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Chapter

Breastfeeding and Premature Newborn in the NICU

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Abstract

Today it is well known that the best gift that a mother can give her baby is breast milk. And what happens with all those children who for some reason are born premature, who cannot start breastfeeding either because of their severity, because they are separated from their breasts or simply because of their severity. For many years, the World Health Organization recommends exclusive human milk during the first 6 months of life, however, the premature newborn sent to the neonatal intensive care unit experiences a series of unfortunate events before starting enteral feeding many of them. They die during their stay. However, at the moment the importance has been given to the beginning of human milk from its mother or from a milk bank, and of the care around the family that the critically ill newborn must have. Unfortunately, Mexico and Latin America continue to have some areas with many lags in terms of nutrition and care of the newborn in the NICU. The success of breastfeeding with a baby in the NICU depends on the information and training provided to the mother about the expression, storage and transport of her milk. That the whole family be made aware that an essential part in the recovery of premature infants is to provide breast milk in a timely manner.

Keywords: breastfeeding, premature children, newborn, nicu, nutrition

1. Introduction

Worldwide, year after year, approximately 15 million premature children are born, a number that is increasing each year. And, adequate nutrition is currently considered a crucial factor for the survival of these babies as well as improving their neurological prognosis in the short and long term. His mother's milk, although it is premature milk, differs from the milk of mothers with full-term children. Far from being harmful to the patient, these differences have been shown to contain beneficial components and nutrients for the premature child. Many intensive care units have pasteurized milk, donated by mothers with sufficient milk production who for some reason did not give it to their babies (fasting children secondary to surgical pathologies, perinatal asphyxia, respiratory distress, deaths), these milk banks have become the only option in Latin American countries for the initiation of human milk in these premature children, demonstrating incredible benefits for all these children, so far

from the benefits that their own mother's milk can give them given the weeks production management [1].

Human milk should be part of the daily medication of these critically ill premature infants or not. In the nutritional aspect, it is well known that it contains countless benefits than infant formulas, not to mention the danger that these substitutes can cause in the intestines of critically ill newborns. Not to mention the protection that human milk provides to reduce Sepsis, enterocolitis and retinopathy of prematurity. In current studies, children with extremely low birth weight, that is, under 1000 grams, human milk has shown to have multiple benefits in neurodevelopment, obtaining better results in the evaluation tests than those fed with substitute formulas. The American Academy of Pediatrics recommends starting your own mother's human milk as soon as possible or, in the case of pasteurized milk, fortifying it [2].

The bioactive components of your own mother's human milk enhance the immune system, improving gastrointestinal development. Containing abundant carbohydrate immunoglobulins, lactoferrins, enzymes and growth factors [3].

2. Epidemiology

In the past decade worldwide, the initiation of breast milk in neonatal intensive care units was 80% with a percentage of continuity at home from 35–54% [4]. however, year after year this percentage has been increasing. Thanks to the efforts of many governments with adequate public policies aimed at the protection of pregnant and lactating women. And so the standardization of perinatal health care was born in Europe, publishing the principles of family care for the newborn admitted to the neonatal intensive care unit. Emphasizing the early initiation of breastfeeding regardless of the severity of the baby. Giving rise to the 10 steps to help the mother to initiate breastfeeding in the NICU [5].

3. Human milk

The biochemical and bioactive components of human milk help the proper state of immunity, nutrition and growth in babies. The characteristics of these bioactive elements depend on genetic, demographic factors and of course lifestyles as well as exposure to pollutants, smokers. Having of course an impact on the health of the baby. For a woman to start breastfeeding after childbirth, a series of hormonal events occurs: when the placenta comes out and the uterus contracts, starting with milk production (many times it starts from the last weeks of pregnancy). The great advances in recent years regarding breast milk have also helped to improve infant formulas, currently many of the most important brands have added oligosaccharides to the composition. But great benefits such as immunological as well as the plethora of bacteria that improve the baby's microbiota have not yet been possible to add to the substitutes. In the past it was thought that these bacteria were part of the skin of the breast or perhaps contaminated during extraction, storage or transport, which is not the case with multiple studies where the presence of an enteromammary route is evidenced [6, 7]. Being able to isolate the multiple probiotics contained in breast milk has opened a new frontier in research in order to demonstrate that these strains contained in human milk improve the immunological and intestinal development of babies, creating in the medical personnel in charge of the critically ill newborn, an

easy-to-get, free weapon to improve the prognosis of these babies regardless of their underlying pathology or that their lives are in danger [7].

3.1 Breast milk with a premature child

Premature births, an event that is increasing worldwide, is associated with nutritionally and immunologically immature babies with a higher risk of complications, including necrotizing enterocolitis. And although the premature child needs caloric and protein contributions that exceed breast milk, the multiple benefits that it offers are not compared to the substitute, in addition to the fact that most of these babies have parenteral nutrition, which provides them with a sufficient amount of calories, protein, and lipids [8].

