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Effect of Labor Epidural Analgesia with and without Fentanyl on Infant Breast-feeding

A Prospective, Randomized, Double-blind Study

Yaakov Beilin, M.D., Carol A. Bodian, Dr.P.H.† Jane Weiser, Ed.D. R.N., I.B.C.I.C.,‡ Sabera Hossain, M.S.,§ Ittamar Arnold, B.A.,‖ Dennis E. Feierman, Ph.D., M.D.,* Gregory Martin, M.D.,# Ian Holzman, M.D.***

Background: **The influence of labor epidural fentanyl on the neonate is controversial. The purpose of this study was to determine whether epidural fentanyl has an impact on breast-feeding.**

Methods: **Women who previously breast-fed a child and who requested labor epidural analgesia were randomly assigned in a double-blinded manner to one of three groups: (1) no fentanyl group, (2) intermediate-dose fentanyl group (intent to administer between 1 and 150 μg epidural fentanyl), or (3) high-dose epidural fentanyl group (intent to administer > 150 μg epidural fentanyl). On postpartum day 1, the mother and a lactation consultant separately assessed whether the infant was experiencing difficulty breast-feeding, and a pediatrician assessed infant neurobehavior. All women were contacted 6 weeks postpartum to determine whether they were still breast-feeding.**

Results: **Sixty women were randomly assigned to receive no fentanyl, 59 were randomly assigned to receive an intermediate dose, and 58 were randomly assigned to receive high-dose fentanyl. On postpartum day 1, women who were randomly assigned to receive high-dose fentanyl reported difficulty breast-feeding (n = 12, 21%) more often than women who were randomly assigned to receive an intermediate fentanyl dose (n = 6, 10%), or no fentanyl (n = 6, 10%), although this did not reach statistical significance ($P = 0.09$). There was also no significant difference among groups in breast-feeding difficulty based on the lactation consultant's evaluation (40% difficulty in each group; $P = 1.0$). Neurobehavior scores were lowest in the infants of women who were randomly assigned to receive more than 150 μg fentanyl ($P = 0.03$). At 6 weeks postpartum, more women who were randomly assigned to high-dose epidural fentanyl were not breast-feeding (n = 10, 17%) than women who were randomly assigned to receive either an intermediate fentanyl dose (n = 3, 5%) or no fentanyl (n = 1, 2%) ($P = 0.005$).**

Conclusions: **Among women who breast-fed previously, those who were randomly assigned to receive high-dose labor epidural fentanyl were more likely to have stopped breast-feeding 6 weeks postpartum than woman who were randomly assigned to receive less fentanyl or no fentanyl.**

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BREAST milk is considered the best source of nutrition for newborn children.[1] A number of studies have sought an association between labor epidural analgesia and breast-feeding.[2–7] These studies have revealed conflicting results that could be due to differences in study design. Some of the studies were retrospective[6] or telephone interviews,[4] and none of the prospective studies were randomized.[2,3,5,7]

Initially, we performed an observational pilot study to evaluate whether epidural analgesia with or without fentanyl has an impact on breast-feeding. We surveyed 500 women of mixed parity on postpartum day 1 to establish whether the infant was having problems with breast-feeding. This was done by asking the mother to complete a nine-point questionnaire developed by Kearney *et al.*[8] The medical records were then reviewed to determine what medications, if any, were used during labor. We did not find a difference in breast-feeding success between those who received an epidural anesthetic and those who did not or among nulliparous women. However, among multiparous women who had breast-fed previously and who received an epidural anesthetic, those who received more than 150 μg epidural fentanyl reported breast-feeding problems more frequently (65%) than those who received 150 μg fentanyl or less (35%). Based on these preliminary data, we performed a prospective, randomized, double-blind study to determine whether fentanyl administered as part of labor epidural analgesia has an impact on breast-feeding.

