Instructions and Expectations

Read the following article and answer questions provided. Make sure you scroll all the way to the bottom to ensure you have read and completed all of this assignment. Responses are due on the day of returning back to school in person.

What happens on an eLearning Day?

On eLearning Days, students will not report physically to school but will instead work from home. Students will have regular assigned classwork and their teachers will be available electronically during office hours. Students will be required to complete and submit all assignments as well as communicate with their teachers during the emergency eLearning Day.

How will students and parents know if an eLearning Day will take place?

Hampton County School District (HCSD) will communicate school cancellations and the announcement of an eLearning Day through automated phone calls, the district's notification system, district/school websites, social media, and local media.

How will students be informed about assignments for an eLearning Day?

Teachers will deliver content and post their assignments in Microsoft TEAMS. Students will download their assignments to their devices ahead of time at school as part of teachers' emergency plans.

How will students get help on their assignments on an eLearning Day?

All teachers will be available during designated eLearning office hours to provide assistance to students, give feedback on assignments, collaborate, and answer questions.

When will assignments be due?

As students complete their work, they should upload their assignments if Wi-Fi is available. If an internet connection is not available, they will have up to three school days after the last school cancellation to turn in assigned work.

How will eLearning be monitored and counted for attendance?

Teachers will assess the student's work and determine if the student has met the instructional goals for the day.

Students will be counted present when they:

Complete and submit their digital assignments for the eLearning Day following the eLearning procedures

Wake-Up Call

Part I—"Panic!"

by
Lisa A. Rubin and **Clyde Freeman Herreid**
University at Buffalo, State University of New York

It was 4:36 a.m. She was in a cold sweat and having difficulty breathing. She felt as though she had run a marathon. Fear swept through her—something terrible was going to happen. Panic-stricken, she woke her husband, Jeremy.

"Denise, what is it? Is it a nightmare?"

"No, it's like I'm having an asthma attack. I feel lightheaded and I can't catch my breath. My heart feels like it's beating a thousand times a minute."

Afraid to upset her husband further, Denise didn't tell him that an immense feeling of apprehension suddenly overcame her. She got up to drink some water and waited for the anxiety to subside. Her mind was racing. Jeremy had a family history of heart disease. This couldn't be happening to her. It was his problem. A few months earlier Jeremy was diagnosed with coronary artery disease. He was only 48 years old, the same age as Denise. The scare had encouraged him to gradually end years of chain smoking and adopt a healthier lifestyle. He was currently working on giving up the occasional cigarette for good.

"No," Denise thought to herself. *"There's no way this was a sign of heart troubles. I didn't have a pain in my chest, I'm physically fit, and I have no family history. There's just no way."*

After assuring herself of this, Denise was somehow able to fall back asleep.

Questions:

1. How likely is this to be a heart problem? Asthma? Panic attack? Or...?
2. Why do you say this? What are the symptoms that are consistent with your preliminary diagnosis? Is there anything unusual?

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Wake-Up Call

Part II—"A Voice from Within"

by
Lisa A. Rubin and **Clyde Freeman Herreid**
University at Buffalo, State University of New York

The next day at work, Denise was having a hard time focusing. Maybe the stress of her job was finally catching up with her. Managing a catering business was no easy task. On top of that, her only daughter, Emily, had left for college this fall and, being the overprotective parent that she was, Denise found herself constantly worrying about how her daughter was faring in a different city, away from the comforts of home. Also, Denise was starting to go through the early stages of menopause. The hormonal changes, combined with fatigue, stress, and her general worrisome nature, were catching up to her. Not only that, she couldn't get last night's scary episode out of her thoughts. Was it just part of the whole perimenopause thing or was it more? Her body was trying to tell her something, but Denise wasn't sure she was ready to hear.

> *"I wonder if Denise realizes how all those years of second-hand smoke have taken a toll on her lungs and on ME, her heart! All that tobacco inhalation has constricted her coronary arteries. Sure, Denise tries to stay physically active but genetics and her food choices have brought her blood cholesterol up pretty high to 245 mg/dl. She could be headed for heart disease. A person's total cholesterol level shouldn't get above 200 mg/dl. That's right. I ought to know! Denise has hypercholesterolemia, a major contributor to heart disease. Geesh. Get with it, Denise.*
>
> *That was a major warning last night. I'm oxygen-starved! Luckily, only a small area of my left ventricle had a big decrease in blood flow and oxygen supply (cardiac ischemia). Thank goodness. If nothing else happens, my body will start growing some new collateral vessels (bypass channels) and I can get some repair work done. Denise didn't experience chest pain (angina pectoris). But her rapid heart beat and shortness of breath sure got her attention. She had better shape up because I don't know if I can handle much more oxygen deprivation. And, hey, all this unstable plaque lurking around is not a good sign either. No indeed. Who knows when it may rupture? I don't like the looks of this at all."*

Questions:

1. Draw a sketch of the heart and show where the coronary blood vessels lie.
2. List in order the blood vessels that a drop of blood would follow as it makes a complete journey around the body starting as it enters the right atrium until it returns to the right atrium.
3. What are the characteristics of Denise's lifestyle that might lead to a heart problem?
4. Has Denise suffered a heart attack?
5. Define these terms: *cholesterol*, *hypercholesterolemia*, *cardiac ischemia*, *collateral vessels*, *angina pectoris*, and *plaque*.

Wake-Up Call

Part III—"Heart Attack Basics"

by
Lisa A. Rubin and **Clyde Freeman Herreid**
University at Buffalo, State University of New York

It appears that Denise has suffered mild heart trauma, which may lead to a more severe heart attack if not treated. But wait ... isn't a heart attack when the heart stops beating? Not exactly.

Cardiac arrest is the term used when the heart muscle literally stops pumping blood. A heart attack, also known as a **myocardial infarction**, may lead to cardiac arrest, but it's defined as a sudden event where at least one of the **three major coronary arteries** (right coronary artery, left anterior descending coronary artery, and left circumflex artery) becomes partially or totally blocked, usually by a blood clot (**thrombus**). A more rare cause of coronary occlusion is an artery spasm that shuts down blood flow to the heart. This can occur with cocaine use and severe emotional stress. Other rare causes of heart attack include sickle cell crisis, allergic reactions, carbon monoxide poisoning, extreme hypoxia, and an unmet increased need for blood flow to the heart such as may occur during extreme physical exertion, shock, or hemorrhage.

Heart cells can live for about 20 minutes without oxygen. The loss of oxygen-rich blood to the heart cells during a heart attack leads to cell damage, which may be permanent and lead to **cell necrosis** (death), depending on the severity of the attack and the amount of heart tissue that the blocked artery supplies. **The area of infarction** is where cell necrosis occurs, if it does. Surrounding it is the **area of injury**, which may or may not suffer permanent damage. The outermost affected area is the **zone of ischemia**, which is weakened but regains function within two to three weeks.

Besides the possibility of cardiac arrest, other possible complications include the following: **cardiogenic shock** (where the heart is too weak to adequately pump blood), **pulmonary edema** (where a weakened heart causes blood backup and leakage of plasma into the lungs), irregular heart rhythm (**arrhythmia**), rupture of a heart wall or valve, or death.

