Why is preterm milk expression so difficult?

This article aims to elucidate the reasons for the difficulties many mothers face following preterm delivery when they attempt to express milk to feed their extremely low birthweight babies. The physiology of lactation is described and practical guidance is given as to the support these mothers should receive in order to initiate and sustain lactation.

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Key points

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1. Preterm lactogenesis is not robust.
2. Early and frequent milk expression is crucial for the initiation of lactation.
3. Double pumping and massage maximises milk production and milk quality.
4. Triggering the milk ejection reflex is essential for effective milk removal.

Human milk (with appropriate fortification) is regarded as important in the establishment of early enteral nutrition in the extremely low birthweight (ELBW) infant. Since these infants are not capable of suckling for many weeks, an effective strategy for milk expression is required to initiate and maintain milk production. It is the common experience of many units that mothers find milk expression difficult and are unable to produce sufficient milk to meet the needs of their premature infants. A shortage in the supply of mother's own milk has lead to a renewed interest in human milk banking, using donations of excess milk from mothers feeding term healthy babies.

Furthermore, a mother's failure to sustain lactation leads inevitably to a failure in the establishment of breastfeeding. Therefore, it is not surprising that whilst preterm breastfeeding rates vary worldwide, current evidence suggests that mothers of preterm infants initiate and sustain breastfeeding at significantly lower rates than mothers of term babies[1-3]. This has important implications, not only for infant nutrition and immunological protection, but also for maternal infant attachment which is often adversely affected by separation in the early post-partum period[4].

So, why do mothers of ELBW infants find milk expression so difficult to achieve? In order to answer this question an understanding of the physiology of lactation is required. This paper then goes on to discuss the practical difficulties mothers dependent on milk expression often encounter and how these barriers can be overcome. When a mother is given appropriate guidance, the adverse impact of early birth on lactation can be counteracted. With the right approach, milk expression can be so successful that storage becomes the immediate problem (**FIGURE 1**).

Lactation physiology

The hormonal changes that occur during pregnancy are associated with breast development (mammogenesis), which is characterised by the growth and proliferation of the ductal tree and formation of lobules. It is the process by which the mammary gland develops the capacity to secrete milk. Lactogenesis occurs in two stages, referred to as lactogenesis I and lactogenesis II. The

FIGURE 1 Abundant milk production can be achieved with the right support.

FIGURE 2 Skin to skin holding helps to promote milk ejection.

capacity of the mammary gland to secrete milk from mid-pregnancy to late pregnancy is called lactogenesis I. During this stage the epithelial cells of the alveoli differentiate into secretory cells (lactocytes) for milk production and the alveoli become distended by colostrum.

Lactogenesis II is the onset of copious milk secretion and occurs during the first four days following delivery[5]. Lactogenesis II is the most critical stage of lactation and is attributable to the dramatic changes that occur after the placenta is delivered. A programmed transformation of the mammary epithelium is characterised by a drop in progesterone and requires elevated levels of prolactin, insulin, adrenocorticoid hormones and oxytocin to establish and maintain lactation. During stage II, the changes in milk volume and composition are significant. Immediately following delivery, sodium and chloride concentrations decrease but lactose concentrations increase inducing water movement into the alveoli to maintain osmotic equilibrium.

This change is usually completed within 72 hours. About 24 hours after these changes occur, milk volume becomes copious[5]. It is suggested that the changes in milk composition that occur during the first four days post-partum should be viewed as part of a continuum[5], followed by smaller changes in milk composition which subsequently occur throughout the course of lactation. The maintenance of established lactation (from day 9) is controlled by the autocrine system which means that supply is primarily determined by demand. This is termed galactopoiesis or lactogenesis III.

There are differences in the changes in milk composition between mothers of term and preterm infants. It has been observed that the concentration levels of four markers of lactogenesis II (lactose, citrate, sodium and total protein) have much greater variation about the mean in preterm compared with term breastfeeding mothers[6]. Only four preterm mothers had all four markers, leading researchers to conclude that most of the mothers studied were likely to have lower milk production. The earlier the gestation of the baby the more this problem is accentuated, resulting in the suggestion that lactogenesis I is still incomplete. The reasons for the delay could also relate to factors such as maternal medications during pregnancy and labour. High breastmilk sodium levels on or before the third day following delivery are a marker for impending lactation problems, suggesting that the frequency and effectiveness of early milk expression may play an important role in milk production. Although all the reasons for the delay in milk supply for preterm mothers are still not fully understood, there is strong evidence that lactogenesis is not entirely robust and is therefore more susceptible to both internal physiologic responses and external influences.