Materials and Methods

The study protocol was approved by the Institutional Review Board of the Mount Sinai School of Medicine, New York, New York. Multiparous women who presented for an attempted vaginal delivery at term had previously breast-fed a child for at least 6 weeks, planned to breast-feed this child, had no contraindication to epidural analgesia, and were eligible to be enrolled in this prospective, randomized, and double-blind study. Writ-

* Associate Professor of Anesthesiology and Obstetrics, Gynecology and Reproductive Sciences, † Associate Professor of Biomathematical Sciences, ‡ Nurse Clinician, Maternal Child Health, § Programmer Analyst of Biomathematical Sciences, ‖ Research Assistant, Department of Anesthesiology, # Fellow, Department of Pedatrics, ** Professor of Pediatrics.

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Address reprint requests to Dr. Beilin: The Mount Sinai Medical Center, Department of Anesthesiology, Box 1010, One Gustave L. Levy Place, New York, New York 10029-6574. Address electronic mail to: yaakov.beilin@mountsinai.org.

Table 1. Issues with Breast-feeding (% of Responders) as Expressed by the Mother

	Overall (n = 176)	No Fentanyl Group (n = 60)	Intermediate-dose Fentanyl Group (n = 59)	High-dose Fentanyl Group (n = 57)	*P* Value
Infant falls asleep	55	50	53	63	0.16
Infant spits up	18	10	22	23*	0.06
Infant fussy after feeding	11	10	5	16	0.31
Infant prefers one breast	7	7*	4*	10*	0.66
Infant feeds too often	6	7	5	5	0.74
Infant fussy, refuses to nurse	19	13	15	28	0.04
Infant does not suck effectively	7	3*	7	12	0.07
Infant does not latch on to nipple	23	20	21*	26	0.42
Infant nurses too long at feeding	12	15	7	14	0.86

* Some missing responses, with minimum of 52 responses per question.

ten informed consent was obtained before the onset of painful contractions. If the woman received any intravenous analgesics during labor, *e.g.*, meperidine, she was not eligible to participate in the study. If the woman underwent cesarean delivery, she was also excluded from the study.

After the patient requested epidural analgesia, she was randomly assigned to one of three groups based on a computer-generated randomization schedule. The results of the randomization were sealed in opaque envelopes and opened sequentially immediately before placement of the epidural. The patient and all individuals who evaluated the patient and her infant were unaware of the group assignment.

Group 1 patients were randomly assigned to receive no epidural fentanyl. Epidural analgesia was initiated with 10 ml bupivacaine, 0.25%, and maintained with an infusion of 0.125% bupivacaine at a rate of 10 ml/h. Additional medication, if needed for pain relief, was with 0.25% bupivacaine in 5-ml increments. Group 2 patients (intermediate-dose fentanyl group) were randomly assigned to receive some epidural fentanyl but a total dose that was 150 μg or less. Epidural analgesia was initiated with 10 ml bupivacaine, 0.25%, and maintained with an infusion of 0.0625% bupivacaine with 2 μg/ml fentanyl at a rate of 10 ml/h. Additional boluses of medication, if needed, were with 0.25% bupivacaine in 5-ml increments. If the women in the intermediate group received 150 μg fentanyl during labor, the anesthetic infusion was changed to 0.125% bupivacaine at a rate of 10 ml/h. Group 3 patients (high-dose fentanyl group) were randomly assigned to receive more than 150 μg fentanyl. Epidural analgesia was initiated with 10 ml bupivacaine, 0.125%, with 100 μg fentanyl, and the anesthetic was maintained with an infusion of 0.0625% bupivacaine with 2 μg/ml fentanyl at a rate of 10 ml/h. Additional boluses of medication were with 0.125% bupivacaine plus 2 μg/ml fentanyl in 5 ml-increments. If analgesia could not be obtained in any patient, regardless of group assignment, she received additional epidural bupivacaine or fentanyl at the discretion of the anesthesiologist. The women, however, were not aware of the specific medication they were receiving.