It is a misconception that having a heart attack leads to chronic **coronary artery disease (CAD)** . In reality, CAD and accompanying **atherosclerosis** (hardened, narrowed arteries) is the number one cause of heart attacks. What causes CAD? The main culprit is **arteriosclerosis**, or plaque buildup in the coronary arteries. **Plaque** is a material composed mainly of lipids, cholesterol (lipoproteins), and calcium. **Cholesterol** (a type of lipid necessary for synthesis of hormones, vitamin D, and bile) is carried through the bloodstream by two main types of **lipoproteins: high-density lipoproteins (HDLs) or "good" cholesterol, and low-density lipoproteins (LDLs) or "bad" cholesterol**. Studies by the American Heart Association and the well-known NHLBI-supported Framingham Heart Study show that HDLs help prevent heart disease by transporting lipids and cholesterol from the arteries to the liver. LDLs, which contain more fat and less protein, are unstable and stick to artery walls to help contribute to plaque formation.

LDLs (**cholesterol-handling system**) produce toxins that form tiny lesions on the inner walls of arteries. These lesions attract triglycerides and other substances in the bloodstream. White blood cells

(**inflammatory system**) rush to the injury site, but cause the inner wall to become stickier and thus attract more LDLs. Platelets (**blood-clotting system**) collect at the lesion site, only to trap more lipids and white blood cells. Plaque build-up slowly occurs. (Note that cholesterol is not the sole cause of plaque formation.) Over time, some of the plaque can develop a thick, hard, calcified fibrous cap and is called **stable plaque**, yet causes the arteries to become narrower and harder (atherosclerosis). Other plaque can develop a large lipid and macrophage core, decreased smooth muscle cell content, and a thinner, softer, more unpredictable fibrous cap (due to increased metalloproteinase enzyme activity). This can rupture, producing a **thrombosis** (artery blockage), **cardiac ischemia**, and a heart attack can ensue.

Wake-Up Call

Part IV—"Call 911!"

by
Lisa A. Rubin and **Clyde Freeman Herreid**
University at Buffalo, State University of New York

It was March. Emily was home for spring break and Denise was enjoying having her 19-year-old daughter around. Unfortunately, it was going to be hard to spend much time with her because it was that time of the year when weddings and other catered events were picking up again after the post-New Year's lull. Denise was feeling the pressure pile up again. She constantly felt fatigued and out of breath, but she attributed these to perimenopause.

Emily could sense that her mother was tense and out of sorts, so she planned a relaxing evening for her parents and offered to cook mushroom lasagna, her mother's favorite dish. All was going well until dessert, when Emily noticed her mother's face growing paler by the minute. Suddenly, just like that night back in October, Denise began to have severe trouble breathing and her heart began racing. The room began to spin and, without warning, she fainted on the dining room floor.

"Oh my God! Dad, call 911!"

> *"Uh oh. Oh! Oh no! Denise. Denise! Do you read me? I'm in the middle of a heart attack!! I know it. I can feel it! That plaque in your left anterior descending coronary artery just ruptured. Now everything is going crazy. Everyone in the whole body seems to be swimming by. High levels of fibrinogen, C-reactive protein (CRP), and interleukin-18 (IL-18-inflammatory markers present in the bloodstream when there's unstable plaque) are combining with your high blood serum cholesterol. BAD things are happening, Denise. Really, really BAD!*
>
> *Plaque ruptures. Platelets stick to the exposed lipid core at the site of rupture. The blood clot grows...too big. Oh too big. Is it going to break? Say it isn't going to break. Not thrombosis, please....*
>
> *.... It's been 10 minutes since my heart cells supplied by the blocked artery have been without oxygen. If something isn't done soon, my cells are going to die. Necrosis! I never thought I could say that word. They say a heart attack can take over four to six hours. This first hour is horrible—the most critical period. Parts of the blood clot may break loose, travel in the blood, and stick in some tiny little blood vessel. My God, it could get in a coronary artery or the brain! An embolism. I need help! Now... NOW. HELP!!*
>
> *I've got to get my self in hand. It's the only way in a crisis. Right? Right! Why didn't Denise go to her doctor to complain about her chronic breathlessness, fatigue, and nausea? All this stress elevated her blood pressure and further increased her risk for a heart attack. Alright, so she didn't know that she had a mutation in her LDL receptor gene. How could she know that LDL was not being efficiently removed from her blood? Whatever. At least she should have known her LDL blood levels were very high. So were*

her levels of lipoprotein (LP a). This stuff increases heart disease risk. Why didn't anyone warn her?

Sure, I know I'm involved. I'm taking it personally. Wouldn't you? But maybe, just maybe, if Denise had been more aware of the symptoms of heart disease she would have sought help. I happen to know that heart attacks are the number one cause of death in the U.S. More people die from cardiovascular disease (including heart attacks, atherosclerosis, and hypertension) each year than the next six leading causes of death combined, including cancer and automobile accidents. It's an epidemic that people need to be educated about. So get it. I'm here to tell you. Denise. If you won't listen to me, who will you listen to?

Questions:

1. Why is the first hour of a heart attack the most critical?
2. What do fibrinogen, C-reactive protein (CRP), and interleukin-18 (IL-18) indicate?
3. What is the cause of Denise's breathlessness, fatigue, and nausea?
4. What are platelets and what do they have to do with Denise's heart problem?
5. What is an embolism and what is its connection to thrombosis?
6. What does LDL have to do with heart attacks?
7. How does hypertension develop and what does it have to do with a high risk of heart attacks?

Wake-Up Call

Part V—"Emergency Room"

by
Lisa A. Rubin and **Clyde Freeman Herreid**
University at Buffalo, State University of New York

The doctor spoke calmly to Jeremy in the waiting room. "Mr. Belmore, your wife is in no immediate danger but she has suffered a heart attack to her left ventricle. She's in the emergency room right now, with the aid of an oxygen mask. We noticed some scar tissue, meaning that some prior heart trauma occurred as well. Is this your wife's first attack?"

"Yeah. I'm actually the one who has been diagnosed with heart disease in the house, and I'm the one with a family history. I don't understand. Where did this come from? Denise is conscious of her weight, and she's healthier than I am. She's the one who usually looks out for me and my daughter."

"Well, from her records, your wife hasn't had her blood pressure and cholesterol tested in a few years. Unfortunately, they were highly elevated, which greatly increased her risk of heart disease. Although she looked fit on the outside, blood work would have revealed hidden dangers. Tell me, had your wife been feeling out of sorts these past few months?"

"She has always been an on-the-go person and tends to worry a lot. Her job is pretty stressful. I did notice that these past few months she seemed more tired than usual and acted almost asthmatic. But, don't heart attack victims experience chest pain? Denise has never complained of that."

"That's a good question. The simple answer is that women's heart disease symptoms can be subtler than men's and are often overlooked. Take a look at the charts on the wall over there and you'll see what I mean. Patients may experience all, some, or none of those symptoms. It is even possible to have a silent heart attack."

Women's Symptoms
Angina (chest pain may radiate into jaw and down left shoulder and arm) **B**reathlessness (especially at night) **C**hronic fatigue (usually overwhelming) **D**izziness or even blackouts **E**dema or swelling, especially in the ankles **F**luttering (rapid heartbeat) and pallor **G**astric upset (nausea) and sweating

Men's Symptoms
1. Sudden *immense* pressure or pain in the chest center (may persist or occur on and off) 2. Pain that radiates from chest center to neck, shoulders, and arms 3. Dizziness, nausea, sweating 4. Sudden onset of rapid heartbeat

The doctor continued, "This is a pamphlet that gives you some background on cardiovascular disease and the factors that go into them. You'll notice that some of these are things you can't change. We call them "non-modifiable." They include your gender, age and your hereditary background; we're all stuck with these. Then there are the "modifiable" factors, things like smoking, stress, and a high fat diet. When more than one factor is present, risk further increases. Once Denise is better I think you both need some time together to consider how you might change your lifestyle."

