

The Influence of Continuous Epidural Bupivacaine Analgesia on the Second Stage of Labor and Method of Delivery in Nulliparous Women

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A randomized, double blind, placebo-controlled study was performed to evaluate the analgesic efficacy and influence of continuing an epidural infusion of 0.125% bupivacaine beyond a cervical dilatation of 8 cm in nulliparous women. When the cervix was ≥ 8 cm dilated, coded study solution was substituted for the known 0.125% bupivacaine solution. The study solution for 46 patients was 0.125% bupivacaine; 46 patients received saline. During the first stage of labor, 44 (96%) women in the bupivacaine group, and 45 (98%) in the saline group, had analgesia of excellent or good quality. During the second stage, 36 (82%) women in the bupivacaine group, versus 18 (41%) women in the saline group, had analgesia of excellent or good quality ($P < .0001$). Six (13%) women in each group underwent cesarean delivery after the start of the study solution. Among the women who delivered vaginally, the mean (\pm S.D.) duration of the second stage of labor was 124 (± 70) min in the bupivacaine group, versus 94 (± 54) min in the saline group ($P < .05$). Twenty-one of 40 (53%) women in the bupivacaine group, versus 11 of 40 (28%) in the saline group, underwent instrumental vaginal delivery ($P < .05$). Twenty-eight of 40 (70%) women in the bupivacaine group, versus six of 40 (15%) in the saline group, had surgical perineal anesthesia for vaginal delivery ($P < .0001$). There were no significant differences between groups in Apgar scores or umbilical cord blood acid-base values. We conclude that, under the conditions of the present study, epidural bupivacaine infusion beyond a cervical dilatation of 8 cm provided satisfactory analgesia, but prolonged the second stage of labor and increased the frequency of instrumental delivery in nulliparous women. However, maintenance of epidural bupivacaine analgesia did not result in an increased incidence of abnormal position of the vertex or a more frequent performance of cesarean section. (Key words: Anesthesia: obstetric. Anesthetic techniques: epidural. Labor: second stage. Local anesthetics: bupivacaine.)

THERE IS CONTROVERSY regarding the use of epidural analgesia during the second stage of labor. In a randomized but nonblinded study using an intermittent epidural

bolus technique, Phillips and Thomas¹ reported no increase in duration of the second stage, and a nonsignificant decrease in the frequency of instrumental delivery, in nulliparous women who received additional epidural bupivacaine at complete cervical dilatation, compared with women who received no additional bupivacaine. However, many obstetricians prefer to discontinue epidural injection or infusion of local anesthetic solutions during the second stage. In an earlier study,² we observed that maintenance of a continuous epidural infusion of 0.75% lidocaine beyond a cervical dilatation of 8 cm did not prolong the second stage of labor or increase the frequency of instrumental delivery in nulliparous women, but it also did not reliably provide second stage analgesia or perineal anesthesia. The purpose of the present study was to determine if maintenance of continuous epidural bupivacaine analgesia beyond a cervical dilatation of 8 cm in nulliparous women: 1) prolongs the second stage of labor; 2) increases the frequency of instrumental vaginal delivery and/or cesarean section; 3) increases the incidence of abnormal position of the vertex; and 4) affects the condition of the infant at birth.

Methods

The protocol was approved by the University of Iowa Institutional Review Board for research involving human subjects. Written informed consent was obtained from healthy nulliparous women with term (≥ 36 weeks) singleton fetuses in vertex presentation. Women with pre-eclampsia or insulin-dependent diabetes were excluded. Each fetus had a normal heart rate pattern before induction of epidural analgesia.

Each patient received an intravenous infusion of 750 ml of Ringer's lactate over 10-15 min before induction of epidural analgesia. When the cervix was 3-7 cm dilated, an epidural catheter was placed *via* the L3-4 interspace and advanced 3-4 cm cephalad. Each patient received, in sequence: 1) 3 ml of 0.5% bupivacaine, with 1:200,000 epinephrine; 2) 6-8 ml of 0.25% bupivacaine; and 3) a continuous infusion of 0.125% bupivacaine, at 12-14 ml/hr *via* a Harvard pump. Uterine displacement was maintained continuously, and each patient was encouraged to

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Received from the Departments of Anesthesia and Obstetrics and Gynecology, University of Iowa College of Medicine, Iowa City, Iowa 52242. Accepted for publication January 23, 1987. Presented in part at the annual meeting of the Society for Obstetric Anesthesia and Perinatology, Salt Lake City, Utah, May 16, 1986, and at the annual meeting of the American Society of Anesthesiologists, Las Vegas, Nevada, October 21, 1986.