At the time of delivery, 10 ml blood was collected from the umbilical vein and analyzed for the concentration of bupivacaine by gas chromatography equipped with a mass-selective detector (Mount Sinai Laboratories, New York, NY) and fentanyl by high-performance liquid chromatography (Rocky Mountain Instrumental Laboratories, Ft. Collins, CO). The lower limit of fentanyl detection was 25 pg/ml. Apgar scores were assessed at 1 and 5 min postpartum.

On postpartum day 1, the mother and a lactation consultant separately assessed breast-feeding, and a pediatrician assessed the neonate's neurobehavior. The goal was to perform the assessments as close to 24 h postdelivery as possible. There was an additional assessment of breast-feeding by a member of the anesthesia research team at 6 weeks postpartum. All evaluators and the mother were blinded to group assignment.

The mother gave a detailed assessment of her infant's ability to breast-feed by completing a nine-point yes or no questionnaire developed by Kearney *et al.*[8] (table 1) that was read to her by a member of the anesthesia research team. After the questionnaire, the mother gave her opinion as to the overall level of difficulty her infant might be having with breast-feeding (none, mild, moderate, or severe).

The lactation consultants observed the mother breast-feeding and completed a 12-point B-R-E-A-S-T Feeding Observation Form developed by Armstrong[9] (table 2). This form is used as part of a breast-feeding training course sponsored by the World Health Organization and the United Nations Children's Fund. The lactation consultants were three registered nurses certified by the International Board of Lactation Consultant Examiners. The lactation consultant, in addition to identifying any breast-feeding problems, gave an opinion as to whether the infant was having difficulty with breast-feeding (none, mild, moderate, or severe).

The infant was assessed by one of three pediatricians trained to perform the Neurologic and Adaptive Capacity

Table 2. Issues with Breast-feeding (% of Responders) as Reported by the Lactation Consultant*

	Overall (n = 147)	No Fentanyl Group (n = 50)	Intermediate-dose Fentanyl Group (n = 50)	High-dose Fentanyl Group (n = 47)	*P* Value
No response to breast	9	4	11	13	0.18
Infant slips off breast	10	7	13	11	0.49
No rooting occurs	7	2	8	10	0.15
Mouth closed, points forward	11	5	18	9	0.47
Lower lip turned in	14	9	17	16	0.36
Cannot see infant's tongue	8	5	13	7	0.70
Cheek tense or pulled in	2	2	2	2	1.0
Rapid sucks	11	9	15	9	0.94
Can hear smacking or clicking	6	2	10	5	0.67
Infant does not latch on	4	0	6	7	0.11
Infant falls asleep	27	30	21	30	0.89
Infant not sucking well	11	11	11	11	0.97

* Most had missing data, with the number of responders ranging from 41 to 50.

Scoring System (NACS). The NACS assesses active and passive tone, primary reflexes, response to sound and light, and alertness. The senior pediatric investigator (I. H.) trained the other two pediatricians to perform the test and observed them to assure consistency before their performing the test on their own. The score generated is between 0 and 40.

The patients' medical records were reviewed to document the use and dose of postoperative opioids administered in the postpartum period. At our hospital, 5 mg oxycodone plus 325 mg acetaminophen is the opioid-containing analgesic most commonly administered. In addition, the infant's medical record was reviewed to ascertain whether the infant received supplemental milk *via* a bottle.

All mothers were called by a member of the anesthesia research team at 6 weeks postpartum to determine whether they were still breast-feeding. If the mother was not breast-feeding at 6 weeks postpartum, she was queried as to whether this was related to difficulty the infant was experiencing with breast-feeding.