Wake-Up Call

Part VI—"The Aftermath"

by
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"Well, it's been four hours since the chaos began here in Denise's heart. I'm pooped! Here's the way I see it. A bunch of my cells are dead. So now there's an inflammatory response of neutrophils and monocytes and an elevated body temperature. Enzyme levels in the bloodstream are up. I don't know one enzyme from the other. They're all just proteins to me. But here's what I heard the doctors say—I mean it, they really use these big words: Creatine phosphokinase (CPK) has become elevated and will peak within 12 to 24 hours since the attack and with luck it'll return to normal within 48 to 72 hours. Its isoenzyme, CK-MB, is also elevated. CK-MB2 undergoes a change to CK-MB when released into the bloodstream. The ratio of CK-MB2 to CK-MB1 is more than 1.5 for heart attack patients, which is a benchmark doctors use to diagnose myocardial infarction within 6 hours of symptom onset. The blood level of aspartate aminotransferase (AST or GOT) has become elevated due to cell injury, will peak in 24 to 48 hours, and will return to normal in five days. In contrast to the rapid rise and decline of these enzymes, lactate dehydrogenase (LDH) will begin to elevate within a day of the attack onset and will persist at high levels for 10 to 20 days.

Cardiac troponins T and I (which help me contract) will remain elevated in the blood for 10 to 15 days after myocardial injury. This means that if the doctors find that the troponins levels are up, they can really be sure the heart has been injured. Well, that's sure to be what happened to me. So now what have I got to look forward to? Some rest and healing time. With luck, four to six weeks from now, Denise's body will have deposited collagen fibers and scar tissue at the plaque rupture site. Some more collateral vessels will have been built. But for me, things will never be the same. Any of my heart tissue that died from oxygen starvation will be lost and replaced with scar tissue ... unless doctors can find a way to regenerate it. Geesh, I never thought this would happen to me. Denise is so young...."

Assignment:

Denise is back home and on cholesterol-lowering medication and is learning how to better handle stress. Your assignment is to help Denise and her family research the key measures in preventing heart disease, or in Denise's case, another heart attack. Answer the following questions briefly and directly. You may include a table if desired. The sources cited in the References for this case are good sites to utilize.

1. Heart-Healthy Diet
    a. What foods/nutrients should be limited and specifically what foods/nutrients are beneficial and why? (Example: what are the benefits of folic acid, monounsaturated fats, omega 3 fats, etc? Why are saturated fats bad?)

2. Lifestyle Changes
    a. What activities are hazardous to heart health and what are some solutions? (Example: handle stress with stress management, not overeating.)
    b. What are the benefits of exercise concerning heart health?

3. Aspirin
    a. How can aspirin help in preventing heart disease?

4. Draw a diagram of the changes in blood enzyme and troponin levels that occur before, during and after a heart attack.

5. Create a pamphlet that the doctor could give to Denise about altering her life style. It should include information on smoking, cholesterol, blood pressure, obesity, diabetes, physical activity, diet, and stress.

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A Healthy Retirement?

Part I—"The Cookout"



by
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Late afternoon on a Monday in June

"The backyard is ready for tonight's cookout," Jim announced as he entered the kitchen and dropped into a chair. "The tables and chairs are set up, the grill is clean, and the drinks are on ice. Sure glad I cut the grass yesterday. I don't think I would have had time to do that today too. What are you doing? Do you need any help?"

"No, thanks," said his wife Nancy. "I'm almost done with these snacks. Why don't you fix us a drink so we can sit and relax a little before the neighbors arrive. Getting ready for these parties used to be a breeze, but right now I'm pooped. Can't understand why I feel so tired all the time."

"OK, Hon. Put your feet up for a bit. I'll be the waiter." He gave her shoulders a good rub and then headed to the refrigerator, returning shortly with two cool drinks.

As they sat on the porch swing and sipped their drinks, Jim and Nancy went over the list of things they had done and the things they had yet to do before their cruise to Alaska. Planning had been intense. It was the middle of June and the Towers had been working hard to get their garden beds planted and odd jobs finished around the house before they left on their two-week vacation.

Jim retired last year after 40 years in sales. He had suffered a massive heart attack a few years earlier and now takes medication to control his blood pressure as well as an aspirin every night. He is 68 years old, overweight, and keeps promising to quit smoking.

Nancy is 62 years old and just retired from teaching mathematics at the college level. She's still trying to find a place at home for the books and papers she decided to keep. Although she swims a few laps and lifts weights several times a week at the local Health and Wellness Center, Nancy weighs more than she should. She has been taking hormone (estrogen) replacement therapy since she had a hysterectomy at age 45. Now she's concerned about developing osteoporosis because her sister was recently diagnosed with it, and their mother died in early April from complications following a broken hip.

Later that evening

The neighborhood cookout was a success.

"I'm stuffed," sighed Nancy as she finished her last bite of pie. "Let's just sit and talk some more before we start cleaning up. I don't know if I can move! I've had a pain in my back all week, and now I have a burning sensation in the lower part of my chest. If I didn't know better, I'd say that something happened to me last month when I retired. I suddenly seem to be falling apart!"

"You probably just ate too much. Why don't you take some antacid?" suggested her friend Harry. "It helps my indigestion every time."

Others agreed with Harry's suggestion, and Nancy left to search the medicine cabinet. The pain in her chest eventually lessened, and Nancy enjoyed the rest of the evening with Jim and their friends.

The next day, Tuesday

After cleaning up the remains of their cookout Jim and Nancy began their final packing in earnest. A few neighbors stopped by to confirm house-sitting duties and to see if they could help with any last minute details.

"Jim and I are really looking forward to getting away. It's been years since we splurged on a vacation. But, getting ready to go is so much work! We thought we'd never get the garden ready in time. Sometimes I think it would be better just to stay home," said Nancy.

"I know what you mean," said their next door neighbor Jill. "But I'm sure you'll love the cruise and Alaska. Don't worry, everything back here will be fine."

In the midst of the day's hubbub, Nancy's test results from an early morning screening at the local Health and Wellness Center arrived in the afternoon mail. She glanced at them briefly and stuck the paper into a book she was taking along on vacation. "Maybe later I can figure out what all of this means," she said to herself.

Nancy's test results (at rest and fasting levels):

TEST	NANCY'S RESULT	NORMAL RANGE
Heart rate	88 beats/min	60-100 beats/min
Blood pressure	138/85 mm Hg	90/60 - 140/90 mm Hg
Total cholesterol	238 mg/dL	<200 mg/dL
HDL	46 mg/dL	45-60 mg/dL
LDL	161 mg/dL	<100 mg/dL
Triglycerides	220 mg/dL	<150 mg/dL
Glucose	128 mg/dL	80-100 mg/dL

Questions:

1. Assess the health of Jim and Nancy by listing the healthy and not-so-healthy things we know about each of them. Fill out a table similar to the one below to list your observations about their health status.

JIM		NANCY	
HEALTHY	**NOT-SO-HEALTHY**	**HEALTHY**	**NOT-SO-HEALTHY**

2. What diseases are Jim and Nancy at risk for and why?

3. What other information might be helpful to know in assessing their health? How would this information help?

A Healthy Retirement?

Part II—"The Cruise"

by
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Jim and Nancy flew to Vancouver to start their cruise. The ship was like a city with thousands of people, lots of activities, and an abundance of delicious food and drink. The Towers enjoyed being wined and dined and kept busy day and night. They rarely missed the afternoon ice cream parties on deck.

Feeling a little guilty about eating so much food, the Towers joined other travelers for early morning and mid-afternoon power walks on deck. They planned to increase their speed and distance a little each day. Their goal was to walk a mile in 18 minutes by the end of the 10-day cruise.

