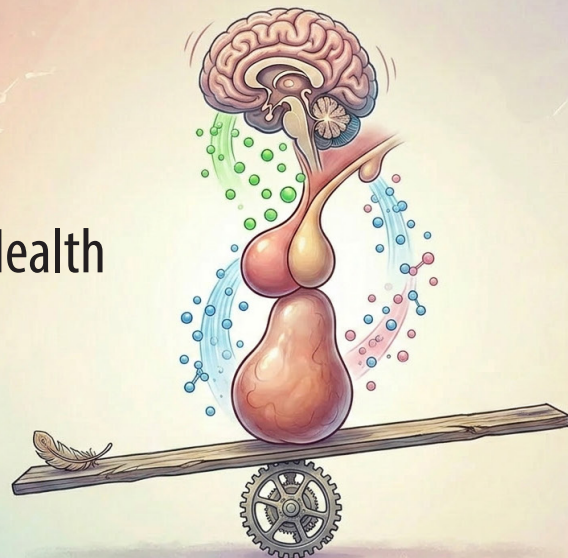


Something's Not Right: An Investigation of Reproductive System Health and the HPG Axis

by

Nicole Palenske Ladner and Peyton Bytnar
Department of Natural Sciences
Central College, Pella, IA



Background Information

The reproductive system is complex, and secretions of hormones vary greatly depending on reproductive status, age, and other health and individual factors. The first column of Table 1 (see next page) lists some of the hormones that can impact a person's reproductive health. Please complete the table by filling in the function, the organ or cells impacted, and the target of each hormone. Once you have completed the table, answer the questions below.

Questions

1. Based on your knowledge of the endocrine and reproductive systems and the information in Table 1, create feedback loops that include the hormones with their release site and target(s).

2. Are all estrogens the same? Discuss estradiol, estriol, and estrone and how their concentrations in the body vary over time and age.

3. What are differences observed in the effects of inhibin A and inhibin B?

Table 1. Identification of selected reproductive hormones or secretions.

<i>Hormone or Other Secretion</i>	<i>Function in Both Males and Females</i>	<i>Organ or Specific Cells Released From</i>	<i>Target Cell or Organ</i>
Estrogen (<i>Note: Question 2 addresses estrogen variations</i>)			
Follicle stimulating hormone (FSH)			
Gonadotropin releasing hormone (GnRH)			
Human chorionic gonadotropin (hCG)			
Inhibin (<i>Note: Question 3 addresses inhibin variations</i>)			
Luteinizing hormone (LH)			
Progesterone			
Prolactin			
Testosterone			

Patient Selection

You will be given a separate handout of a patient profile. Based on the information provided, you will predict what reproductive system imbalance or condition your patient is experiencing. To determine this, use the information you supplied in Table 1 and the information provided in Table 2 below to identify your patient's reproductive system imbalance or condition.

Disclaimer: Please note that the information provided here has been simplified. Hormonal imbalances are complex and require broader diagnostics and patient information to perform. You will be given an opportunity to ask questions about your patient and can ask your instructor questions throughout your investigation. The range of hormone levels differ in each individual. While these may be normal for the general population, being outside of the range does not necessarily indicate disease or disorder but could possibly indicate an imbalance of hormones. A range of clinical measures must be considered in a patient assessment.

Table 2. Normal reproductive hormone values for adult males and females. (Superscripts^{1,2,3...} indicate sources, listed below the table.)

