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.

Image Credit: Crushable Sun Hat available from *Plow & Hearth* (http://www.plowhearth.com/product.asp?pcode=4276).
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Part II—"The Basics of Cancer"

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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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Part III—"Like Mother, Like Daughter?"

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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:

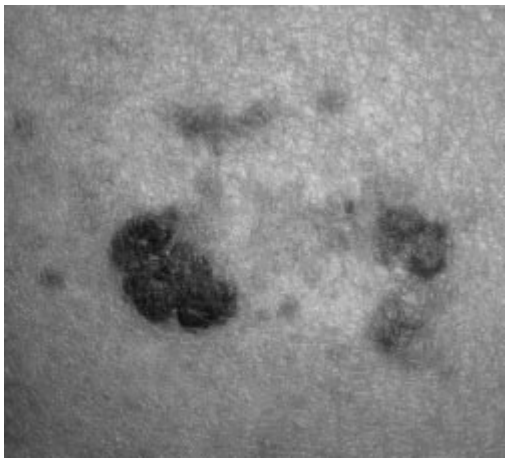

Image courtesy of Arthur C Huntley MD,
University of California Davis
http://www.mpip.org/guide/suspindex.html.

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?