The weather was clear and the scenery was breath-taking as they walked and talked. Early one morning, after about 15 minutes of power walking on deck, Nancy started feeling nauseous and had trouble breathing. "Jim, I think something is wrong with me," she said.

"Let's stop and rest for a few minutes. Maybe that will help," he said. Jim helped her to a deck chair and fussed with a blanket to protect her from the cool morning air. Nancy's nausea decreased and her breathing improved. They sat on deck chairs for the next hour watching the whales swimming beside the ship.

The next morning during their power walking Nancy experienced a similar problem. "Jim, now I'm sure that something is wrong. For weeks I've been feeling tired and have had a nagging backache. But this nausea and shortness of breath are new. I'm scared. Do you think I could be having a heart attack?" she said.

"Nah, I doubt it. I mean, you don't have chest pains or anything like that, do you? Don't you remember how I thought one of those whales was sitting on my chest and wouldn't get up when I had mine?" said Jim.

"You're probably right. I don't have chest pains," she said. "Maybe it's just all the recent changes in my life and eating too much of this rich food."

Later that day Jim and Nancy joined a small group from the ship for a land excursion. They snapped pictures of each other standing in front of totem poles and the picture-perfect scenery and joked about the possibility of getting a salmonburger at the fast food places back home. As the afternoon ended, a blast from the ship's horn warned them that it was time to head back to the ship.

As the group trotted down to the docks, Nancy pulled aside and Jim stayed to keep her company. Carol, a member of their group, slowed her pace, then went back to Nancy and Jim. "You two OK?" she asked.

"Yeah, I think so," replied Jim. "Nancy's been feeling pooped lately and has complained about a backache. Now she's having trouble keeping up with the group."

"What kind of pooped, Nancy?" asked Carol.

"Well, I think all the preparations for the trip wore me out," explained Nancy. "I expected to be energized by the vacation. But both yesterday and this morning as we were walking on deck, I started to feel nauseous and had trouble breathing. It scared me at first, but then it went away after I rested. Now, again, I'm having trouble walking fast."

"I don't mean to scare you, Nancy, but I think this could be serious," warned Carol.

"You do?" questioned Nancy. "You look so young. Have you had these problems too?"

"No, not me," Carol replied. "But some of my patients have. You see, I'm on this cruise for a small break between finishing a residency in family practice and joining a group practice in my hometown. I think you may be experiencing angina equivalent symptoms."

"What does that mean?" asked Jim.

"Women often have symptoms of coronary heart disease, and even of a heart attack, that are different from men's," explained Carol. "Nancy's back pain, fatigue, nausea, and shortness of breath are typical for women. Because the symptoms are different from typical male symptoms they are called 'angina equivalent symptoms.' For now, Nancy, your symptoms go away when you rest. But if they don't go away with rest, it's a good indication that you're actually having a heart attack. I think you should see a doctor who specializes in cardiology or internal medicine soon."

Questions:

1. How are angina equivalent symptoms different from classic angina symptoms?

2. What causes these symptoms?

3. Why do the symptoms lessen when Nancy rests?

4. Before reading this case study did you know that males and females often have different symptoms for coronary heart disease or a heart attack? If so, how did you find out?

5. How do medical researchers find out if individuals of both sexes and from diverse racial and ethnic backgrounds have similar symptoms or react the same to treatment?

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It's Just Stress, Right?
A Case Study on the Endocrine System



by
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Part I – Frustration

Ellie dropped her backpack beside the chair in Dr. Kern's office and sat down with a sigh. Her hands trembled as she glanced again at the graded exam in her hand.

"It's no better than the last one," she mumbled. "I really, really tried this time, Dr. Kern. I did all the reading assignments before and again after class. I completed all of the study guide questions and rewrote my notes and made flash cards and studied with straight-A Cassie every week. But it didn't make any difference. I still failed it." She sniffled loudly and reached for the box of tissues on Dr. Kern's desk.

Dr. Kern sat back and thought for a moment while Ellie made use of several tissues. Ellie was a junior in Dr. Kern's physiology course and had struggled from the start of the semester. One-on-one help sessions and different study strategies hadn't seemed to help. "I know how discouraged you must be, Ellie. Tell me again what you do when you sit down to study."

"I read and review my class notes and reread the assigned sections in the book. But for some reason I can't concentrate on much of anything for very long and, even when I can, I don't remember what I've studied by the next day. It's so frustrating to spend so much time studying and not retain anything. If I fail this class, my GPA might drop enough that I'll lose my scholarships. I'm so stressed that I can't sleep, even when I try."

Ellie broke off, and Dr. Kern gently tried to encourage her. "Let's not give up hope yet. Sometimes you have to use new study methods for a while until you start to see some benefits. Let's also take a look at your exam and see if there's a pattern in the questions you missed."

Ellie sniffled again. "OK, but I'm not very hopeful. I've been thinking about changing my major. All these upper-level courses seem so hard … there's so much to learn in such a short time and I just don't seem to get it even though everyone else does. I can't stand the stress anymore."

"Perhaps talking this over with your parents or a trusted friend would help," Dr. Kern suggested. She noted Ellie's strikingly large blue eyes that gave her a permanent look of surprise. Ellie was also quite thin, almost to the point of being too thin. Dr. Kern paused and chose her words with care. "I also know there are terrific folks over at the health center who are experts in how to deal with stress."

Ellie gave a small, noncommittal smile and pushed a shaking hand through her hair. "Thanks, I'll think about it. See you in class on Monday."

However, Ellie didn't come to class on Monday or Wednesday. She emailed Dr. Kern that she most likely had a sinus infection and would miss class on Friday to see a doctor. Dr. Kern shook her head at Ellie's misfortune; missing a week of class was not going to make it any easier for Ellie to pull up her grade.

Questions

1. Note anything unusual about Ellie's behavior or appearance.
2. What do you think might be going on with Ellie that could cause her difficulties? Consider both physical and psychological causes.

Part II – Health Center

Ellie sat in a small exam room of the student health center, feverish and with a throbbing headache. A sinus infection right before midterms was not what she needed.

Dr. Simmons entered in a rush and took a quick look at her chart. "Hmm … fever, headache, green nasal discharge that you've had for two weeks. Sounds like your sinuses have been invaded by something nasty. Does this hurt?" He pressed his thumbs on Ellie's cheeks, which nearly sent her through the ceiling. "Yep. Let's try some antibiotics to clear that up."

He reached for his prescription pad, but stopped and glanced at Ellie's face again. "Your eyes protrude a bit. Have they always been that way?" He turned her face to look at her profile and frowned slightly.

Ellie had no idea what her eyes had to do with her sinus infection. "I haven't noticed. But I've been so stressed lately that I don't notice a lot of things." She paused and then continued, "My little brother did start calling me 'Bug Eyes' this summer, but he's just an annoying 10-year-old."

Dr. Simmons nodded and then gently palpated her neck. He looked at her chart again. "Your blood pressure and pulse are elevated. Your fever might account for that, but there could be something else going on here." Ellie felt a small knot form in her stomach. This was supposed to be a simple sinus infection, nothing more.

Dr. Simmons began to fire questions at her. Did she have trouble sleeping? Did she often feel nervous or "jittery"? Had she lost weight recently? Did she often feel like the room was too warm? Did she have frequent bowel movements or diarrhea?

Ellie's head spun. "Uh, y-yeah, but I'm just stressed, you know, with classes. Aren't all those things just signs of stress?"

"They certainly can result from stress, and I see a lot of students where that is the case. However, there is a slight swelling in the front of your neck. That combined with your other symptoms suggests that perhaps your thyroid gland isn't functioning quite the way it should. I'd like to take a look before we assume your symptoms are all due to stress. Let's start with some simple blood tests and see what we find."