Breastfeeding support

Five independent UK audits of the support given to preterm breastfeeding mothers have found that breastfeeding facilities and support in many neonatal intensive care units are far below acceptable standards[7-11].

The main obstacles cited by mothers include:

- Poor and conflicting advice
- Scarcity in the provision of milk expression equipment
- Lack of privacy
- A rigid feeding schedule
- Lactation failure
- Minimal encouragement and support

Therefore, in order to minimise these problems a lactation support system must be in place from the time of infant admission. All healthcare professionals who care for preterm infants should have a comprehensive knowledge of preterm breastfeeding management. It is important that this support is both directed and co-ordinated by a nurse/midwife with expertise in both lactation and neonatal care[12,13].

Milk expression barriers

Mothers of preterm infants, especially ELBW infants, experience both physiological and emotional challenges, which adversely affect breastfeeding rates for this population[14]. All of these obstacles are powerful inhibitors of lactation and include:

- Immature mammary development
- Poor hormonal responses
- Infant/maternal separation
- Stress, anxiety and fatigue
- Inappropriate milk expression equipment and technique

It is the common experience of many units that mothers find milk expression difficult and are unable to produce sufficient milk to meet the needs of their premature infants. Although not all these problems are easily resolved, with appropriate guidance many mothers of ELBW infants successfully sustain milk production.

Early milk expression

The first milk expression should take place within six hours following delivery, if a mother's medical condition is stable. It is of crucial importance that mothers initially express at least 8-10 times in 24 hours, with at least one milk expression at night. Adopting a pattern of frequent expression during the early weeks post-delivery when lactogenic hormones directly influence

milk production will help to promote breast maturation. It is helpful to inform mothers that the birth of a premature baby may cause a very slow start with milk production. Most mothers who express following preterm delivery may only obtain a few drops of colostrum for the first three days[15]. Some mothers find colostrum extremely difficult to remove via a breast pump and should be shown how to hand express. Hand expression also makes the collection of colostrum easier, since a syringe can be used to collect the small drops as they appear on the end of the nipple.

The provision of a calm environment for milk expression, ideally within close proximity to the infant, provides the best opportunity for the initiation of milk expression. The early initiation of skin-to skin (STS) holding or kangaroo care has also been implicated in the duration of preterm breastfeeding, with mothers frequently reporting feelings of milk ejection during STS (**FIGURE 2**).

not breastfed previously, so they are not familiar with the sensation caused by the release of oxytocin. Unless the milk ejection reflex is triggered before and during milk expression, milk flow will be compromised leading to a poor milk supply and declining production. Poor breast emptying can also significantly reduce the quality of the milk expressed since the last drops of milk released during pumping contain very high levels of fat, which provides most of the calories in a feed. Methods to elicit the milk ejection reflex include expressing in close proximity to the baby, breast and nipple massage, elongation of the nipple, olfactory and visual imagery and relaxation exercises[6].

It is important that if a mother experiences overdistension of the breasts caused by secondary engorgment that she increases the number of times milk is expressed to prevent involution of the alveoli, caused by the back-pressure of milk and the buildup of suppressor peptides that down-regulate milk volume[17]. The

FIGURE 3 Double pumping in a double pumping bra.

Stimulating milk production

It is important that the initial milk expression sessions are supervised to ensure that pump assembly and use are understood and that expression techniques are mastered. The relationship between the milk ejection reflex and milk removal should be explained[16]. In stressful situations, all mothers may experience difficulties with milk ejection when expressing. Many preterm mothers have initial goal is to maximise milk production, which typically plateaus at by two weeks post-partum[18]. Even with an abundant milk supply initially some mothers can experience a drop in production 10-14 days after birth. Therefore it is important to establish a high milk yield (>750 mL/d) by day 10[19]. This will ensure that even if a mother's milk supply diminishes by 50%, enough milk will be produced to fully breastfeed her infant at discharge. When a mother's goal is to provide milk for a short period of time because she does not wish to breastfeed, then she can be advised to express less frequently.