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turn from side to side at 30-min intervals. The cephalad dermatomal level of anesthesia was determined by pinprick at 30-min intervals. The infusion rate was increased or decreased to maintain a sensory level of T10; if it was necessary to increase the rate of infusion, the patient first received an additional 2–5 ml bolus of 0.125% bupivacaine.

When the cervix was ≥ 8 cm dilated, a 60 ml syringe of coded study solution, freshly prepared by the hospital pharmacist according to a table of random numbers, was substituted for the syringe known to contain 0.125% bupivacaine. The patient, anesthesiologist, obstetrician, pediatrician, and nursing staff were unaware of the identity of the study solution. The study solution for one group of patients was 0.125% bupivacaine; patients in the other group received physiologic saline. The connecting tubing was disconnected from the epidural catheter and flushed with study solution before the infusion of study solution was begun. The rate of study solution infusion was equal to the previous rate of known bupivacaine infusion.

At complete cervical dilatation, each patient assumed the 45° semirecumbent position and was encouraged to push with contractions. One or two 5 ml boluses of coded study solution were given to patients in whom perineal anesthesia was absent. (The hospital pharmacist had prepared a 10 ml syringe of coded study solution for this purpose; patients in the bupivacaine group received 0.25% bupivacaine; patients in the saline group received physiologic saline.)

The obstetric staff had agreed that the infusion of study solution would be continued until delivery in all patients unless there was either fetal distress due to hypotension, or a lack of progression in descent of the vertex after at least 1 h of the second stage. The obstetric staff had also agreed that operative delivery would be performed for obstetric indications only; elective instrumental deliveries were not performed.

The obstetrician was permitted to administer intravenous alphaprodine (20 mg) or meperidine (25–50 mg) at his/her discretion. However, supplemental anesthesia was not administered to any patient until the time of delivery. An epidural bolus of known local anesthetic was administered only if the obstetrician had decided to perform operative delivery for an obstetric indication. Otherwise, pudendal block and/or perineal infiltration with 1% lidocaine were performed as indicated.

The anesthesiologist asked each patient to indicate her pain score on an unmarked 100 mm visual analogue pain scale (0 = no pain, 100 = worst possible pain) at 30-min intervals. Further, the anesthesiologist asked each patient to assess the quality of her analgesia during the first and second stages of labor. The first assessment (“How would you describe the quality of your pain relief since the epidural was begun—excellent, good, fair, poor, very poor?”)

was performed when the study solution was begun. The second assessment (“How would you describe the quality of your pain relief during the time that you were pushing—excellent, good, fair, poor, very poor?”) was performed immediately after delivery. If an epidural bolus of known local anesthetic was administered for operative delivery, the second assessment of analgesia quality was performed before administration of the epidural bolus.

Maternal blood pressure was determined at 1-min intervals for 20 min, and subsequently at 15-min intervals, with an automated blood pressure monitor. Maternal hypotension was defined as a decrease in systolic blood pressure of $\geq 20\%$, or a systolic blood pressure < 100 mmHg. Hypotension was treated promptly by increasing the rate of intravenous fluid administration and by administering 5–10 mg of ephedrine intravenously.

The duration of the active phase of the first stage of labor was defined as the interval between cervical dilatation of 4 and 10 cm. The duration of the second stage of labor was defined as the interval between the diagnosis of complete (10 cm) cervical dilatation and delivery. Instrumental deliveries were recorded as low-pelvis or mid-pelvis deliveries according to the definition of *Williams Obstetrics*.³ (Three conditions were required for an instrumental delivery to be recorded as low pelvis: the fetal head had reached the perineal floor, the sagittal suture was in the anteroposterior diameter of the outlet, and the scalp was visible at the introitus. All instrumental deliveries not fulfilling these conditions were recorded as mid-pelvis.³) Motor block was assessed according to the method of Bromage⁴ (none, partial, almost complete, complete). Neonatal assessment was by Apgar scores and umbilical venous and arterial blood acid-base analysis.

Statistical analysis was by Student's *t* test, Mann Whitney U-test, Chi square, and Fisher exact test as indicated. $P < .05$ was considered statistically significant.

Results

One hundred and ten women consented to participate in the study. Eleven women were excluded because they were noted to have cervical dilatation of ≥ 8 cm either before the epidural catheter could be placed or before a T-10 sensory level could be established. Five women were excluded because they underwent cesarean delivery for dystocia after the start of the known bupivacaine infusion but before the start of the study solution. Two women were excluded because of a protocol violation.

Among the remaining 92 patients, there were 46 patients in each group. There were no significant differences between groups in age, race, socioeconomic status, childbirth preparation, weight, height, gestational age, and cervical dilatation before induction of epidural analgesia (table 1).