He scribbled a lab order and smiled kindly. Ellie grabbed the papers and left, feeling worse than when she first came in.

Questions

1. Where is the thyroid gland located?
2. List the hormones secreted by the thyroid and describe their general actions.
3. Protrusion of the eyes is called exophthalmos. How is it related to thyroid dysfunction? What causes it?
4. What is the significance of the slight swelling in Ellie's neck?
5. Based on the information you have at this point, do you think Ellie's thyroid gland is hyperactive or hypoactive? Explain your answer.
6. Dr. Simmons ordered blood tests to measure Ellie's levels of thyroid hormone and thyroid-stimulating hormone (TSH or thyrotropin). If Ellie has a hyperactive thyroid, what are the expected results? What are the anticipated results if she has a hypoactive thyroid?

Part III – Thyroid Trouble

Once again, Ellie sat in the exam room waiting on Dr. Simmons. He flew in the door, grabbed a stool and, to Ellie's relief, got right to the point. "Well, your blood work does show some problems with your thyroid. Your TSH levels are lower than they should be, your T_4 levels are a bit high and your T_3 levels are very high. Those results suggest that you might have Graves' disease, which means that your thyroid is releasing too much thyroid hormone. Since thyroid hormones are responsible for your metabolic rate, that explains why your heart rate and blood pressure are elevated, why you've felt nervous and can't sleep, and why you've lost weight even though you aren't dieting."

Ellie's mind whirled. "Sooooo, could this also be why I can't concentrate when I try to study and why I can't seem to remember anything?" Maybe there was still some hope for her in Dr. Kern's physiology class.

"Well, maybe," Dr. Simmons answered. "Some studies suggest that excess thyroid hormone is correlated with decreased attention, concentration, and working memory. In other words, your thinking might not be as clear as it should be. However, other experts argue that it's the anxiety and nervousness that cause patients to feel their thinking is impaired, even though there is no actual impairment. The good news is that with treatment patients report an improvement in their cognitive abilities, regardless of the underlying cause."

Ellie felt a twinge of relief. "Oh, good! That will certainly help my grades. But why is my thyroid releasing too much hormone? And you said my TSH levels were low. Isn't TSH a thyroid hormone? If my thyroid is too active, shouldn't it be high instead of low?"

Ellie has just asked some very good questions. If you were Dr. Simmons, how would you answer her?

Questions

1. What is causing Ellie's thyroid to secrete too much hormone?
2. Is Ellie correct in thinking that TSH is a thyroid hormone? Why is her TSH level low instead of high?

Part IV – Options

Dr. Simmons continued. "I'm going to refer you to a local endocrinologist, someone who specializes in disorders like this. She will probably order a radioactive iodine uptake test and a thyroid scan to confirm that you have Graves' disease and determine the best way to treat it."

At Ellie's look of alarm, he explained. "Don't worry … the amount of radioactivity is very small and not harmful, so you won't start to glow. The thyroid gland incorporates iodine into its hormones, and if we tag the iodine with radioactivity, we can measure the amount of iodine taken up by the thyroid."

Ellie jumped in. "And if my thyroid is overactive, it will use more iodine than it should, right?"

"Exactly," responded the doctor. "Assuming that your uptake is elevated, there are several ways to treat your condition. Unfortunately, we can't cure it. However, there are some medications that can help, and another procedure that involves radioactive iodine. Surgery to remove the thyroid is also an option, although not a common one anymore. The endocrinologist will evaluate your test results and help you choose the best treatment. Until then, I'm going to prescribe a beta-blocker that should help lower your heart rate and reduce that nervous feeling you've had."

Several weeks later, Ellie dropped her backpack beside the chair in Dr. Kern's office and sat down with her latest physiology exam and a smile. "I think there's hope!"

"I agree. Tell me about this dramatic turn-around," Dr. Kern smiled in return. Ellie was still very thin and her blue eyes startlingly wide. However, the fidgeting and shakiness were gone and the overall impression was one of calmness and purpose.

Ellie explained how a sinus infection led to discovery of her thyroid disorder. "I'm taking some medication now until the radioactive iodine treatment becomes effective, and I feel so much better. I can sleep, I can concentrate, and I think I can pull up my grade enough to pass the course!"

Dr. Kern smiled again. "So often signs of stress are just that, but occasionally there is another explanation. I'm so glad you found out what was going on sooner rather than later, and I'm sure this will reduce your stress levels even further. We'll look for even better results on the next exam."

Ellie laughed. "Oh, it covers the thyroid gland. I think I can ace that part!"

Questions

1. Ellie is a 20-year-old female. Do some research on the average age of onset and any gender differences in Graves' disease to see if Ellie's diagnosis is unusual.
2. How are beta-blockers like propranolol helpful as an initial treatment for Graves' disease? Do they have any effect in reducing thyroid hormone levels or do they counter the effects of the hormones?
3. After Ellie's diagnosis of Graves' disease was confirmed by the uptake test, her endocrinologist explained several options for long-term treatment, which are listed below. For each treatment, describe the major advantages and disadvantages.

a. Anti-thyroid medications (methimazole, propylthiouracil)—these medications slow the production of thyroid hormones.

b. Radioactive iodine—a stronger dose of radioactive iodine is given to gradually destroy the thyroid gland.

c. Surgery—part or all of the thyroid gland is removed.

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Not An Old Person's Disease

Part I—"Soaking Up the Sun"

by
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Judy sat up, took a swig from her water bottle, and wiped the sweat off of her face. She glanced at her watch and frowned. Had they only been out here for half an hour? Man, trying to get a good tan was way too much work. She glanced over at Mariah who was sleeping peacefully in her lounge chair. No wonder she looked like a Greek goddess every summer—she *enjoyed* lying in the sun. Judy decided that her normally pasty-white skin was tan enough, getting a little red again in fact, and she started to gather her things. Anyway, she reasoned, a dark tan might clash with her red hair.

Judy stopped for a second to scratch her calf. It had been itching for several days now, and she figured that the mosquitoes had really gotten her at the barbecue the other night. Since she was on the ground, she bent her neck to look at it and was surprised to see that it wasn't a mosquito bite but a mole. She'd had this mole ever since she could remember, but it had never itched before. She looked a little more closely and noticed that the mole looked kind of different than she remembered. It was a little bigger and the edges were sort of jagged. One edge was a bit darker than the other and in the middle was a raised purplish-black dot that she tried to wipe away but couldn't. As she was staring at her leg, Mariah woke up.

"What are you day dreaming about, your hot date with Tim tomorrow night?" Mariah teased as she rolled on her side, her black hair falling into her eyes.

Judy shook her head, "Ha, ha, I do have more things in my life to ponder. Anyway, I just noticed that a mole on my leg looks kind of weird and it keeps itching."

Mariah sat up with a concerned look on her face. "Let me see it." As she looked at Judy's leg, she said quietly, "Maybe you should go to the clinic." As Judy stared at her, she continued. "My mom sent me a pamphlet on skin cancer last year. You know, trying to convince me to stop lying in the sun so much. I glanced through it before I tossed it into the garbage. I remember some of the pictures of skin cancer and they kind of looked like your mole."

"What are you talking about?" Judy said defensively. "How could I have skin cancer? I'm barely in the sun compared to you."

"Alright, alright. It's not like I'm a doctor or something. I just remember those pictures. Come on, let's just call the clinic so they can check you out. I'm sure they'll tell you I'm crazy."

Questions:

1. What are some differences between Judy and Mariah that might make Judy more "at risk" for skin cancer than Mariah?
2. What observations did Judy make concerning her mole?

