ORIGINAL ARTICLE

Effect of caesarean section on breast milk transfer to the normal term newborn over the first week of life

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Objective: To determine the effect of caesarean section on breast milk transfer (BMT) to the normal term infant over the first week of life.
Method: A sample of 88 healthy nursing mothers who had a normal vaginal delivery, and 97 mothers who had a caesarean section were recruited from a teaching hospital. Mothers and midwives were instructed to weigh the infants before and after each feed throughout the study period using calibrated portable electronic scales.
Results: The volume of milk transferred to infants born by caesarean section was significantly less than that transferred to infants born by normal vaginal delivery on days 2 to 5 ($p < 0.05$), but by day 6 there was no difference between the two groups ($p = 0.08$). The difference could not be explained by any of the maternal and infant variables measured. Birth weight was regained by day 6 in 40% of infants born vaginally compared with 20% in those born by caesarean section.
Conclusion: There is a lag in the profile of the daily volume of breast milk transferred to infants delivered by caesarean section compared with those born by normal vaginal delivery. This study also challenges the widely followed schedules of milk volumes considered to be suitable for the term infant, which appear to be excessive, at least for the first four to five days post partum.

The effect of obstetric procedures on the transfer of breast milk from nursing mothers to their infants is not known. Anecdotal evidence suggests that variability in breast milk transfer (BMT) is dependent on the mode of delivery of the infant. BMT is a function of a finely tuned feedback mechanism, which is potentially susceptible to pharmacological, physical, and psychological manipulations of the mother and/or her infant.

The effect of maternal opioids on newborn motor and respiratory behaviour is well documented. Nissen *et al*[1] have shown a delay in rooting and suckling behaviour in infants whose mothers received one modest dose of intramuscular pethidine in labour. These initial infant reflexes are considered pivotal in promoting BMT.

The importance of maternal regional anaesthesia on the newborn's neurobehaviour is difficult to assess. There is no uniform neurobehavioural assessment tool, and changing anaesthetic protocols make it difficult to compare one study with another and relate them to continually evolving contemporary practice. Nevertheless, newborn effects have been reported. Scanlon *et al*,[2] using a combination of neurological tests, found that infants whose mothers received a continuous epidural block using lignocaine had lower motor scores, including rooting behaviour, than infants where a block was not used. This effect persisted for at least eight hours. However, the use of epidural bupivacaine did not appear to have the same effect in a later study by the same author.[3] Study infants were similar to the non-medicated control group. Yet, using the neonatal behavioural assessment scale, Sepkoski *et al*[4] found that epidural bupivacaine did affect infant orientation and motor scores, even after confounding variables had been controlled for.

The effect on BMT after physical or psychological manipulation of the mother-infant pair as a consequence of a caesarean section is even less well defined. Nissen *et al*[5] found a reduction in the pulsatility profile of oxytocin and less prolactin released during early suckling episodes in mothers who had an emergency caesarean section compared with those who had a normal vaginal delivery. Oxytocin and prolactin play an important part in breast milk ejection and milk synthesis respectively.

Thus evidence on the influence of caesarean section on BMT is, at best, indirect. We therefore carried out a comparative study of directly measured BMT over the first week of life in healthy term infants born by spontaneous normal vaginal delivery (NVD group) or caesarean section (CS group).

PATIENTS AND METHODS

A sample of healthy nursing mothers and their healthy singleton term infants with birth weight greater than 2800 g was enrolled immediately after birth. The sample was taken from a metropolitan hospital in South Australia with an inhouse birth rate of about 2400 a year. The study was carried out between 1998 and 1999. All mothers exclusively breast fed during the course of the study.

A normal vaginal delivery was defined as being spontaneous onset, unaugmented, without obstetrical intervention, and without regional anaesthesia, although nitrous oxide and one dose of intramuscular pethidine was available in labour. Caesarean section was classified as either elective (without labour) or emergency.

Regional anaesthesia was either spinal (2.5 ml 0.5% bupivicaine, 100 µg morphine) or epidural (20 ml 2% lignocaine). Pain relief after delivery was epidural (50 mg pethidine as required) or oral paracetamol-codeine.

Each mother was supplied with a portable Wedderburn electronic scale (Tanita 1581; accuracy ± 5 g) and instructed how to weigh her infant and record the result in grams. Each scale was calibrated at the start and end of the study. Infants were demand fed and weighed fully clothed, immediately before and after each suckling episode (breast feed) throughout the six day period from birth. The difference between the

Abbreviations: BMT, breast milk transfer; CS, caesarean section; NVD, normal vaginal delivery