TABLE 1. Maternal Characteristics

	Bupivacaine, N = 46	Saline, N = 46	P Value
Age (yr)*	21 ± 4	22 ± 4	NS
Race			
Caucasian	44	46	NS
Black	2	0	NS
Socioeconomic status			
Indigent	39	34	NS
Private	7	12	
Childbirth preparation class			
None	20	18	NS
Lamaze	13	17	
Health department/University	13	11	
Weight (kg)*	76 ± 16	80 ± 14	NS
Height (cm)*	163 ± 7	166 ± 7	NS
Gestational age (weeks)*	40.4 ± 1.3	40.2 ± 1.5	NS
Cervical dilatation before epidural (cm)*	4.8 ± 0.9	4.4 ± 1.1	NS

NS = not significant.

* Mean ± S.D.

CONDUCT OF LABOR AND DELIVERY

Fourteen patients in the bupivacaine group, and 15 in the saline group, were receiving intravenous oxytocin before induction of epidural analgesia. Five patients in the

TABLE 2. Conduct of Labor

	Bupivacaine, N = 46	Saline, N = 46	P Value
Duration of active phase of first stage (min)*	354 ± 236	331 ± 182	NS
Duration of known bupivacaine infusion (min)*	173 ± 126	221 ± 138	NS
Bupivacaine dosage before start of study solution (mg)*	82 ± 42	94 ± 40	NS
Bupivacaine dosage after start of study solution (mg)*	49 ± 28	0	
Total bupivacaine dosage (mg)*	132 ± 60	94 ± 40	<.005
Duration of second stage (min)*†	124 ± 70	94 ± 54	<.05
Motor block at start of study solution			
None	23 (50%)	26 (57%)	NS
Partial	19 (41%)	16 (35%)	
Almost complete	4 (9%)	4 (9%)	
Complete	0 (0%)	0 (0%)	
Motor block before delivery			
None	24 (52%)	41 (89%)	<.0005
Partial	18 (39%)	4 (9%)	
Almost complete	4 (9%)	1 (2%)	
Complete	0 (0%)	0 (0%)	
Position of vertex immediately before delivery			
Occiput anterior	39 (85%)	40 (87%)	NS
Occiput posterior	6 (13%)	5 (11%)	
Occiput transverse	1 (2%)	1 (2%)	

NS = not significant.

* Mean ± S.D.

† Excluding the six women in each group who underwent cesarean delivery.

TABLE 3. Method of Vaginal Delivery

	Bupivacaine, N = 40	Saline, N = 40	P Value
Spontaneous	19 (48%)	29 (73%)	<.05
Low forceps	12 (30%)	7 (18%)	
Mid vacuum followed by low forceps	6 (15%)	0 (0%)	
Mid forceps	3 (8%)	4 (10%)	

bupivacaine group, and ten in the saline group, had intravenous oxytocin started after induction of epidural analgesia ($P = NS$).

Table 2 includes other data regarding conduct of labor. There were no significant differences between groups in duration of the active phase of the first stage of labor, duration of infusion of known bupivacaine, or dosage of bupivacaine before the start of the study solution. The mean (\pm S.D.) dosage of bupivacaine after the start of the study solution in the bupivacaine group was 49 (\pm 28) mg. The total bupivacaine dosage in the bupivacaine group was 132 (\pm 60) mg, versus 94 (\pm 40) mg in the saline group ($P < .005$).

The two groups were similar with regard to motor block at the time of starting the study solution. At delivery, there was significantly more motor block in the women in the bupivacaine group ($P < .0005$). The two groups were similar with regard to position of the vertex immediately before delivery.

Six women in each group underwent cesarean delivery after the start of the study solution (two women in each group underwent cesarean after the start of the study solution but before attaining full cervical dilatation; four women in each group underwent cesarean after attaining full cervical dilatation). The diagnosis for each of these cesarean deliveries was cephalopelvic disproportion.

Among the 40 women in each group who delivered vaginally, the mean (\pm S.D.) duration of the second stage of labor was 124 (\pm 70) min in the bupivacaine group, versus 94 (\pm 54) min in the saline group ($P < .05$). Details regarding method of vaginal delivery are listed in table 3. Twenty-one of 40 (53%) women in the bupivacaine group, versus 11 of 40 (28%) in the saline group, underwent instrumental delivery ($P < .05$). Nine women in the bupivacaine group, and four in the saline group, had mid-pelvis procedures ($P = .13$). One patient in the bupivacaine group, and no patient in the saline group, underwent a rotational instrumental delivery. Indications for the instrumental deliveries were: 1) failure to progress (17 patients in the bupivacaine group, six in the saline group, $P < .05$); and 2) fetal distress (four patients in the bupivacaine group, five in the saline group). Each patient with a diagnosis of failure to progress had had a second stage of at least 120 min.

