Effect of Epidural Analgesia with Ambulation on Labor Duration

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Background: Ambulatory epidural analgesia (AEA) is a popular choice for labor analgesia because ambulation reportedly increases maternal comfort, increases the intensity of uterine contractions, avoids inferior vena cava compression, facilitates fetal head descent, and relaxes the pelvic musculature, all of which can shorten labor. However, the preponderance of evidence suggests that ambulation during labor is not associated with these benefits. The purpose of this study is to determine whether ambulation with AEA decreases labor duration from the time of epidural insertion to complete cervical dilatation.

Methods: In this prospective, randomized study, 160 nulliparous women with AEA were randomly assigned to one of two groups: AEA with ambulation and AEA without ambulation. AEA blocks were initiated with 15–20 ml ropivacaine (0.07%) plus 100 µg fentanyl, followed by a continuous infusion of 0.07% ropivacaine plus 2 µg/ml fentanyl at 15–20 ml/h. Maternal measured variables included ambulation time, time from epidural insertion to complete dilatation, stage II duration, pain scores, and mode of delivery. APGAR scores were recorded at 1 and 5 min. Results are expressed as mean ± SD or median and analyzed using the t test, chi-square, or the Mann–Whitney test at P ≤ 0.05.

Results: The ambulatory group walked 25.0 ± 23.3 min, sat upright 40.3 ± 29.7 min, or both. Time from epidural insertion to complete dilatation was 240.9 ± 146.1 min in the ambulatory group and 211.9 ± 133.9 min in the nonambulatory group (P = 0.026).

Conclusion: Ambulatory epidural analgesia with walking or sitting does not shorten labor duration from the time of epidural insertion to complete cervical dilatation.

AMBULATION is commonly believed to be of value in the establishment and progression of active labor. Ambulation with epidural analgesia reportedly increases mobility and possibly a more natural progression of labor. However, the preponderance of evidence suggests that ambulation during labor is not associated with these benefits. The ambulatory group walked 25.0 ± 23.3 min, sat upright 40.3 ± 29.7 min, or both. Time from epidural insertion to complete dilatation was 240.9 ± 146.1 min in the ambulatory group and 211.9 ± 133.9 min in the nonambulatory group (P = 0.026).

Conclusion: Ambulatory epidural analgesia with walking or sitting does not shorten labor duration from the time of epidural insertion to complete cervical dilatation.

Use of a less-concentrated local anesthetic and development of local anesthetics with relatively selective sensory block while sparing motor function have led to development of the walking or ambulatory epidural for labor analgesia. The theoretical advantages of using ambulatory epidural analgesia (AEA) for labor analgesia include the following: the ability to ambulate and its attendant benefits; less motor blockade, reducing the chances of fetal malposition; and reduced duration of labor with fewer operative deliveries. AEA allows for complete mobility and possibly a more natural progression of labor. The purpose of this study is to determine whether ambulation with AEA shortens the duration of labor from the time of epidural insertion to complete cervical dilatation.

Methods

This study was approved by the Magee-Womens Hospital Institutional Review Board (Pittsburgh, PA). Written informed consent was obtained from 160 nulliparous women at the time of admission to the Magee-Womens Hospital labor and delivery suite from March 1998 to January 2000. Study inclusion criteria were 36–42 weeks’ gestation, singleton pregnancy in the vertex position, and 3–5 cm cervical dilatation at the time of epidural insertion. Uncomplicated parturients who presented in spontaneous labor or who were scheduled to be admitted for elective induction of labor were studied. Parturients with preeclampsia, diabetes mellitus, preterm gestation (< 36 weeks), and postterm gestation (> 42 weeks) were excluded from the study. Indications for elective induction in our study included post dates (< 42 weeks) and patient preference. A random number computer-generated program (Corel Quattro Pro 9; Corel Co., Ottawa, Canada) was used to assign study patients randomly to one of two groups: (1) continuous epidural infusion of 0.07% ropivacaine plus 2 µg/ml fentanyl with ambulation, sitting in a chair, or both permitted; or (2) continuous epidural infusion of 0.07% ropivacaine plus 2 µg/ml fentanyl without ambulation or sitting in a chair permitted.