*__Note:__ Both authors contributed equally to this case and its teaching notes.

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Not An Old Person's Disease

Part II—"The Basics of Cancer"

by
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Judy did a little research about skin cancer on the Internet before her doctor's appointment the next morning. She learned that most cases occurred in people who were significantly older than she was. It didn't make sense that it would happen to her—she was only 20 years old!

The articles talked about how UV light from the sun causes mutations in your DNA. Accumulation of DNA mutations over many years can cause certain cell cycle genes called "proto-oncogenes" to become super-active. Judy actually felt thankful for the college biology course she had been forced to take. She knew that DNA was the hereditary material that acted as a "blueprint" for everything our cells make and that a gene is a piece of DNA that contains the instructions for making a single protein. However, she would have to ask the doctor about these proto-oncogenes.

In the examining room, Dr. O'Brien was silent as he looked at the mole on her leg. Finally, he said kindly, "I want to do a biopsy. All that means is we'll remove your mole and look at the cells under a microscope and see if they look abnormal."

Judy could feel the tears welling up in her eyes. "You mean you can tell if I have a tumor by just looking at some cells?"

"Whoa, slow down a minute," Dr. O'Brien replied calmly. "It's very possible that your cells will look completely normal. And to clarify something, a tumor is not necessarily the same thing as cancer." She looked confused, so he continued. "A tumor means that cells have divided and piled up on one another in a single mass. But not all tumors are automatically cancerous and life threatening. A benign tumor is a mass of normal-looking cells. These tumors are not considered cancer and they're usually relatively easy to treat—we just remove them. On the other hand, a malignant tumor is a mass of abnormal cells whose growth cannot be controlled by the regular mechanisms. In addition, malignant tumors often spread to other parts of the body instead of just staying in one spot. We call this process metastasis. Malignant tumors are cancerous and, therefore, a very serious condition. To treat them, we have to remove the cancerous cells that we find and then do chemotherapy treatments to be sure to kill all the cancer cells that we may have missed surgically."

"So, if I have cancer, is it from these proto-oncogenes that I read about on the Internet?"

The doctor smiled and seemed pleased that Judy had been reading about this on her own. "Let's back up for a minute. You see, we have tens of thousands of genes in our cells, but it's not like mutations in just any of them will lead to cancer. The genes that get mutated and can cause cancer are of a specific type called cell cycle genes. *Everyone* has a set of cell cycle genes in each of their cells that code for cell cycle proteins. Cell cycle proteins control if and when cells divide. Sometimes we need to make more cells in our bodies, and some of these cell cycle proteins allow that normal process of cell division to occur. At other times we don't want the cells to divide, so different cell cycle proteins inhibit cell

division then. In normal, healthy cells, the formation of the cell cycle proteins is tightly controlled so the activating proteins are only made when we really need more cells and the inhibitory proteins are only made when we don't need more cells. However, mutations (or alterations) in these genes can eliminate this tight regulation and lead to uncontrolled cell division. This is what happens in many types of cancer: a normal cellular process, cell division, is no longer properly controlled."

Judy thought for a second. "Okay, but you still didn't say what these proto-oncogenes are."

"Oh yes, sorry. The activating class of these cell cycle genes consists of the proto-oncogenes. The normal job of these genes is to code for proteins that promote cell division. Certain mutations in proto-oncogenes result in proteins that are active all the time, causing cells to divide continuously. But let's not get ahead of ourselves—we won't know if your mole is even cancerous until we do the biopsy."

When Judy didn't say anything in response right away, Dr. O'Brien continued, "I know this is all a bit confusing, but it's good that you're asking these questions. We'll make sure that you understand this a little better before you leave today."

Just then a nurse knocked and entered the room. He needed Dr. O'Brien for a minute. At least Judy would have a minute to gather her thoughts.

Questions

1. Considering the differences between a benign tumor and a malignant tumor, why might a benign tumor be easier to treat?
2. Judy learned that every single person has these cell cycle genes so cells in our body can divide when necessary. What are some normal circumstances where our bodies might need to make more cells?
3. Every person has these cell cycle proto-oncogenes, but not every person has cancer. Why might this be the case?

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Not An Old Person's Disease

Part III—"Like Mother, Like Daughter?"

by
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Dr. O'Brien had handed Judy a pamphlet on melanoma before he left the room. As she started reading it, Judy realized that this is what they were going to test her for. Melanoma is a type of skin cancer that starts in your melanocyte cells, or the pigment cells of your skin. Actually, a mole is just a clump of melanocytes. There were pictures of cancerous moles in the pamphlet and one of them looked a little like hers, only bigger. She was starting to get worried. Below is part of what she saw:

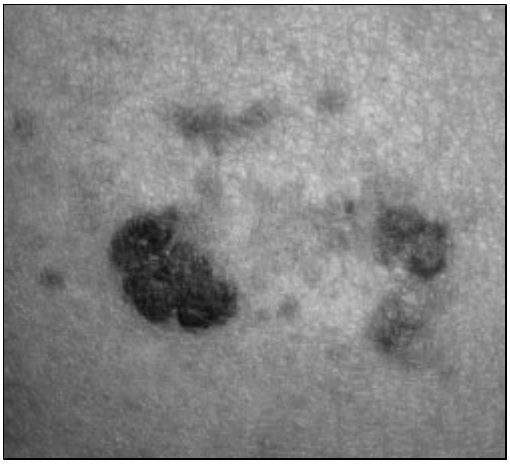


Image courtesy of Arthur C Huntley MD,
University of California Davis
http://www.mpip.org/guide/suspindex.html.

Dr. O'Brien returned just then and apologized for the disruption. "Do you have any more questions?"

"Well, I just don't understand how it's possible for a 20-year-old to get cancer. Isn't cancer an old person's disease?"

"You're right that most cancer patients are older. That's because you accumulate mutations in your genes over time. UV light, cigarette smoke, other chemicals, and even aging itself can cause mutations in genes. The kind of cancer that we're checking your mole for is melanoma. This is the most common cancer in people aged 25 to 29 and is the fastest-growing category of cancer, increasing four percent each year. You are a bit young, but you may be genetically predisposed to melanoma."

"What does that mean?" Judy asked.

"Well, remember the cell cycle genes that we were talking about earlier? I described the proto-oncogenes as being needed for activating cell division. Well, remember that I also mentioned a class of cell cycle genes that prevent cell division. These genes are called tumor suppressors. You usually have two good copies of each of these tumor suppressor genes, but sometimes you inherit one good copy and one mutated copy. Basically it means that, along with inheriting genes for your red hair or blue eyes, you may have inherited a mutated cell cycle gene. You had it when you were born, so it's not the result of lying in the sun too much or anything like that. But for these types of genes to lead to cancer, you need to have both copies of the gene mutated. One good copy is sufficient to prevent your cells from dividing aberrantly. So you can be born with one mutated copy, but not actually get cancer unless the other copy accidentally gets mutated sometime during your life. Mutations in the second copy could be the result of UV light from the sun, like in the case of melanoma. Since you may have been born with one mutated copy already, you are "predisposed" to getting cancer. You are one step closer to getting cancer compared to someone who doesn't have a mutation. We see a genetic, or hereditary, component in about five to 10 percent of melanoma cases. Do you know if anyone in your family has had melanoma?"

Judy shook her head, "I'm pretty sure that my dad hasn't, but my parents split up when I was young and I haven't really talked to my mom in the last 10 years. I thought I heard that she had some mole thing removed a long time ago, but I didn't think that it was cancer."

The doctor said, "You might want to call her. Now, let's get this biopsy done and hopefully prove that all this talk about cancer is unnecessary."

