Upright Versus Recumbent Position in the Second Stage of Labor for Women With Epidural Analgesia: A Randomized Clinical Trial

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Abstract- Epidural analgesia (EA) is an effective and common method of pain relief during labor. However, EA may also have some adverse effects like prolonged labor, increased risk of operative delivery, and some unwanted complications. It's unclear how maternal position affects the outcomes of natural birth with EA. This study aimed to compare mode of delivery and maternal and neonatal outcomes between recumbent and upright positions in nulliparous women with EA. This randomized clinical trial involved 540 women who received EA at cervical dilatation of 4 to 6 cm. During the second stage of labor, they were instructed to adopt upright or recumbent position. The main outcome was the mode of delivery. The secondary outcomes included duration of labor, pain intensity, the Apgar score, and other maternal and neonatal complications. Finally, 528 women were included in the final analysis. The upright group had a higher rate of cesarean section than the recumbent group. The duration of the labor stages did not differ between the groups. The pain intensity in the second stage was higher in the upright position. The Apgar score at 1 and 5 minutes was higher in the recumbent group. There was no difference in terms of other outcomes between the groups. Recumbent positions are beneficial in the case of rate of cesarean, mother's pain, and Apgar score in women with EA. So, adopting a recumbent position during the second stage of labor may be preferable for women with EA.

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Keywords: Epidural analgesia; Natural vaginal delivery; Cesarean section; Labor stages; Patient positioning

Introduction

Epidural analgesia (EA) is often used as a method of pain relief during labor. The first generations of epidural methods required a bolus injection with a relatively high concentration of local analgesics associated with simultaneous motor and sensory blockade, resulting in a temporary loss of motor function and preventing women from being active during labor. With the development of low-dose techniques, also known as "walking" or "mobile" epidurals, women now have the opportunity to remain mobile throughout labor and assume upright positions such as standing or sitting (1). Regardless of the use of the EA, it is generally believed that upright positions during labor can enhance uterine contractions, shorten the duration of labor, and facilitate fetal head decent due to gravity (2,3). In addition, as delivery in upright positions is associated with fewer need for operative delivery and episiotomy as the sacrum is placed in a flexible position and dilation of the pelvic outlet is facilitated (4-6). These benefits are thought to be due to higher intrauterine resting pressure, which contributes to the force of downward pushing and uterine contractions, as well as higher intensity contractions. However, there are also studies with different findings that show an increased risk of obstetric complications in the upright positions, such as postpartum hemorrhage (PPH) and birth canal or perineal lacerations (7). On the other hand, there are some studies showing the superiority of recumbent and semi-recumbent positions, such as convenience for medical staff, easier fetal heart monitoring, and lower risk of perineal injury (7,8).

The number of studies on the effects of different positions during the second stage of labor in women with

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EA is very limited and the results are conflicting. A Cochrane review showed that there is little or no difference between recumbent or upright position during the second stage of labor with EA in terms of operative delivery and duration of the second stage of labor, while the results for most maternal and fetal outcomes were less clear. Considering the large heterogeneity of studies, this study found no definitive results demonstrating the superiority of either position and pointed to the urgent need to conduct further studies (9).

EA may increase pregnant mothers' satisfaction during labor and encourage them to have a natural vaginal delivery (10-11) but there are still debates about the optimal position during the second stage of labor with EA and its impact on maternal and fetal outcomes. Therefore, this randomized clinical trial aims to compare the mode of delivery and some maternal and neonatal outcomes of spontaneous labor with EA between nulliparous women adopting an upright or recumbent position.

Materials and Methods

Design and settings

This study was a randomized clinical trial and was conducted from December 10, 2020 to February 16, 2022 at Arash Women's Hospital, Tehran, Iran. The statistician randomly generated the allocation list using a random number sequence generated by STATA software using the block randomization method. The randomization list was concealed from all research personnel using sealed envelopes. Due to the nature of the intervention, blinding of participants and outcome assessors was not possible.

Participants and interventions

The research community consisted of all pregnant women who underwent spontaneous vaginal delivery at our hospital. Inclusion criteria were maternal age between 18 and 35 years, nulliparity, singleton term pregnancy between 37 and 42 weeks, cephalic presentation, and receiving EA during the active phase of labor. The active phase is the second step of the first stage of labor, which is defined by the degree of cervical dilation. It begins at a cervical dilatation of 4-6 cm and ends at full cervical dilatation. Mothers who received any methods of labor induction, including cervical ripening (balloon catheter, Prostaglandin), artificial rupture of membranes, or Oxytocin injections were not included in this study, while mothers underwent labor augmentation with Oxytocin were considered eligible. Mothers with underlying medical conditions, vaginal bleeding, and drug use or drug addiction were also not included in the study.