Ambulatory epidural analgesia blocks were initiated with 15–25 ml ropivacaine (0.07%) plus 100 µg/ml fentanyl, no test dose, to achieve a T10 dermatome sensory level. After achieving adequate pain relief, a continuous infusion of 0.07% ropivacaine plus 2 µg/ml fentanyl at 15–20 ml/h was administered to study patients to maintain labor analgesia. A modified

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Bromage score (1 = complete block, unable to move feet or knees; 2 = almost complete block, able to move feet only; 3 = partial block, just able to move knees; 4 = detectable weakness of hip flexion; 5 = no detectable weakness of hip flexion while supine with full flexion of knees) was obtained before and after epidural insertion and again at hourly intervals.

After 1 h, patients in the ambulatory group were assessed in bed for motor function as measured by the modified Bromage score. Patients with a modified Bromage score of 5 were asked to stand with assistance, and a Romberg test was performed. If the patient was able to stand on one foot (right and left foot) without assistance and without hypotension (systolic blood pressure < 100 mmHg or a decrease of 20 mmHg), she was encouraged to ambulate with her support person (spouse or friend). The oxytocin infusion pump and the continuous epidural infusion pump were both attached to the same intravenous pole and thus did not prevent ambulation. Continuous fetal heart rate was monitored by telemetry during ambulation or sitting. If the patient could not comply with ambulation, she was encouraged to sit in a chair. Patients in the nonambulatory group were confined to bed, were encouraged to stay recumbent in a lateral position, and were not allowed to raise the head of the bed more than 45° from horizontal. A dedicated clinical research coordinator ensured bed rest compliance in the nonambulatory group.

Ambulation was defined as a minimum of 5 min of walking per hour. Patients were not allowed to ambulate if there were persistent fetal decelerations as determined by the obstetrician. Additionally, patients were not permitted to be out of bed if the presenting part was lower than 0 station (because of the possibility of fetal head compression) or in the second stage of labor when patients were actively pushing. All groups were monitored hourly by the clinical research coordinator for fetal heart rate changes, maternal vitals signs, level of pain using a Visual Analogue Scale (0 = no pain; 100 = greatest amount of pain), intensity of motor block using the modified Bromage Scale, and cervical dilatation. The research coordinator also recorded time spent walking or sitting, time from epidural insertion to complete cervical dilatation (Epid-CD), and second stage of labor. Additionally, the type of delivery (spontaneous, instrumental, vacuum, and cesarean) and Apgar scores at birth were recorded. The clinical pathway for labor management used in our institution defines criteria for dystocia, and this pathway follows the guidelines published by the American College of Obstetricians and Gynecologists.6

**Statistical Analysis**

Assuming a 60-min prolongation of the Epid-CD interval in the ambulatory group compared with the nonambulatory group, with an SD of 180 min, it was determined that 71 patients would be required per group to detect this difference between the two groups, with an α of 0.05 and a β of 0.8, and disprove the null hypothesis. To allow for parurients who might not complete the study, we enrolled 160 patients.

Results are expressed as mean ± 1 SD or median. All interval data were compared using the t test. Frequency data were compared using chi-square. Pain Visual Analogue Scale scores were compared using the Mann-Whitney U test. P ≤ 0.05 was considered to be significant.

**Table 1. Demographic Data**

<table>
<thead>
<tr>
<th></th>
<th>Ambulatory Group (n = 75)</th>
<th>Nonambulatory Group (n = 76)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>26.72 ± 5.18</td>
<td>27.18 ± 6.48</td>
<td>0.631</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>160.25 ± 20.19</td>
<td>159.43 ± 21.54</td>
<td>0.810</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>77.78 ± 11.11</td>
<td>61.56 ± 14.54</td>
<td>0.075</td>
</tr>
<tr>
<td>Gestation (weeks)</td>
<td>39.68 ± 1.19</td>
<td>39.45 ± 1.28</td>
<td>0.255</td>
</tr>
<tr>
<td>Elective induction (%)</td>
<td>22.7</td>
<td>18.4</td>
<td>0.657</td>
</tr>
<tr>
<td>CD at epidural insert (cm)</td>
<td>4.08 ± 1.25</td>
<td>3.91 ± 1.03</td>
<td>0.363</td>
</tr>
</tbody>
</table>

Elective induction = percentage of patients presenting for elective induction; CD at epidural insert = cervical dilatation at the time of epidural insertion.

