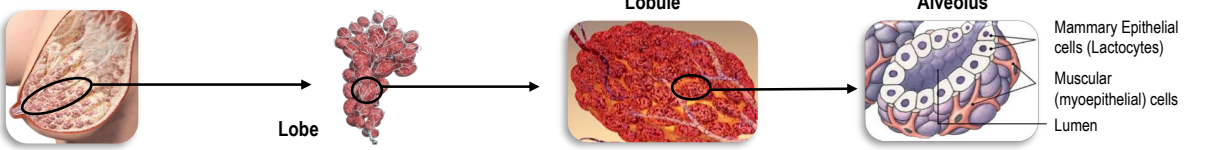
Understanding how lactation works

CPBF
Canadian Premature Babies Foundation

Anatomy of the lactating breast[1]



The lactating breast contains 4 to 18 lobes organized around a complex ductal network. Each lobe is composed of a bunch of lobules forming a grape-like structure. The ratio of glandular to fatty tissue in a lactating breast is 2:1.

The lobules consist of clusters of alveoli (acini) containing lactocytes that synthesize milk. These alveoli are connected to very small ducts that join to form larger ducts and merge into one main milk duct for each lobe. The acini are surrounded by blood capillaries and muscular cells that squeeze the milk out of the alveolus in response to Oxytocin during feeding or pumping.

Physiology of Lactation

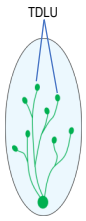
Puberty: quiescent mode

Until puberty, a basic ductal system exists in the breast.[2]

At puberty, the breast increases in size with the deposition of fatty tissue.[3]

In addition, epithelial proliferation begins with elongation and branching of the ductal system to form a more extensive network. The ends of the ducts grow to form what is known as Terminal Ductle Lobular Units (TDLU).[4]

Epithelial growth continues with each successive menstrual cycle.[5]



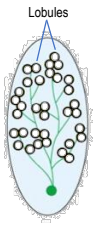
Pregnancy: milk production capability

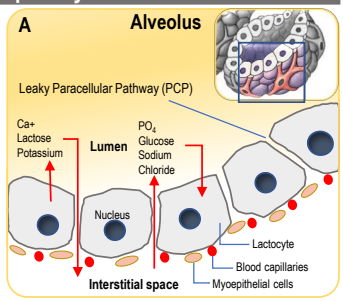
Secretory differentiation (Lactogenesis I)

Under an **endocrine (hormonal) control** in pregnancy, the breast goes through significant changes to develop its future milk production capability.

The TDLUs undergo a remarkable expansion so that each lobule comes to resemble a large bunch of grapes.

During mid-pregnancy, secretory differentiation begins and the epithelial cells in the alveoli become functional lactocytes, starting to produce minimal amounts of milk. However, because the paracellular pathways (PCPs) are leaky, lactose and other milk components are able to move out of the alveoli to be reabsorbed in the interstitial space.[6,7]





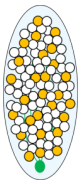
Postpartum: Initiation of copious milk secretion

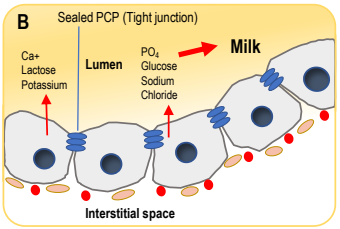
Secretory activation (Lactogenesis II)

Upon delivery of the placenta, the progesterone-inhibition of prolactin is removed, permitting prolactin to 1) catalyze closure of open PCPs (tight junctions), 2) upregulate genes that promote rapid proliferation and differentiation of lactocytes and 3) prevent apoptosis (cellular death) of lactocytes.[6-11]

Simultaneously, the endocrine control of lactation **transitions to an autocrine control** (local control by effective sucking and milk removal). Prolactin release is therefore suckling-induced, and its concentrations are directly related to the intensity of the suckling stimulus.[6,8,12] The rapid increase in lactose following closure of the PCPs draws water into the alveoli and corresponds with mothers' perception of milk coming in.[6,8,14]

The continuing presence of high levels of prolactin is necessary at this stage for optimal secretory activation and high frequency of breastfeeding or pumping in the first 14 days is critical to achieve and maintain adequate milk volumes.[6,8-13]





Model for the transport pathways of macronutrients.[7]
***A**: during pregnancy; **B**: during lactation*

The Initiation of lactation is a time-sensitive, one-time event that is either achieved or not achieved

Educate mothers and families

Receiving scientific information about breastfeeding and lactation greatly supports mothers to make an informed decision and build their breastfeeding confidence.[16-24] It is critical that mothers and families learn the unique benefits of mother's own milk (MOM) and what to expect after delivery, for example:

WHAT...	WHY...	WHAT TO EXPECT...
Mother's own milk (MOM) is a potent medicine.[25,32]	**It is uniquely designed and tailored for their baby.**[25,32]	**Lifelong health benefits: protection against infections, obesity and chronic diseases, etc.**[32]
Begin Breastfeeding or pumping* within 1 hour.[29-36]	**To initiate breast stimulation and for baby to ingest small amounts of colostrum.**[6,8,26,27]	**Little or no milk at first and that's normal. Every drop counts!**[26]
Breastfeed or pump* frequently (8+ times / 24 hrs) including at least once at night.[8-13,15,37-39]	**To maintain high levels of prolactin and optimize secretory activation.**[6,8,27]	**Milk comes in by day 2-3 and a greater milk supply later.**[28,35-37]

Combine hand expression with electric pumping

Combining hand techniques with double pumping may help increase milk volumes in at-risk mothers**.[40,41]

However, hand expression alone should not be used routinely in the absence of a breast pump at any time in the postpartum as this may lead to partial secretory activation resulting in insufficient milk supply.[12,42-45]

Hand expression increases Oxytocin but not Prolactin levels whereas suckling or electric pumping increase both Oxytocin and Prolactin.[42,43]

	Infant Suckling	Breast Pumping	Hand Expression
Compression	✓	✗	✓
Suction	✓	✓	✗
Prolactin	✓	✓	✗
Oxytocin	✓	✓	✓

- *Showing the breast pump prenatally and explaining the importance and benefits of early pumping is key to better prepare at-risk moms for lactation interventions in the postpartum.*
- *The first 2 weeks are the toughest and during this time, mom's job is to eat, sleep, breastfeed/pump and visit baby if in the NICU. The partner and family should be responsible for everything else. Give them a list of jobs![39] It gets easier afterwards!*

* The use of a hospital grade breast pump in the postpartum is only recommended when lactation risk factors are present.
** Mother-infant separation, premature delivery, NICU infant, first time mom, overweight/obesity, diabetes, age over 30, PCOS, history of breast surgery, glandular hypoplasia, etc.

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