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Human milk banking: Every mother's dream

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Abstract

Human milk is recognized as the optimal feeding for new born infants. When mothers' own milk (MOM) is not available, it is possible to provide human milk to premature or term new born infantsthat is donated by lactating mothers. Milk Banking is an important medical-social initiative as far as future of human race is concerned. Paediatricians began using donor human milk in the 19th in responseto anecdotal observation that premature infants had better health outcomes when receiving their own mothers' milk. The history of milk banking and the key steps involved in donation, processing and dispensing of human milk are outlined. Other issues concerning the practice of human milk banks need to be addressed as well as optimization of the feeding strategies for preterm infants. Hence Government, health experts and civil society must join hands to propagate concept of human milk banking for sake of thousands of LBW and preterm babies.

Keywords: human milk banking, breast milk, formula feeding, donor milk, human breast milk issues

Introduction

> "The best food for an infant who cannot get it from his own mother's breast is fromanother healthy mother"

A human milk bank or breast milk is a service in the community which collects, stores, pasteurize and dispense the human breast milk donated by the nursing or lactating mothers (donor) who are not biologically related to the new born baby (recipient) [1]. Human milk bank is alternative solution for the mothers who cannot provide their own breast milk to theirnew born baby due to certain reasons such as risk for getting infection from mother, hospitalization of the baby due to low birth weight, premature birth, extended stay in the hospital etc [2].

Throughout history there have been numerous examples of women who breastfed or otherwise provided their milk for infants who were not their biological offspring. It is universally accepted that breast milk is the optimum exclusive source of nutrition for the firstsix months of life, and may remain part of the healthy infant diet for the first two years of lifeand beyond [3]. Breast milk is known to contain important immunologic, enzymatic, hormonal and endocrine factors which are absent in commercial formulas and contribute to improved gastrointestinal maturation and function. Recently, studies in preterm infants have shown improved feeding tolerance, lower infection risks and a decreased rate of necrotizing entrocolitis with an exclusive human breast milk diet. This has led to innovative clinical practices in neonatal intensive care units utilizing donor human milk in case if mother's own milk is insufficient or unavailable [4]. The World Health Organization and American Academy of Paediatrics among many other health care organizations and associations agree that when a mother's own milk is not available for fragile babies, the next best alternative is banked donor human milk [5].

India faces its own unique challenges, having the highest number of low birth weight babies, and significant mortality and morbidity in very low birth weight (VLBW) population. In our country, the burden of low birth weight babies in various hospitals is about 20% with significant mortality and morbidities [5, 6]. Exclusive and continued breast-feeding has been well established as one of the most important interventions to reduce post neonatal and child mortality. According to a research by Bellagio Child Survival Study Group, among 23 interventions considered by scale-up, it was found that exclusive breast-feeding of infants for 6 months and continued feeding until 1 year could prevent an estimated 1.3 million child deaths per year. Breast-feeding has been shown to reduce the risk of respiratory infections, diarrhoea, and neonatal sepsis [6]. A pooled analysis of data from 3 countries has shown that either predominately or exclusively breast-fed infants are at substantially lower risk for infant mortality than non-breast-fed infants [7]. Since, the supply of donor breast milk is limited in India, priorityshould be given to sick, hospitalized neonates who are most vulnerable. These babies are most likely to benefit from exclusive human donor milk. Hence the Government, health experts and the civil society must join hands to propagate the concept of human milk banking for the sake of thousands of low birth weight and preterm babies [8].

History of human milk banking

The act of mother providing breast milk for a baby that is not their own is wet nursing which dates back thousands of years. Wet nurses are described appropriately in the tomb paintings in ancient Egypt and also found in code of Hammurabi from 2250 BC. At the beginning of 20th Century, practice of breast feeding for the baby becamemore prominent. Most children were fed by the milk of theirown mother or from wet nurse. This concept lost favourwith the recognition of potential disease transmission through breast milk and easy availability of artificial infant feedings [9].

When mother's own milk and wet nurse was not available, many alternatives were used in attempt to feed the infant. Most of these artificial feeding products brought about poor results and often led to the death of the infant, which was evident before the mid-19th century. With the improved sanitation and development of refrigeration, a few human milk banks were established in the early 1900s. The emergence of human immunodeficiency virus early in 1980s resulted in closure of these banks due to the risk of viral

transmission and the requirements of screening of donors and complexity of milk processing. The first of its kind Human Milk Banking Association of North America (HMBANA) was established in 1985 to lay down the guidelines for human milk banking practices, education and research in US, Canada, Mexico. It is a multidisciplinary group of health care providers that promotes, protects and support donor milk banking. HMBANA is a non-profit organization that has developed rigorous standards for the members of milk bans to screen donors, collect, process and dispense human milk whenever it was required. Taking the flagship further few more banks were developed in US and Canada [10].

