A retrospective review of 202 randomly selected records of parturient labors examined the relationship between cervical dilation at epidural analgesia administration and length of the second stage of labor. The epidural group received bupivacaine 0.11% or 0.125% with sufentanil 1 to 2 µg/mL using a Bard™ Patient Controlled Anesthesia II pump. Labor management and outcomes were compared with a nonepidural group who chose unmedicated childbirth, intravenous narcotics, or pudendal block.

A significant inverse correlation was found between cervical dilation at epidural administration and second-stage length in labors that did not use oxytocin. However, linear regression explained only 13.5% of the variance, leaving 86.5% unexplained. In labors in the epidural group that used oxytocin, cervical dilation at epidural administration was not correlated with second-stage length.

The epidural group experienced a significantly longer mean length of the second stage. Labors in the epidural group were 3.5 times more likely to have oxytocin induction or augmentation and 4.5 times more likely to experience instrument-assisted delivery. There were no significant differences in Apgar scores between the two infant groups.

Key words: Cervical dilation, epidural analgesia, second-stage length.

Introduction
The question of whether epidural analgesia affects the length and outcome of the second stage of labor is among the greatest controversies in current obstetrical analgesia. Epidural analgesia is now the most widely accepted form of pain relief in labor and delivery, but its effects on the second stage of labor, have not been adequately studied. Because of the brevity of the second stage in multiparas, most investigations have focused on the first stage of labor. Factors influencing the length of the second stage in women who have received epidural analgesia are poorly understood.

Epidural analgesia has been linked to an increase in the incidence of instrument-assisted deliveries, as much as 40% in multiparas. One study found that parturients receiving epidural analgesia had more forceps deliveries, experienced a longer second stage, and received a significantly greater amount of oxytocin than nonmedicated parturients. Another study, however, found no relationship between epidural analgesia and second-stage length, frequency of low Apgar scores, or rate of infant admission to the special care unit. An increased cesarean section rate has been attributed to epidural analgesia administration before 5 cm of dilation; however, lower cesarean section rates have been attributed to early intervention in the second stage using forceps or vacuum extractors. Ideal management of the second stage of labor with epidural analgesia appears to provide the greatest chance of spontaneous vaginal delivery while providing the least risk of maternal and infant morbidity and mortality.

The current technique of epidural administration consists of initially establishing a sensory blockade with a loading dose of local anesthetic. A continuous epidural infusion (CEI) of a dilute local anesthetic combined with a lipid-soluble opioid is then initiated. Combining local anesthetics with lipid-soluble opioids may provide a more rapid onset and longer duration of analgesia and preserve the benefits of each drug without substan-
tially increasing the risk of side effects and possibly even decreasing the risk. This combination of solutions, which appears to be the best analgesic currently available, can be self-administered by the parturient using patient-controlled epidural analgesia (PCEA). If needed, a perineal or sitting dose can be given during the second stage to reinforce the block and to ensure an adequate level of perineal anesthesia.

To assure fetal safety, the normal 1-hour limit for the second stage of labor has been extended to 2 hours for women receiving epidural analgesia. If more than 2 hours have passed in the second stage and the parturient has not made continuing progress, the American College of Obstetricians and Gynecologists (ACOG) recommends considering operative delivery. Some, however, caution against using the 2-hour rule and urge individual assessment of second-stage progress.

In normal labor or labor induced by oxytocin, epidural analgesia has little effect on uterine response. However, epidural analgesia may lengthen the second stage of labor by interfering with the Ferguson reflex, the distention of the lower vagina by the fetal presenting part, and it may block the normal increase of oxytocin that occurs in the second stage. The prolongation of the second stage of labor may be greater if the timing of epidural analgesia administration is inappropriate. Historically, the timing of epidural analgesia administration has been based on cervical dilation. A segmented epidural analgesic (limited to the lower lumbar and sacral segments) was not administered until the parturient was dilated 4 cm, unless severe pain or medical problems were present. Standard epidural analgesia (extending from T10 to S5) was withheld until the parturient experienced:

1. Cervical dilation of 5 to 6 cm.
2. Normal contractions at 3-minute intervals or less lasting 35 to 40 seconds.
3. Labor that was progressing well with the presenting part engaged in the pelvis.

However, few studies have investigated the relationship of cervical dilation at the time of epidural analgesia administration to second-stage length.

This study, therefore, was designed to determine whether cervical dilation at the time of epidural analgesia was associated with length of the second stage of labor. Labor management and outcomes in an epidural group were compared with a nonepidural group.

