Original Article

Impact of Labor Epidural Analgesia on Maternal and Neonatal Outcomes with Trial of Labor in Previous Caesarean Delivery: A Prospective, Controlled, Longitudinal Study

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Abstract

Background: Labor outcome with regional anesthesia following previous cesarean section has been fraught with concerns regarding uterine rupture. There is sparse literature regarding the association between the impact of epidural analgesia and labor outcome in vaginal birth after cesarean section (VBAC). This study aims to evaluate the effect of labor epidural analgesia on labor outcome following TOL (Trial of labor) in previous cesarean or normal delivery with maternal and neonatal outcomes. **Material and Methods**: This is a prospective controlled longitudinal study in second-gravida patients in labor. A total of 132 patients were enrolled for the study out of which 101 were divided into three groups. Group A included 38 second-gravid women with a history of previous caesarean delivery and Group B included 32 second-gravid having previous normal vaginal delivery, both the groups received epidural analgesia during labor. Group C included 31 second-gravid with a history of previous cesarean section who did not receive epidural analgesia during labor. The aim of the study was to evaluate labor outcome in terms of successful vaginal delivery with or without epidural analgesia, along with visual analogue scale (VAS) pain scores during the conduction of delivery, hemodynamic parameters, and progress of trial of labor (TOL). Other obstetric and neonatal parameters were also evaluated. **Results:** Vaginal delivery was conducted in all patients in Group B (32/32; 100%) and Group C (31/31; 100%), whereas in Group A, two patients underwent emergency cesarean section as a result of impending uterine rupture in one case and acute fetal hypoxia in another. According to the intensity of pain on VAS, women having previous cesarean delivery experienced more severe pain before starting epidural analgesia (VAS in Groups A and C; 7.9 ± 0.2) as compared to previous vaginal delivery (VAS; Group B 6.4 ± 0.2) ($P < 0.0001$). The duration of second stage of labor was significantly prolonged in parturients with previous CD (Group A 22.6 ± 1.2; Group C 25.0 ± 1.9 v/s Group B 18.4 ± 1.1) ($P < 0.0001$). Similarly third stage of labor was also prolonged significantly in Group A and Group C (10.1 ± 0.7, 10.2 ± 0.9) as compared to Group B (7.7 ± 0.6) ($P < 0.0001$). However, total duration of labor was not significantly different among the three groups. ($P > 0.05$) Cervical dilatation on admission to the maternity ward was 4.1 ± 1.0 (Group A and C) and 4.0 ± 1.0 (Group B). The total consumption of ropivacaine in epidural analgesia was significantly high in Group A (previous CD) (29.6 ± 1.2 mg) as compared to Group B (previous vaginal delivery) (28.1 ± 1.6 mg) ($P < 0.0001$). **Conclusions:** Epidural analgesia is an effective and safe method of analgesia for vaginal delivery after previous cesarean section, and does not involve the risk of untimely diagnosis of impending uterine rupture.

Keywords: *Epidural analgesia, labor pain, uterine rupture, uterine scar, vaginal delivery*

Introduction

Epidural analgesia (EA) for vaginal delivery in women having uterine scar of previous cesarean delivery is a matter of concern, as the rate of cesarean delivery (CD) is increasing worldwide as also in Russia.[1]

It is known that previous CD is one of the major indications for CD in parturients for their successive pregnancies. Barber EL *et al*. estimated that in the United States the frequency of CD has increased by 50% from 2003 to 2009, especially in patients having a previous cesarean section.[2] To circumvent this problem the development of an optimal vaginal delivery protocol for patients having previous CD can prove efficacious.

Vaginal delivery is one of the important and most effective methods to reduce the number of operative deliveries and the

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amount of blood loss, purrulent-septic complications, and material expenses in terms of prolonged hospitalization. The age-old dictum from Cragin ER (1916), "Once CD is always CD" has completely lost its relevance and finally given way to another statement: "if a strong uterine scar is indicated and there are no other indications for CD, preference should be given to spontaneous delivery".[3]

A systematic review has shown that the induction of labor is more likely to result in CD than spontaneous labor.[4] Among the most frequent causes why CD is preferred to spontaneous vaginal delivery in previous caesarean deliveries is the risk of uterine rupture along the scar, especially in those who undergo vaginal delivery without adequate analgesia as labor induces severe pain and bearing down, leads to massive pressure on the scar impending it to rupture during the course of labor.[5] It is known that the risk of uterine rupture in patients with a uterine scar is low and does not exceed 1.5%.[6] Another population-based cohort study of second- gravida who had a previous cesarean delivery reported a uterine rupture rate of 5.2 per 1000 following spontaneous labor and a rate of 25.5 per 1000 in labor induced by prostaglandins.[7]

