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A Comparison of Early Sucking Dynamics During Breastfeeding After Cesarean Section and Vaginal Birth

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Abstract

Background: The impact of cesarean section (CS) birth and pethidine for post-CS epidural analgesia on early breastfeeding behavior is unclear. This study aimed to measure infant sucking and breastfeeding behavior in infants of mothers who delivered by CS (CS group) and used pethidine patient-controlled epidural analgesia (PCEA) after CS with that of infants who were delivered by vaginal birth (V group), during secretory activation and again after the establishment of lactation.
Subjects and Methods: Sucking dynamics and milk intake of breastfeeding infants were assessed on approximately 3 and 20 (follow-up) days postpartum (CS group, $n=19$; V group, $n=15$). Nipple diameters, tongue movement, and nipple position during sucking were measured from ultrasound scans of the intra-oral cavity during breastfeeding. Time of the first breastfeed and day of breast fullness were recorded, and infant neurobehavior was assessed.
Results: CS infants displayed more anterior tongue movement on Day 3 than at follow-up compared with the V group, which showed a similar amount of movement at each assessment (p for interaction <0.001). Compared with the V group, the CS group showed faster suck rates, especially on Day 3 ($p<0.001$), later times to first breastfeed ($p=0.01$) and breast fullness ($p=0.03$), and lower neurobehavioral scores ($p=0.047$). Breastfeeding duration and milk intake were similar between groups.
Conclusions: Although the observed effect of CS birth followed by pethidine PCEA after CS during the period of secretory activation was small, our results indicate that successful initiation of lactation may require additional breastfeeding support and monitoring at Day 3 postpartum for mothers who undergo CS.

Introduction

Globally, cesarean section (CS) birth now accounts for 15% of all deliveries,[1] yet this mode of delivery has been shown to negatively impact both the initiation and duration of lactation.[2–4] Analgesia for pain relief after CS can impact the infants' ability to latch on the breast and suck effectively to remove milk. [5] Pethidine, a lipophilic opioid used for patient-controlled epidural analgesia (PCEA) after CS, is effective, but the opioid and its metabolite norpethidine may adversely affect the infant. In adults pethidine has a half life of 3–6 hours and is metabolized in the liver to norpethidine, which has a prolonged half-life[6] that is further exaggerated in newborn infants because of impaired metabolism.[7,8] Given that intramuscular pethidine continues to be used in the United Kingdom and Australia for labor analgesia and that Paech et al.[9] have demonstrated the benefit and favorable pharmacokinetic profile of epidural pethidine compared with intravenous pethidine after CS, it is of interest whether pethidine via the epidural route impacts the breastfeeding infant during secretory activation.

Secretory activation is the initiation of copious milk secretion, which occurs 30–40 hours after birth and is triggered by the withdrawal of progesterone after delivery of the placenta.[10] Clinically this is marked by a maternal sense of "milk coming in" or "breast fullness."[11] The timing of secretory activation is important in ensuring a successful start to lactation, as a delay has been associated with excess neonatal weight loss, suboptimal breastfeeding behavior at Day 7, and reduced breastfeeding duration.[2]

In addition to secretory activation, an intact milk ejection reflex is necessary to ensure milk flow to the sucking infant. Milk ejection is defined as the expulsion of milk from the

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mammary alveoli triggered by the release of oxytocin from the posterior pituitary.[12] Because milk ejection is a transient phenomenon lasting between 45 seconds and 3.5 minutes,[13] the infant must suck effectively in order to take enough milk to facilitate growth and development. The breastfeeding infant does so by removing milk primarily by applying a vacuum, created by lowering the tongue and expanding the nipple and its ducts to facilitate milk flow.[14–16] Healthy term infants usually display this intact sucking reflex from birth; however, infants of mothers who received intramuscular pethidine during labor have shown delayed rooting and sucking behavior in the first few days postpartum.[17] Intravenous pethidine analgesia after CS has been associated with poor infant neurobehavioral responses on Days 3 and 4 postpartum.[18,19] In view of this evidence it cannot be assumed that the infant sucking dynamic, breastfeeding behavior, and neurological behavior in the immediate postpartum period are the same for infants born via vaginal birth and those born via CS with maternal pethidine for PCEA after CS.