<i>Hormone</i>	<i>Source</i>	<i>Age, Conditions</i>	<i>Conventional Units</i>
Estradiol ¹	Serum	Male, >17 years Female, >17 years Follicular phase Midcycle peak Luteal phase Postmenopausal	<29 pg/mL 39–375 pg/mL 96–762 pg/mL 48–440 pg/mL <10pg/mL
Estrone ¹	Serum	Male, > 17 years Postpubertal Female Follicular phase Midcycle Luteal phase Postmenopausal	<68 ng/L 10–138 ng/L 49–268 ng/L 16–173 ng/L <65 ng/L
Follicle Stimulating Hormone (FSH) ¹	Serum	Male, >18 years Female, >18 years Follicular phase Midcycle peak Luteal phase Postmenopausal	1.6–8 mIU/mL 2.5–10.2 mIU/mL 3.1–17.7 mIU/mL 1.5–9.1 mIU/mL 23–116 mIU/mL
Gonadotropic Releasing Hormone (GnRH) ⁴	*	*Direct measurement of GnRH in blood is difficult due to its rapid breakdown; normal function is indicated by healthy, pulsatile secretion of LH and FSH.	
Human Chorionic Gonadotropin (hCG) ^{2,3,4}	Serum	Male, <60 years Male, >60 years Female Premenopausal, nonpregnant Postmenopausal, nonpregnant < 9 weeks gestation 9 weeks gestation 12 weeks gestation	<0.03–1.3 IU/L <0.03–2.3 IU/L <.03–1.0 IU/L 0.17–4.8 IU/L 455–142.5 IU/L 22.6–129.9 IU/L 8.1–164.1 IU/L

Inhibin A ^{5,6}	Serum	Males, >18 years Females, > 20 years Early follicular phase Late follicular phase Periovulatory Midluteal End luteal	<5 pg/mL <7–34 pg/mL <7–99 pg/mL 8–233 pg/mL <7–145 pg/mL <7–145 pg/mL
Inhibin B ^{5,6}	Serum	Males, >19 years Females, > 20 years Early follicular phase Late follicular phase Periovulatory Midluteal End luteal	47–383[g/mL <20–261 pg/mL <20–286 pg/mL <20–189/pg/mL <20–164 pg/mL <20–107 pg/mL
Luteinizing hormone (LH) ¹	Serum	Males, >18 years Females, >18 years Follicular phase Midcycle peak Luteal phase Postmenopausal	1.5–9.3 mIU/mL 1.9–12.5 mIU/mL 8.7–76.3 mIU/mL 0.5–16.9 mIU/mL 5.0–52.3 mIU/mL
Progesterone ¹	Serum	Males, 18–29 years 30–39 years 40–49 years 50–59 years Females, Early follicular phase Late follicular phase Midcycle Luteal phase Postmenopausal	≤0.3 ng/mL ≤0.2 ng/mL ≤0.2 ng/mL ≤0.2 ng/mL ≤0.6 ng/mL ≤14.5 ng/mL ≤16.1 ng/mL ≤31.4 ng/mL ≤0.2 ng/mL
Prolactin ¹	Serum	Males, >18 years Females, Nonpregnant Pregnant Postmenopausal	2.0–18.0 ng/mL 3.0–30.0 ng/mL 10.0–209.0 ng/mL 2.0–20.0 ng/mL
Testosterone ¹	Serum	Males, 18–69 years Females, 18–69 years 70–94 years Pregnancy 1 st Trimester 2 nd Trimester 3 rd Trimester	250–1100 ng/dL 2–45 ng/dL 2–40 ng/dL 20–135 ng/dL 11–146 ng/dL 11–146 ng/dL

Sources: ¹Gardner and Shoback, 2017; ²Stenman et al., 1987; ³Korevaar et al., 2015; ⁴Crowley et al, 1985; ⁵Sehested et al., 2000; ⁶Meachem et al., 2001.

References

- Crowley, W.F., Jr., M. Filicori, D.I. Spratt, & N.F. Santoro. (1985). The physiology of gonadotropin-releasing hormone (GnRH) secretion in men and women. *Recent Progress in Hormone Research* 41: 473–531. <<https://doi.org/10.1016/b978-0-12-571141-8.50015-9>>
- Gardner, D.G., & D. Shoback, eds. (2017). *Greenspan's Basic and Clinical Endocrinology*, 10th ed. McGraw-Hill Education. ISBN: 978-1259589294.
- Korevaar, T.I.M., et al. (2015). Reference ranges and determinants of total hCG levels during pregnancy: the Generation R Study. *European Journal of Epidemiology* 30(9): 1057–66. <<https://doi.org/10.1007/s10654-015-0039-0>>
- Meachem, S.J., E. Nieschlag, & M. Simoni. (2001). Inhibin B in male reproduction: pathophysiology and clinical relevance. *European Journal of Endocrinology* 145(5): 561–71. <<https://doi.org/10.1530/eje.0.1450561>>
- Sehested, A., et al. (2000). Serum inhibin A and inhibin B in healthy prepubertal, pubertal, and adolescent girls and adult women: relation to age, stage of puberty, menstrual cycle, follicle-stimulating hormone, luteinizing hormone, and estradiol levels. *The Journal of Clinical Endocrinology and Metabolism* 85(4): 1634–40. <<https://doi.org/10.1210/jcem.85.4.6512>>
- Stenman, U.H., H. Alfthan, T. Ranta, E. Vartiainen, J. Jalkanen, & M. Seppälä. (1987). Serum levels of human chorionic gonadotropin in nonpregnant women and men are modulated by gonadotropin-releasing hormone and sex steroids. *The Journal of Clinical Endocrinology and Metabolism* 64(4): 730–6. <<https://doi.org/10.1210/jcem-64-4-730>>