EFFECTS ON THE FETUS AND NEONATE

Two patients in the bupivacaine group, and six in the saline group, had transient hypotension during the first hour after induction of epidural analgesia ($P = NS$). One patient in the bupivacaine group, and no patient in the saline group, had transient hypotension thereafter. No patient had hypotension during infusion of the study solution.

A fetal scalp electrode was used to monitor the fetal heart rate in 42 patients in each group; external fetal heart rate monitoring was used in the remaining patients. Three patients in each group had abnormal fetal heart rate patterns which prompted determination of fetal scalp blood pH during the infusion of known bupivacaine. Three patients in the bupivacaine group, and one in the saline group, had fetal scalp blood pH determination during the infusion of the study solution ($P = NS$).

Table 4 includes data relating to the newborn. The times of diagnosis of meconium-stained amniotic fluid were: 1) before induction of epidural analgesia (ten patients in the bupivacaine group, four in the saline group); 2) during known bupivacaine infusion (no patient in the bupivacaine group, one in the saline group); and 3) during study solution infusion (three patients in the bupivacaine group, five in the saline group).

There were no significant differences between groups in umbilical cord blood acid-base values. Mean umbilical venous and arterial blood pH values for all infants delivering by vertex presentation at our hospital are 7.32 and 7.24, respectively (Van de Wetering M, Senden I. Unpublished data).

ANALGESIA QUALITY

Twenty-seven patients in the bupivacaine group, and 20 in the saline group, had received an intravenous injection of alphaprodine or meperidine before epidural analgesia ($P = NS$). No patient received a narcotic during infusion of known bupivacaine. No patient in the bupivacaine group, but four patients in the saline group, received an injection of alphaprodine or meperidine during the infusion of study solution ($P = NS$).

Eight patients in the bupivacaine group, and ten in the saline group, received at least one bolus of 2-5 ml of 0.125% bupivacaine after the continuous infusion of bupivacaine was begun. At the time of starting the study solution, three patients in each group had an infusion rate which was ≥ 2 ml/hr greater than the initial infusion rate.

The two groups were similar with regard to mean pain scores during the first stage of labor, before the start of the study solution (fig. 1). After the study solution was substituted for known bupivacaine, the two groups differed with regard to mean pain scores over time (fig. 2).

TABLE 4. Newborn Assessment

	Bupivacaine N = 46	Saline N = 46	P Value
Infant weight (gm)*	3480 ± 466	3424 ± 481	NS
Meconium-stained amniotic fluid			
13 (28%)		10 (22%)	NS
1-min Apgar ≥ 7	40 (87%)	36 (78%)	NS
5-min Apgar ≥ 7	46 (100%)	45 (98%)	NS
Umbilical venous blood analysis*			
pH	7.32 ± .06	7.31 ± .09	NS
PO_2 (torr)	27.4 ± 5.4	27.3 ± 6.9	NS
PCO_2 (torr)	38.0 ± 5.8	37.8 ± 8.9	NS
Base excess (mEq/L)	-5.2 ± 2.2	-6.3 ± 3.4	NS
Umbilical arterial blood analysis*			
pH	7.24 ± .06	7.21 ± .12	NS
PO_2 (torr)	18.4 ± 10.5	15.8 ± 5.4	NS
PCO_2 (torr)	48.5 ± 10.7	49.3 ± 13.7	NS
Base excess (mEq/L)	-6.4 ± 2.7	-7.7 ± 4.1	NS

NS = not significant.
* Mean ± S.D.

Further, the mean pain score was significantly higher in the saline group at each 30-min interval between 60-240 min after starting the study solution ($P < .01$).

Similarly, there was no difference between groups in patient assessment of analgesia quality during the first stage of labor (fig. 3, table 5). There was a clearly significant difference between the two groups with regard to analgesia quality during the second stage ($P < .0001$) (fig. 4, table 5).

Twenty-three of 44 (52%) women in the bupivacaine group, versus seven of 44 (16%) in the saline group, had perineal anesthesia after attaining complete cervical dilatation, and did not receive an epidural bolus of study solution ($P < .0005$). Among the women who delivered vaginally, 28 of 40 (70%) women in the bupivacaine

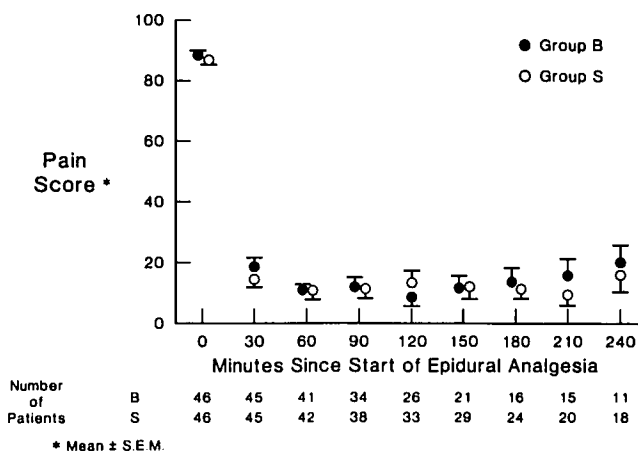


FIG. 1. Mean (\pm S.E.M.) pain scores over time during the first stage of labor, before the start of the study solution.