To investigate the distribution of pethidine into breastmilk and maternal/infant plasma in association with PCEA after CS, Al-Tamimi et al.[20] measured pethidine and norpethidine in the infant's plasma, mother's plasma, and breastmilk; they showed that the absolute infant dose and combined relative infant dose of pethidine and norpethidine were acceptable and placed the breastfed infant at low risk of adverse effects. To verify the breastfeeding outcomes after pethidine PCEA, we compared sucking parameters, breastfeeding behavior, and neurobehavior of infants delivered by uncomplicated vaginal birth with a subset of those from the study by Al-Tamimi et al.[20] who were delivered by CS and exposed to pethidine PCEA after CS. Infants were assessed during the period of secretory activation (Day 3) and again after the establishment of lactation (follow-up).

Subjects and Methods

Participants

Participants were recruited either through the prenatal birthing clinic or in postnatal obstetric wards at King Edward Memorial Hospital for Women (Perth, WA, Australia) as part of a larger study comparing the distribution of pethidine and norpethidine in breastmilk and maternal and infant plasma after PCEA.[20] Mothers of term infants with an uncomplicated vaginal birth (V group) and those from a scheduled elective CS (CS group), who delivered at 37 weeks or more of gestation, were invited to participate in the study (14 of the 20 mother–infant pairs from the larger study were included[20]). All mothers were American Society of Anesthesiologists physical status I or II, had no obstetric or medical complications, and were intending to breastfeed. Participants undergoing CS consented to combined spinal-epidural anesthesia and then pethidine PCEA for postoperative analgesia. Ethics approval was obtained from the Human Research Ethics Committee of the Women and Newborn Health Service of Western Australia. Participants supplied written and informed consent to participate in the study.

Baseline and postoperative protocol

Mothers received pethidine via a PCEA device, starting shortly after birth and continuing to a maximum of 48 hours postoperatively as required, described by Al-Tamimi et al.[20] Time to first breastfeed, time and dose of pethidine administered, and neurological and adaptive capacity score (NACS) were recorded. NACS assesses the effect of obstetric drugs given during labor/delivery on the central nervous system of the neonate.[21] It evaluates 20 criteria covering adaptive capacity, passive tone, active tone, primary reflexes, and general neurological status. With a maximum score of 40, each criterion is given a score of 1, 2, or 3 (normal).[21] Scores were recorded soon after pethidine cessation in the CS group (24–48 hours following birth) and at an equivalent time in the V group.

Breastfeeding protocol

Assessments of breastfeeding were performed at two time points: the first at secretory activation (Day 3; range, 2–4 days postpartum) and the second during established lactation (follow-up; range, 10–45 days postpartum). The Day 3 assessment was carried out either at the hospital or the mother's home, and the follow-up assessment was done at the mother's home. At each session, ultrasound imaging of the infant's intra-oral cavity was recorded during breastfeeding to determine tongue movement, breastfeeding was assessed using the LATCH-R tool, and milk intake was measured. Participants completed a baseline questionnaire detailing breastfeeding and birth history. Mothers were asked to complete a 24-hour milk production after Day 10.

Ultrasound examination

Submental ultrasound scans of the midline of the infant's intra-oral cavity were performed during breastfeeding using a portable ultrasound (Titan® hand-carried; Sonosite, Sydney, NSW, Australia) with a broadband intracavity transducer (model ICT/8-5MHz), as described previously.[14,15,22,23] A small quantity of Parker Laboratories (Fairfield, NJ) ultrasonic gel was placed on the transducer before the scan was begun, to provide good transmission of the ultrasound beam. The transducer was positioned along the midsagittal line of the infant's body, and light pressure was used to maintain contact with the infant's chin. The transducer was rotated until a midsagittal view of the nipple was displayed, along with the hard–soft palate junction and the upper surface of the tongue. All scans were recorded to a PC notebook (Travelmate 6293; Acer, New Taipei City, Taiwan) using a Compro Technology (Taipei, Taiwan) VideoMate S350 digital satellite TV tuner card.

