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1

Analytical considerations and general diagnostic and therapeutic ramifications of milk hormones during lactation

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In this review, we will discuss the changes that occur in the mammary gland from pregnancy to lactation and the issues surrounding the analysis of circulating and milk hormones during the stages of lactogenesis. There is a cascade of events that must occur to achieve milk synthesis, milk ejection, and successful transfer to the breastfeeding infant. The adequacy and success of this process is no small measure and the assessment of milk production, the hormones involved in this process and the ability to properly diagnose conditions and causes of low milk supply are critical for the health and well-being of the mother-infant breastfeeding dyad. The normative data that have been amassed in past decades suggest that there are certain values or circulating concentrations of milk hormones, that if lacking or low, could explain low milk supply status. Yet, in looking more closely at the tests themselves, the certainty of what constitutes “normal” can vary depending on the preanalytical conditions that the blood or milk sample were obtained, the methods used in obtaining circulating or milk concentrations, and the standardization of how that result is expressed. The standardization of these aspects of breast milk physiology are essential for providing important normative data to

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health care professionals and researchers and will result in more consistent findings across multi-disciplinary platforms.

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Practice points

- There are specific changes that ensue during pregnancy and early lactation that must occur for successful lactogenesis or the ability to produce breast milk.
- Some women suffer from low milk supply for various reasons, and there is often difficulty in understanding the root cause of this difficulty.
- Certain tests such as measuring circulating milk hormones, notably prolactin and oxytocin, as well as insulin-like growth factor-1, are utilized to diagnose hormonal difficulties that have led to low milk supply.
- Analysis of the milk sample itself may provide insight into maternal breast function during lactogenesis, but such analysis is fraught with the lack of standardization.
- Because of the lack of standardization in the preanalytical stage of obtaining blood and milk samples, in the processing of the samples, and in the laboratory analyses themselves, there is a lack of consensus of defining “normal” and how to diagnose low milk supply and other problems in lactating women.
- Additional research is needed to determine what aspects of blood and milk collection, the processing of samples, and the laboratory methods used that will lead to the most reliable and meaningful test results.

Research agenda

- Additional research is needed to define milk hormonal changes during lactogenesis 1 (during pregnancy) and during early lactation.
- The effects of preanalytical conditions on the quality of blood and milk samples and the hormonal changes associated with those conditions requires further study at both the individual and the population level.
- The influence of exercise, diet, maternal age, parity, and stage of lactation on the circulating milk hormones and milk components should be further investigated.
- The impact of therapeutic agents that stimulate milk production (called galactogogues) require further study to determine their mechanism of action and as well as efficacy using standardized methods of measuring milk hormone changes in both blood and milk components.

Introduction

In lactation, as in all human biological systems, there is a working relationship between anatomy (form) and physiology (function). This is the case with the mammary gland and the physiology and function that are related to specific changes and processes during the lifecycle, allowing milk to be formed and ejected during lactation. What is known about lactation comes from both observational and indirect studies (such as breast ultrasound and chemical analyses of breast milk samples) in women and in animal (primarily dairy cows, sheep and mouse) models [1–10].

In this review, we will discuss briefly the changes that occur in the mammary gland from pregnancy to lactation and the issues surrounding the analysis of circulating and milk hormones during the stages of lactogenesis. It will become clear that our knowledge about certain hormonal signals and the milk hormones themselves has been influenced by the very methods and assays that are applied to measure

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