Questions:

1. Now that you know a little more, what are the risk factors that increase a person's chances of having melanoma?
2. How does sunlight contribute to the development of melanoma?
3. What does it mean to be predisposed to getting cancer? If you inherit a mutated cell cycle gene, does that automatically mean that you will get cancer some day? If you inherit a mutated cell cycle gene and participate in risky behaviors such as sunbathing, does that mean that you will automatically get cancer some day?

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NATIONAL CENTER FOR CASE STUDY TEACHING IN SCIENCE

Black and Blue with Love: A Case Study in Blood Clotting

by
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Part I – Initial Office Visit

You are a nursing student and you have been given the opportunity to shadow Yasmin Gonzalez, a nurse practitioner. Today, Kelly Hunter brings in her 5-month-old son, Tristan, for an exam. Mrs. Hunter is anxious and concerned because she has recently noticed lots of bruises on Tristan and cannot figure out where they are coming from. Ms. Gonzalez looks over Tristan's body and sees visible bruises at different stages of healing along his arms. Upon further inspection, she finds bruises that are the size of half dollars that protrude along his rib cage. You and Ms. Gonzalez are concerned by the bruising and want to discuss this with the mother.

Questions

1. What do you think could be causing the bruising? Please list two possible explanations.

2. What are some important questions to ask the parent?

After talking with a tearful mom it is revealed that the parents had been trying for several years to become pregnant. Tristan sleeps no more than 20 minutes at a time even throughout the night. The mom says the baby's schedule "is tiring, but isn't that normal?" She has noticed the bruising over the past week and the bruises are getting bigger. She thinks they are coming from the excersaucer and jumpers that he plays in, but she is not sure. Tristan does not attend any daycare centers; he stays at home with his mom throughout the day. The mom verbalizes and physically shows that she loves her son and is concerned for his wellbeing.

Ms. Gonzalez calls a meeting with the medical team, which consists of the pediatrician, a social worker, a nurse, and you. The possible diagnoses discussed by the team include child abuse, leukemia, clotting disorders, nutritional deficiencies, and autoimmune diseases. Everyone on the team agrees that due to the location and sizes of the bruises, x-rays need to be taken to rule out broken ribs. X-rays are ordered for Tristan.

The x-rays return normal and show no broken bones. This result prompts the team to order a series of blood work. Tristan and his mother return to the hospital and blood is drawn. Ms. Gonzalez orders a complete blood count (CBC), a partial thromboplastin time (PTT), and a prothrombin time (PT) to evaluate Tristan's clotting time. She also orders a complete metabolic panel to get a comprehensive analysis of Tristan's blood work. The team meets again and you are curious as to what the blood tests are and why they are important in this situation. The pediatrician, Dr. Martavius Johnson, gives you a quick rundown of the tests.

Complete Blood Count

Used to measure: the number of red blood cells (RBC count), the number of white blood cells (WBC count), platelet count (PLT), breakdown of the white blood cells (granulocytes, lymphocytes, monocytes), the total amount of hemoglobin (HGB), and the percent of the blood sample composed of red blood cells (HCT). A CBC also tells us the average RBC size (MCV), hemoglobin amount per RBC (MCH), the amount of hemoglobin relative to size of the cell (hemoglobin concentration) per red blood cell (MCHC), and the RBC distribution width (measure of variability in RBC size). A CBC can be used to evaluate RBC production or destruction, test for infections, or detect clotting or blood disorders.

Comprehensive Metabolic Panel

A group of blood tests which provide information about body metabolism. This is usually performed to measure kidney function, acid/base balance, blood sugar, and electrolytes. For the metabolic panel, patients fast for 8h prior to having blood drawn. BUN (blood urea nitrogen) is determined to check function of kidneys. Creatinine is a breakdown product of creatine (from phosphocreatine – used to store ATP to fuel muscle activity), and is generally a measure of kidney function (high values indicate a kidney problem). Low levels of creatinine can be benign, or can mean a low-protein diet, pregnancy, or liver disease. Men tend to have higher creatinine levels than females due to higher muscle mass. eGFR = estimated glomerular filtration rate (based on creatinine and sodium clearance). BUN/creatinine ratio can be used to determine acute kidney injury or dehydration, both urea and creatinine are freely filtered by the glomerulus, but urea can be reabsorbed in the tubules whereas creatinine excretion remains fairly constant. Albumin is a blood protein made by the kidneys (it helps with the colloid pressure of the blood and keeps it from leaking out of the vessels; also carries other molecules). Globulin (proteins made by liver and immune system) can indicate blood disease. The ratio of albumin/globulin can indicate disease states (e.g., kidney disease, autoimmune disease, leukemias). Alkaline phosphatase is an enzyme and levels can indicate liver disease or bone problems. Bilirubin test checks for liver function. AST = asparate amino transferase, ALT = alanine amino transferase.

Partial Thromboplastin Time and Prothrombin Time

These blood tests measure how long it takes blood to clot. Blood is taken from the patient and kept in an airtight tube that contains certain chemicals. Then, additional chemicals are added to the blood and clotting (coagulation) time is measured (PTT is a measure of the intrinsic pathway and PT is a measure of the extrinsic pathway). For the PTT test, blood generally clots within 25 to 35 seconds, for the PT test it usually takes about 10 to 14 seconds. The coagulation cascade contains several clotting factors (XII, XI, IX, VIII, X, V, II [prothrombin], and I [fibrinogen]) and by performing PTT and PT together the health care provider can get an idea of what might be happening in the clotting process. These tests are performed when patients have a problem with bleeding or clotting. It can be used to help diagnose several disorders, including: factor XII or factor XI deficiency, hemophilia A, hemophilia B, hypofibrinogenemia, liver disease, vitamin K deficiency, or Von Willebrand's disease.

— *Information from NIH Medline*

Part II – Blood Work

Tristan's blood work comes back and the results are listed below. Please use this information to answer the questions below.

CBC Panel – T. Hunter

Measure	Value	Normal Range
White Blood Cells (WBC) (K/ul)	14.3	5.0–19.5
Red Blood Cells (RBC) (M/ul)	4.07	3.1–4.5
Hemoglobin (HGB) (g/ul)	9.4	10.0–14.0
Hematocrit (HCT) (%)	26.7	28–42
Platelets (PLT) (K/ul)	513	150–400
Mean Corpuscular Volume (MCV) (FL)	65.6	77–110
Mean Corpuscular Hemoglobin (MCH) (PG)	23.0	26–35
Mean Corpuscular Hemoglobin Concentration (MCHC) (g/dl)	35.0	33–36
Red Cell Distribution Width (RDW) (%)	14.8	11.5–14.5
Mean Platelet Volume (MPV) (FL)	7.8	7.4–10.4
RBC morphology	normal	normal-abnormal
WBC morphology	normal	normal-abnormal

Comprehensive Metabolic Panel – T. Hunter

Measure	Value	Normal Range
Glucose (mg/dl)	92	60–100
Sodium (Mmol/l)	137	139–146
Potassium (Mmol/l)	4.6	3.7–5.6
BUN (mg/dl)	6	5–17
Creatinine (mg/dl)	0.2	0.3–0.6
Chloride (Mmol/l)	104	98–108
CO2 (Mmol/l)	22	20–28
Calcium (mg/dl)	10.4	8.7–9.8
Protein, total (Gm/dl)	6.0	5.9–7.0
Albumin (mg/dl)	4.0	2.1–4.5
Bilirubin, total (mg/dl)	0.5	0.6–1.4
AST (u/l)	51	20–60
ALT (u/l)	36	6–50
ALK phosphatase (u/l)	234	145–320
Globulin (u/l)	2.0	2–4

PTT and PT tests – T. Hunter

Measure	Value	Normal
PTT Average (sec)	107.2	23.3–37.1
Prothrombin average (sec)	10.2	9.9–12.3
INR	0.94	See below

Historically, a PTT prolongation of 1.5–2.5 times the median of the normal range is considered to be the therapeutic level. However, many clinical factors may alter the therapeutic range.