Table 1 Maternal and infant characteristics by group

	Normal vaginal delivery (n=88)		Caesarean section (n=97)	
Maternal age (years)	29.3 (0.63)		30.1 (0.57)	
Parity				
Primiparous	18	(20.5%)	52	(53.6%)*
Multiparous	70	(79.5%)	45	(46.4%)*
Breast feeding experience				
Yes	66	(75%)	42	(43.3%)*
No	22	(25%)	55	(56.7%)*
Smoking status				
Yes	12	(13.6%)	20	(20.5%)
No	76	(86.4%)	77	(79.5%)
Maternal education				
Secondary school	55	(62.5%)	49	(50.5%)
Metric	8	(9.1%)	11	(11.4%)
Certificate/diploma	10	(11.4%)	17	(17.5%)
Tertiary	15	(17%)	20	(20.6%)
Maternal occupation				
Unskilled	35	(39.8%)	46	(47.4%)
Skilled	49	(55.7%)	46	(47.4%)
Management/professional	4	(4.5%)	5	(5.2%)
Infant birth weight (g)	3544	(40)	3491	(50)
Sex				
Male	53	(60.2%)	51	(52.6%)
Female	35	(39.8%)	46	(47.4%)
Apgar scores				
1 minute	8.3 (0.14)		7.9 (0.16)	
5 minutes	9.2 (0.07)		9.2 (0.07)	
First breast feed				
<1 h	57	(64.8%)	18	(18.6%)*
1–<4 h	29	(32.9%)	53	(54.6%)*
>4 h	2	(2.3%)	26	(26.8%)*

Unless otherwise indicated, values are mean (SE).
*p<0.001.

two recordings was calculated by the investigator analysing the data collected in four hourly epochs from birth. From these weight data, BMT was calculated as ml/kg birth weight/24 h postpartum period. Naked weights for all infants were recorded at birth and on day 6 (before a feed).

Realistically, some mothers would be unlikely or unable to enter data in the first four hours after birth (epoch 1). In this case, the value for the first epoch (if it was missing) was to be imputed by averaging the other five epochs of that 24 hour period.

For days 2–6 (epochs 7–36), any mother who failed to enter data for four or more feeding episodes was excluded from the study. For the remaining mothers, where data were missing, the value of the missing observation was imputed by averaging the two adjacent values.

Maternal variables collected included age, parity, previous breast feeding experience, smoking status, socioeconomic profile, drugs used during labour, and type of anaesthesia (regional or general anaesthetic). Duration of labour and degree of perineal trauma were recorded for vaginal deliveries. Infant variables included sex, time to first breast feed (0 to < 1 h, 1 to < 4 h, > 4 h after delivery), one and five minute Apgar score, birth weight, and percentage weight change from birth weight to weight on day 6.

Written informed consent was obtained following guidelines stipulated by the committee on clinical investigations (ethics) at Flinders Medical Centre.

Statistical analysis

Data were analysed using SPSS version 10 for Windows. A sample size of 60 in each group had a 90% power to detect a difference in total BMT over the first six days from birth of 60 ml/kg birth weight (the expected difference between the NVD and CS groups) assuming that the common standard deviation was 100 using a two group *t* test with a 0.050 two sided significance level. This was based on the volume of breast milk likely to be transferred to a term infant (600 ml/kg birth weight) over the first six postnatal days.[6]

Independent samples Student's *t* tests were used to assess differences between group means. Analysis of covariance was used to assess differences between group means after adjustment for potentially confounding variables.

RESULTS

A total of 240 mothers were recruited to the study. Removal of incomplete records left data for 185 mother-infant pairs available for analysis (77%). This comprised 88 mothers with a normal vaginal delivery and 97 mothers delivered by caesarean section, of which 45 had an elective and 52 an emergency section.

Twenty six mothers in the NVD group had sufficiently complete information for the first 24 hours, whereas for days 2–6, data for a further 62 were available (total 88). Twenty three mothers in the CS group had sufficiently complete information for the first 24 hours, whereas for days 2–6, data for a further 74 were available (total 97).

Of the 97 mothers in the CS group, 91 (94%) had regional anaesthesia, and six had general anaesthesia. Of the former, 41 had epidural and 50 had spinal blocks.

Except for parity, previous experience of breast feeding, and time from delivery to first breast feed, there were no significant differences in relevant maternal or infant variables in the NVD and CS groups, as measured by Student's *t* test and χ^2 test where applicable (table 1).

Student's *t* tests showed that, of the two CS groups, emergency CS had a significantly higher mean BMT on day 2 ($p = 0.047$) and day 4 ($p = 0.044$). However, the profiles of BMT were very similar and certainly not clinically different. Accordingly, the CS groups were combined for this study. Student's *t* tests also showed that there was no significant difference in BMT between the spinal anaesthesia and the epidural anaesthesia group.

Table 2 shows the mean BMT for infant-mother pairs in the NVD and CS groups from birth to the end of day 6. For each of the six days, the mean BMT in the NVD group was consistently greater than the corresponding BMT in the CS group. Student's *t* tests showed that the differences were significant for days 2–5. Figure 1 shows these differences and clearly indicates the lag in BMT seen in the infants born by caesarean section.

