Evaluation of the Effect of Body Mass Index on Labor Progress in Mothers Undergoing Epidural Analgesia: A Double-Blind Randomized Clinical Trial

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Abstract- The present study evaluates the association between epidural analgesia and the duration of the active phase of labor and pregnancy outcomes in mothers with high body mass index (BMI). All term pregnant women undergoing epidural analgesia for pain-free labor entered the study from September 2016 to March 2020. After recruiting 300 subjects into the study, mothers were categorized into six groups based on their BMI levels. Each BMI sub-group was analyzed regarding the duration of the active phase of labor and delivery mode. In addition, the relationship between BMI and labor outcome and characteristics was studied. Overall, 300 laboring women with epidural analgesia were included. 79.3% had a vaginal delivery, and 20.7% undergo cesarean section. Different BMI sub-groups showed no significant difference regarding the duration of the active phase of labor under epidural analgesia. Cox regression analysis revealed that BMI had no significant effect on the length of the active phase of labor (P=0.787). No significant association was found between BMI and the cesarean delivery rate, uterine atony, maternal pyrexia, neonatal Apgar score, and NICU hospitalization rate. However, BMI was significantly associated with the incidence of dystocia and headache. labor with dystocia exhibited a significantly higher Mother's BMI (P<0.05). The results suggest no significant association between epidural analgesia and the active phase of labor duration in mothers with high BMI.
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Keywords: Epidural analgesia; Labor; Body mass index (BMI)

Introduction

Many women perceive childbirth as one of their most painful experiences. Pain during labor has been associated with unwanted effects on both fetus and mother, including reduced placental blood flow, impaired fetal oxygenation, fetal acidosis, maternal cognitive and depressive disorders, and post-traumatic stress disorder (PTSD) (1).

Labor pain relief is one of the most significant factors contributing to maternal satisfaction with labor. In this respect, epidural analgesia is one of the most popular and effective analgesic modalities (2).

There is some inconsistency in the literature concerning adverse neonatal and maternal outcomes of epidural analgesia (3,4). In high-quality studies, including Cochrane reviews and meta-analyses, epidural analgesia has been suggested to extend the first stage of labor by 30 minutes and the second stage by 15 minutes, when compared with alternative forms of analgesia. Although this may be a reproducible effect, it may be argued that it is clinically negligible (5).

On the other hand, the prevalence of overweight and obese women of child-bearing age has increased over generations, 1, 2 and as body mass index (BMI) increases. Maternal obesity is positively associated with post-term gestation and increased pregnancy complications, such as preeclampsia, hypertension, intrauterine fetal death, diabetes, and a higher need for labor induction (6,7). Lack of progress is among the most frequent causes of failed labor induction in obese women. Duration of spontaneous labor is shown to increase with maternal body mass index (BMI) (8). Studies have shown that women with obesity have longer labors (9). But the combination of labor

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epidural analgesia and obesity, and whether these two have a synergic effect in reducing the labor progression in obese mothers has not been studied.

The present study aims to evaluate the relationship between BMI and consequent complications of normal delivery in mothers undergoing epidural analgesia. Specifically, it seeks to determine whether epidural analgesia can aggravate the risk of prolonged labor and other consequences encountered in obese women.

Materials and Methods

The study was approved by an Investigational Review Board of Faculty of Medicine, Tehran University; an informed written consent was obtained from all patients participating in the study .

