Administration of Colostrum for the Prevention of Infection in the Low Birth Weight Infant in a Developing Country

by INDIRA NARAYANAN, K PRAKASH, R. K. VERMA *and* V. V. GUJRAL
Kalawati Saran Children's Hospital and Lady Hardinge Medical College, New Delhi, India

While considerable work has been carried out on the in vitro analysis of anti-infective factors in human milk and their efficacy in experimental animals[1-8] there have been very few clinical reports.[9-11] Studies have also been mainly carried out on infants who are able to suck directly from the breast, these being compared with bottle fed infants.[12-14] In an earlier controlled prospective study we have reported our experiences with supplementation with expressed breast milk for the prevention of infections in low birth weight infants.[15] In an attempt to determine an alternative in situations where adequate amount of breast milk may not be available we evaluated the use of limited volumes of colostrum.

Material and Methods

This study formed a part of a more extensive controlled prospective project on the use of varying quantities of expressed colostrum and mature breast milk on the prevention of infection (Narayanan *et al.*, unpublished observations). This report comprises of 66 low birth weight infants admitted in the neonatal special care unit. These were babies who ran the highest risk of acquiring infection being born to mothers who were actually or 'potentially' infected. Under the latter category were women who had 'leaking' or rupture of membranes for more than 24 hours and those who had been examined vaginally in a possibly unhygienic manner by untrained traditional birth attendants (indigenous 'dais'). Moreover, these mothers belonged to the low socio-economic and poor educational status and their personal hygiene was at best unsatisfactory. Babies with a much lower risk of acquiring major infections such as the normal term infants roomed in with their mothers and babies in the 'clean' nursery were not included in the study. Only those babies who were likely to stay for at least three days in the nursery and those who could be fed by bottle or tube at admission were included. Babies with major congenital malformations were excluded.

The infants were divided into two groups:

Group I. The babies in this group were given 10 ml of colostrum three times during the day after obtaining permission from the mother along with the nursery formula (Lactodex–Raptakos) In very low birth weight infants whose initial feeds were less than 10 ml, the volume of colostrum at any one time was equal to the total volume determined for that particular feed and it was then increased to a maximum of 10 ml three times a day. This volume was empirically chosen after noting the lower range of the average volumes that could be collected at a time from mothers in the maternity wards 48 hours after delivery, in order to ensure a constant supply to the infants. The milk was manually expressed directly into autoclaved feeding bottles by mothers within 72 hours after delivery, under the supervision of trained personnel. The colostrum was transported from the wards to the nursery in ice in a thermocole (insulated) container and all used within one hour of collection. Milk samples collected at home and brought to the hospital by the relatives were not utilized for the study, but mothers were encouraged to come to the nursery as often as possible.

Group II. (Control) Infants were given only the nursery formula.

Being part of the larger study, allocation of the babies into the groups was by a randomized block design[16] in order to make the groups relatively homogeneous for predisposing factors which could influence the occurrence of infections and which could be identified at the time of admission. These included birth weight, prolonged labour, prolonged 'leaking' or rupture of membranes for more than 24

Acknowledgements

The authors are grateful to the Indian Council of Medical Research for having funded this study. They wish to express their grateful appreciation to Dr. Shashi Bala, Miss Shobhana Baijal and Miss Indu Walia for their untiring efforts to obtain human milk They are also thankful to Dr. S Chawla, principal, Lady Hardinge Medical College, New Delhi for having granted permission to publish this paper.

hours, obvious maternal infection, vaginal examination by indigenous 'dais' and birth asphyxia.[15]

The identification of the various infections was according to defined criteria which were set at the beginning of the study.[17,18,19] The total volume of milk given daily to the infants was similar in both groups and was determined by the weight, gestational period and postnatal age.[20] The criteria for discharge were again the same in the two groups and were based on a planned early discharge programme which has been found to be useful.[21] Random samples of breast milk and the nursery formula were sent daily for culture.

The results were evaluated by standard statistical tests.[16]

Observations

Some difficulty was experienced in collecting colostrum as mothers often believed that the breasts did not secrete milk during the first three days. However, with some perseverance on the part of the staff many of them could be motivated. No mother in this study objected to the use of milk from another woman for her own infant where required.

The sex, birth weight, and assessed period of gestation are indicated in Table 1 and were statistically comparable in the two groups. Some of the other predisposing factors are shown in Table 2. There was again no statistically significant difference.

Seven babies in group I and eighteen infants in group II developed infection, some having multiple problems. The actual infections are recorded in Table 3. Infection was less in group I and this difference is statistically significant ($p < 0.01$). The organisms isolated in the major infections included *E. coli*, *Klebsiella*, *Staph. aureus*, and *Serratia marcescens*. The numbers, however, were too small, particularly in group I to determine the relationship, if any, to the type of milk feeding.

