Objectives

- Describe breast development through the life cycle.
- Label major anatomical features of the lactating breast.
- Discuss the endocrine and autocrine phases of lactogenesis.
- Describe the milk ejection reflex.
- Discuss how the emptiness of the breast influences milk production.

Outline

- Anatomy
  - Historical Perspective
  - Breast Development
  - Breast Anatomy
- Physiology
  - Endocrine control – Lactogenesis I & II
  - Autocrine control – Lactogenesis III
  - Milk storage capacity
  - Milk Ejection Reflex (MER)
- Applying current information on anatomy & physiology to clinical practice

ANATOMY

Historical Perspective

On the anatomy of the breast
by Sir Astley Paston Cooper
1840

ANATOMY

Breast Development
Human Breast Development

- Mammogenesis / organogenesis – Ductal and lobular growth

3 Major phases:
- In Utero/early infancy (4 - 40 weeks)
- During puberty
- During pregnancy & lactation

Mammary Gland Development

Immature
Pregnancy
Lactation
Involution

Mouse Mammary Gland

Human Breast Development

- At Birth
  - Main milk ducts and alveolar buds are present, forming the basis of the ductal system
- Birth to Puberty
  - Mammary glands are inactive

Human Breast Development

- Puberty
  - Ductal growth and branching
  - Sprouting of new alveolar buds
  - Only a small number of alveoli present before pregnancy
  - Additional growth with each menstrual cycle

Human Breast Development

- Pregnant breast
  - Rapid growth of ductal-lobular-alveolar system during the first trimester
  - Breast begins to function as milk-producing gland with the onset of Lactogenesis I (16-22 weeks into pregnancy)

Human Breast Development

- Lactating breast after birth
  - Alveoli continue to multiply

Mouse mammary gland

National Institutes of Health

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9 days pregnant
16 days pregnant

#2
Human Breast Development

- **Weaning breast**
  - Alveoli begin to involute
  - Lower level of milk production
- **After weaning**
  - Gradual return to a resting state

Breast Development Cycle

ANATOMY

**Breast Anatomy**

- **External**
  - Nipple
  - Montgomery’s glands
  - Areola

**Connective Tissue, Nerves, Blood Vessels**

- Connection with skin
- Cooper’s Ligaments

**Fatty (Adipose) Tissue**

- Subcutaneous fat increases in thickness further away from the nipple
- intraglandular fat
- Subcutaneous fat is minimal near the nipple
- Retroammary fat
Cooper’s Ligaments provide a support framework for the breast.

Lobules consist of clusters of alveoli, which are lined with milk-secreting epithelial cells (lactocytes).

Intraglandular Fat intermingles with the glandular tissue.

Subcutaneous Fat thinner near the nipple.

Main Milk Ducts branch close to the base of the nipple (no lactiferous sinuses).

4-18 ducts (average of 9) exiting the nipple (OLD: 15-20).
**PHYSIOLOGY**

Stages of Lactation

**Endocrine (Hormonal) Control** of milk synthesis
- Lactogenesis I - ability to synthesize milk components
- Lactogenesis II – increase in milk volume

**Autocrine (Local) Control** of milk synthesis
- Lactogenesis III - maintenance stage

**Lactation Cycle**
**Autocrine (Local) Control of Milk Synthesis**

- Current research suggests that there are two factors that control milk synthesis:
  - **Feedback Inhibitor of Lactation (FIL)**
  - **Prolactin receptor sites**

**Feedback Inhibitor of Lactation**

- **Feedback Inhibitor of Lactation (FIL)** is a small whey protein found in milk – its role appears to be to slow milk synthesis when the breast is full.
- Milk synthesis slows when milk accumulates in the breast (and more FIL is present).
- Milk synthesis *speeds up* when the breast is emptier (and less FIL is present).

**Prolactin & Milk Synthesis**

- The hormone **prolactin** must be present for milk synthesis to occur.
- **Prolactin receptor sites** on the walls of the lactocytes allow the prolactin to enter.
- If the alveolus is full of milk, the walls stretch and alter the shape of the prolactin receptors – prolactin can’t get in through the altered prolactin receptors so the rate of milk synthesis decreases.
- Likewise, milk synthesis rate increases as the milk empties from the alveolus.

**Prolactin Receptor Theory**

- The **prolactin receptor theory** suggests that frequent milk removal in the early weeks will **increase** the number of receptor sites.
- More receptor sites means that more prolactin can pass into the lactocytes and thus milk production capability would be increased.

**Autocrine (Local) Control of Milk Synthesis**

| FULL Breast | SLOWER Milk Production |
| EMPTY Breast | FASTER Milk Production |

**PHYSIOLOGY**

- Milk Storage Capacity
Milk Storage Capacity

- **Milk Storage capacity** is the amount of milk that the breast can store between feedings.
- Varies widely from mom to mom, and between breasts for the same mom
- Not determined by breast size (but can be constrained by breast size)
- Does NOT limit the amount of milk that mom can produce
- DOES impact feeding frequency

PHYSIOLOGY

Milk Ejection Reflex (MER)

- **Neuro-hormonal reflex**
- MER can be initiated or inhibited by psychological factors
- During MER, the entire ductal system dilates.
- Milk intake associated with number & duration of milk ejections

APPLYING CURRENT INFORMATION ON ANATOMY & PHYSIOLOGY TO CLINICAL PRACTICE

Applications to clinical practice

- Milk producing tissue continues to proliferate in the first 4-6 weeks after birth in response to milk removal, so good breastfeeding management is particularly important to those moms who don’t have many breast changes during pregnancy.

Applications to clinical practice

- The number of main milk ducts is lower than previously believed, so the loss of only a few milk ducts due to breast surgery could compromise a mother’s ability to breastfeed.
Applications to clinical practice

- Autocrine (local) control of milk synthesis becomes important as soon as Lactogenesis II occurs – so thorough milk removal and prevention/treatment of engorgement are important.

Applications to clinical practice

- The speed of milk synthesis depends upon the emptiness of the breast.

**FULL = SLOWER**

Breast = Milk Production

**EMPTY = FASTER**

Breast = Milk Production

Applications to clinical practice

- The storage capacity of a mother’s breasts affects the frequency with which she should breastfeeding.

Applications to clinical practice

- The volume of milk taken in by baby depends upon the number & duration of milk ejections. Baby’s growth rate is related to the volume of milk intake, not to the specific composition of the milk.

Summary

- Breast development occurs in several stages and is cyclical through the childbearing years.
- Our knowledge of breast anatomy has changed based on research in the last 10 years.
Summary

• During pregnancy and the first few days postpartum, milk supply is hormonally driven — this is the endocrine (hormonal) phase of lactogenesis.
• Once mom’s milk comes in, milk synthesis is controlled locally (at the breast) & milk removal is the primary control mechanism for supply. This is the autocrine (local) phase of lactogenesis.

Summary

• The milk ejection reflex (MER) is a neuro-hormonal reflex that is essential to establishing and maintaining milk production.
• It is important to teach mothers how the fullness of the breast affects milk production. “Use it or lose it.”

QUESTION & ANSWER