

EFFECTS OF EPIDURAL ANALGESIA WITH LOW-DOSE BUPIVACAINE AND FENTANYL ON THE PROGRESS OF LABOR AND MODE OF DELIVERY

S. ATASHKHOII M.D.*, M. JAFARI SHOBEIRI, M.D.**,
AND S. NEGARGAR, M.D.***

*From the Departments of *Anesthesiology and **Obstetrics and Gynecology, Tabriz University of Medical
Sciences, Tabriz, I.R. Iran.*

ABSTRACT

Background and Objective: Epidural analgesia (EA) has been used to relieve labor pain in many obstetric units, yet controversy persists about its effect on progress and outcome in labor. The purpose of the current study was to evaluate the effect of EA on the rate of cervical dilation and myometrial contractility.

Methods: In a 6-month period, 36 women who received standardized EA were matched with the next two delivering women of 72 patients of the same parity who did not receive EA. The outcome variables were uterine activity, rate of cervical dilation, oxytocin therapy, and operative deliveries.

Results: Intermittent EA with bupivacaine and fentanyl did not result in a change in myometrial contractility and the rate of cervical dilation. Oxytocin therapy was significantly higher in the epidural group than in the nonepidural group ($p < 0.002$). Operative deliveries were not more common in those without it ($p > 0.05$).

Conclusion: After intermittent low-dose bupivacaine and fentanyl EA, myometrial contractility and the ability of the uterus to dilate the cervix are maintained with oxytocin. Despite prolongation of the second stage of labor, cesarean delivery was not common in the epidural group.

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INTRODUCTION

Epidural analgesia (EA) provides excellent relief from the pain of labor and is being used in a large percentage of laboring women. However, the trade-off for pain relief

may be longer labor and more operative deliveries.^{1,2} Properly administered EA provides adequate pain relief during labor and delivery, avoids adverse effects of narcotics, hypnotics, or inhalation drugs and it could be used as anesthesia in case a cesarean section (CS) is required.³

The potential effects of EA on the progress of labor and the incidence of operative or instrumental delivery have been a subject of lasting controversy, particularly between obstetricians and anesthesiologists.^{4,6} One of the oldest and most controversial questions concerns the timing of initiation of an epidural block for labor analgesia. Conventional wisdom holds that if started too

*Assistant Professor of Anesthesiology, Tabriz University of Medical Sciences, Tabriz.

**Assistant Professor of Obstetrics and Gynecology, Tabriz University of Medical Sciences, Tabriz.

*Corresponding Author: Dr. Simin Atashkhooi: Iran, Tabriz, South Ardash Ave, Al-Zahra Hospital, Department of Anesthesia E-mail: siminatashkhooi@yahoo.com

Tel: 0098914-1148861 Fax: 0098411-556

early in labor (during the latent phase), EA may markedly slow or even arrest the progress of labor.^{7,8} Chestnut and colleagues^{7,8} randomized women requesting EA to early or late groups (approximately 4 and 5 cm dilation). No differences in labor outcome were seen in either spontaneous or induced labors.

Because EA may be initiated at very different times during the first stage (i.e., 3-versus 8-cm cervical dilation), and because uterine contractility increases during labor, much of the variability in labor duration may exist before the EA is administered.¹ Norris et al.⁴ reported that when analgesia was initiated at a greater cervical dilation (4.0-4.5 cm), it was associated with faster cervical dilation. This underlying dilation rate may have minimized the impact of analgesia technique. In addition, obstetrical management of labor, including using oxytocin for induction and assisting membrane rupture, may play significant roles in the progress and outcome of labor.⁹

New variations of the techniques are EA with local anesthetic plus short acting opioids, the combined spinal epidural (CSE), patient-controlled EA (PCEA), and the use of regional anesthetics (i.e., midazolam) instead of local anesthetics. In these, because of the using of low-doses of local anesthetic, mothers to be have a better chance of being truly ambulant during labor, and decrease mother and fetus/neonate morbidity.^{10,12}

The purpose of this study was to examine the effect of intermittent EA with low-dose bupivacaine and fentanyl on the rate of cervical dilation and myometrial contractility at the initiation of EA and during the remainder of labor.

PATIENTS AND METHODS

Forty consecutive generally healthy parturients following normal pregnancy were included in this prospective, randomized, and case-controlled study. Before patients were enrolled, we standardized the methods of EA. Consecutive patients who received EA (EA group, n= 40) were identified within a 6-months period. Each study patient was matched with the next two delivering patients (control group), regardless of the mode of delivery, who did not receive EA during labor and were of the same parity as the study patients.

