge? What data support this diagnosis?

7. What treatment would you recommend for this patient?

Part II – Janique Johnson

Carefully inspect the test results below and use the information together with what you learned from Part I to diagnose the patient and answer the following questions.

Johnson, J. Lab Results – Dr. Gupta, M.D.

Test	Result	Normal Range
Random blood sugar (mg/dl)	250	< 140
Fasting blood sugar (mg/dl)	165	75–105
GTT glucose at 2hr	242	< 200
Fasting morning cortisol (ug/dl)	24	5–23
Hemoglobin A1c %	10	< 6.5
c-peptide (ng/ml)	0.2	0.5 to 2
Antibodies against pancreas	high	varies
Urinary glucose (mg/dl)	25	0–15
Urinary ketones (mg/dl)	35	Very little to none
T3 (ng/dl)	175	80–180
T4 (ug/dl)	10	4.6–12

Questions

5. Based on the data, what is your diagnosis for Janique? What data support this diagnosis?

6. Dr. Gupta asks you to explain the diagnosis to the patient. Please write out how you would describe this to Janique.

7. What treatment would you recommend for this patient?

Part II – Mary Smith

Carefully inspect the test results below and use the information together with what you learned from Part I to diagnose the patient and answer the following questions.

Smith, M. Lab Results – Dr. Gupta, M.D.

Test	Result	Normal Range
Random blood sugar (mg/dl)	155	< 140
Fasting blood sugar (mg/dl)	110	75–105
GTT glucose at 2 hr	180	< 200
Fasting morning cortisol (ug/dl)	28	5–23
DEX challenge cortisol (ug/dl)	27	< 5
DEX challenge ACTH (pg/ml)	100	<10
Hemoglobin A1c %	6	< 6.5
c-peptide (ng/ml)	1.3	0.5 to 2
Antibodies against pancreas	normal	normal
Testosterone (ng/dl)	90	15–75
Non-ovulatory estrogen (pg/ml)	45	40–50
Urinary glucose (ug/dl)	15	0–15
T3 (ng/dl)	175	80–180
T4 (ug/dl)	10	4.6–12

DEX Challenge: Mary was given 1 mg of DEX at 11 PM and then a blood sample was collected at 8 AM for analysis of cortisol and ACTH.

MRI Results: Mary's brain MRI was clear but the MRI of her body showed lumps in her peritoneal cavity.

Questions

5. What would you expect DEX to do to Mary's ACTH and cortisol levels?

6. Compare the results of Mary's DEX challenge to her baseline hormone values. What do Mary's baseline post-DEX levels tell you about her HPA axis?

Time	Cortisol Level (ug/dl)	ACTH (pg/ml)
Fasting morning	28	---
9-hr post DEX	27	100

7. What diagnosis do the baseline and post-DEX results suggest?

8. What are the results of Mary's MRI scan? What does this tell you about Mary's HPA axis?

9. What is your *specific* diagnosis for Mary? Which data support this?

10. What treatment would you recommend for this patient?

DIAGNOSTICS PRIMER

This sheet will be helpful for deciding which tests to order for your patients and for determining diagnoses.

- *Fasting Glucose/Blood Sugar Test:* This test measures the amount of glucose present in the bloodstream. The test is performed after at least eight hours of fasting, and resulting glucose values should fall between 70–100 milligrams per deciliter (mg/dL). This test is conducted if patients have: an increase in urination frequency, blurred vision, confusion or trouble talking, change in behavior, fainting spells, or a seizure. It is also conducted to screen for diabetes. A glucose level of 126 mg/dl or higher is usually indicative of diabetes (> 200 mg/dl often means the patient has diabetes).

- *Oral Glucose Tolerance Test:* This lab test determines how effectively the body breaks down/takes up sugar. First, a baseline blood sample is drawn. Next, the patient drinks a sugary liquid (usually containing 75 g of glucose). Blood is drawn every 30–60 min for up to three hours. All blood samples are analyzed for glucose concentration. This test is performed to check for diabetes. Normal results: at baseline (fasting) 70–100 mg/dL, after 1 hr < 200 mg/dL, after 2 hrs < 140 mg/dL. A glucose level between 140 and 200 is often diagnosed as pre-diabetes; levels over 200 mg/dL are used to diagnose diabetes.