(347) healthy (ASA I, II), 18-40-year-old nulliparous women at term (≥34 weeks), in active labor and had a preference for using an epidural , from September 2016 to March 2020 at Arash women hospital, Tehran, were enrolled into the study. the process of inclusion into the study went on until the requested number of patients was reached. The inclusion criteria were women who born at term (34-42 weeks of gestation), planned a vaginal birth, had a viable single fetus, with vertex presentation, no known medical conditions, uncomplicated pregnancy, aged 18 years or older. Exclusion criteria included women who experienced preterm labor (<34 weeks of gestation), had received pethidine or fentanyl within 24 hours of active labor (regular contractions and cervical dilatation of at least 3 cm), were diagnosed with antenatal conditions such as pre-eclampsia, severe bronchial asthma, history of head injuries, glaucoma, heart or liver problems, diabetes Patients with pre-existing hypertension requiring treatment, hepatorenal or other end organ disease, patients with extremes contraindications of height (<140 or >180 cm) were excluded from the study, patients with coagulation or neurological disorders, spine deformity, or skin infection were also excluded. Women requesting epidural analgesia received a bolus OF 500 ml intravenous infusion of lactated Ringer's solution before initiation of the procedure. Epidural analgesia was performed in the sitting position, it was done by a single anesthesiologist with 15 years of experience in obstetric anesthesia. The epidural space was identified in L3-4-5 interspace by the loss of air resistance technique, using an 18-gauge Tuohy needle (MEDIKIT, Gurgaon, India). The patients received a test dose of 3 mL of 1.5% lidocaine with 1: 200,000 epinephrine. If the test dose became negative for intravascular injection (20% increase in maternal heart rate within 20 seconds of test dose) and intrathecal injection (no signs of motor block after 3 minutes of monitoring), preservative free isobaric bupivacaine 0.125% 16 ml in 50 microgram fentanyl, (17 ml), was injected for labor analgesia. Then a clear catheter with 20 gauge and closed Tip-3 lateral eyes (MEDIKIT, Gurgaon, India) was easily inserted in the patient's epidural space in sitting position. 3-4 cm of catheter was left in the epidural space and was taped in place. After performing the block patients were placed in the supine position, with left uterine displacement. patients were continuously monitored using electrocardiogram, pulse oximeter, while non-invasive blood pressure was measured every 5 min for the first 30 min and then every 15 min throughout the labor period, also fetal heart monitor was attached to patient. Episodes of side effects such as hypotension (SBP <20% of base line or SBP <90 mmhg), bradycardia (<50/min), respiratory depression (RR <10/min and hypoxia spo2 <90%) were recorded and treated immediately. After performing the procedure, the onset of sensory block was assessed by patient labor pain relief. After 30 min, VAPS scores were recorded in every minute for 10 minutes, motor block for every 5 minutes for 30 minutes If patient complained of pain (defined as VAS >5), consider technique-catheter or drug-related factors and the patient exclude from study and only the patients who had pain relief in first thirty minutes clinically and vaps score less than 5, was evaluated for study. After the first 30 minutes, patients were allowed to ambulate, if there was no detectable motor block and the fetal heart rate pattern was normal.`

In this study, the pregnant women were categorized based on their BMI levels as follows:

- BMI<18.5
- BMI=18.5-24.9
- BMI=25-29.9
- BMI=30-34.9
- BMI=35-39.9
- BMI≥40

Each sub-group was then analyzed regarding the length of the active phase of labor, mode of delivery, and the association between BMI and labor outcome and characteristics.

Results

The frequency of BMI categories was as follows: BMI ≤18.5: (0), BMI=18.5-24.9: 27 (9%), BMI=25-29.9: 103 (34.3%), BMI=30-34.9:109 (36.3%), BMI=35-39.9:52

(17.3%), and BMI ≥40: 9 (3%).

Statistical analysis

Collected data were stored in the database of SPSS statistical software version 22 and analyzed according to the specified goals. Data analysis involved descriptive-inferential statistics using measures of central dispersion, mean and standard deviation. Chi-square and Fisher's exact tests were utilized to analyze the qualitative variables, and the independent t-test was used for quantitative variables. The effect of BMI on the length of the active phase of labor was examined using Cox regression analysis. A significance level of 0.05 with a confidence interval of 0.95 was considered for all tests.

A total of 300 laboring mothers with epidural analgesia were included in the study.

Table 1 and 2 provides the demographic and clinical information of the study participants and their offsprings. Also Figure 1 shows a flowchart of mothers undergoing epidural analgesia based on their BMI group.

Table 1. The demographic and clinical information of study participants.

