From Menses to Menopause: How Hormones Can Affect Blood Glucose Levels

Christine Day, RN, MS, CNS-BC
Lake Superior College
Overview

- Will review hormonal changes over the female lifespan
- Discuss the effects of sex and growth hormones
- Will consider how these changes affect blood glucose control
- Review how the educator may assist the client for better control in light of these issues
<table>
<thead>
<tr>
<th>Age</th>
<th># of cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-6 weeks of gestation</td>
<td>Early development of cells</td>
</tr>
<tr>
<td></td>
<td>10,000</td>
</tr>
<tr>
<td>8 weeks</td>
<td>Proliferation by mitosis</td>
</tr>
<tr>
<td></td>
<td>600,000</td>
</tr>
<tr>
<td>8-20 weeks</td>
<td>Maximum number of cells</td>
</tr>
<tr>
<td></td>
<td>6-7,000,000</td>
</tr>
<tr>
<td>20-40 weeks</td>
<td>80% loss</td>
</tr>
<tr>
<td></td>
<td>1-2,000,000</td>
</tr>
<tr>
<td>Birth to puberty</td>
<td>Loss to atresia</td>
</tr>
<tr>
<td></td>
<td>300,000</td>
</tr>
<tr>
<td>Reproductive years</td>
<td>Ovulation</td>
</tr>
<tr>
<td></td>
<td>400-500</td>
</tr>
</tbody>
</table>
Pubescent Growth

- Generally may be affected by:
  - 1. Culture, economy, and health
  - 2. Body type

- In diabetes may be affected by:
  - 1. poor glycemic control
  - 2. hyperglycemia (delays onset of puberty)
Menarche

- Puberty: gradual transition from immaturity to functional capability of reproduction
- Menarche is the first ovarian controlled uterine bleed in a woman’s lifetime
- Average age at menarche: 13 years
- Normal range in girls:
  - Onset: 9-13 years of age (periods erratic)
  - Completion: 12-17 years of age (normalized periods)
Menarche

- The average age of menarche in industrialized countries declined by 3 years from 1860 to 1965.
- Age at menarche appear earlier in countries with the longest life expectancy (poor nutrition delays age at menarche).
- Age of menarche is affected by a variety of factors including genetic variability and environmental issues.
- Effects of pesticides? Other chemicals? Obesity?
Menarche

- Peak growth precedes the first menstruation

- 5 stages: Tanner Scale

- Generally beginning at age 10 and continues to full adult characteristics by 15

- Growth hormone active during the time preceding and in first year after menses

- Often after the first year of menstruation, female growth slows or ceases
Menstrual cycle
Timing

- Follicular phase: day 1-14, menses: day 1-5
- Ovulatory phase: day 14-16
- Luteal phase: day 16-28
Menstrual cycle:

**Days 1-5: Estrogen Falls, FSH Rises.**

Menstrual bleeding begins on Day 1 of the cycle and lasts approximately 5 days. During the last few days prior to Day 1, a sharp fall in the levels of estrogen and progesterone signals the uterus that pregnancy has not occurred during this cycle. This signal results in a shedding of the endometrial lining of the uterus.
Since high levels of estrogen suppress the secretion of FSH, the drop in estrogen now permits the level of follicle stimulating hormone (FSH) to rise.

FSH stimulates follicle development.

By Day 5 to 7 of the cycle, one of these follicles responds to FSH stimulation more than the others and becomes dominant. As it does so, it begins secreting large amounts of estrogen.
Days 6-14: Estrogen Is Secreted, FSH Falls.

Estrogen is secreted by the follicle during this phase of the menstrual cycle. It

- stimulates the endometrial lining of the uterus
- suppresses the further secretion of FSH.
At about mid-cycle (Day 14), the estrogen helps stimulate a large and sudden release of luteinizing hormone (LH).

This LH surge, which is accompanied by a transient rise in body temperature, is a sign that ovulation is about to happen.

The LH surge causes the follicle to rupture and expel the egg into the Fallopian tube.
Days 14-28: Estrogen And Progesterone Secretion First Rise, then Fall.

After rupture of the follicle, it is transformed into the corpus luteum and produces progesterone.

Progesterone supports the endometrial lining for implantation of the fertilized egg.

(If the egg is fertilized, a small amount of human chorionic gonadotrophin (hCG) is released that stimulates further progesterone production.)
After implantation, the trophoblast will secrete human Chorionic Gonadotropin (hCG) into the maternal circulation. HCG keeps the corpus luteum viable. The corpus luteum continues to produce estrogen and progesterone, which keep the endometrial lining intact.

By about week 6 to 8 of gestation, the newly formed placenta takes over the secretion of progesterone.

If the egg is not fertilized, the corpus luteum shrinks, and the levels of estrogen and progesterone drop, the uterus sheds its lining, and menstruation begins.

FSH levels again start to rise. Thus, one cycle ends and another begins.
Estrogens stand for a group of hormones:

- Estradiol
- Estrone
- Estriol

**Estradiol** is produced by the ovaries. It is the primary circulating estrogen before menopause. It is also the strongest estrogen and is responsible for monthly ovulation and normal menstrual cycles.

**Estrone** is produced by the fatty tissues. It is less potent than estradiol, but more important after the menopause.

**Estriol** is an estrogen that is prominent mostly during pregnancy.

Estrogen tends to increase blood glucose levels and increase insulin resistance.
Progesterone is made by the adrenal glands in both sexes and by the testes in males. It is a precursor of testosterone.

Progesterone stimulates the growth of endometrial lining, prepares breast tissue for the secretion of breast milk, and generally maintains the advancement of pregnancy.