Analysis of covariance was used to assess the difference between mean BMT on days 1–6 between the NVD and CS groups after adjustment for breast feeding experience, parity, and time to first breast feed. The results were quite similar, except that the difference in day 1 means became significant ($p = 0.03$). Notably, in neither the NVD nor CS group did time to first breast feed appear to influence total milk volume over the study period.

Birth weight was regained by day 6 in 40% of infants in the NVD group, but by only 20% of those in the CS group ($p = 0.003$). This probably reflects the significant difference in total BMT over days 1–6 between the two groups (table 2).

Student's *t* test showed that pethidine in labour did not appear to affect BMT for those mothers delivering vaginally.

DISCUSSION

The aim of this study was to investigate a clinical notion held by experienced midwives that lactogenesis is delayed in mothers delivered by caesarean section.

Lactogenesis was indirectly assessed by weighing the infants immediately before and after suckling on identical calibrated portable electronic scales. Cognisant of the relative inaccuracy of the scales and the potential error inherent in the two weighings, we sought to minimise these errors by ensuring a relatively large sample size.

Table 2 Breast milk transfer (ml/kg body weight) for days 1–6

Group	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Total days 1–6
NVD							
Mean (SE)	6 (1.4)	25 (2.2)	66 (3.6)	106 (3.9)	123 (4.5)	138 (3.9)	450 (30.4)
Number	26	88	88	88	88	88	26
CS							
Mean (SE)	4 (0.6)	13 (1.1)	44 (2)	82 (3.5)	111 (3.5)	129 (3.2)	358 (22.1)
Number	23	97	97	97	97	97	23
Unadjusted significance	0.151	<0.001	<0.001	<0.001	0.033	0.079	0.020
Adjusted significance	0.031	<0.001	0.001	<0.001	0.046	0.118	0.001

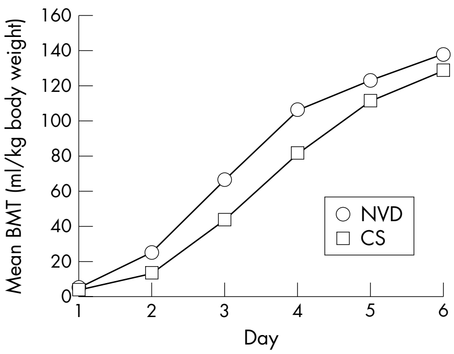

Figure 1 Profile of breast milk transfer (BMT) over the first six postnatal days to infants born by caesarean section (CS) or normal vaginal delivery (NVD).

There was the potential for a Hawthorn effect to have taken place—that is, the weighing process may have influenced the amount of breast milk expressed. However, this effect, if any, might have been to increase or decrease the volume of breast milk expressed. Regardless, the study was primarily designed to be a comparative study.

The profile of breast milk volumes taken by the infant over the first 6 days of life appears to be much less than artificial feeding regimens recommended in contemporary neonatal texts. However, the evidence for such regimens appears to be empirical. Our findings suggest that artificially fed infants are subjected to excessive loads of water and substrate when these feeding regimens are followed.

Our results show that the volume of breast milk transferred to infants born by caesarean section is less than that transferred to infants born by normal vaginal delivery over the first 6 days of life. Not only was this statistically significant but probably clinically significant as indicated by the weight profiles of these two populations over this period. By day 6, only 20% of infants in the CS group had regained their birth weight compared with 40% in the NVD group. However, by day 6 the difference in BMT between the two groups was smaller and not significant, suggesting that this effect on lactation, or BMT, is transient.

Although it would seem intuitive that labour, previous breast feeding experience, and the timing of the initial suckling contact could influence BMT throughout this postpartum period, differences in the BMT could not be explained by any of the maternal and infant variables measured except on the first day when time after delivery to first breast feed had a transient effect. About 25% of infants in the CS group had not suckled within the first four hours post partum compared with only 3% in the NVD group. However, this was shown to have little impact on total milk volume over the study period. The study did highlight the unacceptable delay in initiating the first infant-breast contact, especially in the CS group. This was determined to be a system problem which has subsequently been addressed.

Unmeasured but potentially confounding variables, such as the effects of maternal perioperative stress, degree of hydration, blood loss, mobility score, anaesthesia, and postoperative analgesia, on maternal lactation and infant suckling may have contributed to the observed differences. Further, it could be argued that women requiring caesarean section may be physiologically or psychologically different from mothers having a normal vaginal delivery. However, information on these potentially confounding variables was not collected. The effect of general anaesthesia on BMT could not be investigated in this study as almost all caesarean sections were performed under regional block.

Although this study shows a significant lag in the naturally progressive postpartum BMT profile in term infants delivered by caesarean section compared with those delivered vaginally without obstetric intervention, it is unlikely that this has any long term detrimental effect on the child. Furthermore, whether or not this lag in BMT influences long term lactation is debatable.

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