One of the effective methods of labor pain management for this category of obstetric patients is epidural analgesia (EA).[8,9] However, in everyday practice, analgesia for labor is not requested for women with a history of the previous CD, which is probably due to the age-old concept that EA can mask the clinical picture of an impending uterine rupture. According to the Clinical recommendations of the Russian Federation Health Ministry (2015) the presence of uterine scar is not considered a contraindication to any of the existing childbirth anesthetic support methods.[10] Similarly, the 2010 American Association of Obstetrician and Gynecologist guidelines recommend that trial of labor after CD (TOLAC) is safe.[11-13]

The aim of conducting this study was to assess the success of vaginal delivery in second-gravid following previous CD or normal delivery and the impact of epidural analgesia (EA) on the course and outcome of labor.

Materials and Methods

After approval by the local ethics committee of the Smolensk State Medical Academy (SSMA), this study was conducted in a Tertiary care center, Smolensk (Russia) from 2010–2014 over a period of 4 years. Patients were included in the study after informed and written consent for participation. Patients were fully explained about the purpose of the study and assured about the confidentiality of their identity.

This study included 132 second-gravida women who were admitted for labor in the age group from 22 to 40 years, having a previous normal vaginal delivery, or cesarean delivery. The exclusion criteria involved women with multifetal pregnancy, abnormal (other than cephalic) presentation, the presence of two or more CDs in anamnesis, mental and other medical illnesses, previous history of uterine rupture, infections or postpartum hemorrhage, as well as organ-preserving operations on the uterus, no diagnosed fetal malformations, or low birth weight on ultrasound examination.

Patients were enrolled in the study according to their request for analgesia if there were no absolute contraindications to EA. After exclusions and dropouts, 101 parturients were divided into 3 groups according to the consort flow diagram in Figure 1.

1. Group A (n = 38): women with previous CD receiving epidural analgesia during labor
2. Group B (n = 32): women with a history of previous normal vaginal delivery receiving epidural analgesia during labor
3. Group C (n = 31): women with a history of previous CD not receiving epidural analgesia during labor.

The time gap between the epidural placement and the administration of the first analgesic dose was 30 min. Analgesia was considered adequate if VAS was <4 cm.

Primary outcome measures were the success rate of vaginal delivery following the trial of labor and the impact of epidural analgesia.

Secondary endpoints included maternal parameters like demographic characteristics, VAS pain score, duration of labor, hemodynamic parameters (heart rate, mean arterial pressure), respiratory rate, complications like hemorrhage or uterine rupture, and Apgar scores to assess neonatal status.

After the patients were admitted in the labor ward, laboratory evaluation was performed, which included blood Group, hemoglobin, platelet counts, and coagulation function. To assess the state of the fetus in utero, all the parturients were monitored by cardiotocography. Fetal heart rate and uterine contractions were evaluated throughout the duration of the labor period. Parturients were closely watched for the progress of labor, and operation theater was kept ready for emergency cesarean delivery.

In the delivery room, parturients were nursed in the left lateral position. Peripheral intravenous access was taken with 18 gauge cannula, and IV fluid was started. Then under all aseptic precautions, epidural puncture was done in L2–L3 or L3–L4 intervertebral space, and epidural catheter was inserted at a depth of 3–4 cm. A test dose of 3 mL of 1.5% lignocaine with adrenaline (1:200,000) was injected to check the position and for any abnormal local anesthetic reaction.

The doses used in this study were as per the safe dose recommended for local anesthetic (LA) for analgesia in childbirth,[14] and ropivacaine 0.15% solution was used according to standard department protocol. Based upon the intensity of pain according to VAS and the size of