Progesterone tends to increase appetite and may complicate blood glucose management.
Onset of sex hormone activity

- 1. Highly individualized
- 2. Characterized by increasing A1C despite increasing insulin dose
- 3. Markedly increased insulin resistance
- 4. Noted to affect peripheral insulin action
- 5. Characterized by changing counter-regulatory hormonal responses
- 6. Etiology of BG variation may not be fully understood and may be multi-factoral
Other Factors

1. Adolescent’s earlier and greater epinephrine response to drops in BG concentrations combined with insulin resistance leads to lability in control
2. Personal and family stress during this period
3. Omitted insulin because of emotional issues of feeling different
4. Omitted insulin to lose weight
5. Need for support as teen assumes more responsibility ---as they mature sometimes more slowly than we would want
Difficulties controlling for changing hormone levels in diabetes

- Hormone levels are not constant
- Nor are they predictable in adolescence
- Effects of cortisol and stress compound issues
- Some have suggested in the difficult to manage females with DM
  - 1. Frequent testing at a minimum
  - 2. Oral contraceptives for more predictability with cycles
Use of Oral Contraceptives

- Because each female responds differently to hormonal replacement and oral contraceptives, follow up is very important.
- Generally should be seen within 3 months of initiation of therapy.
- Blood glucose levels should be monitored closely during therapy.
Growth Hormones

- Complicating BG control in the pre/adolescent female

- Inhibit glucose movement into cell

- Associated with age – young adolescents secrete at a rate of 700 micrograms/d (average: adults 400 micrograms/d)

- Increase BG levels – but in a “pulsatile” manner (even affects adolescents without diabetes but not as dramatically)
Factors Increasing Growth Hormone

- 1. Growth hormone-releasing hormone
- 2. Sex hormones
- 3. Deep sleep
- 4. Exercise
Factors decreasing Growth Hormone

- 1. Feedback from GH levels
- 2. Hyperglycemia – poor control of diabetes
- 3. Glucocorticoids
Polycystic Ovary Syndrome (PCOS)

- PCOS is a common cause of menstrual irregularity in premenopausal women.

- According to the initial description by Stein and Leventhal in 1935, the diagnosis of PCOS was based on the clinical symptoms (oligo/amenorrhea, infertility, hirsutism, and obesity) in the presence of histologically verified polycystic ovaries.

- PCOS affects between 3-10% of women of reproductive age and is associated with insulin resistance – hormone levels may be variable.
PCOS

- Treatment may include:

  1. Medical Nutrition Therapy with weight

  2. Metformin

  3. Other insulin resistance lowering medications

- Both may help to normalize hormonal changes with PCOS with resumption of more normal cycles and fertility
Menopause

- The menopause is the time of a woman's life when her reproductive capacity stops:
  - **No period for 12 months**

- The ovaries cease functioning and they produce fewer hormones – might feel this may make DM easier to control, but hormone levels may vary.

- The body undergoes a variety of changes because the ovaries stop functioning.

- The menopause is sometimes marked by unpleasant symptoms – these symptoms seem to vary greatly.
Menopause

- The number of follicles in the ovary determines the age at which the menopause takes place.
- The number declines steadily until around age 40 and the decline becomes more rapid until after the menopause when essentially there are no follicles left.

After menopause, the typical pattern of the hormones is:

- Continually high levels of FSH
- Continually low levels of estrogen and progesterone.
Stages

Average: 47-55 years

Premenopausal: 5 years before

Postmenopausal starts 1 year after menopause

Perimenopausal: transitional phase between pre- and postmenopausal: 2 years before and 1 year after
Menopause

- The **average age** at menopause is about 51 years in industrialized countries. The age tends to be lower in women who smoke and in those who have had no children.
- Lower age at menopause may also be related to poor socioeconomic status.
- Women with menstrual cycles averaging less than 26 days seem to reach the menopause 1.4 years earlier than those with longer cycles.
Menopause

• The changes in hormone production affect various parts of the body, for instance the bones and the cardiovascular system.

• Various hormonal therapies (hormone replacement therapy=HRT) have been tried to lessen the consequences of the menopause.

• HRT has in turn raised concerns with regard to increased risk of diseases such as cancer.
Menopause

- **Hot flashes** and night sweats are characteristic of the menopause. Hot flashes arise as a sudden feeling of heat in the face, neck and chest. Night sweats are the night-time manifestation of hot flashes.
- **Insomnia** is often cited as a menopausal complaint, but it usually occurs as a secondary effect of sleep disruption caused by the night sweats.
- **Hot flashes** may be increased by tension or nervousness or triggered by changes in room temperature.
Prevalence of hot flashes

- Mayan women: 0%
- Hong Kong women: 10-22%
- Japanese women: 17%
- Thai women: 23%
- North American: 45%
- Dutch women: up to 80%

- Is it diet… or perception… or what?
Menopause

In general hot flashes and sweats are more common in European and North American women than in other populations. A high intake of dietary phytoestrogens has been suggested as a possible explanation of the lower frequency of menopausal symptoms in Japanese as compared with Caucasian women.
Concerns During This Period

- Fluctuations in hormone levels with symptoms and stress leading to difficulties with blood glucose control
- Instability of blood pressure – fluctuations in cortisol levels
- Difficulty predicting levels
- Frustration/Depression regarding life changes and symptoms
- Lack of conversation regarding normality of menopausal changes
In Summary

- Diabetes in the female is complicated by hormonal issues throughout the life span
- Control can be improved by frequent testing and knowledge regarding the normal menstrual cycle and changes over time
- Discussion with the educator and provider may help set realistic goals and expectations for control of blood glucose levels
Thanks for your Attention

Questions?