- *Hemoglobin A1c Test:* This test can provide an estimate of blood glucose levels over the last three months. When blood sugar is high, glucose attaches to the oxygen-carrying molecule in red blood cells created glycated hemoglobin (Hg A1c). A small blood sample is taken and analyzed for percentage of glycated hemoglobin. This test is used to screen for diabetes. Normal results for no diabetes are < 5.7%, values for pre-diabetes are 5.7–6.4%, and values for diabetes diagnosis are above 6.5%.

- *C-peptide Test:* C-peptide is cleaved from the parent insulin molecule before insulin is released. This peptide is created in a 1:1 ratio with insulin and is released into the bloodstream with insulin. The C-peptide test measures the amount of C-peptide in the blood. A small blood sample is taken and C-peptide levels are determined. This test can determine if the body is producing insulin. Normal ranges for C-peptide are 0.5–2.0 nanograms per milliliter (ng/ml). People with Type II diabetes might have very high C-peptide levels if they are producing insulin but are resistant to its effects.

- *Urinary Glucose Evaluation:* Under normal circumstances, urine should not contain glucose. The nephron (functional unit of the kidney) removes glucose from the filtrate and brings it back to the blood stream. In individuals with very high blood glucose levels, the glucose transporters in the nephron get overwhelmed and glucose escapes into the urine. A urine sample can easily be tested for the presence of glucose. Glycosuria (glucose in the urine) is a hallmark of diabetes mellitus (it can also signal kidney disease/damage).

- *Urinary Ketone Evaluation:* Individuals with diabetes cannot process glucose correctly. Therefore, despite high levels of circulating glucose, their tissues cannot take in the glucose for fuel (either due to lack of insulin as in Type I or lack of sensitivity to insulin as in Type II). Due to this, the body "thinks" it is starving and begins to burn fat. A by-product of burning fat is the production of ketone bodies. When these ketone bodies build up, they are detectable in the urine and the blood. If ketone levels get too high the individual can go into diabetic ketoacidosis; this is generally more common in Type I diabetics than in Type II diabetics. Ketoacidosis can be life-threatening. Urine screening for ketones is done if the blood sugar is over 240 mg/dL, if the person gets a severe illness, or if there is nausea and vomiting.

- *Blood Pressure:* The blood in the circulatory system is under pressure; a blood pressure reading determines the pressure produced during contraction of the heart (systolic pressure; the top number) and during relaxation of the heart (diastolic pressure; the bottom number). Blood pressure measures are taken as routine vital signs during visits to the physician. Normal values are 119/79 mmHg. Readings of 140/90 or higher qualify as hypertension (high blood pressure); 120–139/80–89 is considered pre-hypertension. High blood pressure is a risk factor for Type II diabetes.

- *Lipid Panel/Cholesterol Test:* Cholesterol is an important lipid that circulates in the bloodstream. Too much of this substance can be problematic and is related to heart disease. A cholesterol test measures the amount of high density lipoprotein (the "good" cholesterol), low density lipoprotein (the "bad" cholesterol), and triglycerides present in the blood stream. This test is done after fasting for at least eight hours and a blood sample is collected for analysis. High cholesterol and triglycerides are a risk factor for Type II diabetes.

- *Morning Cortisol Test:* Cortisol is an important adrenal hormone. Cortisol levels are highest in the morning and decrease throughout the day. For this test, a blood sample is drawn and analyzed for cortisol concentration. This test is often done to test for Cushing's and Addison's disease. Cortisol has many physiological functions, so this test can be ordered for other reasons as well. Normal values are between 6–23 ug/dL when samples are collected in the morning.

- *Dexamethasone Challenge/Dexamethasone Suppression Test:* This test is used to determine if ACTH secretion from the anterior pituitary can be suppressed. This test is useful in determining HPA axis function and for determining if ACTH is being produced anywhere else in the body besides the anterior pituitary (e.g., a tumor). Dexamethasone is a synthetic glucocorticoid and when given acts on the hypothalamus and anterior pituitary (mainly acts here) to induce negative feedback; DEX suppresses the release of ACTH. Dexamethasone is administered to the patient and a follow up blood sample is collected for analysis of ACTH and/or cortisol. The low dose overnight method involves a dose of DEX at 11 PM and then a blood draw at 8 AM the next day. Morning values of cortisol should be < 1.8 ug/dL following the low-dose overnight method.

- *MRI Scan:* Magnetic resonance imaging. This procedure uses a large magnet and radio waves to look at internal body structures. MRIs can be used to look at ligaments, tissues, tumors, and various organs, including the brain and spinal cord. They can be helpful in multiple types of diagnoses and the images need to be read and interpreted by a healthcare professional.

All information for tests was retrieved from the National Institutes of Health, Medline.

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