Statistical Analysis

The results from the observational pilot study were the basis for this study design, including definition of study groups and determination of sample sizes. The primary outcome of interest in the pilot study was the proportion of nursing mothers who gave a positive response to any of the issues on the breast-feeding questionnaire (table 1). The medical records were then reviewed to determine what medications, if any, were used during labor. The results indicated such high rates of difficulty with firstborns that it was difficult to assess the influence of anesthetic agents. Therefore, this study was limited to women who had previously breast-fed. Among such women in the pilot study, we found a difference based on the amount of epidural fentanyl received during labor. The proportions reporting breast-feeding difficulty were similar for those receiving no fentanyl, 1–100 μg fentanyl, and 101–150 μg fentanyl (39.5%, 40.0%, and 32.1%, respectively). The proportion reporting breast-feeding difficulty among those receiving 151–200 μg was 57%, and the proportion for those receiving more than 200 μg fentanyl was 70.0%. The overall rate of breast-feeding difficulty among those who received more than 150 μg fentanyl was 65%. This led us in the current study to randomly assign our patients to receive no epidural fentanyl, 150 μg epidural fentanyl or less, or more than 150 μg epidural fentanyl.

Power analysis demonstrated that a sample size of 58 in each group would be sufficient to provide 80% power to detect a 30% difference, as indicated in our preliminary study, between the high-dose fentanyl group (> 150 μg fentanyl) and the no fentanyl group or the intermediate-dose fentanyl group, assuming a 35% incidence of breast-feeding difficulties in the latter groups. These numbers provide an overall significance level of 0.05, based on two pairwise two-tailed tests, each at the 0.025 (0.05/2) significance level.

Continuous variables were compared among groups by Kruskal-Wallis tests and binary outcomes by chi-square tests. The influence of potential confounding variables such as maternal age, duration of labor, and use of other medications were explored using Mantel-Haenszel tests. Associations between outcomes were estimated by κ statistics and by correlation coefficients. Some continuous-valued factors were divided into approximate equal groupings (*e.g.*, amounts of cord fentanyl were grouped with cutoffs at 50, 100, and 200 pg/ml) to explore the form of putative relations with outcome variables.

The study plan allowed the use of more or less fentanyl than mandated by the randomization, if the woman had inadequate analgesia. We planned to analyze the data based on group assignment and also based on actual medication received, if necessary.

Table 3. Patient Demographics and Labor Characteristics*

	No Fentanyl Group (n = 60)	Intermediate-dose Fentanyl Group (n = 59)	High-dose Fentanyl Group (n = 58)
Age, yr	35 (24–42)	36 (20–48)	35 (21–44)
Height, cm	163 (152–180)	168 (147–180)	165 (137–190)
Weight, kg	73 (55–96)	75 (55–105)	73 (55–123)
Oxytocin use, %	97	98	95
Highest oxytocin dose, mU	6 (2–18)	8 (1-24)	6 (2–18)
White, %	92	97	95
Parity	1 (1–4)	1 (1–11)	1 (1–4)
NSVD, %	97	95	97

* Data are presented as per the patients' original group assignment and are recorded as median and range or percent.

NSVD = normal spontaneous vaginal delivery (the rest were forceps deliveries).

Results

We enrolled 189 women and studied 180 during a 4-yr period. Seven patients were excluded because they had a cesarean delivery (3 were randomly assigned to the no fentanyl group, 2 were randomly assigned to the intermediate-dose fentanyl group, and 2 were randomly assigned to the high-dose fentanyl group), 1 voluntarily withdrew who had been randomly assigned to the no fentanyl group, and 1 did not request an epidural anesthetic. Three additional patients were excluded because of missing data (1 was randomly assigned to the intermediate-dose fentanyl group and 2 were randomly assigned to the high-dose fentanyl group). This left 177 women for analysis: 60 in the no fentanyl group, 59 in the intermediate-dose fentanyl group, and 58 in the high fentanyl dose group.

There were 15 patients who received a different amount of fentanyl than planned: 5 in the no fentanyl group received some fentanyl, 1 in the intermediate-dose group received more than 150 μg fentanyl, and 9 in the high-dose fentanyl group received less than 150 μg fentanyl. All except one mother completed the questionnaire. Thirty women were not evaluated by the lactation consultant, and 10 infants were not evaluated by the pediatrician either because the evaluator or the subject was unavailable in the first 24 h after delivery.