Breastfeeding evaluation

Breastfeeding characteristics were assessed at each visit using the LATCH-R, a clinical assessment tool[24,25] assessing latch, audible swallowing, type of nipple, comfort hold (positioning), and responsiveness (confidence) during breastfeeding. A score of 0, 1, or 2 is given for each criterion for a maximum score of 12.

Milk intake

At each visit, milk intake was determined by weighing the infant before and after breastfeeding using an electronic Baby Weigh scale (Medela AG, Baar, Switzerland). Milk production for a 24-hour interval was measured by mothers test-weighing their infants before and after each breastfeed from each breast for a time period of 24 hours plus one breastfeed.[26] The duration of the monitored feed was calculated as the time between test weighs.

Ultrasound measurement

A suck cycle was defined as starting when the midtongue (Fig. 1a and c) was in apposition with the palate (tongue up) followed by downward excursion of the tongue until the midtongue reached its lowest point (tongue down) (Fig. 1b and d) and ending with the tongue in apposition with the palate again. Nutritive sucking was defined as suck cycles resulting in the delivery of milk into the oral cavity as imaged by ultrasound where the milk bolus appeared as a hypoechoic (black) area filled with echogenic white flecks (milk fat globules) (Fig. 1a and b). Nonnutritive sucking was defined as suck cycles in which no milk was observed in the intra-oral cavity on ultrasound (Fig. 1c and d).[14,15] For each infant, three consecutive suck cycles of first and clearest imaging during both nutritive sucking and nonnutritive sucking were selected for both Day 3 and follow-up scans ($n=3$; suck cycles were not consecutive). During each suck cycle, two frames were analyzed: one at tongue up and one at tongue down. Six anatomical measurements were made: nipple diameters at 2, 5, 10, and 15 mm from the tip of the nipple, depth of the intra-oral space (distance from the hard–soft palate junction to the surface of the posterior tongue), and distance from the nipple tip to the hard–soft palate junction. Measurements were made using Screen Callipers version 3.2 (Iconico Inc., New York, NY) using a PC notebook (Acer Travelmate 6293). This method has been validated and is described in detail elsewhere.[15] Suck rates were determined by counting the number of sucks per burst on the ultrasound recording for the first 3 and the last 3 minutes of the feed.

Statistical analysis

Data analysis was performed using R 2.9.0 (The R Core Team).[27] Packages nlme,[28] multcomp,[29] and lattice[30] were used for linear mixed models, multiple comparisons of means, and graphical displays, respectively.

Comparisons of breastfeeding characteristics between Day 3 and follow-up (milk intake, feed duration, and LATCH-R score) and between the CS and V groups (NACS score, time to first breastfeed, time to breast fullness, milk intake, feed duration, and LATCH-R score) were made using paired and unpaired Student's *t*-tests, respectively, testing for normality using the Shapiro test or Wilcoxon rank sum test otherwise.

Tongue movement and nipple position were evaluated using linear mixed models with a random effect of a different intercept for each infant. Fixed effects of suck type (nutritive sucking/nonnutritive sucking), tongue position (tongue up/tongue down), and assessment age (Day 3/follow-up) were