The following protocol was used for EA. Once labor was well established (active phase; cervical dilation at 4-5 cm) patients received a 750 mL bolus of normosol. With patients in the left lateral decubitus or sitting position and after sterile preparation and drape, the epidural space was identified. Under local anesthesia, an 18-gauge Tuohy needle was inserted in the epidural space at the L_{3,4} or L_{4,5} lumbar interspaces using a midline approach with a loss of resistance technique. Then the epidural

catheter was inserted. A 3 mL test dose of 1% lidocaine with 1: 200,000 epinephrine was given after no aspiration of cerebrospinal fluid or blood. Vital signs were observed for evidence of subarachnoid injection or intravascular injection. If the test dose was negative, a 10 mL bolus of 0.125% bupivacaine with 20 µg fentanyl was injected through the catheter. The level of sensory blockade (as assisted by a pinprick) at 5 and 20 minutes after the initial dose extended to at least the tenth thoracic dermatome (T₁₀), but not above T₈. Repeat injections were given when the women requested additional pain relief.

Women in the subject group were allowed to walk after fulfilling acceptable analgesia, acceptable systolic blood pressure (>100 mmHg), and the ability to stand on one leg. Each laboring patient in the study and control groups had pelvic examinations every 1-2 hours during the active phase to follow their progress. One physician performed these examinations. The goal of management was to maintain a rate of cervical dilation greater than 1 cm/hour. If this was not achieved, augmentation with oxytocin was initiated. Four outcome variables were used to demonstrate the effect of intermittent EA on myometrial function: the rate of cervical change, uterine activity, dose of oxytocin, and the incidence of operative delivery.

Fetal heart rate was monitored throughout labor with an external monitoring system. Need for oxytocin, amount of local anesthetics used, labor duration (time elapsed between cervical dilation at 4-5 cm and delivery), and mode of delivery (spontaneous, instrumental, or CS) were recorded. Apgar scores were recorded at 1-min and 5-min after birth.

Statistical analysis was performed using Chi-square, and student *t* test for normally distributed continuous data, and Mann-Whitney *U* test for nonnormally distributed continuous data. *p*<0.05 was considered significant.

RESULTS

In the 6-months study period, 40 patients received EA. Four patients were failed EA, and were excluded. The remaining 36 study patients were matched with 72 control patients. Five (7.2%) patients with EA received ephedrine for hypotension. No patient had her EA discontinued because of hypotension.

Table I shows participant's demographic data. No differences were noted with respect to parity, age, height, and weight at the time of labor, and cervical dilation at the time of EA.

Table II shows the effect of EA on the progress of labor after cervical dilation at 4-5 cm. The mean number of contractions was 0.37±0.1/min, 0.38±0.1/min (*p*>0.05) in the study and control patients, respectively. Patients

Table I. Demographic data.

	EA group (N=36)	Controls (N=72)	P
Maternal height (cm±SD)	160±6	162±6	NS
Nulliparus (%)	14(38.8)	30(41.6)	NS
Age (years)	25.4±4.2	25.5±4.3	NS
Weight (kg)	84.7±9.6	85.6±12.7	NS
Cervical dilation at EA onset (cm)	4.2±1.3	4.3±1.4	NS
Birth weight (g±SD)	3230±510	3370±612	NS

SD=standard deviation; NS=not significant.

Table II. Rate of cervical dilation after epidural insertion, uterine activity, and duration of labor.

Time period	EA group	Controls (N=36)	P (N=72)
Cervical dilation rate one hour after EA (cm/h ± SD)	0.8±0.4	1.3±0.5	0.03*
Mean of cervical dilation rate from EA onset to 10 (cm/h±SD)	2.3±0.7	2.7±1.1	NS
Uterine contractions/min after EA onset	0.37±0.1	0.38±0.1	NS
Duration of labor after RA (min)			
First stage	187.5±32.2	157.8±25.3	NS
Second stage	42±15	30±10	<0.001*

NS=not significant. * Mann-Whitney u test

who received EA had a slower mean rate of cervical dilation at one hour after EA (0.8±0.4) versus 1.3±0.3 cm/h for EA and control groups, respectively, ($p=0.03$). No statistically significant differences were observed between the two groups with regard to mean cervical dilation rate, after oxytocin therapy (2.3±0.7 and 2.7±1.1 cm/h in the study and control patients, respectively); ($p>0.05$). The duration of second stage in the control group was 30±10 min, and in the study patients was 42±15 min ($p<0.001$ after EA (0.8±0.4 versus 1.3±0.5 cm/h for EA and control groups, respectively; $p=0.03$; no statistically significant differences) (Table II).

Oxytocin was increased or initiated more after EA in the study patients than in the control women (25 of 36 versus 22 of 72; $p<0.002$), with maximum dose of oxytocin being higher in study patients (7.6±2.3 μ /min) than in control patients (4.2±1.4 μ /min) ($p<0.002$) (Table III).