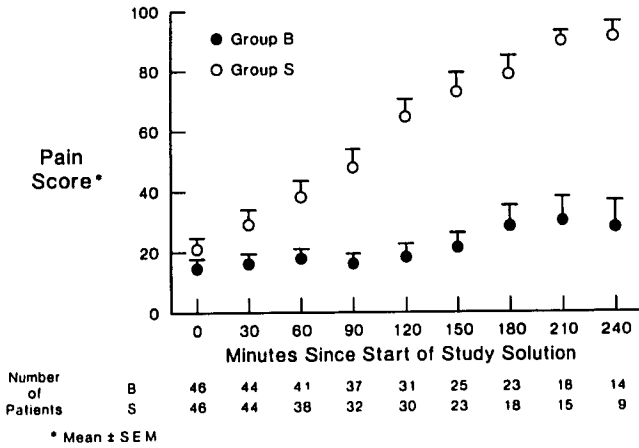


FIG. 2. Mean (±S.E.M.) pain scores after the start of the study solution. The mean pain score was significantly higher in the saline group at each 30-min interval between 60–240 min after starting the study solution ($P < .01$ at 60 min, and $P < .0001$ at 90–240 min).

group, versus six of 40 (15%) in the saline group, had surgical perineal anesthesia at delivery, without administration of pudendal block, perineal infiltration, or an epidural bolus of known local anesthetic solution ($P < .0001$).

Discussion

There is renewed interest in continuous infusion epidural analgesia during labor.⁵⁻¹² Purported advantages of the continuous infusion technique include: 1) a more stable level of analgesia; 2) reduced risk of systemic toxicity or total spinal block if the catheter is inadvertently positioned in a vein or the subarachnoid space; and 3) reduced risk of hypotension as a result of less variation in sympathetic blockade.¹³

Regardless of the method of epidural analgesia administration, there is controversy regarding the association

† Rosenblatt R, Wright R, Denson D, Raj P: Continuous epidural infusions for obstetric analgesia. *Reg Anesth* 8:10-15, 1983.

** Hanson AL, Hanson B: Continuous mini-infusion of bupivacaine into the epidural space during labor: Experience from 1000 deliveries. *Reg Anesth* 10:139-144, 1985.

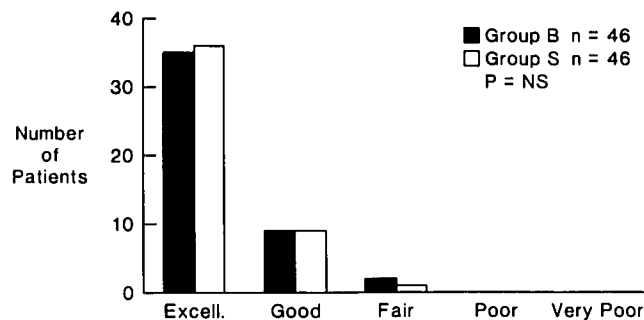


FIG. 3. Patient assessment of analgesia quality during the first stage of labor, before the start of the study solution.

TABLE 5. Analgesia Quality

	Bupivacaine	Saline	P Value
First stage	N = 46	N = 46	NS
Excellent	35 (76%)	36 (78%)	
Good	9 (20%)	9 (20%)	
Fair	2 (4%)	1 (2%)	
Poor	0 (0%)	0 (0%)	
Very poor	0 (0%)	0 (0%)	
Second stage*	N = 44	N = 44	<.0001
Excellent	23 (52%)	6 (14%)	
Good	13 (30%)	12 (27%)	
Fair	6 (14%)	9 (20%)	
Poor	2 (5%)	12 (27%)	
Very poor	0 (0%)	5 (11%)	

NS = not significant.

* Excluding the two women in each group who underwent cesarean delivery after the start of the study solution, but before attaining complete cervical dilatation.

between epidural analgesia and the frequency of instrumental delivery. At least eight studies identified a significant increase in the frequency of instrumental delivery in women who had received epidural analgesia,¹⁴⁻²⁰ whereas six others identified no significant increase.²¹⁻²⁶ Each of these studies had one or more of the following weaknesses: 1) lack of randomization; 2) use of historical controls; 3) failure to describe and/or adhere to a rigid protocol for management of epidural analgesia during the second stage of labor; and 4) failure to report the frequency of second stage analgesia and perineal anesthesia in the epidural group.