In addition, in recent studies, the analysis of the composition of breast milk with term babies and premature babies have shown that significantly the amount of protein, fat; as well as much higher levels of immunoglobulins, lactoferrin, growth factors and lysozyme [8, 9].

3.2 Lactating is a natural event

Providing the breast is the most natural way to provide all the clinical benefits of milk, however, on an emotional level, it creates a bond with your baby. In the intensive care unit, due to the severity of these babies, immediate attachment is often impossible, even They are children who spend months on invasive ventilation, which makes attachment to the mother's breast impossible. Currently, thanks to the importance that has been given to involving the family in the care of their critically ill child, there are therapies to improve the emotional aspect such as kangaroo mom or dad, the intention is that the emotional bond remains present and involves the family to favor the production of breast milk despite not having stimulated the baby, only breast pumps [10].

3.3 The popular phrase “human milk is pure gold”

The reason why the opportune initiation of breast milk despite the health status of the premature baby, is that the contribution of nutrients and immunoglobulins depends on the amount of milk that is provided, the greater the amount of milk, the greater the benefits, even more if it is from your own mother, which will have the gestational weeks with the fair benefits according to the gestational age. The great challenge in these units occurs when the mother is also in critical condition, since currently the main reason for premature birth is preeclampsia, leaving the mother in a state of vulnerability that of course makes it difficult to extract colostrum.

It has also been shown that the time of extraction, storage and transport of milk is vital for its conservation, it is advisable to extract it as close as possible to intensive therapy, and if this is not possible, follow the appropriate techniques of extraction to preserve your milk in the most hygienic way [11].

3.4 Differences between premature milk and term milk

As early as 1980, Shander et al. discovered that the protein content during the first two weeks of life was significantly higher than that of mature milk. At present, multiple meta-analyses have shown that milk from a breast with 28 weeks of gestation or less produces milk with a protein content of 2.3 g/100 ml, while the breast of

32–34 weeks produces between 1.8 to 1.9 grams. of protein per 100 ml. And not only is it the largest amount of protein, but also fat [12]. Of the free amino acids, 50% is made up of glutamine and glutamic acid in significantly higher quantities, so at the protein and free amino acid level, premature milk It is ideal to adapt to the growing needs of the premature child.

Regarding fats, these are also influenced by gestational age, mainly in the content of medium chain triglycerides and fatty acids. In a longitudinal study in 27 premature infants, it was found that the breast milk of premature infants had a much higher amount (between 0.8 and 0.5 grams/100 ml) of fats. As well as a greater contribution of saturated fats and medium chain lipids [13].

3.5 Oligosaccharides

Oligosaccharides are non-digestible carbohydrates that act as bioactive components in breast milk and provide a series of benefits such as improving microbiota colonization, reducing the pathogenesis of bacteria involved in enteral infections, and improving the immune system [14]. All oligosaccharides are produced in the mammary gland, demonstrating that in the early stages of lactation the concentration increases and gradually decreases over time. Among the many benefits of oligosaccharides, direct protection against enterocolitis (specifically flucosyltransferase 2) has been demonstrated. Another benefit that oligosaccharides have is that they do not lose effectiveness despite pasteurization, and their existence has been proven mainly between weeks 23 to 26 of gestation. Now, in comparison to premature babies fed with their own breast milk against those fed with pasteurized milk, it has been shown that those fed with their own breast milk have greater protection against enterocolitis, late sepsis, bronchopulmonary dysplasia and severe retinopathy, in a meta-analysis where 6 different studies were analyzed, 1472 babies and in observational studies where 14,950 babies were analyzed, a clear improvement in said pathologies was found in those fed with milk from their own breasts versus those fed with pasteurized milk [15].

In relation to the biocomponents of breast milk, the most significant element was the production of antioxidants found in colostrum and that decreases as lactation progresses. These levels are also much higher in the milk of breasts with premature babies than those of term. Finally, regarding the microbiota of breast milk with premature babies, it changes and is specific for each mother, providing the exact protection for the bacterial flora shared by mother and baby [16].

4. Gut microbiota of premature infants

The mode of birth, antibiotic administration, care environment and nutritional exposures, which particularly in intensive care are always present, and most notably breastfeeding, have all been shown to play important roles in the acquisition of the gut microbiome. Exposure to breast milk during infancy appears to be particularly important in shaping the microbiome. Among preterm infants, gestational age at birth and postnatal age have also been shown to be relevant to their microbiome characteristics. We also know that the microbiota of breastfed versus formula-fed infants has a more profound effect on genes in neonatal enterocytes that influence host protection and development [17].

