

Breast-feeding and plasma oxytocin concentrations

A LUCAS, R B DREWETT, M D MITCHELL

Summary and conclusions

The patterns of response of oxytocin to a breast feed were studied in 10 mothers in the first week post partum. The initiation of lactation did not appear to be related to release of oxytocin. In established lactation an oxytocin response did not appear to be essential for adequate milk flow and did not occur always at the time of peak milk flow. The only factor identified that positively correlated with release of oxytocin was multiparity. In those subjects who showed a response the hormone was released in surges, some of which persisted in the circulation for less than one minute.

These findings cast some doubt on the conventional view that release of oxytocin is essential for satisfactory milk flow during breast-feeding.

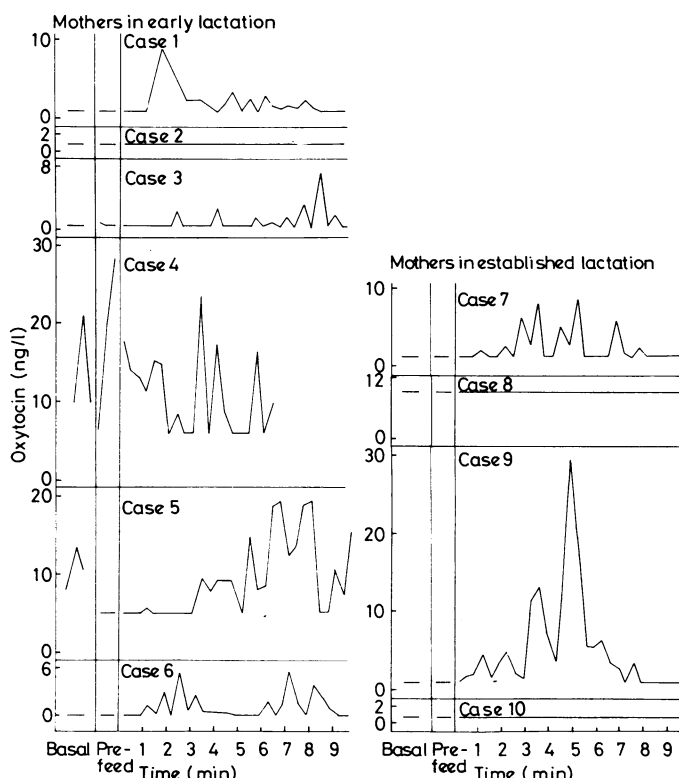
Introduction

Stimulation of the milk ejection reflex is widely assumed to play an essential part in satisfactory breast-feeding, comparable with that played in other mammalian species.¹⁻³ This assumption has led to the use of synthetic oxytocin in the management of breast-feeding.^{4,5} A clear definition of the circumstances in which this may be of value depends on more precise knowledge of the role of oxytocin in normal lactation. With the advent of highly sensitive radioimmunoassays for measuring circulating oxytocin concentrations the physiological response of oxytocin during breast-feeding can now be monitored closely. In this study we measured plasma concentrations of oxytocin via a peripheral venous sampling line in 10 mothers throughout a feed from the first breast during the first week of lactation.

Patients and methods

With the approval of the Oxford ethics committee we studied 10 mothers who had delivered per vaginam healthy term infants (gestational age 37-40 weeks) of appropriate weight for gestational age (birth-weight range 2750-3770 g). Six of the mothers (cases 1-6) were studied in early lactation on the first to third postpartum days, and four mothers (cases 7-10) were studied in established lactation on the fifth to seventh postpartum days. Allocation to these groups was random. All the mothers and their infants were well and not receiving any medication. Maternal haemoglobin concentrations were all above 11 g/dl. Forty-five minutes before a feed (the second, third, or fourth of the day) a peripheral venous sampling line was set up using a narrow-gauge needle that would not cause subsequent discomfort. Fifteen minutes before the feed three basal blood samples (1.5 ml) were taken over one minute. The infant at this stage was not in the room, so that possible release of oxytocin by the proximity of mother and infant was avoided. During the minute before suckling started, but

with the infant in the mother's arms, three more samples (prefeed samples) were taken to assess the extent of any "anticipatory" release of oxytocin. Further samples were taken over successive 20-second periods during a feed from the first breast. The dead space of the sampling system was 20% of the sample size. The sampling was continuous and blood in the dead space not discarded, so that blood taken in the last four seconds of each 20-second sampling period was included in the next sample. The feed lasted 10 minutes (except in one



Plasma oxytocin concentrations in all 10 mothers. Basal values were obtained 15 minutes before the feed (with the infant out of the room), and prefeed values during the minute before suckling started. Subsequent values represent measurements on samples drawn continuously over successive 20-second periods. Mothers in early lactation (cases 1-6) were one to three days post partum; those in established lactation (cases 7-10) were five to seven days post partum. (For technical reasons, in two mothers (cases 1 and 5) three samples in each case were taken over 40-60 seconds.)

mother (case 4), in whom it took seven minutes). Feeding was carried out with the mother seated and the infant lying across her lap on a pillow. An experienced nurse helped the mother attach the infant to the breast. The sampling procedure did not appear to interfere with the feed. Venous occlusion was not required.

The blood samples (up to 36 aliquots of 1.5 ml) were collected on ice and immediately after the study were centrifuged at 4°C and separated, the plasma being stored at -20°C. Plasma oxytocin concentrations were measured in duplicate on each sample using a highly sensitive radioimmunoassay as described.⁶

To determine the volume of the feed the infants were weighed before and after the feed using a sensitive electronic balance that recorded weighing accurate to 1 g.⁷

Statistical analyses were by the non-parametric Mann Whitney rank sum test unless otherwise stated.