Breast pumps

A hospital grade electric breast pump, enabling a mother to pump both breasts simultaneously, should be available to the mother for use in hospital and at home. In contrast to sequential pumping there is evidence that a double pump results in higher milk yield, reduced time, and higher prolactin levels[20]. Breast massage used in conjunction with double pumping has also been shown to improve both milk output and fat content[21]. It can also be helpful for mothers to wear a bra that has been adapted to hold double collections sets securely, since it will allow a mother to pump hands free (**FIGURE 3**). Many mothers have reported that utilising a specialist bra leads to increased milk volume, since they feel more relaxed. When problems do occur with milk production a systematic approach to problem solving is required (**FIGURE 4**).

Milk collection sets should be measured to fit the size and shape of individual mothers. Unless a collection set is used which fits the anatomical configuration of the breast, nipple tissue will rub against the sides of the tunnel causing friction. This may lead to severe nipple excoriation predisposing the mother to a risk of mastitis through bacterial invasion. Milk drainage may also be compromised leading to maternal engorgement and a decrease in milk production. Women with either large or wide nipples may have difficulty with a set that has either a small opening or narrow slope[22]. The ideal range is 68 to 82 mm outer diameter and 35 to 40 mm depth of flare[22]. The availability of range of collection sets such as the large glass funnel (**FIGURE 5**) are dependent on the manufacturer.

Maintenance of a milk supply

Once lactation is well established it is important to consider the major determinates of milk production (synthesis). An understanding of how these vary between mothers can be used to make individualised recommendations in order to maximise milk output[6]. When milk production is established the short-term (between breast expressions) rate of milk synthesis is controlled locally within each breast and is dependent on the amount of

Problem: Sore Nipples

Advice

- Take history (refer to primary care team if thrush/severe excoriation/mastitis)
- Determine method and technique of expression
- Correct mismanagement
- Check diameter of tunnel (milk expression set)
- Avoid excess vacuum
- Adjust vacuum during pumping (negative pressure increases as bottle fills)
- Avoid long periods of uninterrupted pumping
- Turn off vacuum before removing collection sets
- Change breast pads frequently
- Apply expressed milk to nipples following expression (to encourage healing)
- Apply modified lanolin (sparingly) to minimise friction
- If severe trauma, utilise hand expression

Problem: Poor Milk Production

Advice

- Take history
- Correct mismanagement
- Instill confidence
- Teach relaxation techniques
- Relieve engorgment/blocked ducts
- Express in close proximity of baby
- Encourage skin to skin contact
- Use warm heat directly on breast tissue
- Warm collection sets
- Use visual imagery (photograph of baby)
- Trigger milk ejection reflex before and during pumping
- Allow enough time for breast emptying
- Massage breast tissue before & during pumping
- Stroke nipples prior to expressing
- Use breast compression while pumping
- Go hands free (utilise a double pumping bra)
- Employ frequent, regular use of pump (8 –12 times in 24 hours initially)
- Do not drop night time expression sessions
- Mimic growth spurt by:
  - Pumping 2 hourly for 48 hours (or)
  - Cluster pumping – half hourly (for approximately 10 minutes for several hours.

FIGURE 4 Systematic approach to problem solving.

milk stored in the breast. Rates of milk synthesis are greatest when the breast is drained, and slowest when the breast is full[23]. Therefore breasts with smaller storage capacities may need to be expressed more frequently than breasts with larger storage capacities[23, 24], even though both types of breasts are capable of synthesizing similar amounts of milk in 24 hours. Breast asymmetry is common and many mothers report that they consistently get more milk from one breast. A calculation of the rate of milk production (mL/hour) for a range of intervals between breast expression sessions should form the basis for advice for individual mothers. This is an invaluable strategy for mothers dependent on milk expression for a long period of time.

Conclusion

The two most common misconceptions that undermine successful lactation for mothers of preterm infants are:

- The initiation of milk expression can be delayed until an infant is stable.
- The responsibility for lactation support rests exclusively with midwifery staff involved in the provision of postnatal care.

In order to overcome these problems it is imperative that collaborative management guidelines are in place so that neonatal staff are integral to the early establishment of a regular milk expression regime and schedule. All healthcare professionals who care for preterm infants should have expert knowledge of both lactation physiology and milk expression management. This requires a comprehensive training programme such as the one currently recommended by the Department of Health[13].

FIGURE 5 Large glass funnel to facilitate collection of milk from large or wide nipples.

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