To our knowledge, there is no published study in which parturients were randomized to receive epidural or systemic analgesia during the first stage of labor. We and others²⁷ believe that comparisons between patients selecting epidural analgesia and patients selecting no or systemic analgesia are biased in favor of the latter group, in that patients with abnormal or dysfunctional labor are more likely to request and receive epidural analgesia.

In our earlier study,² nulliparous women receiving a continuous epidural infusion of 0.75% lidocaine were randomized to receive either additional lidocaine or saline when the cervix was ≥ 8 cm dilated. We observed that there was no increase in the duration of the second stage or increase in the frequency of instrumental delivery in the lidocaine group; however, there was no clearly significant difference between groups in quality of second stage analgesia or frequency of perineal anesthesia. The present study differs from our earlier study in that 1) bupivacaine, rather than lidocaine, was given; and 2) a bolus of study solution was given to patients who lacked

†† Van Zundert A, Van der Aa P, Van der Donck A, Meeuwis H, Vaes L: Motorblockade, expulsion times and instrumental deliveries associated with epidural analgesia for vaginal delivery. *Obstet Anesth Digest* 4:152-156, 1984.

perineal anesthesia at complete cervical dilatation (however, 23 of 44 [52%] women in the bupivacaine group had perineal anesthesia at the time of diagnosis of complete cervical dilatation, and did not require a bolus of study solution). The increased mean durations of the second stage in the present study (124 and 94 min) versus the earlier study (73 and 76 min)² are consistent with the previous study of Abboud *et al.*⁹ They noted a significant increase in duration of the second stage of labor in patients who had received a continuous epidural infusion of 0.125% bupivacaine, when compared with patients who had received 0.75% lidocaine.⁹

Phillips and Thomas¹ reported no increase in duration of the second stage, and a nonsignificant decrease in the frequency of instrumental delivery, in 28 nulliparous women who received additional epidural bupivacaine at complete dilatation, compared with 28 women who received no additional bupivacaine. In contrast, in the present study, we observed an increase in frequency of instrumental delivery in the bupivacaine group, despite the significant increase in duration of the second stage. Potential reasons for these conflicting results include: 1) the study of Phillips and Thomas was randomized but non-blinded; 2) Phillips and Thomas used an intermittent epidural bolus technique, whereas we used a continuous infusion technique; 3) the total dosages of bupivacaine in their study (72 and 63 mg)¹ were less than those in the present study (132 and 94 mg); and 4) it is unclear as to how their two groups actually differed from one another in management, as there was no significant difference between groups in total dosage of bupivacaine or mean number of doses of bupivacaine (four doses per patient in each group).¹

We acknowledge that the presence or absence of second-stage analgesia may have betrayed the identity of the study solution in some patients in the present study. However, the double blind study design insured that there was similar treatment of patients in each group before the start of the study solution. Further, the loss of analgesia in patients in the saline group was often delayed and/or gradual, making it difficult to speculate accurately on the identity of the study solution.

We may be criticized for encouraging our patients to push at the onset of complete cervical dilatation. Maresh *et al.*²⁷ reported a study of 76 nulliparous patients with epidural analgesia who were randomly assigned to early pushing or late pushing in the second stage. There was a significant increase in the duration of the second stage, but a nonsignificant decrease in the frequency of instrumental delivery in the late pushing group. The increased second-stage duration was not associated with an increase in fetal heart rate abnormalities or a decrease in Apgar scores or umbilical cord blood pH.²⁷ There is an emerging consensus that a delay in the second stage is not necessarily harmful to infant or mother, provided that there is elec-

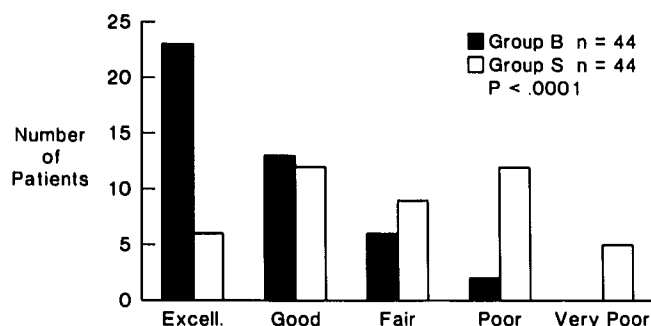


FIG. 4. Patient assessment of analgesia quality during the second stage of labor.