TABLE 1
Distribution of sex, birth weight and gestation

	Group I	Group II
1. Total number	33 (7)	33 (18)
2. Sex		
Males	18 (4)	18 (10)
Females	15 (3)	15 (8)
3. Weight		
1,001–1,500 gm	3 (2)	2 (2)
1,501–2,000 gm	23 (5)	22 (15)
2,001–2,500 gm	7	9 (1)
4. Gestation		
28–32 weeks	1 (1)	1 (1)
33–36 weeks	20 (6)	21 (13)
⩾ 37 weeks	12	11 (4)

Note: The figures in parentheses indicate the babies who developed infection

TABLE 2
*Distribution of some predisposing factors**

	Group I	Group II
1. Prolonged labour	3 (11)	3 (2)
2 Prolonged leaking	3 (1)	3 (2)
3 Obvious maternal infection	11 (3)	11 (7)
4. Vaginal examination by 'dais'	9 (3)	9 (8)
5. Birth asphyxia	8 (1)	8 (6)

Note: The figures in parentheses indicate the babies who developed infection.

* Some babies had more than one predisposing factor.

TABLE 3
Types of infection

Infection	Group I	Group II
1 Diarrhoea	1	8
2. Pneumonia	—	2
3. Septicaemia	4	9
4. Conjunctivitis	5	6
5. Pyoderma	1	2
6. Thrush	1	5
7. Upper respiratory tract infection	1	1

Regarding the duration of stay, for babies who did not develop any infection there was no statistically significant difference between the two groups (group I—6.44 ± 3.55 days and group II—5.66 ± 1.54 days). The minor variations were due to the fact that smaller babies were surviving in group I and hence the mean stay was slightly longer. The corresponding figures for babies who developed infection and recovered were as follows; group I—8.25 ± 5.31 days and group II—10.1 ± 5.37 days. The differences, which were again not statistically significant, were due to the fact that there were more major infections in group II and hence the mean stay was somewhat longer.

Due to lack of milk bank facilities, samples were sent for culture just before the milk was given to the babies and the results were known only the next day. The infants were kept under close observation for any untoward signs. As far as the bacteriological analysis of expressed breast milk was concerned among 346 samples, 292 were either sterile or grew nonpathogenic organisms (micrococci, Staph. epidermidis, aerobic spore bearers, etc.) with a count of ⩽ 2,500 organisms/ml. In 18, the count was between > 2,500–5,000 organisms/ml and in 5, it exceeded 5,000 organisms/ml, the highest being 20,000/ml in one case. In 32 specimens, pathogenic organisms were isolated as indicated in Table 4. It was interesting to note that none of the babies fed with the aliquots of milk, samples of which had grown pathogenic microorganisms developed infection. All samples of the nursery formula were sterile.

TABLE 4
Bacteriological analysis of expressed breast milk: potential pathogens

	Bacterial counts/ml			
	≤ 2,500/ml	> 2,500–5,000/ml	5,000–7,000/ml	Total
E. Coli	10	5	2	17
Klebsiella	9	2	1	12
Staph. aureus	3	—	—	3

Discussion

In many communities in India, mothers unfortunately refrain from giving breast feeds during the first two to three days for a variety of reasons.[22] Some feel that milk secretion is inadequate in the early days after delivery and being more yellowish in colour than mature breast milk colostrum is considered unsafe for the baby. Still others do not breast feed until a traditional ceremony is performed on the second or third day. In the meantime the babies are offered other fluids such as water with sugar, glucose, honey or jagaree, other animal milks or herbal concoctions (eg 'Janam ghutti'). The composition of the latter is variable and some infants have actually been brought to hospital after the administration of such herbal preparations with signs of opium toxicity. Thus, besides losing the benefits of colostrum and early breast feeding, the babies actually run the risk of poisoning, inhalation due to forced feeding with a spoon of viscid fluids and infection due to unhygienic administration.[22] The advantages of colostrum should, therefore, be widely publicized in these areas and the mothers must be encouraged to put the baby to the breast as soon as possible.

In the event that a small baby is unable to suckle from the breast but is able to suck from a bottle, based, on our present and earlier experiences[15,23] we recommend that breast milk should be expressed directly into sterilized bottles after washing the breasts with soap and water, and the milk offered immediately to the infant. The mother's own milk or, when it is inadequate milk from a willing healthy relation or friend may be used.[23] We have been recommending this to the mothers of our low birth weight babies after discharge and have found it to be of benefit. Preliminary results in our follow-up study suggest that major infections are less in such infants than in those who receive other fresh animal or powder milks by bottle. In remote rural communities some of the preterm and low birth weight infants have to be managed at home.[24] We are of the opinion that expressed breast milk should be of great value in such a situation.

We are in the process of evaluating the use of larger volumes of colostrum, 15–20 ml three times a day. Preliminary analysis has shown a trend towards better results. We are aware that one can not administer very large volumes of colostrum over long periods without adequate biochemical monitoring of the infants since the composition of colostrum is different from that of mature breast milk.[25] Further work would be required to determine the safe limits.