Case 1 – Jill Jones, Missed Periods

Name: Jill Jones

Gender and Age: FEMALE, 37 years old

Presenting Complaint: I have not had a period for the past five months. I have one child and I have been off my birth control for the past five months as we are trying to conceive. I have also been having intense night sweats and have felt irritable and moody lately. I do want to have another child, but I have noticed a significant drop in my sex drive, especially since after months of trying we still aren't pregnant yet. My periods have always been a bit irregular, but I have never gone this long without one. I take a pregnancy test every month and it is always negative.

Medical/Family History: I have one child currently and was pregnant when I was 33 years old. I haven't had any surgeries or been in the hospital for anything other than having my first child.

My mother and sister had children at 38 and 40 years old and went into early menopause.

Today's Patient Vitals: Weight: 154.22 lbs, BMI: 24.8
Height: 5' 6"
Blood pressure: 124/88

Questions

1. Give a brief description of the patient profile, including any presenting patient vitals of concern and presenting complaint information.
2. If you were their physician, what tests would you recommend for the patient to gather more information?

Table 1. Test results for J. Jones. Five months since her last known menstrual cycle.

<i>Test</i>	<i>Result</i>
Pregnancy test	Negative
Estradiol (serum)	35 pg/mL
FSH (serum)	31 mIU/mL
LH (serum)	14 mIU/mL
Prolactin (serum)	25ng/mL

- Based on these test results, and using the normal data for hormones provided in the first exercise, are any hormones out of range? If so, in what direction are the hormones out of range?
- Based on what you know about hormones and feedback, what do the levels suggest about the hypothalamus-pituitary-gonadal axis feedback?
- Is there additional information that you need to predict your diagnosis?
- Based on the patient profiles and the data provided in the tables, what reproductive system imbalance or condition do you believe your patient is suffering from?



Once you have your predicted diagnosis, consult with your instructor to see if you are correct.



Presentation

Prepare a brief synopsis of your patient to present to the class. Be sure to include information that you found above including hormone levels and imbalances, other presenting patient information, and signs and symptoms your patient has. Include how the patient information supports your diagnosis. Address the following:

- Does your diagnosis differ from what you predicted? If so, how? What questions or comments do you have?
- Are there any treatment options for this diagnosis?
- Are there additional questions that you have regarding this diagnosis?

Case 2 – Felicia Fieldhouse, No Menstrual Periods & Lack of Secondary Sex Characteristic Development

Name: Felicia Fieldhouse

Gender and Age: FEMALE, 18 years old

Presenting Complaint: I'm here today to try and get some answers. I've always felt small for my age, but since starting college, I'm so surprised that I have never yet had a period. So many of my friends have gone through the stages of puberty and I don't really feel like I have. I don't have any hair in my genital region or in my arm pits, and my breasts have hardly developed. I'm not currently sexually active. Also, I've realized that I don't smell things like everyone else. My friends comment about smelling cookies baking in the cafeteria, and I can't smell a thing. It's probably not related at all, but just something I've noticed for a while.

Medical/Family History: I had surgery for cleft palate repair when I was younger. My parents went through fertility treatments to have me, and I wonder if I will also have trouble having children when I am older.

Today's Patient Vitals: Weight: 129 lbs
Height: 4' 11"
Blood pressure: 109/75

Questions

1. Give a brief description of the patient profile, including any presenting patient vitals of concern and presenting complaint information.

