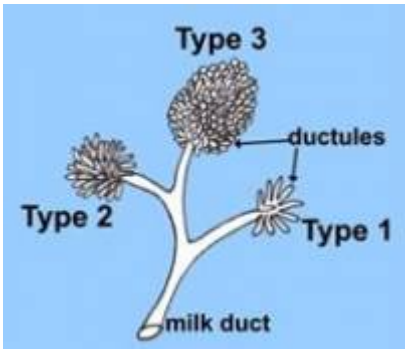
Biology of the Abortion-Breast Cancer Link

1. Breast Development

The developmental biology of changes in the breast that occur during puberty and during a normal pregnancy supports the existence of an independent link between induced abortion and breast cancer.

1.1 Lobular Structure

A lobule is a unit of breast tissue comprised of a milk duct with surrounding mammary (milk) glands, which are both composed of individual breast cells. The ductules which surround the terminal end, or milk, duct become the glands where milk is produced.[1)] Each type of lobule has varying numbers of ductules, which become the milk-producing glands during lactation. These lobules are different morphologically (i.e., in their shape) as well as metabolically (e.g., in their doubling time).



1.2 Lobule Development

Type 1 and Type 2 lobules are cancer-vulnerable. Type 3 and Type 4 lobules are cancer-resistant.

During the first half of pregnancy, the proliferation phase, Type 1 and Type 2 lobules increase in number. During the second half of pregnancy (after week 20), the differentiation phase, these cancer-vulnerable Type 1 and Type 2 lobules begin to mature into cancer-resistant Type 4 lobules. After 32 weeks of pregnancy, sufficient Type 4 lobules have developed that a mother is protected against breast cancer, and she incrementally gains the breast cancer risk reduction that will maximize at 40 weeks. After birth and after a mother has lactated and breastfed (or should she choose not to breastfeed), Type 4 lobules regress to Type 3 lobules, which retain the epigenetic changes that protect against cancer's development.

If a pregnancy is healthy and lasts past 32 weeks, even should a mother deliver prematurely, she will have partial protection against breast cancer. Between 32 and 40 weeks' gestation, she will gain an additional 11 percent reduction in breast cancer risk.[2] By the end of a normal pregnancy, 70 to 90 percent of the mother's breast is composed of cancer-resistant Type 4 lobules.[3] A woman's risk of breast cancer will decrease an additional 10 percent with each subsequent pregnancy.[4] This observed additional reduction in risk may be due to increased breastfeeding among these women, fewer lifetime menstrual cycles, and more anovulatory postpartum cycles (that is, postpartum cycles that do not produce an egg) with lower estrogen exposure, all known to reduce risk. Therefore, the woman who has a full-term pregnancy obtains lifelong benefits from the epigenetic changes it produces in the breast cells and gains even more risk reduction with additional births and breastfeeding.[5]

Table 1: Progression of Lifetime Breast Development

Breast Development	State of breast lobule development
After puberty	75 percent Type 1 lobules and 25 percent Type 2 lobules
After conceiving	Increase in Type 1 lobules and Type 2 lobules
At 20 weeks' gestation	Absolute number of Type 1 lobules and Type 2 lobules has greatly increased; maturation into Type 4 lobules commences
At 32 weeks' gestation	Sufficient Type 1 and Type 2 lobules have matured into Type 4 lobules that the mother has a lowered risk of breast cancer
At 40 weeks' gestation	70 to 90 percent of the breasts are cancer-resistant Type 4 lobules
After weaning	Type 4 lobules stop milk production and regress to Type 3 lobules, which have permanent epigenetic changes that protect against cancer
After menopause	Type 3 lobules change morphologically into what appear to be Type 1 lobules; however, their genes do not change in their up- or down-regulation, so risk reduction is maintained

2. Breast Cancer Formation

2.1 Cancer formation and breast cell growth

Cells grow through mitosis, or cell division. Before a single cell divides into two cells, it must make a complete copy of its DNA. The process of cell division occurs during the cell cycle, which also includes a resting phase after the synthesis of new DNA and other cell structures; thus, if errors are made when DNA is copied, they can be repaired during this resting phase.