All mothers were randomly divided into two groups. Group A included mothers who were in an upright position during the second stage of labor (determined by the obstetrician based on full cervical dilatation). The upright position includes any position in which the pelvis is held as vertical as possible during labor or delivery, such as walking, standing, sitting outside the bed, sitting upright in the obstetric bed, supported kneeling, or any other vertical position during second stage of labor, as much as possible. Group B included women who were in the recumbent position. The recumbent position includes any position in which the pelvis remains horizontal during labor or delivery, including the left lateral or right lateral positions. During the second stage, the supine position (flat on the back) and the lithotomy position were not used because of the possibility of aortocaval compression, but the participants with episiotomy and all participants during delivery used a lithotomy position.

Epidural analgesia

EA was performed using the loss of resistance technique in the lumbar region below L2. The initial dose was 18 ml of solution, including 16 ml of bupivacaine 0.125% and 20 mg of meperidine administered as a bolus injection. Analgesia was maintained with intermittent bolus injections if the mother wished.

Ethical considerations

Informed consent was obtained from all participants and the study was conducted in accordance with the Declaration of Helsinki. The study protocol was approved by the ethics committees of the Faculty of Medicine, Tehran University of Medical Sciences, Tehran, Iran on April 21, 2020 (Ethics approval code: IR.TUMS.MEDICINE.REC.1399.045, Registration Date: October 28, 2020), and registered on the Iranian Registration of Clinical Trials website (http://www.irct.ir: IRCT20121006011020N13).

Study Outcomes

The primary outcomes of the study included the mode of delivery (NVD or cesarean section [C/S]). Secondary outcomes of the study included duration of different stages of labor after EA, pain intensity, rate of maternal complications including instrumental delivery, PPH, need for blood transfusion, perineal lacerations, and neonatal outcomes, including one-minute and five-minute Apgar scores and admission to the intensive care unit. Perineal lacerations are classified into four basic categories. First-degree lacerations are superficial injuries to the vaginal mucosa that may also affect the

perineal skin. Second-degree lacerations are first-degree laceration that affect the vaginal mucosa and the perineal muscles. Third-degree lacerations are lacerations involving the anal sphincter. Fourth-degree lacerations are lacerations that extend through the anal epithelium (12,13).

The severity of pain was determined by mean pain score using the visual analog scale (VAS) with a 10-point scale, ranging from zero (no pain) to 10 (intolerable pain). The pain score was measured before performing EA and every 15 minutes until delivery. The Apgar score comprises five components: 1) color, 2) heart rate, 3) reflexes, 4) muscle tone, and 5) respiration, and each category is scored with 0, 1, or 2 (14).

Statistical considerations

Sample size calculation

Study sample size determination was based on findings of BUMPES study. Assuming a 41% C/S delivery rate in the recumbent group, observing a 12% difference in the NVD rate between the two groups, and considering a 10% loss to follow-up and exclusion, it would be necessary to have about 270 participants in each group to have 80% power to detect a significant difference between recumbent and upright positions (two-tailed α-level of 0.05).

Analytical statistics

Normally distributed quantitative data were summarized as mean (SD). The quantitative data were summarized as frequency (percentage).

Descriptive statistics

Chi-square and Fisher's exact test were used for the qualitative data, and T-tests were used for quantitative data. Since the sample size in this study is 528 participants, parametric tests were used according to the central limit theorem. All statistical analyses were performed by SPSS software version 26 (IBM Corp., Armonk, NY, USA). All p-values were considered significant at $P<0.05$.

Results

We screened 1156 women for inclusion during 14 months. Of these, 540 women met the inclusion criteria and agreed to participate in this study. We randomized the 540 eligible women to recumbent (n:270) and upright (n:270) positions. After the allocation, 1/270 women (0.37 %) in the upright group and 3/270 (1.11 %) in the recumbent group did not receive the assigned position. We also excluded 5/269 (1.85 %) patients in the upright group and 3/267 (1.12 %) in the recumbent group because they discontinued the allocated intervention. Figure 1 shows the study flow.

Table 1 presents the demographic and baseline characteristics of the participants. The participants had a mean age of 32.32±13.24 years. The two groups were similar in terms of age, BMI, medical history, and labor characteristics. The neonatal weight in the upright group was slightly higher than in the recumbent group, but this difference was not statistically significant (3441.7±303.3 gr vs 3392.9±292.1gr; $P=0.069$).