Demographic and labor characteristics were similar among groups, as were the duration of labor analgesia and type of delivery. More than 95% had a normal spontaneous vaginal delivery, and the rest were forceps-assisted vaginal deliveries (table 3).

We did not find a difference in Apgar score among the three groups at 1 or 5 min (median score of 9 in all three groups at 1 and 5 min). There was also no significant difference in the number of infants who had supplemental bottle feeding or the number of women who received 5 mg oxycodone with 325 mg acetaminophen within 24 h of delivery (table 4).

Among the three groups, there were significant differences in the amount of fentanyl and bupivacaine received. The umbilical cord fentanyl concentrations differed among groups, but bupivacaine cord concentrations did not (table 4).

In the maternal overall assessment at 24 h after delivery, 24 women (14%) reported problems with breast-feeding. Fifteen of these problems were mild, and 9 were moderate. No one had a severe problem. Women randomly assigned to the high-dose fentanyl group reported a problem breast-feeding (n = 12, 21%) more often than those randomly assigned to the intermediate-dose fentanyl group (n = 6, 10%) or those randomly assigned to the no fentanyl group (n = 6, 10%), although this was not statistically significant ($P = 0.09$). Most women (72%) related some issue with breast-feeding on the Kearney questionnaire, although most were consid-

Table 4. Outcomes*

	No Fentanyl Group (n = 60)	Intermediate-dose Fentanyl Group (n = 59)	High-dose Fentanyl Group (n = 58)	*P* Value
Apgar score—1 min	9 (7–9)	9 (8–10)	9 (8–9)	0.51
Apgar score—5 min	9 (8–10)	9 (8–10)	9 (8–10)	0.61
Supplemental bottle feed	71%	75%	67%	0.63
5 mg oxycodone with 325 mg acetaminophen	62%	49%	64%	0.26
Duration of epidural analgesia, min	304 (39–868)	306 (30–1091)	268 (38–775)	0.11
Total fentanyl in labor, μg	0 (0–100)	70 (20–350)	200 (75–395)	<0.0001
Fentanyl cord, pg/ml	0 (0–82)	54 (0–323)	122 (0–533)	<0.0001
Total bupivacaine in labor, mg	77.5 (39–175)	57.5 (24.5–352.5)	45 (17–86)	<0.0001
Bupivacaine cord, ng/ml	11.4 (0.1–60.7)	8.7 (0.1–58.7)	9.8 (0.1–87)	0.55
NACS score	35 (24–40)	34 (19–40)	32 (20–40)	0.03
BF difficulty 24 h postpartum—mother†	6 (10%)	6 (10%)	12 (21%)	0.09
BF difficulty 24 h postpartum—nurse	20 (40%)	20 (40%)	19 (40%)	1.0
Not BF at 6 weeks‡	1 (2%)	3 (6%)	10 (19%)	0.002

* Data are presented as per the patients' original group assignment and are recorded as median and range or percent. † Numbers of responders are 50, 50, and 47 in the no fentanyl, intermediate-dose fentanyl, and high-dose fentanyl groups, respectively. ‡ Numbers of responders are 51, 54, and 52 in the no fentanyl, intermediate-dose fentanyl, and high-dose fentanyl groups, respectively.

BF = breast-feeding; NACS = Neurologic and Adaptive Capacity Scoring System.

ered manageable. The most common issues noted were as follows: the infant is sleepy (55%), the infant does not latch to the nipple (23%), and the infant is fussy and refuses to feed (19%) (table 1).

In the lactation consultant's assessment at 24 h after delivery, 59 of 147 infants (40%) were identified as having difficulty with breast-feeding. The proportion was similar in all three groups. Of the 59 cases, 52 were classified as mild (40), moderate (9), and severe (3). One severe breast-feeding problem occurred in the intermediate-dose fentanyl group, and two problems occurred in the high-dose fentanyl group. The most common problems noted were as follows: the infant was asleep (27%) and the lip was turning in (14%), with no statistical difference among the groups (table 2). Maternal and lactation consultant evaluations of breast-feeding difficulty correlated poorly (κ statistic = 0.11).