International normalized ratio (INR) therapeutic values: anticoagulant therapy = 2.0–3.0; Prosthetic heart valve = 2.5–3.5

Questions

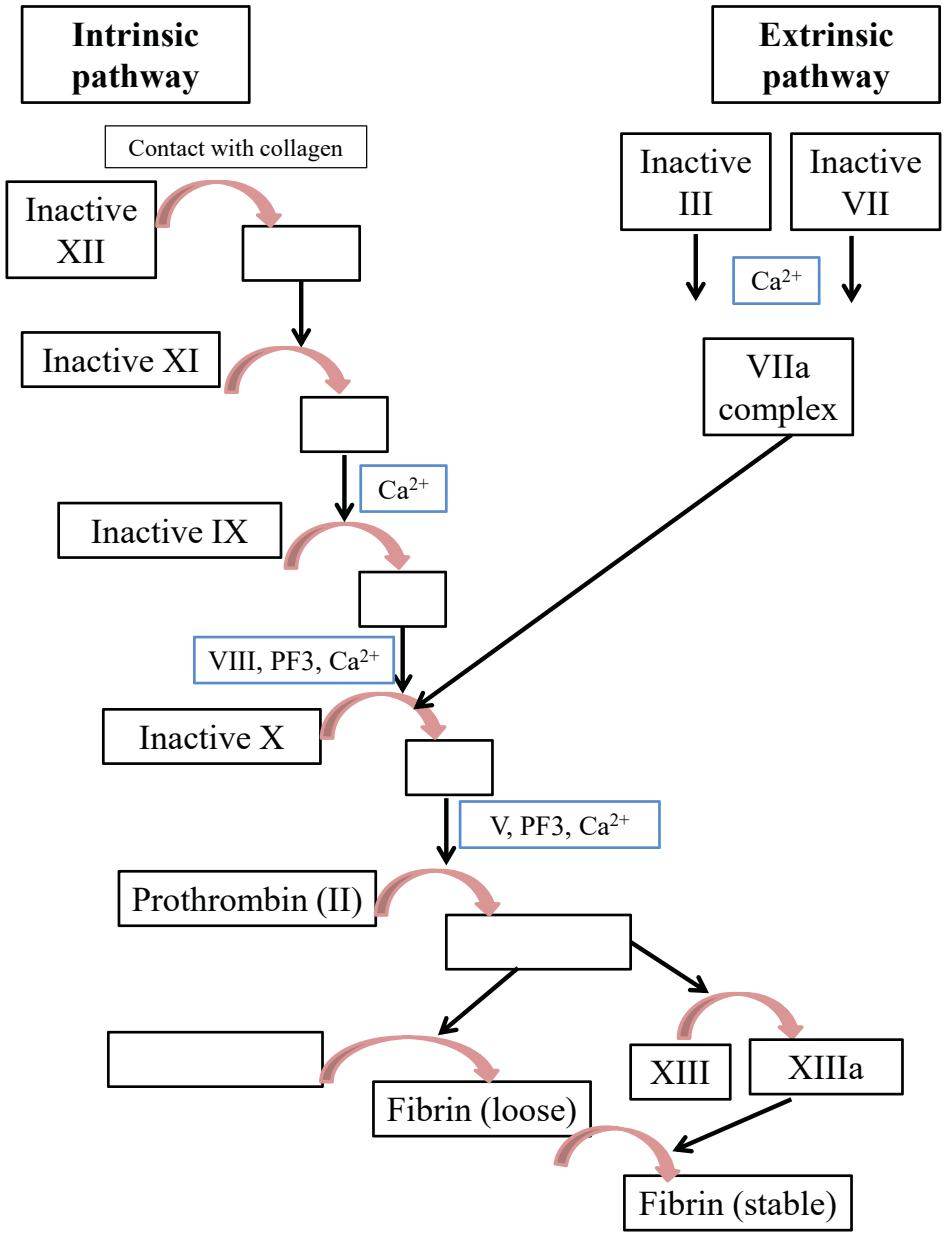
3. What results came back abnormal?

4. One of the largest lab abnormalities is Tristan's PTT (partial thromboplastin time). What does the PTT measure? What diseases/disorders could this abnormal test result indicate?

Part III – Clotting and Factor VIII

Question

5. What are the steps involved in blood clotting? Fill in the figure of the clotting cascade (use "a" to designate the activated form of the factor). What happens if there is a break in the cascade (i.e., what if one part does not function properly)?



Ms. Gonzalez and the team look over the results from Tristan's bloodwork and discuss the possible outcomes. The extended PTT values, combined with the elevated platelets, make the team decide to call in the local hematology/oncology specialist. Upon viewing the results the hematologist requests a factor VIII assay. Again you are curious as to what a factor VIII test is, and Dr. Johnson explains.

Factor VIII Assay

This is a blood test that measures the activity of factor VIII. Factor VIII or factor 8 is a large protein that is important to the clotting cascade. It accelerates the activation of factor X. Factor VIII is not an enzyme, but it plays a large role in the activation of factor X. The factor VIII assay measures the percentage of factor VIII present in the blood. Results are represented as a percentage of factor VIII needed to from a clot. Normal levels range from 50–200%. When results are low, this test can be used to diagnose hemophilia A, Von Willebrand's disease, and presence of factor VIII inhibitor (an antibody). For hemophilia A, levels less than 1% constitute severe hemophilia, 1–5% signifies moderate hemophilia, and values of 6–49% are diagnostic of mild hemophilia. When values are too high, this test can be used to diagnose/as a marker for diabetes, liver disease, inflammation, obesity, or pregnancy.

Results from Tristan's test are listed below.

Factor VIII Assay Results – T. Hunter

Measure	Value	Normal
Factor VIII	0.27%	50–200%

Questions

6. What is factor VIII? Why would having a decreased/absent amount of factor VIII be problematic?

7. What can an abnormal factor VIII test result mean? Do any of these conditions overlap with the possible outcomes from the PTT test? Based on the combined results, what is the most likely diagnosis?

Part IV – The Diagnosis

Ms. Gonzalez and her team meet with the hematologist and determine that Tristan has severe hemophilia A. Use the information provided by the National Hemophilia Foundation (http://www.hemophilia.org/Bleeding-Disorders/Types-of-Bleeding-Disorders/Hemophilia-A) and the National Institutes of Health (http://www.nlm.nih.gov/medlineplus/ency/article/000538.htm; http://ghr.nlm.nih.gov/condition/hemophilia) to answer the following questions about hemophilia A.

Questions

8. What is hemophilia A? What is the incidence of hemophilia A (i.e., how often does it occur)?

9. What genes are affected in hemophilia A?

10. What are symptoms of hemophilia A?

11. What treatments are used to help manage hemophilia A?

12. What are the three severity levels of hemophilia A? What are the differences/criteria for diagnosis?

13. How would you explain this diagnosis to the parents?

Part V – Hemophilia A Inheritance

Questions

14. How is hemophilia A passed from parent to child? If a mother is a carrier, what is the likelihood that she'll pass that gene on to a son? To a daughter?

15. If the mother has hemophilia A what is the likelihood that her offspring will get a copy of the mutated gene (X)? It might be helpful to draw out a family tree or Punnett square to answer this question.

16. Will Tristan's sons and daughters have hemophilia A? Why or why not?

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