**Method**

- **Setting.** The study was conducted in a privately owned, 180-bed regional hospital located near a major southern city. The protocol was approved by the University Review Committee for Human Studies of Case Western Reserve University and the institutional review board of the regional hospital. More than 1,000 infants are delivered yearly in this hospital in five birthing rooms (combined labor, delivery, and recovery room) by nine board-certified obstetricians and three board-certified nurse-midwives. Five board-certified anesthesiologists administer epidural analgesia, and eight Certified Registered Nurse Anesthetists give bolus dosages if needed.

- **Sample.** The sample consisted of 202 randomly selected parous parturients who delivered a singleton infant vaginally between January 1, 1992, and November 26, 1993. The epidural group consisted of 100 parturients who received epidural analgesia for the relief of labor and delivery pain. The nonepidural group consisted of 102 parturients who received intravenous narcotics or pudendal blocks or experienced an unmedicated childbirth.

Inclusion criteria were as follows:

1. American Society of Anesthesiologists physical status I or II.
2. Age between 20 and 40 years.
3. Height 62 inches or more.
4. Weight 250 pounds or less.
5. Previous delivery of at least one full-term viable infant by the vaginal route.
6. Infant birth weight at least 2,500 g and less than 4,100 g.
7. Gestation between 38 and 42 weeks.
8. Cephalic presentation.

Exclusion criteria included:

1. Planned vaginal birth after cesarean section.
2. More than four previous vaginal deliveries.
3. Epidural analgesia more than 30 minutes before measurement of cervical dilation performed by digital examination or more than 30 minutes after this measurement.

Epidural analgesics were administered in the first stage of labor using the Bard Patient Controlled Anesthesia II computerized pump with the CEI or PCEA method of administration. A CEI delivered a preset amount of medications (mL/hr) at a continuous rate, and a PCEA allowed the patient to control the amount of medication received during specified periods. All subjects in the epidural group received a combination of 0.11% or 0.125% bupivacaine with the addition of 1 to 2 µg/mL of sufentanil. Cervical dilation was measured by vaginal examination by digital tactile sen-
sation. Epidural analgesic or oxytocin was administered less than 30 minutes before or after vaginal examination.

- Data collection. The following sections of the medical record were reviewed:
  1. Admission/outpatient surgery form.
  2. Obstetric admitting record.
  3. Labor and delivery summary.
  4. Nursing labor progress record.
  5. Physician's order sheet.
  7. Discharge record.
  8. Obstetric discharge summary.
  10. Obstetrical history and physical examination.
  11. Prenatal record.
  12. ACOG antepartum record.
  14. Laboratory report.
  16. Fetal monitor strip.

Each medical record was read twice, beginning with prenatal screening and ending with hospital discharge. All records that reported the administration of narcotic or oxytocin were rechecked on another day to verify data entry. Data were abstracted onto a form developed by the researchers and pilot tested with medical records of 25 nulliparous women. The form was refined and made more straightforward based on the pilot.

Results

Overall, 94% of the parturients were Caucasian, 89% were married, 71% had private insurance, and 79% had attended prenatal classes. Women and infants in the two groups did not differ significantly except on two variables. Women in the epidural group had a longer mean length of hospitalization (P = .02), and they had previously delivered fewer infants (P = .02). The mean amount and duration of oxytocin administration for the women who received it did not differ between the two groups.

- Cervical dilation and second-stage length. Standard epidural analgesia was administered at the parturient's request (dilation range 1 to 10 cm) according to ACOG guidelines. In labors that did not use oxytocin, a significant inverse correlation was found between cervical dilation at the time of epidural analgesia administration and second-stage length (Figure 1). That is, when epidural analgesia was administered at smaller measurements of cervical dilation, the second stage was longer than when epidural analgesia was administered at greater dilations. Analysis of variance indicated that cervical dilation at the time of epidural administration affected second-stage length \([F(1.56) = 8.77, P = .004]\). However, linear regression indicated that only 13.5% of the observed variance in the second stage of labor was explained.

When oxytocin was used for augmentation or induction of labor, no significant correlation was found between cervical dilation at epidural analgesia administration and second-stage length.

- Length of second stage. Excluding cesarean sections, labor in the epidural group (range, 3-169 minutes) was significantly longer than labor in the nonepidural group (range, 3-72 minutes) (Table I). However, only three labors in the epidural group were longer than the ACOG-recommended length.