Table 1. Baseline characteristics

	Upright position (n=264)	Recumbent Position (n=264)	*P*
Demographic Characteristics			
Age (years) [a]	24.17 ± 3.38	24.09 ± 3.26	0.761
BMI (Kg/m^2) [a]	24.56 ± 3.91	24.62 ± 3.49	0.857
Medical History			
GDM [b]	18 (6.8)	26 (9.8)	0.270
PHTN [b]	5 (1.9)	10 (3.8)	0.295
Hypothyroidism [b]	94 (35.6)	108 (40.9)	0.244
Asthma [b]	0	1 (0.4)	1.000
CVD [b]	0	0	-
Hypothyroidism [b]	94 (35.6)	108 (40.9)	0.244
Labor Characteristics			
GA at delivery [a]	39.63 ± 0.63	39.53 ± 0.61	0.087
Cervical dilatation [a, c]	4.77 ± 1.00	4.62 ± 1.02	0.098
Cervical effacement [a, c]	49.39 ± 8.74	50.56 ± 10.51	0.169
Rupture of membranes [b, c]	148 (56.1)	157 (59.8)	0.428
Neonatal weight [a]	3441.7 ± 303.3	3392.9 ± 292.1	0.069

a: data presented as mean ± standard deviation and analysis was based on T test; b: data presented as number (%) and analysis was based on Chi-squared or Fisher's Exact test; c: at time of epidural analgesia; BMI: Body Mass Index; CVD: Cardiovascular Diseases; GA: Gestational Age; GDM: Gestational Diabetes Mellitus; PHTN: Pregnancy Hypertension

Table 2 displays the duration of different stages of labor and EA efficacy in the allocated positions. The upright and recumbent positions did not differ significantly in the duration of different stages of labor. The number of episodes of epidural infusion for maintaining analgesia and the pain intensity (VAS score) immediately after the epidural and during the active phase were also similar between the two groups. However, the pain intensity (VAS score) during the second stage of labor was significantly higher in the upright group than in the recumbent group (P<0.001).

Table 2. Duration of different stages of labor and EA efficacy in allocated positions

	Upright position (n=264)	Recumbent Position (n=264)	*P*
Time from EA to full cervical dilatation (min) [a]	183.62 ± 125.67	171.64 ± 130.72	0.617
Duration of active phase (min) [a]	205.8 ± 111.6	210.2 ± 106.9	0.638
Duration of second stage of labor (min) [a]	48.2 ± 34.5	47.5 ± 34.1	0.813
Episodes of epidural infusion for maintenance of analgesia [b]			
1 time	219 (83)	207 (78.4)	0.117
2 times	43 (16.3)	57 (21.6)	
3 times	2 (0.8)	0	
Pain Intensity (Mean VAS score) in different stages [a]			
Before EA	9.11 ± 0.86	9.15 ± 0.86	0.615
After EA	2.52 ± 0.70	2.47 ± 0.86	0.394
Active phase	2.12 ± 0.75	2.19 ± 1.12	0.498
Second stage	3.10 ± 1.06	2.78 ± 0.98	0.0001

a: data presented as mean±standard deviation and analysis was based on T test; b: data presented as number (%) and analysis was based on Chi-squared or Fisher's Exact test; EA: Epidural Analgesia; FCD: Full Cervical Dilatation

Table 3 reports the study outcomes related to maternal and neonatal complications. The rate of cesarean delivery was significantly higher in the upright group than in the recumbent group (P=0.031). The two groups did not differ in other maternal outcomes, such as perineal lacerations, postpartum hemorrhage, blood transfusion, or instrumental delivery. The Apgar score at 1 and 5 minutes after birth was significantly lower in the upright group than in the recumbent group (P<0.001).

Table 3. Comparison of maternal and neonatal outcomes between two allocated positions

	Upright position (n=264)	Recumbent Position (n=264)	*P*
Maternal Outcomes			
Augmentation [b]	156 (59.1)	168 (63.6)	0.326
Mode of Delivery [a]			
NVD	189 (71.6)	210 (79.5)	0.031
C/S	75 (28.4)	54 (20.5)	
Perineal Lacerations [a]			
degree 2	187 (98.9)	209 (99.5)	0.605
Degree 3	2 (1.1)	1 (0.5)	
PPH [a]	0	0	
Blood transfusion [a]	0	0	
Instrumental Delivery [a]	0	0	
Neonatal Outcomes			
Apgar Score			
One Minute	8.58 ± 0.68	8.78 ± 0.46	0.0001
5 Minutes	9.57 ±0.82	9.87 ± 0.46	0.0001
NICU admission	1 (0.4)	1 (0.4)	1

a: data presented as number (%) and analysis was based on Chi-squared or Fisher's Exact test; b: data presented as mean ± standard deviation and analysis was based on T test; PPH: Postpartum Hemorrhage

Discussion

The aim of this randomized clinical trial was to compare the effects of upright and recumbent positions during the second stage of labor in nulliparous women with EA on mode of delivery and some maternal and neonatal outcomes. The primary outcome was mode of delivery. Secondary outcomes included duration of different stages of labor after EA, pain intensity, instrumental delivery, PPH, blood transfusion, perirenal lacerations, Apgar scores, and admission to neonatal intensive care unit. We hypothesized that upright positions would result in shorter second stage of labor and a higher rate of NVD than recumbent positions; however, our results did not confirm our hypothesis. On the contrary, we found that there were no significant differences between the two positions in terms of duration of labor or maternal outcomes, but recumbent positions were associated with lower rate of cesarean section, a lower pain intensity, and a higher Apgar score than upright positions.