2. If you were their physician, what tests would you recommend for the patient to gather more information?

Table 1. Test results for F. Fieldhouse. Patient has not had a menstrual cycle.

<i>Test</i>	<i>Result</i>
Pregnancy test	Negative
Estradiol (serum)	35 pg/mL
FSH (serum)	31 mIU/mL
LH (serum)	14 mIU/mL
Prolactin (serum)	25ng/mL
Testosterone (serum)	2 ng/dL

- Based on these test results, and using the normal data for hormones provided in the first exercise, are any hormones out of range? If so, in what direction are the hormones out of range?
- Based on what you know about hormones and feedback, what do the levels suggest about the hypothalamus-pituitary-gonadal axis feedback?
- Is there additional information that you need to predict your diagnosis?
- Based on the patient profiles and the data provided in the tables, what reproductive system imbalance or condition do you believe your patient is suffering from?



Once you have your predicted diagnosis, consult with your instructor to see if you are correct.



Presentation

Prepare a brief synopsis of your patient to present to the class. Be sure to include information that you found above including hormone levels and imbalances, other presenting patient information, and signs and symptoms your patient has. Include how the patient information supports your diagnosis. Address the following:

- Does your diagnosis differ from what you predicted? If so, how? What questions or comments do you have?
- Are there any treatment options for this diagnosis?
- Are there additional questions that you have regarding this diagnosis?

Case 3 – Katie Kinnick, Missed Periods and Stubborn Weight

Name: Katie Kinnick

Gender and Age: FEMALE, 27 years old

Presenting Complaint: I've had irregular periods my whole life. I don't even remember when my last period was, but they are completely unpredictable. I've been married for a few years, and my husband and I are trying to have a baby, and not knowing my cycles has made things difficult. I've noticed that no matter how much I work out, I just can't get this weight off my belly. It's so frustrating! I feel like my hair is thinning, and I have acne that won't go away. I also have excessive chin hair growth that just keeps coming back. I've had some tests done previously, and all that I remember is that I have high insulin levels. I didn't think that had anything to do with my periods, so I wanted to get a second opinion.

Medical/Family History: I don't have any sisters to talk to as I'm the only daughter to my mom. She had a hard time conceiving me.

Today's Patient Vitals: Weight: 185.7 lbs, BMI: 30
Height: 5' 7"
Blood pressure: 131/80

Questions

1. Give a brief description of the patient profile, including any presenting patient vitals of concern and presenting complaint information.
2. If you were their physician, what tests would you recommend for the patient to gather more information?

Table 1. Test results for K. Kinnick. Unknown last menstrual cycle.

<i>Test</i>	<i>Result</i>
Pregnancy test	Negative
Estradiol (serum)	275 pg/mL
FSH (serum)	5 mIU/mL
Inhibin A (serum)	6 pg/mL
Inhibin B (serum)	57 pg/mL
Insulin (serum)	25 mIU/L
Testing for insulin was completed after fasting for 8–12 hrs.	(Normal range 2.3–12mIU/L)
LH (serum)	15 mIU/mL
Progesterone (serum)	2 ng/mL
Testosterone (serum)	70 ng/dL

- Based on these test results, and using the normal data for hormones provided in the first exercise, are any hormones out of range? If so, in what direction are the hormones out of range? Based on what you know about hormones and feedback, what do the levels suggest about the hypothalamus-pituitary-gonadal axis feedback?
- Is there additional information that you need to predict your diagnosis?
- Based on the patient profiles and the data provided in the tables, what reproductive system imbalance or condition do you believe your patient is suffering from?



Once you have your predicted diagnosis, consult with your instructor to see if you are correct.



Presentation

Prepare a brief synopsis of your patient to present to the class. Be sure to include information that you found above including hormone levels and imbalances, other presenting patient information, and signs and symptoms your patient has. Include how the patient information supports your diagnosis. Address the following:

- Does your diagnosis differ from what you predicted? If so, how? What questions or comments do you have?
- Are there any treatment options for this diagnosis?
- Are there additional questions that you have regarding this diagnosis?