- Labor management. As shown in Figure 2, 56% of the parturients in the nonepidural group delivered unassisted (without induction or augmentation) compared with 9% of the parturients in the epidural group. Induced and augmented labors

<table>
<thead>
<tr>
<th>Table I</th>
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<tbody>
<tr>
<td><strong>Length of second-stage labor for parturients with nonepidural and epidural analgesia excluding cesarean sections</strong></td>
</tr>
<tr>
<td><strong>Length of second stage (minutes)</strong></td>
</tr>
<tr>
<td>Total labors:</td>
</tr>
<tr>
<td>Nonepidural (N = 102)</td>
</tr>
<tr>
<td>Epidural (N = 95)</td>
</tr>
<tr>
<td>Labors without oxytocin:</td>
</tr>
<tr>
<td>Nonepidural (N = 90)</td>
</tr>
<tr>
<td>Epidural (N = 58)</td>
</tr>
<tr>
<td>Labors with oxytocin augmentation:</td>
</tr>
<tr>
<td>Nonepidural (N = 8)</td>
</tr>
<tr>
<td>Epidural (N = 29)</td>
</tr>
<tr>
<td>Labors with oxytocin induction:</td>
</tr>
<tr>
<td>Nonepidural (N = 4)</td>
</tr>
<tr>
<td>Epidural (N = 8)</td>
</tr>
<tr>
<td>Labors with oxytocin augmentation or induction:</td>
</tr>
<tr>
<td>Nonepidural (N = 12)</td>
</tr>
<tr>
<td>Epidural (N = 37)</td>
</tr>
</tbody>
</table>

*The level for statistical significance was set at .05.
SD—Standard deviation

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are delineated in Figure 3. The epidural group was 1.7 times more likely to have had induced labor and 2 times more likely to have had augmented labor. The epidural group was 3.5 times more likely to have received oxytocin induction or augmentation than the nonepidural group. Among the par-

![Figure 1](image1.png)

**Figure 1**
Cervical dilation at administration of epidural analgesia and length of second-stage labor without the use of oxytocin and excluding cesarean sections

Least squares prediction line

\[ Y' = bX + a \]

\[ b = -6.103, a = 73.3 \]

Length of second stage (minutes)

![Diagram of cervical dilation and length of second-stage labor](image2.png)

The four outliers (circled) received epidural analgesics at 6 cm or less.

![Figure 2](image3.png)

**Figure 2**
Unassisted (without augmentation or induction), augmented (artificial rupture of membranes [AROM], oxytocin, or AROM and oxytocin) or induced (AROM, prostaglandin suppository, oxytocin, or combination) labor management for nonepidural and epidural labors

![Diagram of labor management](image4.png)

**Figure 3**
Labor management for induced and augmented labors

- **Induction of labor**
  - AROM
  - PS
  - AROM and PS
  - AROM, PS, and Oxytocin
  - Oxytocin
  - Oxytocin and AROM
  - Oxytocin and PS

- **Augmentation of labor**
  - AROM
  - Oxytocin
  - AROM and oxytocin

AROM - Artificial rupture of membranes
PS - Prostaglandin suppository

![Diagram of labor management](image5.png)
turients in the epidural group who had oxytocin-augmented labors, 20 (65%) were given oxytocin after the administration of epidural analgesia.

Using the two-way chi-square test, the type of labor management (unassisted, medically induced, or augmented) was associated with administration or nonadministration of epidural analgesia \( [X^2(1, N = 202) = 4.275, P = .0387] \).

- Labor and delivery characteristics. The type of delivery, (spontaneous, instrument-assisted with forceps or vacuum extractors, or cesarean section) was associated with the administration or nonadministration of epidural analgesia. \( [X^2(1, N = 202) = 9.77, P = .025] \). The epidural group (9%) was 4.5 times more likely to have labor that used instrument-assisted delivery than the nonepidural group (2%).

As shown in Table II, the epidural group was 5.6 times more likely to have used oxygen during the second stage and 1.7 times more likely to have had an episiotomy. A two-way chi-square test of goodness of fit demonstrated that having an episiotomy for delivery was significantly associated with the type of analgesia administered \( [X^2(1, N = 200) = 6.469, P = .011] \). Apgar scores of infants did not differ significantly between the two groups.