There was a significant difference in the infant's NACS score at 24 h, with median scores of 35, 34, and 32 in the no fentanyl, intermediate-dose fentanyl, and high-dose fentanyl groups, respectively ($P = 0.03$). The clinical significance of these differences is not clear. We found an association between the maternal evaluation of difficult breast-feeding at 24 h and NACS score ($P = 0.0003$), but we did not find an association between NACS score and the lactation consultant's evaluation of difficulty breast-feeding ($P = 0.86$) or between NACS score and cessation of breast-feeding at 6 weeks ($P = 0.65$).

Among the 157 who responded at 6 weeks postpartum, there were 14 women (9%) who were not breast-feeding: 1 in the no fentanyl group, 3 in the intermediate-dose fentanyl group, and 10 in the high-dose fentanyl group ($P = 0.002$). In all cases, the mother reported stopping because the infant was having difficulty breast-feeding. Overall, if a woman reported a problem at 24 h, she was more likely not to be breast-feeding at 6 weeks (29%) than if she did not report a problem at 24 h (6%) ($P = 0.004$). There was no association between breast-feeding success at 6 weeks and the lactation consultant's evaluation at 24 h or with the NACS, but women in the high-dose fentanyl group with an umbilical cord fentanyl concentration greater than 200 pg/ml were less likely to be breast-feeding at 6 weeks postpartum than were their counterparts with smaller fentanyl concentrations ($P = 0.02$).

We did not find an association between the duration of labor or the duration from when the first dose of fentanyl was given until delivery on breast-feeding problems at 24 h or 6 weeks postpartum. Within the two groups of women who received epidural fentanyl, there was also no association between the dose of fentanyl per hour of epidural and breast-feeding problems at 24 h or 6 weeks postpartum. The total dose of fentanyl administered during labor is the only factor we could identify that had an impact on breast-feeding.

When the data were reanalyzed based on the amount of fentanyl the patient actually received (rather that the group assignment), the results were similar, except that the difference among groups in the mother's evaluation of breast-feeding difficulty at 24 h became statistically significant. More mothers who received more than 150 μg fentanyl reported difficulty (10 of 50, 20%) than those who received an intermediate dose (10 of 72, 14%) or no fentanyl (4 of 55, 7%) ($P = 0.05$). The lactation consultants' results remained similar among the three groups defined by amount of fentanyl actually received: 40%, 42%, and 38% for high, intermediate, and low doses, respectively. The 6-week data remained statistically significant when women were classified according to the amount of fentanyl they actually received. At 6 weeks postpartum, there were 14 women who stated they were not breast-feeding, 1 (2%) who received no fentanyl, 4 (6%) who received intermediate fentanyl doses, and 9 (20%) who received more than 150 μg fentanyl ($P = 0.003$).

Discussion

The main finding of this study of women who had successfully breast-fed previously and who now delivered a child vaginally with epidural analgesia is that those women who were randomly assigned to receive more than 150 μg epidural fentanyl were less likely to be breast-feeding 6 weeks postpartum as compared with women who were randomly assigned to receive less fentanyl or no fentanyl.

Controversy exists as to the impact of opioid-supplemented labor epidural analgesia on neonatal well-being after delivery. Initial studies in this regard focused on the impact of epidural analgesia on the newborn's neurobehavior, and the results have been conflicting.[10,11] There are a number of different neurobehavior scales used for clinical and research purposes. We used the NACS because it is easy to administer and some have found it reliable,[12] although others have questioned its reliability.[13] We attempted to assure interobserver reliability by having the test performed by only three pediatricians, two of whom were taught how to administer the test by the senior pediatric investigator. The clinical relevance of lower neurobehavioral scores is debatable,[14] but anecdotal and observational evidence suggests an impact on the infant's ability to breast-feed.[15] Although we found a statistically significant difference among groups with NACS score (35 *vs.* 34 *vs.* 32 in the no fentanyl, intermediate-dose fentanyl, and high-dose fentanyl groups, respectively; $P = 0.03$), the differences were small, and their clinical relevance can be questioned.