A total of 160 nulliparous parturients were entered in the study. Of these, nine patients were excluded because of one-sided block (two patients), inadequate analgesia despite rebolusing (three patients), or incomplete data (four patients). Therefore, 151 patients completed the study; 75 were in the ambulatory group, and 76 were in the nonambulatory group. Obstetricians cared for all study parturients. No parturient received midwife care.

Table 1 shows demographic data. No differences were noted with respect to age, height, weight, gestation, percentage of patients presenting for scheduled elective induction, or cervical dilatation at the time of epidural insertion. Also, no differences were noted with respect to age, height, weight, gestation, or cervical dilatation at the time of epidural insertion among the parturients who presented for elective induction. Oxytocin use among patients admitted in spontaneous labor was comparable between groups (36% in the ambulatory group vs. 40.8% in the nonambulatory group; P = 0.662).

No patient in either group had lower extremity motor weakness at any time as measured by the Modified-Bromage Score. No patient at any time in the ambulatory group had loss of proprioception as measured by a positive Romberg sign, and all patients in the ambulatory group were able to stand on one foot (left or the right foot) without assistance. Therefore, no patient in the ambulatory group failed to meet ambulation eligibility requirements because of loss of proprioception, exces-
sive motor block, or hypotension. All patients from both groups had a modified Bromage score of 5 throughout labor and delivery. No patient from the ambulatory group had fetal heart rate abnormalities that prevented ambulation.

Of the 75 patients in the ambulatory group, 35 (46.7%) walked for 25.0 ± 23.3 min and 40 (53.3%) sat upright in a chair for an average of 40.3 ± 29.7 min. Twenty patients (26.7%) in the ambulatory group both walked 28.2 ± 24.7 min and sat in a chair 41.4 ± 30.7 min. No patient in the nonambulatory group walked or sat in a chair.

Figure 1 shows labor duration times. No differences were noted in the Epid-CD interval (240.9 ± 146.1 min in the ambulatory group vs. 211.9 ± 133.9 min in the nonambulatory group; \( P = 0.206 \)) or stage II labor duration (97.3 ± 76.0 min in the ambulatory group vs. 89.1 ± 67.3 min in the nonambulatory group; \( P = 0.487 \)). Table 2 shows no differences in mode of delivery (spontaneous vaginal, forceps-assisted, vacuum extraction, or cesarean) or in the use of oxytocin for labor augmentation or augmentation between the two groups. No differences were noted in maternal outcome and APGAR scores in parturients who presented for elective induction (table 3).

Table 2. Maternal Outcome and Apgar Scores

<table>
<thead>
<tr>
<th></th>
<th>Ambulatory Group (n = 75)</th>
<th>Nonambulatory (n = 76)</th>
<th>( P ) Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSVD</td>
<td>68.0% (51)</td>
<td>73.7% (56)</td>
<td>0.556</td>
</tr>
<tr>
<td>Forceps</td>
<td>6.7% (5)</td>
<td>5.3% (4)</td>
<td>0.984</td>
</tr>
<tr>
<td>Vacuum</td>
<td>6.7% (5)</td>
<td>1.3% (1)</td>
<td>0.205</td>
</tr>
<tr>
<td>Cesarean</td>
<td>18.7% (14)</td>
<td>19.7% (15)</td>
<td>0.968</td>
</tr>
<tr>
<td>Apgar(^1) &lt; 7</td>
<td>6.7% (5)</td>
<td>6.6% (5)</td>
<td>0.760</td>
</tr>
<tr>
<td>Apgar(^5) &lt; 9</td>
<td>4.0% (3)</td>
<td>3.9% (3)</td>
<td>0.689</td>
</tr>
</tbody>
</table>

\( \text{NSVD} = \text{normal spontaneous vaginal delivery}; \text{Apgar}\(^1\) = \text{Apgar score at 1 min after delivery}; \text{Apgar}\(^5\) = \text{Apgar score at 5 min after delivery}. \)

between groups (fig. 2). Figure 3 shows the volume of initial bolus and the total infusion dose in both groups. There was no significant difference in the initial bolus of 0.07% ropivacaine between groups. The ambulatory group had a significantly higher total infusion volume of local anesthetic. No differences were noted between the two groups in the number of babies with APGAR scores of less than 7 at 1 min or less than 9 at 5 min (table 2).