<p>| Table II |
| Delivery characteristics for parturients in the epidural and nonepidural groups |</p>
<table>
<thead>
<tr>
<th>Delivery characteristic</th>
<th>Nonepidural group</th>
<th>Epidural group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forceps</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Vacuum extraction</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Delivered by registered nurse</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Cesarean section</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Oxygen use</td>
<td>5</td>
<td>28</td>
</tr>
<tr>
<td>Episiotomy</td>
<td>23</td>
<td>39</td>
</tr>
<tr>
<td>Spontaneous</td>
<td>100</td>
<td>86</td>
</tr>
</tbody>
</table>

- Cesarean sections. Five cesarean sections occurred in the epidural group, and none occurred in the nonepidural group. Two of the five parturients experienced the second stage of labor, but in three parturients, labor was terminated due to fetal complications during the first stage.

Discussion

The epidural group (excluding cesarean sections) experienced a significantly longer mean length of hospitalization than the nonepidural group. Parturients who chose epidural analgesia also had previously delivered significantly fewer full-term infants. Lowe found that multiparas experienced more pain during the second stage of labor than nulliparas, suggesting that pain progression may differ as a function of parity. However, the relation of parity to choice of analgesia was beyond the scope of this study, since whether the epidural group experienced greater pain than the nonepidural group could not be determined from available data.

Women at increased risk for operative delivery have been shown to be more likely to choose epidural analgesia than women who anticipate uncomplicated childbirth, making selection bias inherent in retrospective epidural analgesia studies. Prospective randomization of parturients into epidural and nonepidural groups, however, is extremely difficult because of the popularity of epidural analgesia. Therefore, this retrospective study was subject to some selection bias.

In labors in which oxytocin was not used, 86.5% of the variance in second-stage length was unexplained by the relation between cervical dilation and the time of epidural administration. Using multiple maternal, neonatal, and labor factors, previous research also was unable to predict second-stage length based on timing of epidural analgesia. Clearly, along with cervical dilation, analgesia agent, and timing of epidural administration, an array of maternal, fetal, and labor management circumstances must be considered when evaluating the second stage of labor.

This study’s findings were similar to earlier findings that cervical dilation at the time of epidural analgesia administration differed for parous parturients who were induced or received augmentation with oxytocin and parturients who received no oxytocin. Cervical dilation at the time of epidural administration was less in parous parturients who received exogenous oxytocin for uterine inertia.

The findings of this study also agree with research that found that labors in which epidural analgesia was given were terminated with more instrument-assisted deliveries. In reviewing 25,069 consecutive singleton deliveries, a positive correlation was found between epidural analgesia and use of forceps, cesarean section rate, and second-stage length. It remains unclear, however, whether there is a causal relationship between epidural analgesia and instrument-assisted deliveries, though epidural analgesia is frequently blamed for the increased incidence of instrument-assisted deliveries.

In this study, the management of labor differed between the two groups. The majority of oxytocin augmentation (65%) was seen after epidural
analgesia administration. When oxytocin was used in the epidural group, the second stage was shorter, the nonrotational forceps delivery rate was reduced, and there was less perineal trauma.34

The design of this study did not permit controlling for interrater reliability in the measurement of cervical dilation or for differences in the management of labor between midwives and physicians. However, compared with certified nurse-midwives, obstetricians have been shown to be more likely to use epidural analgesics.10 Clearly, the management of labor varied with practitioner. A randomized prospective study using standardized epidural analgesia concentration and technique should be conducted using cervical dilation, uterine contractions, and pelvic engagement as criteria for epidural administration, as recommended by Bonica and Hunter.31

In the meantime, prior to the stress of labor, parturients should be given information about the advantages and risks of epidural analgesia to allow informed decisions about pain management during labor and delivery.10 Women who choose epidural analgesia should be informed that this may result in a longer second stage of labor. As long as infant outcomes remain similar, as they were in this study, many women will choose a pain-free or pain-diminished labor that only epidural analgesia can offer; however, informed consent mandates that parturients consider both the advantages and disadvantages of epidural analgesics.

REFERENCES


AUTHORS

Cheryl E. McRae-Bergeron, CRNA, ND, RNCs, is a freelance anesthetist in Blairsville, Georgia, and a Colonel in the U.S. Air Force Reserve. She is also an adjunct assistant professor of Nursing at the Uniformed Services University of the Health Science, Bethesda, Maryland.

Claire M. Andrews, RN, PhD, CNM, FAAN, is on the faculty at the Frances Payne Bolton School of Nursing, Case Western Reserve University, Cleveland, Ohio.

Patricia J. Lupe, MSN, ND, CNM, is the director of the Nurse-Midwifery Program at Lorain Community Health, Lorain, Ohio.

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