Variable		Value
Maternal age (mean (SD), years)		26.46 (4.96)
Maternal weight (mean (SD), kg)		82.82 (10.35)
Maternal height (mean (SD), cm)		163.67 (6.51)
BMI (mean (SD), kg/cm^2)		31.05 (4.56)
Number of pregnancies (number (%))	**1**	230 (76.7%)
	2	61 (20.3%)
	3	5 (1.7%)
	4	3 (1%)
	5	1 (0.3%)
Mode of delivery (number (%))	**Normal**	238 (79.3%)
	cesarean section	62 (20.7%)
Indications for cesarean section (number (%))	**Full arrest**	14 (22.6%)
	Decreased fetal heart rate	25 (40.3%)
	Fever and tachycardia	2 (3.2%)
	Thick meconium	1 (1.6%)
	Lack of progress	18 (29%)
	Others	2 (3.2%)
Uterine atony (number (%))		8 (2.7%)
Induction (number (%))		291 (97%)
Apgar score (number (%))	**Low Apgar score**	34 (11.3%)
	Acceptable Apgar score	266 (88.7%)
Maternal pyrexia (number (%))		16 (5.3%)
Maternal headache (number (%))		52 (17.3%)
Dystocia (number (%))		35 (11.7%)
NICU hospitalization (number (%))		21 (7%)
Instrumental delivery (number (%))		11 (3.7%)
Length of NICU stay (mean (SD), day)		0.73 (3.50)
Length of the active phase of labor (mean (SD), hour)		3.30 (2.11)

Spearman correlation could not demonstrate a significant association between maternal BMI and the duration of the active phase of labor with epidural analgesia (Spearman rho=0.008, *P*=0.884). Moreover, there was no significant difference between various BMI groups regarding the duration of the active phase of labor (*P*=0.762).

The results of Cox regression analysis suggested the non-significant effect of BMI on the length of the active phase of labor (*P*=0.787).

BMI was not significantly related to the cesarean delivery rate. In addition, the various BMI sub-groups showed no significant difference in the cesarean rate (Table 3).

No significant association between BMI and uterine atony was established. In addition, various BMI subgroups displayed no significant difference regarding the degree of uterine atony (Table 3).

The relationship between maternal BMI and pyrexia was insignificant. No significant difference was observed between various BMI subgroups regarding maternal pyrexia (Table 3).

A significant association was noted between maternal BMI and headache incidence. Mothers affected by the

headache had a significantly higher BMI compared to those without the headache (P<0.001). Additionally, maternal headache was significantly associated with BMI sub-groups. Specifically, mothers with high BMI were more likely to experience headaches (P<0.001) (Table 3).

Likewise, a significant relationship was noticed between BMI and dystocia incidence. Compared to mothers whose infants were not affected by dystocia, mothers of newborns with shoulder dystocia had a significantly higher BMI (P=0.030). However, various BMI sub-groups showed no significant difference regarding dystocia incidence (Table 3).

There was a non-significant relationship between BMI and Apgar scores of newborns. Various BMI sub-groups had no significant difference in the neonatal Apgar scores (Table 3).

No significant association was observed between BMI and NICU hospitalization of infants. Similarly, various BMI groups were not significantly different regarding the NICU hospitalization rate of newborns (Table 3).

Table 2. The clinical information of study participants' offsprings.

Variable		Value
Apgar score (frequency (%))	**Low Apgar score**	34 (11.3%)
	Acceptable Apgar score	266 (88.7%)
Dystocia (frequency (%))		35 (11.7%)
NICU hospitalization (frequency (%))		21 (7%)
Length of NICU stay (mean (SD), day)		0.73 (3.50)