tronic fetal heart rate monitoring and adequate maternal hydration and analgesia.²⁷⁻²⁹ In both our earlier² and present study, there were trends toward higher umbilical cord blood pH values in the study group than in the control group. We speculate that there may have been less reduction in uterine and/or umbilical blood flow as a result of decreased maternal levels of catecholamines in the study groups (*i.e.*, lidocaine group in the earlier study² and bupivacaine group in the present study).^{30,31}

We are less encouraged by the increase in frequency of instrumental delivery in the bupivacaine group. There is consensus that a properly performed low forceps delivery is not associated with adverse neonatal outcome.³²⁻³⁵ However, the role of mid-pelvis instrumental deliveries in modern obstetric practice remains controversial. It is unfortunate that the present definition of mid-pelvis delivery includes deliveries of widely differing difficulty and hazard. Although Friedman *et al.*³⁴ have suggested that mid-forceps deliveries should be abandoned, others^{33,35,36} have recently reported data which support the continued performance of selected mid-forceps deliveries. Baerthlein *et al.*³⁷ recently noted no significant differences in neonatal morbidity between infants delivered by mid-pelvis vacuum extraction and infants delivered by mid-forceps. Regardless of these or other data, many patients perceive that an increased risk of instrumental delivery is undesirable.

We conclude that continuous epidural infusion of 0.125% bupivacaine consistently provided excellent-good analgesia during the first stage of labor, with infrequent hypotension and modest motor block. Second, epidural bupivacaine infusion beyond a cervical dilatation of 8 cm resulted in second-stage analgesia which was clearly superior to that provided by replacement of the bupivacaine with placebo. Third, under the conditions of the present study, epidural bupivacaine infusion beyond a cervical dilatation of 8 cm prolonged the second stage of labor and increased the frequency of instrumental delivery in nulliparous women. However, maintenance of epidural bupivacaine analgesia did not result in an increased incidence of abnormal position of the vertex, and it did not result in a more frequent performance of cesarean section. Fur-

thermore, there were nonsignificant tendencies toward better neonatal condition in the bupivacaine group, as evaluated by umbilical cord blood acid-base status and Apgar scores.

Results of the present study should not be extrapolated to other methods of epidural analgesia administration. Additional controlled studies are needed to determine if it is possible to avoid the dilemma of choosing between: 1) satisfactory analgesia during the second stage of labor, with an increased risk of instrumental delivery; and 2) a painful second stage, with a decreased risk of instrumental delivery.