### Discussion

Our results show that ambulatory epidural analgesia with walking, sitting in a chair, or both does not shorten labor duration from the time of epidural insertion to complete cervical dilatation. Because cervical dilatation at the time of epidural insertion was not significantly different between the two groups, the Epid-CD interval may be considered a true measure of the effect of treatment on the duration of the first stage of labor from initiation of the block. Our study does not have sufficient power to show statistical significance (if any) for the duration of stage II labor, the operative delivery rate, or neonatal outcome.

Table 3. Maternal Outcome and Apgar Scores in Parturients for Elective Induction

<table>
<thead>
<tr>
<th></th>
<th>Ambulatory Group (n = 17)</th>
<th>Nonambulatory (n = 14)</th>
<th>( P ) Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxytocin</td>
<td>100% (17)</td>
<td>100% (14)</td>
<td>—</td>
</tr>
<tr>
<td>NSVD</td>
<td>52.9% (9)</td>
<td>64.3% (9)</td>
<td>0.786</td>
</tr>
<tr>
<td>Forceps</td>
<td>11.8% (2)</td>
<td>7.1% (1)</td>
<td>0.859</td>
</tr>
<tr>
<td>Vacuum</td>
<td>11.8% (2)</td>
<td>0.0% (0)</td>
<td>0.554</td>
</tr>
<tr>
<td>Cesarean</td>
<td>23.5% (4)</td>
<td>28.6% (4)</td>
<td>0.926</td>
</tr>
<tr>
<td>Apgar(^1) &lt; 7</td>
<td>5.9% (1)</td>
<td>0.0% (0)</td>
<td>0.921</td>
</tr>
<tr>
<td>Apgar(^5) &lt; 9</td>
<td>11.8% (2)</td>
<td>0.0% (0)</td>
<td>0.554</td>
</tr>
</tbody>
</table>

\( \text{NSVD} = \text{normal spontaneous vaginal delivery}; \text{Apgar}\(^1\) = \text{Apgar score at 1 min after delivery}; \text{Apgar}\(^5\) = \text{Apgar score at 5 min after delivery}. \)
Labor pain is associated with maternal physiologic responses, which are not necessarily beneficial to fetal well-being. Maternal hyperventilation causes an increase in oxygen consumption, plasma catecholamine concentrations, hypertension, and tachycardia. In addition, maternal hyperventilation may reduce fetal oxygenation, resulting in abnormal fetal heart rate patterns and an increased operative delivery rate.\(^8\) Effective labor analgesia attenuates these physiologic changes and optimizes uteroplacental circulation, oxygenation, and function.\(^9,12\) Of all labor analgesic techniques, epidural analgesia is the most effective form of analgesia and has become the “gold standard” in obstetric care.\(^13,14\)

Conventional epidurals, which use concentrated local anesthetics (0.25% bupivacaine or 0.2% ropivacaine), can inhibit the ability to push secondary to motor blockade, leading to longer labor, an increased operative delivery rate, or both, compared with less-concentrated epidural local anesthetics.\(^1,4,8\) The use of a less-concentrated local anesthetic has led to the development of the walking or ambulatory epidural, which has the advantage of providing analgesia while sparing motor function and can eliminate the disadvantages of conventional epidurals.

In a retrospective, nonrandomized, multicenter study, Albers et al.\(^5\) showed that women who ambulated during labor had a lower operative delivery rate. However, these women did not receive oxytocin or epidural analgesia during labor, and the ambulating time was not quantified. In addition, the patients of Albers et al.\(^5\) were healthy, childbearing women who were treated by midwives, who tend not to favor epidural analgesia, which may have influenced their findings. Albers et al.\(^5\) did show that ambulation did not shorten labor duration. Likewise, in a randomized trial, Bloom et al.\(^2\) found that ambulation during labor without epidural analgesia did not affect the duration of the first stage of labor, the use of oxytocin for labor augmentation, the need for analgesia, or the operative delivery rate.