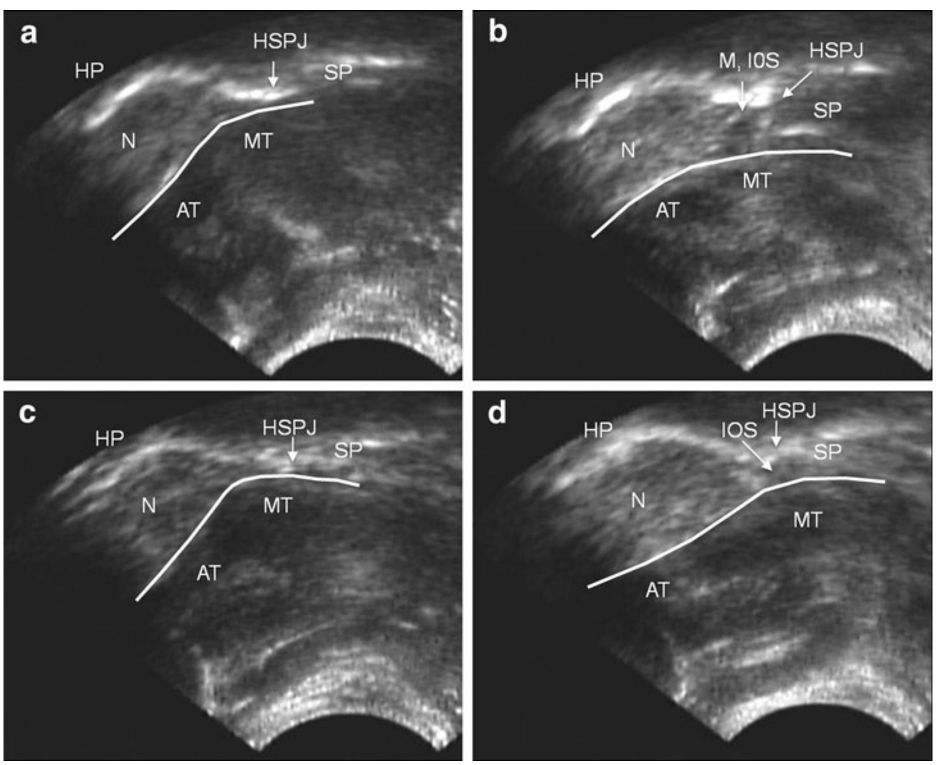

FIG. 1. The infant oral cavity during a breastfeed on Day 3 from the cesarean section group. During nutritive sucking, at **(a)** tongue up, the nipple (N) is evenly compressed from the tip to base by the anterior tongue (AT), and the tongue is in contact with the hard and soft palates (HP and SP, respectively). **(b)** As the tongue lowers, at tongue down, the N has evenly expanded in size and moved closer to the hard–soft palate junction (HSPJ), and the midtongue (MT) has lowered, allowing milk (M) to flow into the intra-oral space (IOS). During nonnutritive sucking, **(c)** the nipple is less compressed at tongue up compared with during nutritive sucking, and (**d**) as the tongue is lowered, at tongue down the N has expanded to a lesser degree, and the MT is lowered to a lesser extent compared with during nutritive sucking.

tested in each model, with all two- and three-way interactions considered. No covariates were included in the models. The position of the nipple in the infant's mouth was tested by comparing nipple to hard–soft palate junction distances, midtongue movement was tested by comparing the depth of the intra-oral space, and anterior tongue movement was tested by comparing nipple diameters at 2, 5, 10, and 15 mm. Nipple diameter at 15 mm, however, exhibited a large amount of missing data (17% of the cycles) and was therefore excluded from the final analysis. Differences in suck rate were measured by the suck rate (sucks/minute) measurement with fixed effects of suck type (nutritive sucking/nonnutritive sucking), assessment age (Day 3/follow-up), and burst duration. Tukey's multiple comparisons of means were made separately for each combination of tongue position by suck type, visit, and birth, using general linear hypothesis tests. Final models were determined using forward stepwise regression using a $p = 0.05$ threshold. All nonsignificant predictors and interactions were omitted from the final models unless they were included in a higher-level interaction. Data are presented as mean ± SD values. Results were considered significant for all adjusted p values < 0.05.

Results

Demographics and baseline characteristics

Fifteen women in the V group ($n = 14$ spontaneous vaginal delivery, $n = 1$ forceps delivery) and 19 women in the CS group were included in the study. An additional 17 participants exited the study after baseline hospital data had been collected and were therefore excluded from this analysis. Reasons for exiting included breastfeeding issues, infant issues, or other maternal reasons. The majority of infants (50% female) were 3 days postpartum (V group, 3.2 ± 0.8 days; CS group, 3.0 ± 0.2 days) on the first visit and were approximately 20 days postpartum (V group, 19.8 ± 10.8 days, $n = 13$; CS group, 21.9 ± 8.1 days, $n = 14$) at the follow-up measurement. Because of maternal time constraints, only half of the participants completed 24-hour milk productions (age range, 10–43 days), and those completed were within the normal range,[32] with no differences between birth mode ($p = 0.17$). The time to first breastfeed ($p = 0.015$) and timing of breast fullness ($p = 0.03$) were significantly later in the CS group. NACS scores were higher in the V group ($p = 0.047$) (Table 1).