No statistically significant differences were observed with regard to operative deliveries in the two groups (3 of 36 versus 5 of 72 in study and control women, respectively; $p>0.05$). All operative deliveries were for fetal dis-

stress. No patients were delivered by assisted vaginal deliveries with vacuum or forceps.

Mean of neonates Apgar scores in study patients was 8.53 ± 0.9 at 1-min and 9.4 ± 0.3 at 5-min, and in control patients was 8.80 ± 0.8 at 1-min and 9.50 ± 0.6 at 5-min ($p>0.05$) (Table III).

DISCUSSION

The potential effects of EA on progress, operative or instrumental delivery has been a subject of lasting controversy. Most studies indicated that EA is associated with longer labors and/or increased incidence of associated delivery or CS.^{1,4} Newton et al¹ showed that despite a lack of change in uterine activity, continuous fentanyl-bupivacaine EA blunted the normal increase in the rate of cervical dilation in the first stage and prolonged the time to complete dilation. There are several reports indicating that EA has no adverse effects on vaginal delivery. Studd et al² noted that EA did not effect the rate of cervical dilation in women with spontaneous labor or with labors augmented with oxytocin.

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Table III. Oxytocin requirements, operative delivery, and neonate Apgar scores.

	EA group (N=36)	Controls (N=72)	P
Patients given oxytocin (%) (After EA)	25(69.44)	22(30.55)	<0.002*
Maximum dose of oxytocin before EA (mu/min)	3.9±1.4	4.1±1.3	NS
Maximum dose of oxytocin after EA (mu/min)	7.6±2.3	4.2±1.4	<0.002*
Operative delivery (%)	3(8.33)	5(6.9)	NS
Mean of neonate Apgar score			
At 1 min	8.53±0.9	8.80±0.8	NS
At 5 min	9.40±0.3	9.5±0.6	NS

NS=not significant. * Mann Whitney u test

Uterine activity usually has significant effects on the progress of labor. This activity may be modified by many factors. Estrogen, oxytocin, α -adrenergic drugs, mechanical manipulation of the cervix, stimulates uterine contractions. Progesterone, magnesium sulfate, β -adrenergic drugs and decrease in uterine blood flow due to hypotension can decrease uterine contractions.² Matadial and Cibils² noted no significant changes in uterine activity when 1.0-1.5% lidocaine without epinephrine was administered epidurally. However, when 1.0-1.5% lidocaine with epinephrine was used, a decrease in uterine activity was noted.² Vasika and Kretchmer² showed that in the absence of hypotension, EA did not interfere with uterine contractions.² In another study, Schellenbery² stressed the avoidance of aortocaval compression during labor when evaluating the effect of an epidural anesthetic on uterine activity. Wildeck-Lund et al³ reported that EA caused a transitory decrease in uterine activity irrespective of the local anesthetic used. It has been shown that changing the high concentration of bupivacaine to a lower concentration, and adding an opioid, significantly decreased instrumental and cesarean delivery rates.⁴ Some obstetrical studies have shown the benefits of ambulation on labor and encouraged it. One study found that ambulation shortens labor duration, reduces the need for analgesia, and improves Apgar scores as well; another found that ambulation is as effective as oxytocin for the enhancement of labor; and that walking during labor decreases the rate of operative delivery.⁵ In addition, studies^{6,8} show that EA early in labor (before 5-cm cervical dilation) increased instrumental and CS rates.^{6,8}

Obstetrical management of labor, including oxytocin injection for induction, and assisting membrane rupture, may play significant roles in the progress and outcome of labor.⁹ Furthermore, the intermittent bolus technique

has been shown to be associated with lower consumption of drugs than the continuous infusion technique and PCEA, which decreases instrumental and cesarean delivery rates.^{10,13}

In summary the available data indicate that the effects of epidural analgesia may vary, depending on the timing and extent of block, position of the patient, the choice and concentration of local anesthetic, and the addition of epinephrine or an opioid. Finally premature rupture of membranes and the choice of obstetrical service may be the most important factors affecting the course of labor and delivery.^{4,14}

Results of this study concerning the outcome of labor agree with previous findings. In this study, intermittent low-dose epidural analgesia with bupivacaine and fentanyl was used. Furthermore, regarding starting of EA at 5-cm cervical dilation, not using epinephrine, use of low-dose bupivacaine (thus reducing the concentration of drug), using high-dose oxytocin in the EA patients, and walking during labor, didn't change the duration of the first stage of labor. Although the duration of the second stage in the EA group was significantly longer than the control group, this didn't increase operative delivery rate in EA parturients.

In conclusion, after intermittent low-dose bupivacaine and fentanyl EA, myometrial contractility and the ability of the uterus to dilate the cervix are maintained with oxytocin. Despite prolongation of the second stage of labor, cesarean delivery was not common in the epidural group.

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