Chestnut et al.\(^15-17\) have shown that low-dose bupivacaine-fentanyl mixtures have minimal effect on the duration of the second stage of labor and on the rate of assisted deliveries. In a randomized study, Nageotte et al.\(^1\) found that nulliparous women who were assigned to receive combined spinal-epidural analgesia had a significantly higher rate of spontaneous vaginal delivery and a lower rate of instrumental vaginal delivery than did women who received conventional epidural analgesia. However, in the same study by Nageotte et al.\(^1\), no difference in spontaneous versus instrumental deliveries occurred in women in the combined spinal-epidural analgesia group who were encouraged to ambulate, compared with those who did not ambulate. Collis et al.\(^18\) also found no significant difference in duration of labor, analgesia requirements, mode of delivery, or condition of the baby in nulliparous parturients given combined spinal-epidural analgesia who were assigned to ambulate or to be confined to bed. Our study indicates that AEA with ambulation does not shorten labor duration.

Ambulation reportedly reduces the use of oxytocin for labor augmentation.\(^1,4,5\) Bloom et al.\(^2\) found that ambulation during labor did not affect the use of oxytocin augmentation, but the patients in their study were not allowed to ambulate after oxytocin administration and regional analgesia were initiated. In our institution, AEA is not a contraindication for oxytocin use and is in fact often used in conjunction with epidural analgesia. Oxytocin use did not prevent ambulation in our study.

We defined ambulation as a minimum of 5 min of walking per hour, the same criteria used in the study of Nageotte et al.\(^1\). We encouraged patients to walk 1 h after epidural placement to allow for an adequate level and stabilization of the epidural block (T10 dermatome level) and hourly thereafter. Patients in the ambulatory group walked for 25.0 ± 23.3 min, which is similar to the protocol used in the study of Nageotte et al.\(^1\). We cannot confirm that this is enough time to make a difference, but the criteria for ambulation of Nageotte et al.\(^1\) was met in our study.

Not all the patients in the ambulatory group walked. However, those who did not walk sat upright. In the study by Bloom et al.\(^2\), 75% of the patients assigned to the walking group actually walked. In the study of Nageotte et al.\(^1\), 66% of the patients encouraged to ambulate did so. Our study is consistent with the studies cited in that 46.7% of patients in the ambulatory group walked, 53.3% sat upright, and 26.7% both walked and sat upright. Interestingly, exhaustion was the main reason laboring parturients gave for not wanting to walk after effective pain relief. The total infusion dose of 0.07% ropivacaine was significantly higher in the ambulatory group (118.7 ± 70.1 vs. 99.0 ± 45.9 ml; \(P = 0.045\)), which is because of the longer Epid-CD and stage II times in the ambulatory group.

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Although all parturients had a vertex presentation, we do not know how many patients had occipitut-anterior position, and this is a limitation in our study. Many clinicians believe without direct proof that epidural analgesia results in more persistent fetal malrotations and abnormal labor patterns. Fetal malpresentation with epidural analgesia may lead to an increased operative delivery rate. Nevertheless, Nageotte et al.\(^1\) has shown that low-dose regional analgesia results in higher rates of spontaneous vaginal deliveries and lower rates of instrumental vaginal deliveries compared with women who receive conventional epidural analgesia.

The cesarean delivery rate in our study for both groups is approximately 19%. The total operative delivery rate (cesarean delivery + instrumental deliveries) was 32% in the ambulatory group and 26% in the nonambulatory group \((P = \text{not significant})\). The 19% cesarean delivery rate is the prevalent rate for nulliparous women at Magee-Womens Hospital. The instrumental delivery rate is most likely higher because our institution is a teaching hospital. It is of interest to note that Nageotte et al.\(^1\) reported similar incidences in their institution.

In conclusion, we have shown that AEA with ambulation does not shorten the duration of labor between epidural insertion and complete cervical dilatation. Although ambulation with AEA does not shorten labor, it does not prolong labor, and it can be a satisfactory choice for women who want to ambulate with labor epidural analgesia. Even though there are safety concerns with ambulation, such as the risk of falling, no ambulatory patient in our study fell. A support person with telemetry allows for ambulation to be safe for both the mother and the fetus. The ability to walk to the bathroom and change positions in bed are compelling enough as reasons in support of low-dose epidural analgesia. Prime importance is maternal comfort and satisfaction, and ambulatory epidural analgesia can be a useful tool for the anesthesiologist toward providing a rewarding and satisfactory experience in the birthing process.

**References**

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