Table 1. Demographics and Breastfeeding Characteristics

	V group		CS group	
	n	Mean (SD)	n	Mean (SD)
Primiparas	11		6	
Breastfeeding type[31]				
Exclusive	10		8	
Complementary	2		5	
Not identified[a]	3		6	
Mother's age (years)	15	33.4 (5.0)	19	32.4 (4.6)
Gestational age (weeks)	15	39.9 (0.7)	19	38.6 (0.7)
Birth weight (g)	15	3368 (350)	19	3526 (381)
24-hour milk production (g)	7	613 (104)	8	717 (177)
Time to 1st breastfeed (minutes)	14	55.1 (47)	16	100.9 (47.9)[b]
Time to breast fullness (days)	11	2.85 (1.0)	13	4.8 (2.4)[b]
NACS score (maximum of 40)	14	35.1 (2.3)	19	33.4 (3.1)[b]

[a]Not identified at baseline questionnaire but breastfeeding at study assessments.
[b]$p < 0.05$ between cesarean section (CS) and vaginal birth (V) groups.
NACS, neurological and adaptive capacity score.

Breastfeed characteristics

Compared with Day 3, milk transfer in both groups ($p < 0.001$) and LATCH-R scores in the CS group ($p = 0.002$) were greater at follow-up. A three-way interaction was shown, whereby suck rates were faster at follow-up, especially in the CS group, but nonnutritive sucking suck rates were faster at follow-up in the V group only ($p = 0.0026$). Additionally, a two-way interaction showed suck rates in general were faster in the CS group than the V group at both visits, with the effect being more pronounced at Day 3 ($p = 0.0003$). There was no difference in milk intake between birth mode ($p = 0.5$), in LATCH-R scores between birth mode ($p = 0.08$) or between visits in the V group ($p = 0.15$), or in the duration of the feed between visits ($p = 0.69$) or birth mode ($p = 0.11$) (Table 2).

Sucking dynamics

Depth of the intra-oral space. Across both assessments, as the midtongue lowered milk flow was observed during nutritive sucking (Fig. 1b), and the depth of the intra-oral space was greater at tongue down compared with at tongue up ($p < 0.001$) (Table 3). During NS the mid-tongue started higher and lowered further compared with nonnutritive sucking (p for interaction < 0.001). An interaction between visit and birth mode was also observed whereupon at Day 3, the midtongue lowered further in the CS group than the V group, but at follow-up the tongue lowered further in the V group ($p = 0.029$).

Tongue/nipple movement. As the tongue lowered, the nipple moved closer to the hard–soft palate junction ($p < 0.001$), and this was similar for both CS and V groups ($p = 0.06$). In both the CS and V groups, all nipple diameters increased as the tongue lowered ($p < 0.001$) (Table 3), with larger nipple expansion occurring during nutritive sucking compared with nonnutritive sucking, whereby the tongue lowered further during nutritive sucking (p for interaction = 0.004). Overall, nipple diameters were smallest 2 mm from the tip and largest 10 mm from the tip ($p < 0.001$); there was more nipple expansion at 5 mm from the tip of the nipple than at 2 mm ($p = 0.03$) or 10 mm ($p = 0.02$).

In the CS group, nipple diameters were smaller at follow-up, but in the V group diameters were similar between visits (p for interaction = 0.003). Nipple expansion (tongue up to tongue down) was greater in the V group during nutritive sucking (on average, 2.8 mm) and nonnutritive sucking (on average, 1.7 mm) compared with the CS group (nutritive sucking average, 1.9 mm; nonnutritive sucking average, 1.3 mm) ($p = 0.01$).