Of the entire population of premature infants, those under 32 weeks are exceptionally more vulnerable, requiring full attention and human and material resources

for a long time, with a higher risk of comorbidities that would complicate their evolution in the short, medium, and long term. 10% of these children will develop enterocolitis [18]. In a longitudinal study where the milk of their own mothers was analyzed, a considerable increase in the microbiota of babies was seen, mainly those with premature milk. Therefore, the Nutrition Committee of the European Society of Gastroenterology, Hepatology and Nutrition recommends early initiation of breast milk and preferably from your own mother [19].

5. Mothers of premature babies

Given the difficult circumstances these mothers live through, such as premature labor (most likely complicated by some circumstance), removing the mother from her baby, the poor suction that these babies present and the poor milk extraction technique, it seems consequently the failure of successful breastfeeding. Having a success rate in most countries of the world close to 25% (according to official UN records) [19]. Given the bad figures that exist worldwide, it is necessary not only to raise awareness among the medical personnel in charge of these children, but also to pay extra attention to these mothers. Feeling that there is an accompaniment during your breastfeeding from the staff who care for your baby, and sharing the experience with the whole family [20].

6. Nursing care and skills

The comprehensive care of a critically ill child is in charge of a multidisciplinary staff led by a neonatologist. However, also with the participation of the infectologist, nutritionist, neonatal surgeon and other specialists. But who is taking care of these babies 24 hours a day is the nursing staff. And they are the ones who provide advice and accompaniment to the mother for breastfeeding, and if they fail in their work, we will most likely not be able to maintain breastfeeding in the NICU. Fortunately, the knowledge of nurses has been improving over the years, with successful interventions at the beginning of the year 2000 barely 10–94% today [21]. And one of the most important and significant advances in these years was the timely start of the extraction of breast milk. The initial steps for the success of adequate breastfeeding in the neonatal intensive care unit is to begin with the education of the woman with a high-risk pregnancy, well aware of the possibility of having a premature birth, educating them with the necessary information about the use of the breast pump, the frequency, adequate nutrition and the nutrients that the mother needs to successfully carry out breastfeeding, regardless of the adverse situations that having her newborn in neonatal therapy implies [22].

7. Safe way of transportation of breast milk

7.1 Extraction

The physiological and emotional challenges associated with mother-infant separation, as well as inappropriate breast stimulation, can interfere with the establishment of lactation and increase the likelihood of complications. Consequently, for

many mothers of preterm infants, the milk pathway begins with expressing rather than breastfeeding to initiate, build, and maintain lactation. And this milk expression can pose significant challenges for mothers of premature babies. If the initiation of lactation is delayed and the mother does not express milk consistently from the beginning, it is difficult to ensure adequate milk production in the long term. Therefore, having access to the right equipment and timely support is essential. It is important to recognize that the development of the mother's milk supply will require the mother to initiate, generate, and maintain lactation. And informing mothers that their milk supply will increase over time, thus setting the correct expectations, is the key to successful lactation. Necessary steps for expression: teach mothers to use their hands to massage the breasts, express milk during the first hour postpartum and keep it that way at least every 6 hours during the first 72 hours after birth, always start breastfeeding with a pump of milk (preferably bimanual), then express frequently, at least 6 times a day, express milk after skin-to-skin contact with your premature child, regardless of whether they have assisted ventilation [23].

7.2 Harvest

After expression, breast milk needs to be handled and stored, with attendant risks of nutrient loss and milk contamination. Therefore, it is essential to consider the best practices for handling human milk to ensure that the premature baby can access optimal nutrients. All certified intensive care units must standardize milk handling procedures in order to minimize losses (fewer containers) As well as loss of quality or integrity of milk components, milk contamination, risk of confusion between patients [23–25].

7.3 Labeling/tracking

It is very important to establish specific protocols to minimize errors in feeding with expressed milk. Giving a mother's expressed milk to a baby other than her own can have consequences for the baby in the NICU. The importance of providing milk from their own mother has already been discussed due to the difference in the weeks of gestation and in the days of life that the deceased children in the NICU have, therefore different nutritional needs. It is essential to control the feeding of the mothers and monitor expressed milk. This is to ensure that each patient has sufficient volume and receives the correct milk based on expression time and nutritional content, for each feed [24, 25].

7.4 Label expressed milk

Every institution must have a standard that must contain the milk label, giving priority to the baby's name, in this case their last names, the day and very importantly the time of extraction, as well as the quantity **Figure 1** [25].

7.5 Cold chain maintenance

The milk must be cooled immediately after expression and the cold chain must not be interrupted. Freezing the milk or simply chilling it is based on criteria such as







Extraction	Pick up	Label	Cold chain maintenance	Heating	Feeding
					

Figure 1.
 Procedure to be followed for the collection and storage of breast milk as well as its transfer to the NICU until its ingestion.



