The milk ejection mechanism is initiated by suckling (1). The test contains sensory neurons and impulses from these neurons travel through different nerves (3) to the hypothalamus. Avenues in the paraventricular nuclei are stimulated by these afferent neurons and the terminals in the posterior lobe of the pituitary (2) release oxytocin. Oxytocin then enters the blood and is delivered to the mammary gland (4). The target cells for oxytocin are the myoepithelial cells that surround the alveoli. Contraction of the myoepithelial cells (5) causes milk to be “inverted” out of each individual alveolus into small ducts and then into larger ducts. The net effect of simultaneous contraction of the myoepithelial cells throughout the entire mammary gland is to deliver milk to the large ducts and the gland cistern so that it is available for removal by the neonate.

Lactation
Endocrinology of Mammary Growth and Milk Synthesis

AVS 172
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The Mammary Gland

- Exocrine gland; common to all mammals

- Function: nourish the neonate
  - Food source: fat, protein, sugar (CHO), vitamins, minerals, water
  - Protection: immunoglobulins
The Mammary Gland

• Loosely considered part of the reproductive system:
  Serves a “reproductive function”; nourishment of the neonate = survival of species.

• Relies on same endocrine (hormonal) support for development and function.
  Example: gonadal steroids, prolactin, etc.

The Mammary Gland

Secretory Tissues:

• Glandular; secreting tissue = Parenchyma
  – Alveoli; secreting epithelial cells
  – Duct system; lined by epithelial cells
  – Lobules & lobes; clusters of alveolar tissue supported by connective tissue
Alveolus: – basic secretory unit; lined by epithelial cells which synthesize and/or secrete:

- lipid -
- protein -
- lactose –
- minerals & vitamins - Ca, P, K; Vits. A, B, C, D
- water
Milk Synthesis

- Milk synthesis is dependent on:
  -
  -
  - supply of
  - endocrine support for lactogenesis
  - milking
- No. secreting cells is dependent on:
  - genetics
  - endocrine support for mammogenesis
  - nutrition
  - disease (mastitis)
Example: What volume of blood would a 1400 lb. Holstein pump per day?

1400 lb. Cow ~ .9 liters/ heart stroke
Volume/day = .9 x 70 strokes/min = 63 liters/min
63 liters/min x 1440 min/day = 90,720 liters/day
= ~ 22,600 gal/day

Blood Components

Blood Flow (cattle)

• Volume of blood/ volume of milk synthesized = (this is an approximation; actual ratio is affected by stage of lactation, efficiency, etc.)
Steroid Hormones and Mammogenesis

- Estrogens:  

- Progesterone:  

- Corticoids:
Steroid Hormones and Mammogenesis

- Estrogens (E2) (follicle, placenta)

1) stimulate
2) release
3) synergize with progesterone & prolactin to stimulate _______________ and duct growth

Steroid Hormones and Mammogenesis

- Progesterone (P4) (corpus luteum, placenta)

1) stimulates
2) retards synthesis of enzymes (a-lactalbumin) necessary for lactogenesis in the prepartum mammary gland
**Lactogenesis; Cortisol**

- **Cortisol:** (from adrenal cortex) synthesis stimulated by maternal, fetal ACTH (dexamethasone is synthetic cort.)

**Action:**

1) essential to ________________ (Initiation and maintenance of lactation)

2) increase _________________ metabolism and Protein synthesis

3) cortisol potentiates action of PRL

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**Mammogenesis**

*(Mammary Growth and Development)*

- Placental E2 + luteal P4 =
  - duct development
  - _________________development
  - suppression of milk synthesis

(P4 suppresses
  \( \alpha \)-lactalbumin; lactose synthesis)
Mammogenesis
(Mammary Growth and Development)

• Action of cortisol + PRL:
  – increase PRL receptor synthesis
  – increase __________
  – increase mRNA
  – increase protein transcription/translation
  – increase _______________/lactose synthesis

• cortisol is permissive to action of PRL

Endocrine Glands Supporting Mammary Function

Oxytocin

Posterior pituitary (protein hormones):

✓ Synthesized in the hypothalamus

✓ Transferred to post. pit.

Action:
✓ Secreted into blood > _________________

✓ Contraction of myoepithelial, smooth muscle
Endocrine Glands Supporting Mammary Function

- **Prolactin, (PRL):**
  - ________________

**Action:**
- Mammary growth
- Increases _____________
- Initiation and maintenance of lactation
Endocrine Glands Supporting Mammary Function

- GH (STH, BST):
  – Anterior Pituitary
  Action:
  - Increases________________
  - Increases protein synthesis
  - increases ______________________ to mammary gland
  - GH Increases ________________
  - increases blood glucose