Table 2. Breastfeeding Characteristics at Day 3 and at Follow-Up Assessments

	Mean (SD)			
	Day 3		Follow-up	
	V group	CS group	V group	CS group
Milk intake on visit (mL)	22.2 (17.5)	16.8 (14.2)	56.8 (31.2)[a]	51.2 (45.3)[a]
Duration of feed (minutes)	19.1 (6.5)	19.9 (6.5)	16.1 (6.7)	17.6 (5.2)
LATCH-R score (maximum of 12)	11.2 (0.7)	10.5 (1.4)	11.4 (0.7)	11.2 (0.8)[a]
Suck rate (sucks/minute)				
Nutritive sucking[b]	68.0 (14.8)	83.0 (17.8)	74.0 (17.1)	92.0 (18)[c]
Nonnutritive sucking[b]	77.8 (18.2)	94.3 (18.2)	88.9 (23.9)	93.8 (20)[c]

[a]$p<0.05$, significant difference between Day 3 and follow-up.
[b]$p<0.05$, significant interaction among cesarean section (CS)/vaginal birth (V) group (birth), nutritive sucking/nonnutritive sucking (suck type), and Day 3/follow-up (visit).
[c]$p<0.05$, significant interaction between CS and V groups (birth) with Day 3/follow-up (visit).

Discussion

Infants of mothers who delivered by scheduled CS and used pethidine PCEA after CS showed a greater range of tongue movement between Day 3 and follow-up, as well as faster suck rates and lower central nervous system responses, than infants delivered vaginally. Considering delayed onset of maternal breast fullness but acceptable concentrations of norpethidine in breastmilk and infant/maternal plasma,[20] this suggests a small influence of CS birth during secretory activation. Increased monitoring of these breastfeeding infants and mothers in the first 3 days postpartum may allow early intervention to facilitate successful initiation of lactation.

Sucking dynamics

The sucking dynamics of infants in this study, both at secretory activation and in established lactation, are consistent with those reported in older term breastfeeding infants (up to 6 months postpartum). As the tongue lowered the nipple expanded in size and moved closer to the hard–soft palate junction, and during nutritive sucking, milk flow was observed in the intra-oral space (Fig. 1).[14–16] Anterior and mid-tongue movement decreased for non-nutritive sucking. The increased downward movement of the tongue during nutritive sucking is likely necessary for both expansion of the milk ducts and accommodation milk flow into the intra-oral cavity.

The slight differences in tongue movement noted between the CS and V groups, especially at Day 3, suggest that sucking may have been slightly affected by the CS birth at the time of secretory activation, which could reflect a less controlled behavioral state at Day 3. This is further supported by findings that suck rates were faster in the CS group, especially at Day 3, the breastfeeding evaluation (LATCH-R scores) improved at follow-up, and NACS scores were lower for the CS group (Table 2). Lower neurobehavioral scores after intravenous administration of pethidine, compared with morphine, have been demonstrated before. Wittels et al.[18,19] found that infants of mothers who received patient-controlled intravenous

Table 3. Anatomical Measurements at Day 3 and Follow-Up Assessments

	Day 3				Follow-up			
	V group		CS group		V group		CS group	
Measure, nipple diameter (mm)	TU	TD[a]	TU	TD[a]	TU	TD[a]	TU	TD[a]
NS								
2	5.5 (1.0)	7.8 (2.2)	5.7 (1.4)	7.2 (1.3)	5.4 (1.3)	8.1 (1.5)	5.6 (1.3)	7.7 (1.4)
5	7.1 (1.1)	9.9 (2.4)	7.8 (1.7)	9.2 (1.9)	7.1 (1.6)	10.0 (1.8)	7.3 (1.3)	9.9 (1.6)
10	8.2 (1.1)	10.1 (2.0)	8.8 (1.8)	9.9 (1.9)	8.2 (1.3)	10.1 (1.8)	8.6 (1.8)	10.1(1.6)
NNS								
2	6.1 (1.6)	7.4 (1.9)	5.7 (1.2)	6.6 (1.2)	5.6 (1.6)	7.5 (1.8)	5.1 (0.8)	6.8 (1.2)
5	7.7 (1.7)	9.1 (2.0)	7.6 (1.6)	8.8 (1.5)	7.3 (1.6)	9.7 (2.2)	7.2 (0.9)	8.9 (1.6)
10	8.6 (1.8)	9.9 (2.0)	8.8 (1.6)	9.6 (1.9)	9.0 (1.6)	10.1 (2.2)	8.7 (1.2)	10.0 (1.5)
HSPJ								
NS	6.5 (1.8)	5.5 (1.4)	6.1 (1.9)	5.0 (1.6)	7.3 (2.0)	5.5 (1.5)	6.0 (1.6)	4.8 (1.8)
NNS	6.7 (1.6)	6.5 (1.4)	5.9 (1.7)	5.1 (1.5)	5.4 (1.6)	5.2 (1.6)	6.0 (2.2)	5.2 (1.8)
IOS								
NS	0.35 (NA)	5.2 (2.8)	0.7 (NA)	4.0 (1.7)	0.32 (NA)	6.0 (2.2)	0.6 (NA)	4.3 (2.0)
NNS	0.75 (NA)	3.7 (2.0)	0.7 (NA)	3.1 (1.4)	0.45 (NA)	5.2 (1.6)	0.4 (NA)	3.7 (1.6)