Table 2: Lobular Morphology, Cancer Vulnerability, and Structure

Type of lobule	Morphology of lobules	Type of cancer that forms from lobules	Structural and metabolic differences of lobules
Type 1	Average 11 ductules per lobular unit	Ductal cancers (which are approximately 85 percent of all breast cancers), arising in milk ducts*	• Highest number of estrogen and progesterone receptors in the cells • Highest rate of cell proliferation (marked by Ki67 protein) • Shortest DNA doubling time
Type 2	Average 47 ductules per lobular unit	Lobular cancers (which are approximately 15 percent of all breast cancers), arising in milk glands	• Approximately half the number of estrogen and progesterone receptors as Type 1 lobules • One third of the cell proliferation marker Ki67 protein of Type 1 lobules • A shorter DNA doubling time than Type 3 lobules
Type 3	Average 81 ductules per lobular unit	Cancer-resistant	• Negligible numbers of estrogen and progesterone receptors • Less than one tenth of the cell proliferation marker Ki67 protein of Type 1 and Type 2 lobules

* A lobule has a milk duct and glands. The gland makes the milk, and the milk duct collects the milk. Under the microscope, a pathologist can determine whether a cancer is ductal or lobular carcinoma. Ductal cancers start in the ducts of Type 1 lobules, and lobular cancers start in the glands of Type 2 lobules.

2.2 Lobules' Cancer Vulnerability

The shorter the total cell's doubling time, the greater is the risk of forming a mutation or cancer cell, because the cell has a shorter resting phase, and thus less time for DNA repair. Type 1 and Type 2 lobules copy their DNA more quickly than Type 3 lobules, so they are more cancer-vulnerable. Almost all cancers arise in Type 1 (ductal cancers, 85 percent) and Type 2 (lobular cancers, 10 to 15 percent) lobules.

Estrogen and progesterone production stimulates this DNA reproduction and cell growth. Type 1 lobules have the most estrogen and progesterone receptors, Type 2 lobules have fewer than Type 1, and Type 3 lobules have negligible numbers. Differing quantities of receptors in the lobules' cells' nuclei correspond to cell proliferation levels.

2.3 Cancer Detection

On average, one breast cancer cell takes eight to 10 years to grow into a clinically detectable tumor mass one centimeter in diameter.[6)] This is why cancer triggered by an induced abortion[7)] may not become detectable for eight to 10 years.

2.4 Types of Cancer

There are invasive and in situ cancers of both the milk ducts and milk glands. When cancer cells form but do not penetrate the basement membrane, or outer layer of the duct or gland, a cancer is said to be an in situ cancer. These cancers are curable, because they cannot spread to other parts of the body. Invasive cancers have penetrated the basement membrane and can spread throughout the body, becoming metastatic and life-threatening. Most invasive cancers start as in situ cancers.

[1)] The ductules come off the duct draining the lobule called the “terminal end duct.” The small terminal ducts drain into larger and larger milk ducts, or lactiferous ducts. These lactiferous ducts transport milk to the lactiferous sinuses, which are just below the nipple.
[2)] L.J. Vatten, P.R. Romundstad, D. Trichopoulos, and R. Skjærven, “Pregnancy Related Protection Against Breast Cancer Depends on Length of Gestation,” *British Journal of Cancer* 87 (2002): 289-290.
[3)] Jose Russo and Irma H. Russo, “Development of the Human Mammary Gland,” in *The Mammary Gland*, eds. M. Neville and C. Daniel (New York: Plenum Publishing Corporation, 1987).
[4)] Mats Lambe, Chung-cheng Hsieh, Hsiao-wei Chan, Anders Ekbom, Dimitrios Trichopoulos, and Hans-Olov Adami, “Parity, Age at First and Last Birth, and Risk of Breast Cancer: A Population-Based Study in Sweden,” *Breast Cancer Research and Treatment* 38 (1996): 305-311.
[5)] V. Beral, D. Bull, R. Doll, R. Peto, G. Reeves, Collaborative Group on Hormonal Factors in Breast Cancer, “Breast cancer and breastfeeding: collaborative reanalysis of individual data from 47 epidemiological studies in 30 countries, including 50,302 women with breast cancer and 96,973 women without the disease,” *The Lancet* 360 (2002):187-195.
[6)] J. Gershon-Cohen, S.M. Berger, and Herbert S. Klickstein, “Roentgenography of breast cancer moderating concept of ‘biologic predeterminism,’” *Cancer* 16, no. 8 (August 1963): 961-964.
[7)] An examination of the timing in which breast cancer is statistically most likely to manifest itself after a woman obtains an induced abortion (around a decade to 14 years thereafter, with a seemingly diminished risk of manifestation 15 or more years after the abortion is procured) seems to indicate that induced abortion is itself a carcinogenic experience and is not merely an event that weakens a woman’s defenses against breast cancer.

This entry draws heavily from Induced Abortion and Breast Cancer Link.