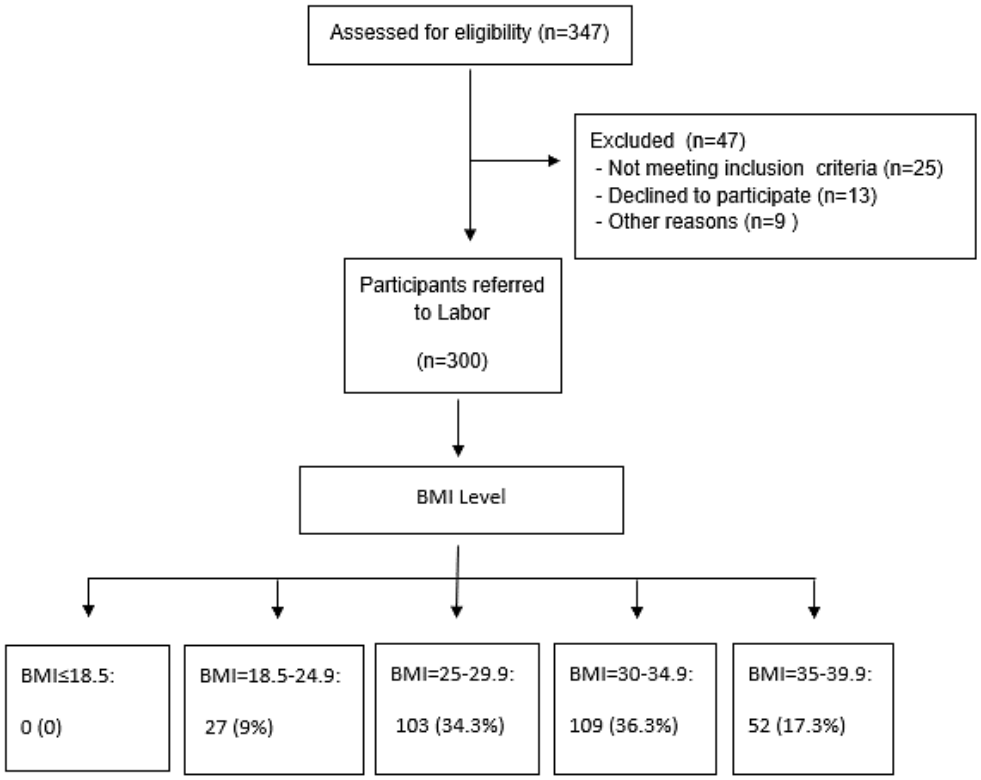

Figure 1. Flowchart shows mothers undergoing epidural analgesia

Table 3. The relationship between BMI and maternal and neonatal outcomes

		BMI						*P*
		≤ 18.5	18.5-24.9	25-29.9	30-34.9	35-39.9	≥ 40	
Cesarean Section	**Yes**	30.86 (4.68)	7 (11.3%)	21 (33.9%)	21 (33.9%)	11 (17.7%)	2 (3.2%)	0.962
	No	31.10 (4.54)	20 (8.4%)	82 (34.5%)	88 (37%)	41 (17.2%)	7 (2.9%)	
P					0.710			
Uterine atony	**Presence**	27.97 (3.51)	2 (25%)	4 (50%)	2 (25%)	0 (0%)	0 (0%)	0.299
	Absence	31.14 (4.56)	25 (8.6%)	99 (339%)	107 (36.6%)	52 (17.8%)	9 (3.1%)	
P					0.053			
Maternal pyrexia	**Febrile**	31.08 (4.57)	1 (6.3%)	6 (37.5%)	6 (37.5%)	3 (18.8%)	0 (0%)	0.948
	Non-febrile	30.53 (4.38)	26 (9.2%)	97 (34.2%)	103 (36.3%)	49 (17.3%)	9 (3.2%)	
P					0.637			
Maternal headache	**Present**	34.09 (4.19)	2 (3.8%)	5 (9.6%)	22 (42.3%)	20 (38.5%)	3 (5.8%)	<0.001
	Absent	30.42 (4.38)	25 (10.1%)	98 (39.5%)	87 (35.1%)	32 (12.9%)	6 (2.4%)	
P					<0.001			
Dystocia incidence	**Yes**	32.62 (4.24)	0 (0%)	11 (31.4%)	13 (37.1%)	8 (22.9%)	3 (8.6%)	0.076
	No	30.85 (4.57)	27 (10.2%)	92 (34.7%)	96 (36.2%)	44 (16.6%)	6 (2.3%)	
P					0.030			
NICU hospitalization of neonates	**Yes**	31.35 (4.82)	3 (14.3%)	6 (28.6%)	7 (33.3%)	3 (14.3%)	2 (9.5%)	0.299
	No	31.03 (4.55)	24 (8.6%)	97 (34.8%)	102 (36.6%)	49 (17.6%)	7 (2.5%)	
P					0.757			
Apgar score	**Low**	31.33 (4.43)	3 (8.8%)	11 (32.4%)	13 (38.2%)	5 (14.7%)	2 (5.9%)	0.367
	Acceptable	31.02 (4.58)	24 (9%)	92 (34.6%)	96 (36.1%)	47 (17.7%)	7 (2.6%)	
P					0.707			