References

- Phillips KC, Thomas TA: Second stage of labour with or without extradural analgesia. *Anaesthesia* 38:972-976, 1983
- Chestnut DH, Bates JN, Choi WW: Continuous infusion epidural analgesia with lidocaine: Efficacy and influence during the second stage of labor. *Obstet Gynecol* 69:323-327, 1987
- Pritchard JA, MacDonald PC, Gant NF: *Williams Obstetrics*, Seventeenth Edition. Norwalk, Appleton-Century-Crofts, 1985, pp 837-838
- Bromage PR: *Epidural Analgesia*. Philadelphia, WB Saunders, 1978, p 144
- Evans KRL, Carrie LES: Continuous epidural infusion of bupivacaine in labour: A simple method. *Anaesthesia* 34:310-315, 1979
- Davies AO, Fettes IW: A simple safe method for continuous infusion epidural analgesia in obstetrics. *Can Anaesth Soc J* 28:484-487, 1981
- Kenepf NB, Cheek TG, Gutsche BB: Bupivacaine: Continuous infusion epidural analgesia for labor (Abstract). *ANESTHESIOLOGY* 59:A407, 1983
- Taylor HJC: Clinical experience with continuous epidural infusion of bupivacaine at 6 ml per hour in obstetrics. *Can Anaesth Soc J* 30:277-285, 1983
- Abboud TK, Afrasiabi A, Sarkis F, Daftarian F, Nagappala S, Noueihed R, Kuhnert BR, Miller F: Continuous infusion epidural analgesia in parturients receiving bupivacaine, chloroprocaine, or lidocaine—Maternal, fetal, and neonatal effects. *Anesth Analg* 63:421-428, 1984
- Denson DD, Knapp RM, Turner P, Thompson GA: Serum bupivacaine concentrations in term parturients following continuous epidural analgesia for labor and delivery. *Ther Drug Monit* 6:393-398, 1984
- Li DF, Rees GAD, Rosen M: Continuous extradural infusion of 0.0625% or 0.125% bupivacaine for pain relief in primigravid labour. *Br J Anaesth* 57:264-270, 1985
- Nadeau S, Elliott RD: Continuous bupivacaine infusion during labour: Effects on analgesia and delivery (Abstract). *Can Anaesth Soc J* 32:S70-S71, 1985
- Morison DH, Smedstad KG: Continuous infusion epidurals for obstetric analgesia (Editorial). *Can Anaesth Soc J* 32:101-104, 1985
- Crawford JS: The second thousand epidural blocks in an obstetric hospital practice. *Br J Anaesth* 44:1277-1287, 1972
- Johnson WL, Winter WW, Eng M, Bonica JJ, Hunter CA: Effect of pudendal, spinal, and peridural block anesthesia on the second stage of labor. *Am J Obstet Gynecol* 113:166-175, 1972
- Hollmen A, Jouppila R, Pihlajaniemi R, Karvonen P, Sjøstedt E: Selective lumbar epidural block in labour. A clinical analysis. *Acta Anaesthesiol Scand* 21:174-181, 1977
- Hoult IJ, MacLennan AH, Carrie LES: Lumbar epidural analgesia in labour: Relation to fetal malposition and instrumental delivery. *Br Med J* 1:14-16, 1977
- Studd JWW, Crawford JS, Duignan NM, Rowbotham CJF, Hughes AO: The effect of lumbar epidural analgesia on the rate of cervical dilatation and the outcome of labour of spontaneous onset. *Br J Obstet Gynaecol* 87:1015-1021, 1980
- Kanto J, Erkkola R, Mansikka M, Aarimaa L: Segmental epidural analgesia—A modern method for safe and effective management of labor pains. *Biol Res Pregnancy* 4:172-176, 1983
- Walton P, Reynolds F: Epidural analgesia and instrumental delivery. *Anaesthesia* 39:218-223, 1984
- Doughty A: Selective epidural analgesia and the forceps rate. *Br J Anaesth* 41:1058-1062, 1969
- Potter N, MacDonald RD: Obstetric consequences of epidural analgesia in nulliparous patients. *Lancet* 1:1031-1034, 1971
- Maltau JM, Andersen HT: Continuous epidural anaesthesia with a low frequency of instrumental deliveries. *Acta Obstet Gynecol Scand* 54:401-406, 1975
- Jouppila R, Jouppila P, Karinen JM, Hollmen A: Segmental epidural analgesia in labour: Related to the progress of labour, fetal malposition and instrumental delivery. *Acta Obstet Gynecol Scand* 58:135-139, 1979
- Matouskova A, Dottori O, Forssman L, Victorin L: An improved method of epidural analgesia with reduced instrumental delivery rate. *Acta Obstet Gynecol Scand [Suppl]* 83:9-13, 1979
- Rudick V, Niv D, Golan A, Hethman M, Galon A, David MP, Chayen MS: Epidural analgesia during labor in 1,200 monitored parturients. *Isr J Med Sci* 19:20-24, 1983
- Maresh M, Choong KH, Beard RW: Delayed pushing with lumbar epidural analgesia in labour. *Br J Obstet Gynaecol* 90:623-627, 1983
- Cohen WR: Influence of the duration of second stage labor on perinatal outcome and puerperal morbidity. *Obstet Gynecol* 49:266-269, 1977
- Pearson JF, Davies P: The effect of continuous lumbar epidural analgesia on maternal acid-base balance and arterial lactate concentration during the second stage of labour. *J Obstet Gynaecol Br Commonw* 80:225-229, 1973
- Shnider SM, Abboud TK, Artal R, Henriksen EH, Stefani SJ, Levinson G: Maternal catecholamines decrease during labor after lumbar epidural anesthesia. *Am J Obstet Gynecol* 147:13-15, 1983
- Marx GF, Patel S, Berman JA, Farmakides G, Schulman H: Umbilical blood flow velocity waveforms in different maternal positions and with epidural analgesia. *Obstet Gynecol* 68:61-64, 1986
- Livnat EJ, Fejgin M, Scommegna A, Bieniarz J, Burd L: Neonatal acid-base balance in spontaneous and instrumental vaginal deliveries. *Obstet Gynecol* 52:549-551, 1978
- McBride WG, Black BP, Brown CJ, Dolby RM, Murray AD, Thomas DB: Method of delivery and developmental outcome at five years of age. *Med J Aust* 1:301-304, 1979
- Friedman EA, Sachtleben-Murray MR, Dahrouge D, Neff RK: Long-term effects of labor and delivery on offspring: A matched-pair analysis. *Am J Obstet Gynecol* 150:941-945, 1984
- Gilstrap LC, Hauth JC, Schiano S, Connor KD: Neonatal acidosis and method of delivery. *Obstet Gynecol* 63:681-685, 1984
- Dierker LJ, Rosen MG, Thompson K, Lynn P: Midforceps deliveries: Long-term outcome of infants. *Am J Obstet Gynecol* 154:764-768, 1986
- Baerthlein WC, Moodley S, Stinson SK: Comparison of maternal and neonatal morbidity in midforceps delivery and midpelvis vacuum extraction. *Obstet Gynecol* 67:594-597, 1986