In most centres in developing countries, bacteriological analysis of human milk prior to administration may not always be feasible. It was interesting to note in the present study that even in those cases where potentially pathogenic organisms were isolated in the milk sample, the infants did not develop infection. It is possible that the presence of secretory IgA and other factors provide protection.[26] However, how much load can be administered with impunity is not known and hence all attempts must be made to avoid contamination. While it is essential that human milk banks in advanced centres should adhere to their rules for careful selection of milk,[27,28] absence of such facilities in developing countries should not preclude the use of expressed breast milk provided proper care is taken. In these situations the advantages of human milk, especially the nutritive, economic and anti-infective benefits, far outweigh the theoretical risks.

Summary

The efficacy of limited volumes of colostrum (10 ml) administered three times a day in the prevention of infection was evaluated in 33 high risk low birth weight infants (group I) who were compared with 33 matched controls (group II). Infections were found to be significantly less ($p < 0.01$) in group I.

References

1. Jelliffe DB, Jelliffe EFP. The uniqueness of human milk. Am J Clin Nutr 1971; 24: 968–1025.
2. Michael JG, Ringerback R, Hottenstein, S. The antimicrobial activity of human colostral antibody in the newborn. J Infect Dis 1971; 124: 445–8.
3. Hanson LA, Winberg J. Breast milk and defense against infection in the newborn. Arch Dis Child 1972; 47: 845–8.

4. Goldman AS, Smith CW. Host resistance factors in human milk. J Pediatr 1973; 82: 1082–90.
5. Ogra SS, Ogra PL. Immunological aspects of human colostrum and milk I Distribution—Characteristics and concentrations of immunoglobulins at different times after the onset of lactation. J Pediat 1977; 92: 546–9.
6. Editorial-Breast feeding: The immunological argument. Brit Med Jour 1976; 1: 1167
7 Welsh JK, May JT. Anti infective properties of breast milk. J Pediatr 1979; 94: 1–9.
8 Barlow B, Santulli TV, Heird WC, Pitt J, Blanc WA, Schullinger JN. An experimental study of acute neonatal enterocolitis, the importance of breast milk. J Pediatr Surg 1974; 9: 587–94.
9. Svirsky-Gross S Pathogenic strains of coli (0 111) among prematures and the use of human milk in controlling the outbreaks of diarrhoea Ann Paediatr 1958; 190: 109–15.
10. Largua AM, Uraman J, Stoliar OA, Ceriani JM, O'Donnell A, Buscuglia JC, Martinez JC. Fresh human colostrum for prevention of E. coli diarrhoea—a clinical experience. J Trop Pediat 1977; 23: 289–92.
11. Winberg J. Wessner G Does breast milk protect against septicaemia in the newborn? Lancet 1971, 1: 1091–4.
12. Mellander O, Vahlquist B, Mellbin T. Breast feeding and artificial feeding. Acta Paediat Uppsala 1959; 48: Supp. 116
13. Mata LJ, Wyatt RG. The uniqueness of human milk Host resistance to infections. Am J Clin Nutr 1971, 24: 976–86.
14. Wyon JB, Gordon JE The Khanna Study. Cambridge: M.I T. Press, 1971
15 Narayanan I, Prakash K, Bala S, Verma RK, Gujral VV Partial supplementation with breast milk for prevention of infection in the low birth weight infant—a preliminary report. Lancet 1980; ii: 561–3.
16. Armitage P. Statistical methods in medical research. Oxford and Edinburgh: Blackwell Scientific Publications, 1971.
17. Davies PA. Bacterial infections in the foetus and newborn. Arch Dis Child 1971; 46: 1–27.
18. Bergquist G, Eriksson M, Zetterstrom R. Neonatal septicaemia and perinatal risk factors. Acta Paediat Scand 1979; 68: 337–9.
19. Yeung CY, Tam ASY Gastric aspirate findings in neonatal pneumonia Arch Dis Childh 1972; 47: 735–40.
20. Berger HM, Scott PH, Kenward C, Scott P, Wharton BA. Curd and whey proteins in the nutrition of low birth weight babies. Arch Dis Childh 1979; 54: 98–104.
21. Karan S. Early discharge of low birth weight babies and their outcome. Current Topics in Pediatrics. New Delhi. Interprint, 1979, 228.
22 Narayanan I, Gujral VV. Infant feeding patterns in an urban community Arch Childh Hlth 1980, 22: 7–15.
23 Narayanan I, Paul S, Mitter A, Gujral VV. The role of the mother/mother-figure in the care of the high risk newborn infant in a developing country. Ind J Pediatr 1980; 47: 27–32.
24. Kumar V. Home care of the newborns and management of high risk pregnancies in rural India Ind J Pediatr 1980, 47 33–36.
25. Gyorgy P Biochemical aspects of human milk Am J Clin Nutr 1971; 24. 970–75.
26. Williams RC, Gibbons RJ. Inhibition of bacterical adherence by secretory immunoglobulin A: A mechanism of antigen disposal. Science 1972, 177: 697–9.
27. Williamson S, Hewitt JS, Finucane E, Gamsu HR. Organisation of raw and pasteurized human milk for neonatal intensive care. Brit Med J 1978; 1. 393–6.
28. Davidson DC, Poll RA, Roberts C Bacteriological monitoring of unheated human milk. Arch Dis Childh 1979, 54 760–4