Breast milk is considered the ideal nutrition for newborns.[1] Early contact between mother and infant is important for the establishment of breast-feeding. This initial contact should occur, if possible, during the first hour postpartum.[16] There are many factors that are

thought to influence breast-feeding including, but not limited to, type of delivery,[17] general *versus* epidural anesthesia,[18] nulliparity *versus* multiparity, and supplemental bottle feeding.[19] Also, breast-feeding problems can be due to infant issues (*e.g.*, infant does not latch onto the breast or suck well, palate structure) or maternal issues (*e.g.*, inverted nipples, lack of education or incentive.

The use of regional anesthesia has become increasingly popular for labor analgesia; however, its effect on breast-feeding has been questioned.[15] The concern regarding epidural analgesia and breast-feeding is that epidural medication, especially opioids, crosses the placenta and decreases neurobehavior scores, which may have an impact on breast-feeding. The concern has not been substantiated because there have been few studies that have specifically addressed whether epidural analgesia influences breast-feeding.

Halpern *et al.*[4] performed a telephone interview at 6–8 weeks postpartum to determine whether women were still breast-feeding. They reviewed the charts to determine delivery mode and analgesic medication received. They were not able to find an association between breast-feeding success and labor analgesia. They concluded their discussion by recommending performance of a prospective randomized study.

Baumgarder *et al.*[7] enrolled 231 mothers and evaluated whether there were at least two successful breast-feeding sessions in the first 24 h. They evaluated 115 consecutive women who received epidural analgesia and matched them with 116 control patients who did not. They found that women who received epidural analgesia had successful breast-feeding interactions (70%) less frequently than those who did not (90%). However, the study was not randomized, there was no comment on the epidural medications used, and there were no assessments beyond 24 h.

Riordan *et al.*[5] conducted a study in which lactation consultants evaluated the mother–infant breast-feeding interaction and assessed success during the hospital stay and then again at 6 weeks postpartum *via* a telephone interview. They reviewed the medical records for medications administered and found that those who received epidural and intravenous analgesia during labor did not breast-feed as well during the hospital stay, but there was no impact on long-term breast-feeding success. However, they did not randomly assign the women to treatment groups, and they enrolled a combination of nulliparous and multiparous patients who had both vaginal and cesarean deliveries.

Radzyminski[2] enrolled 56 multiparous women who had a vaginal delivery to evaluate the effect of epidural analgesia on breast-feeding. Twenty-eight received epidural analgesia with 0.044% bupivacaine, 0.000125% fentanyl, and 1:800,000 epinephrine, and the other 28 did not receive any labor medication. Breast-feeding and neurobehavior were assessed by a nurse at 1 and 24 h after delivery using the premature infant breast-feeding scale and NACS, respectively. They did not find a significant difference in these parameters between the groups, but their study was small, was not randomized, and included women who had not breast-fed previously.

Our study differs from those previously published by being randomized, controlled, and blinded. Furthermore, the study design was based on the results of an observational pilot study. We were careful to enroll a homogeneous population of multiparous women who had successfully breast-fed previously and who delivered vaginally. We followed their experience in the first 24 h and again at 6 weeks after delivery. We changed the definition of difficulty breast-feeding between the pilot study and our current study. In the pilot study, an infant was considered to be having difficulty breast-feeding if the mother responded in the affirmative to any of the breast-feeding issues listed in table 1. In this study, we considered the mother having difficulty breast-feeding only if she answered in the affirmative when asked if she was having difficulty breast-feeding, regardless of her response to any specific issue. This change in definition led to a smaller rate of breast-feeding problems at 24 h in the current study.