Our results are consistent with the BUMPES study (15) which is the largest study ever to compare effect of different positions on the outcomes of labor in women receiving EA. This study enrolled 3093 nulliparous women. In line with our findings, a higher rate of spontaneous vaginal delivery was reported in the recumbent position than the upright position. The results of this study, like those of ours, failed to reveal any significant differences between the two groups in terms of maternal complications, such as perineal trauma, PPH, or blood transfusion. Nonetheless, in contrast to our findings, the BUMPES study failed to detect any significant difference in Apgar scores between the two groups.

Our results are consistent with a study presented at the American Association of Obstetricians and Gynecologists (ACOG) International Congress in 2019, which compared the cost-effectiveness and outcomes of the recumbent and upright positions during E A (16). This study examined a cohort of 1.1 million pregnant women in the United States and found that the use of low-dose EA in the recumbent position led to fewer cesarean deliveries, lower costs, lower risk of maternal death, uterine rupture, and hysterectomy, and saved 165 million dollars. However, this study did not report the duration of the second stage of labor or the neonatal outcomes. This study also used a theoretical model instead of actual data, which may limit its validity and applicability. Nevertheless, this study provides valuable insight into the economic and health benefits of recumbent positions with EA. It suggests that recumbent positions may be preferable for both the first and the subsequent deliveries.

The mechanism behind the effects of different positions on progression of labor with EA is not fully understood. It is suggested that in upright positions, gravity and better pelvic expansion may enhance the uterine contractions, the intrauterine pressure, and the fetal head descent. However, these beneficial effects may be compromised by reduced uterine and placental blood flow, maternal discomfort and fatigue, and increased risk of PPH and perineal lacerations (3,5-7). Moreover, the effects of different positions may depend on the type and dose of EA, the degree of maternal mobility and sensation, the fetal presentation and size, and the maternal anatomy and physiology.

It seems that the optimal maternal position during the second stage of labor would be different when EA is applied. An overview of systematic reviews by Zang *et al*., (17) stated unlike births without EA, in births with EA, upright positions significantly reduced the rate of poor outcomes (like instrumental delivery, episiotomy, abnormal fetal heart rate patterns), shortened the second stage of labor, and increased the risk of PPH and second-degree perineal trauma. They stated it seems that there are no definite benefits or risks for upright positions in women with EA. On the other hand, according to the findings of the present study and also the BUMPES trial, it seems that the rate of NVD decreases in women adopting an upright position during labor with EA. So, the deciding the optimal maternal position in cases with EA needs further investigation and implementation of different approaches from the cases without EA.

One of the main limitations of the present study was its non-blinding design, which was inevitable. The results may have been influenced by negative or positive attitudes of caregivers or patients towards the upright position. On the other hand, we have found that mothers with an upright position reported higher pain scores in the second stage of labor. It may seem that the higher pain score in the upright group was due to the reduced efficacy of EA; however, considering the equal number of doses received between the two groups, this hypothesis seems inaccurate. Also, considering the subjective nature of this variable, it is not unlikely that the pain perception of mothers in this group was higher than the recumbent group due to reasons other than EA efficacy, such as reluctance of the patient for to maintain an upright position or fatigue. It is even possible that mothers reported their pain in an exaggerated way to please their

caregiver not to adopt or continue an upright position for the remaining time of labor. Another limitation of our study was that there were no cases of PPH, blood transfusion, or instrumental delivery between our participants. So, we were could not compare the two positions in terms of these poor maternal outcomes. This finding may reflect the low sample size of this study or even indirectly indicate the extremely cautious approaches of caregivers in our hospital.

Another limitation of our study was that we did not measure the umbilical cord pH and the pelvic dimensions, which may have affected the labor process and the maternal and fetal outcomes. We also did not assess the maternal satisfaction, comfort, and preference regarding the different positions, which may have influenced their compliance and adherence to the assigned position.

In summary, this randomized clinical trial found that recumbent positions were associated with a lower rate of cesarean delivery, lower pain intensity, and higher Apgar score than upright positions in nulliparous women with EA. There were no significant differences between the two positions in terms of other maternal or fetal outcomes. These results suggest that recumbent positions are be preferable for women with EA during the second stage of labor, as they may improve labor outcomes and maternal and fetal well-being. However, further high-quality studies are needed to verify and generalize these findings, and to explore the mechanisms and factors that may influence the effects of different positions during the second stage of labor with EA.

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