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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