In India, The first human milk bank was established at Sion hospital in Mumbai in 1989. The growth rate for these bankshave been slow. The cost of a conventional milk bank is high and unsustainable at the village or block level in India. Pasteurization process bears a major time, expertise, staff, maintenance and financial expenses. List of some of the active human milk banks in India (Table No.1) "*AMAARA*" the first pasteurized breast milk foundation in NCR in an initiative by Fortis la femme, New Delhi, towards expanding the breast milk banking in India. Presently the bank has 21 active donors who donate breast milk every 10-

15 days. The human milk collected is given to babies weighing less than 1500 gm or born before the scheduled time. Due to limitation in the availability of active donors, the bank is not able to provide milk for babies who are born normal but are otherwise malnourished [11].

Table 1: List of some active human milk banks in India.

1.	**AMAARA Milk Bank (In collaboration with Fortis la Femme)**	**Greater Kailash, New Delhi**
2.	Lokamanya Tilak Hospital (Sion Hospital),	Sion, Mumbai
3.	Cama Hospital, Fort	Mumbai
4.	KEM Hospital	Parel, Mumbai
5.	Sir JJ Group of Hospitals	Byculla, Mumbai
6.	Divya Mother Milk Bank	Udaipur, Rajasthan
7.	Dheenanath Mangeshkar Hospital and Research Centre	Pune
8.	SSKM Hospital	Kolkata
9.	Institute of Child Health	Egmore, Chennai
10.	Vijaya Hospital	Chennai

Current Scenario

Human milk is species specific and placed superior to all alternatives for new born feeding. Although bovine and plant based formulas approach has all the nutrient like fat, protein and carbohydrate composition equivalent to human milk, still they are not able to replicate the complexity or functionality of other bioactive factors found in human breast milk. The use of human milk as the primary source ofnutrition for the infants have received acknowledgementover the past decade from both national and international groups [12]. Human milk contain important immunologic, enzymatic, hormonal and endocrine factors which are completely absent in artificial formulas and thus it contributes to improved gastrointestinal maturation and function. Recently its proved by a research on preterm infants which showed improved feeding tolerance, lower infection risks and a decreased rate of necrotizing entrocolitis that is preventable to exclusive human milk feeding. In addition to the be a blessing to infants there are maternal health benefits also as well as societal and environmental advantages [13]. The WHO, UNICEF and IAP all have issued various statements declaring the importance of human milk for optimal feeding of infants. These combined efforts of multiple agencies have led to increase awareness and support to develop strategies to reduce commercialization of artificial infant feed formulas particularly in health facilities, by encouraging breastfeeding and promotion of human milk banks to provide donor milk when mothers are not available or not able to produce adequate milk for their infants [14].

The aim of human milk banking is to provide safe donor milk to (premature) infants so that the babies can get advantage of human milk when their own mother is unable to provide her milk [12].

This worldwide initiative to reduce infant mortality rate by advocating human milk feeding to all the new-borns was developed to reduce infant death by malnutrition, chronic illness, particularly in developing countries. Even in the developed countries like US and Canada, the evidences have shown that there is significant decline in the incidence of

diarrhoea, otitis media, diabetes, childhood obesity and the associated health care costs by increasing breast feeding [15]. The challenges are multifactorial, cultural and commercial pressures in promoting universal breastfeeding and the human milk. Further recommendations have been developed to support improved education and resources to promote breast milk as the best, sole nutritional source for infant [16].

Working of Human milk Banks

Donor Breast Milk Consideration

The mothers who are willing to donate milk are screened with detailed telephone and written questionnaires about their health history, potential infectious diseases, serology includes testing for hepatitis B and C as well as HIV, Creutzfeldt -jakob disease (CJD) and the human T cell Leukemia virus following the American Association of blood banks (AABB) standards[17]. Donor breast milk must be considered and handled as any other body fluid. The mother's obstetrical and lactation history is reviewed, including pregnancies, milk production, diet and if any medications she is taking. Donors should be in good health, non- smokers, not taking medications like Nicotine replacement therapy (except vitamins, insulin, hormone replacement hormones). She should have limited caffeine intake and completely avoid alcohol within specified time period. [Fig.1]

Fig 1 (a): Mothers expressing their breast milk **(b)** Donor milk is dispensed in glass bottles prior to pasteurization

Before pasteurisation, test a sample from each batch of pooled donor milk for contamination [Fig. 1(b)] and discard if samples exceed a count of: 10^5 Colony-forming units (CFU)/ ml for total viable microorganism, 10^4 CFU/ml for Enterobacteriaceae or 10^4 CFU/ml for Staphylococcusaureus. Candidates must undergo blood testing for viral diseases according to the AABB guidelines. Donors do not receive any financial compensation for their milk. This process is convenient and maintain confidentiality of the donors. The donation process takes 1-2 weeks to approved [10, 16].