In this study, we used two methods to assess breast-feeding, both of which focus on problems the neonate may have with breast-feeding rather than those related to the mother, *e.g.*, sore nipples, breast engorgement, and milk insufficiency. Although our breast-feeding assessments have not been validated, they are clinically relevant and incorporate variables found in other breast-feeding assessment tools. Because our breast-feeding tool has not been validated, not only did we assess individual variables, we asked the mother and the lactation consultant to give their opinion as to whether the infant was having difficulty breast-feeding.

Although we found a negative association between epidural fentanyl and breast-feeding success, the overall incidence of breast-feeding problems was small, 24 (14%) at 24 h and 14 (9%) at 6 weeks, as assessed by the mother. The lactation consultants reported a greater incidence of breast-feeding problems with no difference among the groups (approximately 40%). Similar to the results of Righard and Alade,[20] the lactation consultant identified breast-feeding problems that the mother did not. We cannot determine whose evaluation is more germane, but we believe that maternal assessment is more relevant because the mother's perception of breast-feeding difficulties may lead to frustration and future breast-feeding problems. We found that mothers who reported difficulty at 24 h postpartum were less likely than their counterparts to be breast-feeding at 6 weeks. We chose 6 weeks for our long-term outcome because this is the time frame most other studies use, and it is past the time when the mother's milk supply is

well established and mother and infant have learned the skills of breast-feeding.[21]

Fentanyl is highly lipophilic and easily crosses the placenta, which may lead to neonatal depression. Although the protocols were different, the umbilical vein fentanyl concentrations we found are similar to those found by both Loftus *et al.*[10] and Bader *et al.*[11] We also found that those who received more than 150 μg epidural fentanyl had decreased NACS scores and more difficulty breast-feeding at 6 weeks postpartum as compared with those who received less (both by randomization group and by the amount of fentanyl actually received). Our results also indicate that it may be the absolute dose of fentanyl that is important rather than the dose as related to time. Fentanyl rapidly crosses the placenta,[22] and opioids are metabolized more slowly in neonates than in adults.[23] This may explain why the total dose is important even if administered over the course of a long labor. This is in agreement with the results of Bader *et al.*,[6] who also found that umbilical vein fentanyl concentrations were unrelated to the duration of labor.

There is no one best medication or combination of medications for labor epidural analgesia. The trend among obstetric anesthesiologists is to use small concentrations of local anesthetic during labor epidural analgesia. This is generally accomplished by adding opioids, such as fentanyl or sufentanil, to the epidural anesthetic.[24] The advantage of using small concentrations of local anesthetic is to minimize lower extremity motor block that might have an impact on both obstetric outcome and patient satisfaction.[25] The three regimens we used mimic clinical practice in that those who receive more fentanyl tend to receive less bupivacaine and *vice versa*.

This study did not include a group that did not receive an epidural anesthetic. Therefore, we cannot make any inferences about a relation between epidurals and breast-feeding, only about fentanyl use among women who have an epidural. Also, the overall incidence of breast-feeding problems was small. We found a significant difference among groups at 6 weeks postpartum, but the difference at 24 h, based on randomization group, did not reach statistical significance. Because we found a lower-than-anticipated incidence of difficulties than predicted by the pilot study, this study may have been underpowered to find a significant difference. However, the 24-h differences were statistically significant when evaluated in terms of the amount of fentanyl actually received. Based on the results of this study, we do not recommend abandoning the use of epidural fentanyl, because that could lead to other problems, including an increase in instrumental deliveries.[25] Rather, we suggest the need for greater awareness of potential problems between epidural fentanyl and breast-feeding that might well be ameliorated with early intervention and education.

In summary, we found that multiparous women who had previously breast-fed and who were randomly assigned to receive more than 150 μg fentanyl had a significantly lower breast-feeding success rate at 6 weeks postpartum as compared with comparable women who were randomly assigned to receive less fentanyl or no fentanyl.

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