Case 4 – Taylor Trice, Low Libido and Sex Drive

Name: Taylor Trice

Gender and Age: MALE, 32 years old

Presenting Complaint: For the past few years, I've noticed a decrease in my libido. My partner and I are trying to have more children and I have less energy than I once did and a decreased sex drive. I know I've gained some weight since the birth of our first two children (first when I was 27), but I don't feel good about myself at the moment and wonder if there is something wrong.

Medical/Family History: I haven't heard my dad or brothers talk about anything similar, so I don't think there is any family history that pertains to this.

Today's Patient Vitals: Weight: 253 lbs, BMI: 32.5
Height: 6' 2"
Blood pressure: 135/89

Questions

1. Give a brief description of the patient profile, including any presenting patient vitals of concern and presenting complaint information.
2. If you were their physician, what tests would you recommend for the patient to gather more information?

Table 1. Test results for T. Trice.

<i>Test</i>	<i>Result</i>
Estradiol (serum)	35 pg/mL
FSH (serum)	1.7 mIU/mL
LH (serum)	3.0 mIU/mL
Testosterone (serum)	125 ng/dL

- Based on these test results, and using the normal data for hormones provided in the first exercise, are any hormones out of range? If so, in what direction are the hormones out of range?
- Based on what you know about hormones and feedback, what do the levels suggest about the hypothalamus-pituitary-gonadal axis feedback?
- Is there additional information that you need to predict your diagnosis?
- Based on the patient profiles and the data provided in the tables, what reproductive system imbalance or condition do you believe your patient is suffering from?



Once you have your predicted diagnosis, consult with your instructor to see if you are correct.



Presentation

Prepare a brief synopsis of your patient to present to the class. Be sure to include information that you found above including hormone levels and imbalances, other presenting patient information, and signs and symptoms your patient has. Include how the patient information supports your diagnosis. Address the following:

- Does your diagnosis differ from what you predicted? If so, how? What questions or comments do you have?
- Are there any treatment options for this diagnosis?
- Are there additional questions that you have regarding this diagnosis?

Case 5 – Helen Hilton, Irregular Periods and Fluctuation in Hormones

Name: Helen Hilton

Gender and Age: FEMALE, 49 years old

Presenting Complaint: I've been having irregular periods for a couple of years. I don't miss a cycle, but sometimes my periods are shorter or longer than normal, and sometimes they are heavy flow or light flow. I'm sleeping poorly and feel exhausted all the time. I'm irritable to others, and my mood just isn't good. I feel a bit heavier than my average weight, but I'm eating the same things I always have and not overeating. Every other doctor I have seen has tested my reproductive hormone levels and there really isn't a pattern to them. Some hormone levels appear higher than normal, sometimes they are low. They are never consistent and I don't feel like I'm getting anywhere, so I'm coming to you to see what advice you have.

Medical/Family History: I've had regular predictable periods with the same flow up until about two years ago.

Today's Patient Vitals: Weight: 175 lbs, BMI: 26.6
Height: 5' 8"
Blood pressure: 135/89

Questions

1. Give a brief description of the patient profile, including any presenting patient vitals of concern and presenting complaint information.
2. If you were their physician, what tests would you recommend for the patient to gather more information?

Table 1. Test results for H. Hilton.

<i>Test</i>	<i>Result</i>
Estradiol (serum)	61 pg/mL
FSH (serum)	30 mIU/mL
LH (serum)	52 mIU/mL
Progesterone	0.1 ng/mL

- Based on these test results, and using the normal data for hormones provided in the first exercise, are any hormones out of range? If so, in what direction are the hormones out of range?
- Based on what you know about hormones and feedback, what do the levels suggest about the hypothalamus-pituitary-gonadal axis feedback?
- Is there additional information that you need to predict your diagnosis?
- Based on the patient profiles and the data provided in the tables, what reproductive system imbalance or condition do you believe your patient is suffering from?



Once you have your predicted diagnosis, consult with your instructor to see if you are correct.



Presentation

Prepare a brief synopsis of your patient to present to the class. Be sure to include information that you found above including hormone levels and imbalances, other presenting patient information, and signs and symptoms your patient has. Include how the patient information supports your diagnosis. Address the following:

- Does your diagnosis differ from what you predicted? If so, how? What questions or comments do you have?
- Are there any treatment options for this diagnosis?
- Are there additional questions that you have regarding this diagnosis?