Discussion

The present study aimed to determine the relationship of body mass index on labor progression in women under epidural analgesia. We found that there is any significant relationship between maternal BMI and the length of the active phase of labor in mothers that undergo epidural labor analgesia. A 2020 study by Carlhäll *et al*., on 63829 primiparas reported slower progress of labor in obese compared to normal BMI women (10). The authors found the shorter duration of the second stage of labor in obese women. However, their definition of the second stage was confined to the onset of pushing attempts. Thus, it is not directly comparable to our results, given that our study considered the second phase as the time of full dilatation until the delivery of the fetus. Additionally, in contrast to our study, the use/non-use of epidural analgesia was not a confounding factor in the Carlhäll *et al*., work (10). One strength of the present study is that it only includes laboring women with epidural analgesia to eliminate the effect of epidural analgesia.

Contrary to our findings, most past studies reported the independent effect of BMI on the total duration of active labor. These studies specifically indicate the increased length of the first phase of labor, supporting the overall prolongation of labor (8,11,12). Kominiarek *et al*., evaluated 118978 nulliparous and multiparous women in separate analyses and found a considerable increase in the total duration of labor with BMI in primiparous females (13). However, they presented a different definition of active labor from other studies, which accepted a cervical dilatation of only 1 cm as the onset of the labor. Thus, the latent phase of labor described by other studies was included in the active phase. Epidural has been proposed as a variable in this study as well.

We also assessed the relationship between maternal

BMI and pregnancy outcomes. No significant association was found between the BMI of mothers undergoing epidural analgesia and the cesarean delivery rate, uterine atony, maternal pyrexia, neonatal Apgar score, and NICU hospitalization.

In a retrospective 2018 study, Angeliki *et al*., evaluated the relationship between BMI and pregnancy outcomes in primiparas under 40 years undergoing labor induction at term due to various indications. The authors revealed that increasing BMI was independently related to the odds of a cesarean section. The likelihood of cesarean delivery was 1.58 and 2.75 times higher in overweight and obese women, respectively. The increase in BMI did not affect the instrumental delivery in this study group. Apgar scores at minutes 1 and 5 were notably lower in overweight and obese women than those with normal BMI (14).

A 2006 study investigating the effect of obesity on epidural analgesia and mode of delivery identified high weight and obesity as major causes of the increased rate of caesarian deliveries. This study is similar to ours in that its statistical population included all subjects undergoing epidural analgesia. However, their results were inconsistent with ours (15).

Furthermore, our study revealed that BMI was implicated in headache and dystocia incidence in mothers. The headache incidence appears more due to the increased risk of unwanted dural perforation during the epidural analgesia procedure. Dural perforation is a well-established complication of epidural anesthesia, and as previously highlighted in the literature, obesity aggravates epidural complications (15). Concerning obesity and elevated risk of dystocia, our findings corroborate those of previous studies (16).

The large sample size and the prospective nature of the study, which caused the information to be collected with high precision, can be considered as the strengths of the present study.

The present study explored the relationship between maternal BMI and the duration of the active phase of labor and pregnancy outcomes. Altogether, we found no significant relationship between the maternal BMI and the length of the active phase of labor in women undergo epidural analgesia in labor. Moreover, a non-significant association was noticed between BMI and cesarean delivery rate, maternal pyrexia, neonatal Apgar score, and NICU hospitalization rate. This is a promise for the promotion of painless childbirth in my country, because the concept of this complication prevents provision of analgesia to mothers. However, BMI had a significant relationship with maternal dystocia and headache. It seems that more studies on this subject, for example with two groups with and without epidural, are necessary.

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