[a]Tukey's pairwise comparisons show overall tongue up (TU) to tongue down (TD) differences are significant at $p<0.01$ for nipple diameters of 2, 5, and 10 mm, hard–soft palate junction (HSPJ), and intra-oral space (IOS).
CS group, cesarean section group; NA, not applicable; NNS, nonnutritive sucking; NS, nutritive sucking; V group, vaginal birth group.

pethidine after CS had elevated concentrations of norpethidine up to Days 3[18] and 4[19] postpartum and lower neurobehavioral scores than infants of mothers receiving post-CS intravenous morphine.[18,19] Infants of mothers given pethidine during labor with a short-dose delivery time interval have also shown delayed rooting and sucking responses and delayed lip/mouth movements compared with those infants for whom the dose delivery time was long.[17] Nonetheless, infant exposure to pethidine and norpethidine during PCEA confers a low risk of harm.[20] In the study of Al Tamimi et al.,[20] the concentrations of pethidine and norpethidine were measured within 2 hours of pethidine cessation (median pethidine cessation, 41 hours) and again 6 hours later in the maternal milk and plasma and between 48 and 72 hours postpartum in the infant's plasma. The relative infant dose of pethidine and norpethidine fell well within the arbitrary acceptable range. These data suggest that differences between the CS and V groups in the current study may be related more to differences in delivery mode than to pethidine PCEA, but comparison with alternative methods of post-CS analgesia would be required to clarify this.

Timing of secretory activation

Secretory activation commencing after 72 hours is considered delayed[2,3] and is associated with excess neonatal weight loss, suboptimal breastfeeding behavior at Day 7, formula supplementation, and reduced breastfeeding duration.[2] Late timing of reported maternal breast fullness found in the CS group (Table 1) suggests that secretory activation may be delayed by this mode of delivery in our study. Different levels of oxytocin release between CS and vaginal birth could be a major factor to delayed secretory activation.[33] Nissen et al.[33] measured more oxytocin pulses during breastfeeding in women who delivered vaginally compared with those who delivered by CS and suggested that the differences were related to CS delivery bypassing the second stage of labor where oxytocin pulses normally reach maximum frequency. Similarly, a delay in mother–infant sucking contact as observed in the CS group (Table 1) may also impact breastfeeding success. Lack of early sucking contact may influence the duration of breastfeeding as well as the maternal–infant bonding process.[34,35] Time to first breastfeed may be important in coordinating the early pulsatile oxytocin response in the mother because reduced release of oxytocin is related to decreased milk removal.[5] Our results support the notion that there are differences in secretory activation when women deliver via CS compared with vaginally.[2,3,36] However, the infants in our CS group were successfully feeding. Future study of the breastfeeding duration of women with delayed secretory activation after pethidine for PCEA is necessary to clarify the long-term effects.

Conclusions

During the initiation of breastfeeding (Day 3), CS infants displayed greater range in tongue movement compared with subsequent follow-up, faster suck rates, and lower central nervous system responses than infants delivered vaginally. In combination with delayed maternal breast fullness but apparently safe exposure of the breastfeeding infant to pethidine and norpethidine, our findings suggest that birth via CS per se may impact secretory activation, although an effect of pethidine cannot be excluded. Therefore additional monitoring of breastfeeding in the first 3–4 days postpartum may be beneficial, specifically for mothers delivering by CS.

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Disclosure Statement

No competing financial interests exist.

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