Figure 2.
 Storage and conservation of breast milk.

the available distance from the home to the hospital, the amount of milk the mother already has in the NICU, and hospital policies. Freezing, although a necessary tool in the NICU, alters the integrity of the components of breast milk. Although most changes are now considered harmless, milk loses some of its value when fresh. For example, full-term infants ingest millions of live cells from breast milk every day. Unfortunately, these cells do not survive the freezing process [25].

To maximize the nutritional content between container transfers, the following should be considered: before handling the milk, it should always be shaken so that all

the components are mixed homogeneously, consider the fat the most valuable component, and the greater the yellow coloration, the greater the nutritional components. and finally transport in the minimum number of containers (**Figure 2**) [26, 27].

7.6 Warming of breast milk in the NICU

I consider the science of heating milk and maintaining its properties to be the biggest challenge for nursing staff, milk must be gently heated to preserve its nutritional and immunological values. As well as the precaution that must be taken when giving it to the premature child. Due to the nature of the gastric and intestinal mucosa of the premature baby, the milk must have a certain temperature so as not to endanger his life and keep it as close as possible to fresh milk that has just been extracted.

8. Indications for use

This will depend 100 percent on the decision of the neonatologist and depending on his critical condition, as well as the weight of the baby to decide on the amount and frequency of administration.

9. Impact of breast milk on neurodevelopment

The biggest and most fearsome complication when we have a premature baby is that it has some type of delay, mainly motor [28].

The breastfed infant receives nutrients from breast milk which, once it crosses the intestinal barrier and ends up in the blood, with differences in phosphatidylcholine, sphingomyelin and triglycerides. This result is not necessarily related to the difference in triglyceride composition between breast milk and infant formula, but it may also be that neonatal nutrition has had additional effects on lipid metabolism. As we know the baby's brain and its entire peripheral nervous system is made up of fats, of course it does have a long-term impact on the fat intake provided by breast milk versus formula-fed [29]. The issue of breast milk in nutrition programming is really difficult to resolve. In fact, the interindividual variability of human milk and the heterogeneity of lactation times make it difficult to establish associations between a particular composition of breast milk and certain clinical parameters of the child who has received this milk. Breast milk lipids are the second most important macronutrient, it is rich in linoleic acid as well as alpha linoleic acid, important precursors of long-chain poly-saturated acids essential for brain development [30]. At present, multiple associations between breast milk and neurodevelopment have been studied, mainly omega 3 and omega 6 [31]. We found a strong relationship between the growth of these premature infants during hospitalization and the presence of several lipid biomarkers in the In breast milk, faster growth was associated with milk containing more saturated medium-chain fatty acids and sphingomyelin, more phosphoethanolamine containing dihomogamma-linolenic acid, and fewer oxylipins [32].

The oligosaccharide fraction of premature breast milk is probably the most interesting that raises challenging scientific questions [33]. The microbiome of children with severe growth delays is not refractory to nutritional supplementation with oligosaccharides. This opens up interesting perspectives for the care of premature newborns [34, 35].

After the battle that these preemies have in the NICU, when these preterm infants go home, they obtain a greater intestinal microbiota with greater bacterial diversity thanks to breast milk compared to formula-fed infants [36]. And of course we could not leave behind the economic benefit for the health system as well as for their families when they go home [37]. And, while it must be admitted that breast milk is not always perfect, the balance of benefits and risks tilts in the direction of benefits, especially for premature babies [38]. Epidemiologically speaking, morbidity and mortality in premature infants has decreased globally since more countries have joined breastfeeding programs, and of course better management of the nutrition of these babies improves their development. And, although it contains macronutrients with a fairly stable concentration, breast milk has a very diverse composition of micronutrients, which depends in particular on the physiology of the mother and her environment, so the question of whether it has an adaptive composition, according to the needs of the child, remains unanswered to this day [39].

10. Conclusion

Breast milk is a “natural” and “sustainable” food, without any impact on the environment, proving maternal attachment to be one more tool for these warriors to get ahead with the minimum of both physical and neurodevelopmental complications. And although the ideal will always be the direct suction of the mother, we are aware that for these babies the way of feeding is difficult; The important thing is that we are aware and that we are a team with the families, involve the family in the evolution of these babies by providing information that the best gift that can be given to a baby regardless of the week of gestation is breast milk.

Soon, all NICU units will be able to progress to a breastfeeding supplement or other device that will deliver expressed breast milk from a bottle or syringe through a small tube that is taped next to your nipple. With this method, all premature babies should begin feeding partly from the tube and partly from the breast while latching on to their mother’s breast and actively feeding.

And what is the future of breastfeeding in neonatal intensive care units? The intention is not to have devices such as syringes or bottles to transport the milk, but rather devices that connect directly to the mother’s nipple regardless of the baby’s ventilatory support. And that the intensive care areas become a family environment involving the whole family in the care of their critically ill newborn.

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