Mothers are taught the recommended techniques for expressing and storing milk for donation, including good hand-washing technique, using clean containers, labelling the bottles with date when collected. Donors are advised who begin taking any medication that they should contact the milk bank to discuss suspending or stopping their breast milk donation or to stop their breast milk donation of they develop lesions, infections of the breast (including mastitis or herpes, viral fever or exanthematous disease) [8]. The milk is then frozen and brought to the milk bank or to an outlyingdepot. The milk bank also receives shipped frozen milk in insulated containers on dry ice, where it is stored in large freezers at -20 C or colder. Then the milk is thawed and pooled among multiple donors into glass flasks. It is then poured into two or four ounce sterilized glass bottles, thus preparing them for pasteurization. The bottles are placedinto water bath with temperature minimum of 62.5 C for 30 minutes [Fig.2(a)], killing bacteria and viruses but preserving the other biologically active immune factors and hormones present in human milk [10].

After pasteurization a bacterial culture is taken to ensure sterilization and milk is analysed for amount of fat, protein, carbohydrates and lactose using Milkoscope [Fig.2(b)]. Also caloric content is calculated for each batch. The pasteurized milk is cooled, labelled and placed in -20 C deep freezers where they can be stored for a year from the date it was expressed from the donor mother [6]. [Fig.3]

Fig 2 (a): Milk is pasteurized in a water bath > 62.5 ℃ for 30 min **(b)** The Milkoscope measures milk contents

Human milk is available in several formulations in these human milk banks depending upon the requirements of infants such as term milk, early term milk, colostrum, preterm milk, non- fat (0-0.3% fat for treatment of infants with chylothorax), non-dairy and several caloric densities from 20-24 kcal/oz. It is dispensed according to the medical condition of the baby and the recipients are charged with money for processing and shipping [16].

Fig 3: The pasteurized milk is stored in -20℃

Who can be the recipient?

The human breast milk is regarded as "the next best" after the biological mother's breast milk. Infants whose mothers cannot supply sufficient milk or have any special medical needs such as prematurity, allergies, failure to thrive, immune deficiencies, gastrointestinal disorders, some congenital anomalies, formula intolerance, immune deficiencies (IgA) and metabolic diseases. Studies have found that breast milk a protective effect against NEC. Moreover, if a family adopt an baby or older child with severe food allergies, that also make the candidate for donor's milk as well [18].

The demand of donor milk

Donor breast milk is increasingly become available throughout the world including in the United States, Europe, South America and Australia. The neonates who are either preterm or require gastrointestinal surgery as a new born are the most vulnerable group that has high demand for donor breast milk. According to WHO, Almost 1 million children die each year due to complication of preterm birth. Every year, an estimated 15 million babies are born preterm (before 37 completed weeks of gestation), and this number is rising. In India, out of 27 million babies born every year (2010-2013), 3.5 million babies born are premature. The donor breast milk is boon for these babies and is the only nutritional source.[19] there are many barriers that keep the baby (born preterm) for receiving their mother's milk suchas physical barrier, when a neonate is admitted to the hospital which is far from the mother's location. There may be certain medical conditions or emotional disturbance felt by the mother due to having a new-born in Intensive care unit, where she is not able to produce an adequate milk supply for her new-born. For these families donor breast milk is not the only acceptable source of nutrient for their baby, but also this will relieve the mother of tremendous stress knowing that their infant can still have human breast milk in place of artificial feed. This does not remove the mother initiative to express her own breast milk [20].

Issues related to human breast milk bank

Several studies have highlighted certain practical issues regarding the processing of human milk and feeding of premature neonates that needs to be addressed. These are:

- Method and effect of pasteurization
- Safety of the milk
- Collecting and banking
- Method of fortification
- Economic impact on banking
- Religious issues

Method and effect of pasteurization

The process of pasteurizing human breast milk inactivates bacterial and viral contaminants such as cytomegalovirus. There are certain spore-forming bacillus species are known to survive routine holder pasteurization (heating at 62.5 C for 30 minutes) but this is rare contaminant of human breast milk which is detectable from the surveillance cultures performed before and after pasteurization[21]. Most of the nutritional components are not altered or only minimally reduced in content through the process of pasteurization. New methods such as flash pasteurization (heating the milk to higher temperature for a short time) is comparativelymore effective in eliminating pathogens while preserving valuable biological substances and nutrients. Although high temperature - short terms (HTST) pasteurization are widely used in dairy industry, but none are proved for the use in human milk banks. More research needs to be performed to ensure the safety for these methods and the optimal temperature (duration) needed for pasteurization process [22].