John Radcliffe Hospital, Oxford

A LUCAS, MRCP, clinical research fellow, university department of paediatrics (present appointment: lecturer in paediatrics, Addenbrooke's Hospital, Cambridge)

M D MITCHELL, DPHIL, MRC senior fellow, Nuffield department of obstetrics and gynaecology

Department of Psychology, University of Durham

R B DREWETT, BA, DPHIL, lecturer

Results

The figure shows the 10 records of oxytocin release. The basal values recorded are the means of the three consecutive samples, each taken over 20 seconds. Although interassay variation was low (11%),⁶ the sensitivity of individual assays varied, accounting for slightly different limits of detectability in different subjects. In each series of measurements the samples in which oxytocin was not detectable were assigned the value of the lower limit of detection (shown as a horizontal line on each graph). The total oxytocin response to a feed was obtained by measuring the area under the curve above the limit of detection and recorded in arbitrary units (table).

In three patients (cases 2, 8, and 10) oxytocin showed no response to feeding. Comparing the total oxytocin responses in the mothers in early and established lactation showed no significant difference. The total oxytocin response was greater ($p < 0.04$), however, in multiparous mothers (cases 1, 4, 5, 6, 8, and 9) than primiparous mothers (cases 2, 3, 7, and 10). No correlation could be found by Spearman's rank correlation between total oxytocin response and either the number of previous children or the number of children breast-fed (see table).

Feed volume, oxytocin release, parity, and number of previous infants breast-fed for all 10 patients studied

Case No	Feed volume (ml)	Oxytocin release*	Parity	No of previous infants breast-fed
<i>Mothers in early lactation</i>				
1	0	33	5+1	5
2	0	0	0+0	0
3	1	15	0+0	0
4	2	93	2+0	2
5	9	123	4+1	4
6	9	28	2+1	1
<i>Mothers in established lactation</i>				
7	21	27	0+0	0
8	23	0	1+0	1
9	60	122	2+0	1
10	66	0	0+0	0

*Measured in arbitrary units reflecting the area under the oxytocin response curve during the feed, taking the lower limit of detection to be zero response.

Milk flow in the mothers in early lactation was minimal (range 0-9 ml from the first breast), whereas in the mothers in established lactation it was in the range 21-66 ml.

Discussion

The 10 records in the figure show in detail the patterns of oxytocin release during physiological feeding in early lactation. In those subjects in whom an oxytocin response was recorded—that is, a rise above the lower limit of detection occurred—the hormone often appeared to be released into the circulation in short surges. The record for one patient (case 4) shows in the last four minutes of the feed three such surges lasting only 40-60 seconds. In some subjects—for example, cases 5 and 9—the plasma oxytocin concentration remained raised for several minutes, though this might represent the fusion of several discrete surges. Oxytocin appears to have an extremely short half life in maternal plasma at this stage of lactation, and clearly in studies of this nature frequent sampling is needed to obtain an accurate record of the release of the hormone.

The magnitude of oxytocin release was not significantly different between the mothers in early and established lactation, so the increase in milk flow during the first week of lactation does not appear to be due to an increased oxytocin output. As a corollary, the appreciable responses seen in some of the mothers in early lactation (for example, cases 4 and 6), in whom milk flow was minimal, suggests that the poor milk output in early lactation is not due to a failure of release of the hormone.

Interestingly, oxytocin was not detectable in some cases. Of

the four subjects in established lactation (cases 7-10), two (cases 8 and 10) showed no detectable rise in oxytocin yet produced adequate volumes of milk during the feed (23 and 66 ml respectively from one breast; the average milk transfer from the first breast at this stage of lactation is reportedly 37 ml⁷). Plasma oxytocinase may possibly have contributed to the low oxytocin concentrations found in some subjects, but the rapid collection of samples on to ice and prompt separation and storage of plasma at -20°C would have minimised enzymatic degradation.

Our data must cast some doubt on the concept that release of oxytocin is necessary for the ejection of milk from the breast. Inspection of the response patterns shows that in several subjects oxytocin was released maximally in the middle or even towards the end of the feed, whereas our previous studies⁷ in a population of mother-infant pairs showed that on the sixth day post partum 50% of milk flow has occurred within two minutes and 90% within four minutes of the start of a feed from the first breast. Thus the timing of oxytocin release may not coincide with peak milk flow. Indeed, our previous data on the pattern of milk flow would have led us to predict high oxytocin concentrations at the onset of the feed, yet, surprisingly, none of the mothers in established lactation showed a prefeed rise in oxytocin concentrations and only one showed an increased concentration in the first two minutes of the feed. The only subject in whom the concentration rose appreciably both before and at the beginning of the feed (case 4) was in early lactation and she produced only 2 ml of milk during the study.

Although we found little relation between oxytocin release and milk flow, we observed a significant positive correlation between the oxytocin response and multiparity. This may accord with the findings of Sandholm⁸ that the average rise in intramammary pressure is greater in multiparas than primiparas. All six multiparous mothers in the study had breast-fed their previous infants. Thus oxytocin release may perhaps be modified by previous experience of breast-feeding.

We studied the pattern of oxytocin release in the first week of lactation in only a small sample. Clearly further studies are needed, in particular to examine the pattern of release later on, since it may change at different stages of lactation. The role of oxytocin in human lactation may need to be re-evaluated, however, since our data show that successful transfer of milk can occur in the absence of detectable changes in plasma oxytocin concentrations.

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