Safety of the milk

The milk bank commonly uses the same selection and screening procedures for the donor mothers that the local blood banks uses for screening of blood donors. This is a very appropriate practice as the breast milk is produced from blood. However, the procedure of breast milk donor should include certain characteristics such as on the basis of properties of human lactation, the practices of milk banks and the vulnerability of the recipient population. In contrast to the blood products, donor milk is administered eternally Freshly collected human milk contains bacteria originating from the skin and duct micro flora of the nipples. In addition, herpes virus, cytomegalovirus, rubella and hepatitis B have been shown in human milk. Some disease (known and unknown) which are highly transferrable byhuman milk, whereas some disease which are transferrable by blood but is of least significant while giving donor breastmilk to the baby. The risk of transmission of disease throughhuman donor breast milk is rather an unexplored field. In the last few years, there was an outbreak of *coxiella burnetti*, commonly known as Q fever in Netherlands. It was known to be transmitted by consumption of raw milk from infected cattle but is also thought to potentially be transmitted by blood transfusion [23]. There are evidence of vertical transmission of Q- fever in utero, during delivery and lactation. However, pasteurization (63 C for 30 minutes) has been shown to eliminate *C. burneii* effectively from cow's milk. Nevertheless, further research and evidences is required to prove whether pasteurized milk from an infected donor possess potential risk to the premature new born [24].

Collecting and banking

There is an increase awareness of the value of human milk for infant. The vast availability of information and networking via internet has led to serious boom in the trade of human breast milk form donor to recipient. Although it has been seen that human breast milk is not properly collected and tested as per the given guidelines of HMBANA, which could lead to potential infections andhealth risks to the baby [10].

Method of fortification

Some of the researchers have shown both human breast milk

and formula feed lacks sufficient nutrients to meet high metabolic demands of premature neonates. Therefore, human milk is fortified by multinutrient supplements, comprising extra protein, fat, carbohydrates, vitamins and minerals. These nutritional supplements are derived from cow's milk, so it can be hypothesised that these bovine fortifiers are contributing factor in development of NEC in preterm infants, as seen in formula fed neonates. The study result from Sullivan *et al*. shown that infant receiving this fortifier in addition to their own mother's milk and donor milk had significantly lower risk to die or to develop NEC compared to infant fed with bovine milk-based fortifier and preterm formula in addition to their own mother's milk [25].

Economic impact on human milk banking

It is difficult to measure the full financial impact of using human donor breast milk in NICU. Till now, there have been no research published comparing the economic evaluation of donor breast milk. The processing andshipping charges of donor breast milk is still modest ascompared to the treatment cost of single case of NEC or short bowel syndrome secondary to NEC. There areevidence supporting the cost effectiveness of using donor human breast milk by reducing the length of stay, sepsis and NEC in sick hospitalized neonates. Moreover, the high cost of commercial – grade milk pasteurizers is one of the biggest barriers to implementation of human milk bank in a hospital setting A parallel benefits of this initiative is the wide spread awareness of exclusive breast feeding in the community [26].

Religious issues

The issues like human milk sharing in certain religions like Muslims have been debated among Muslim scholars. There is no unanimity of opinion. However, European Council for Fatwa and Research (ECFR) in 2004 has accepted donation by Muslim mothers and acceptance of milk by Muslim baby as legal. Most countries like UAE and Saudi Arabia world have not accepted this idea. At present there is no official position among Indian Muslim scholars on it [27].

Conclusion

The growing demand for the resource of human milk is increasing exponentially given the on-going advances in the scientific field It is equally important for professional organizations to advocate for donor milk banks and to their influence. Health professional bodies, including medical schools, schools of public health and institutions that train other allied health care workers dealing with mothers and children need to make sure that the training being given adequately covers breastfeeding and lactation management. Other groups such as child care organizations and facilities, the mass media, and educational systems have a role to play in to protect and support donor milk banking as an integral component of protecting, promoting and supporting breastfeeding in order to ensure optimal health for all infants and children, regardless of their health status at birth. In addition, the limited supply of human milk requires leaders to rise to the challenge of doing justice for mothers who have given their milk and recipients who stand to benefit from this gift. Now is the time to consider the best practices for the solicitation and distribution of this time limited and valuable resource.

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