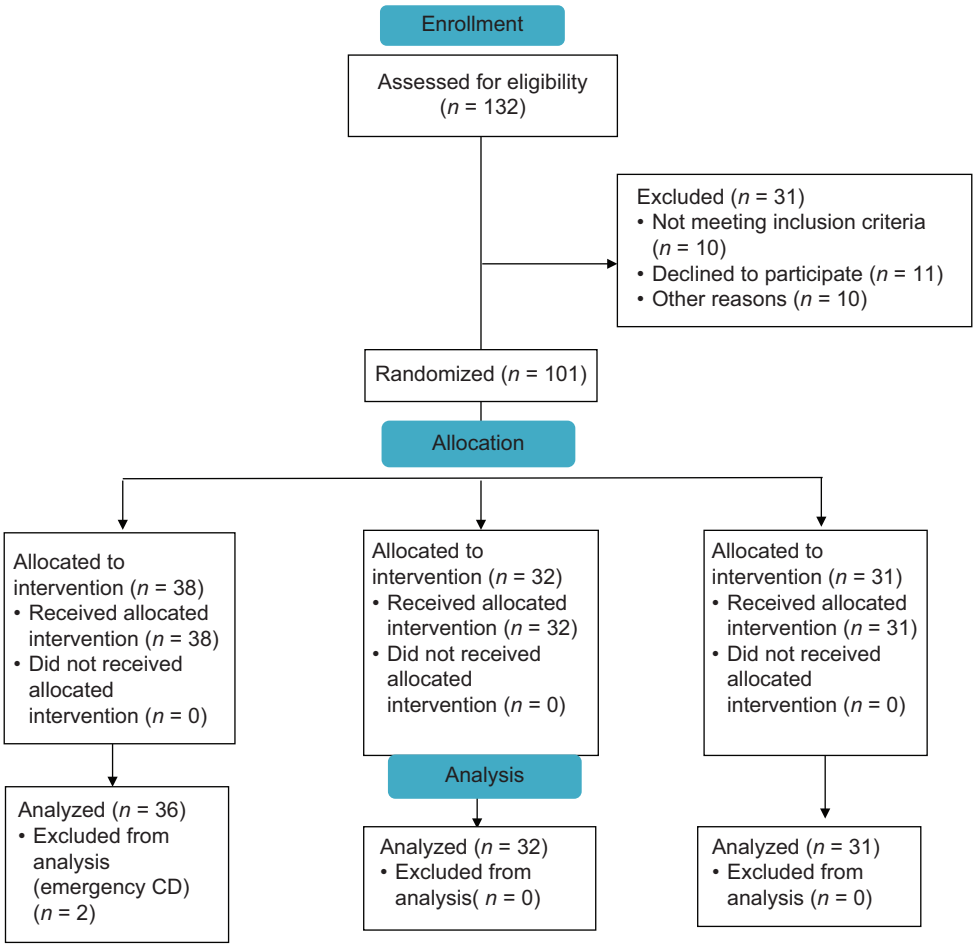

Figure 1: Patients flow diagram

the cervical dilatation, the need for ropivacaine was determined [Table 1].

Epidural bolus was repeated at pain severity ≥4 cm according to VAS. Epidural analgesia was continued until the baby was delivered. VAS pain scores, hemodynamic parameters, and respiratory rate were recorded during 5 phases [Phase 1: in maternity ward before initiating epidural analgesia; Phase 2, (30 min) Phase 3 (60 min) Phase 4 (90 min) after epidural analgesia, and Phase 5: active pushing phase.] Parameters were measured every 5 min during the first 20 min and then every 30 min during the course of labor. Oxytocin was used in parturients with weak uterine contractions. Duration of all three stages of labor and total duration of labor was recorded and compared.

Statistical analysis was performed in Microsoft Excel 10 and in the statistics package R (http: r-project. org.). The methods of descriptive statistics and parametric criteria for testing statistical hypotheses were used in statistical processing. The arrangement of criteria followed the Gaussian distribution law. The sample results of descriptive statistics were presented in the form of mean and standard deviation, and Student t-test was used for analysis. Categorical data were computed as frequencies and percentage and analyzed by Chi-square and Fisher exact test. $P < 0.05$ was considered significant.

Table 1: Doses of ropivacaine according to cervical dilation and VAS

Cervical dilatation, cm	VAS (cm)	Ropivacaine (mg)
3-6	5-7	27
	8-10	30
7-8	5-7	19.5
	8-10	25.5

Results

On ultrasound examination, in all the parturients, fetus was in the longitudinal position with cephalic presentation. All parturients had a normal-sized pelvis, and the placenta was not located in the scar area. The thickness of the uterine scar was more than 2.5 mm; there was a good scar vascularization with minimal amount of connective tissue elements.

On cardiotocography the basal rhythm for fetal heart rate was 120–160 per min, the amplitude of the rhythm variability was 10–25/min, sporadic acceleration was noted, and deceleration was absent. The frequency of

contractions of the uterus during the established normal labor corresponded to 3–5 contractions in 15 min, and the duration of each contraction was 30–50 s.

All women in labor were comparable in age, the time interval between previous and present childbirth, and concomitant pathology. Uterine inertia was observed in 8 (21%) women of Group A, 10 (31%) of Group B, 9 (29%) of Group C. Dystocia (discoordinated labor activity) was observed in 2 parturients (5%) of Group A and 2 (6%) of Group B. Preterm rupture of membranes occurred in 7 (18%) parturients in Group A, 6 (19%) of Group B, and 5 (16%) of Group C [Table 2].

The total consumption of ropivacaine in epidural analgesia was significantly high in Group A (previous CD) (29.6 ± 1.2 mg) as compared to Group B (previous vaginal delivery) (28.1 ± 1.6 mg) ($P < 0.0001$) [Table 2].

Oxytocin was required in 5.3% of Group A; 3.2% Group C and 6.2% of Group B patients [Table 2].

There were no significant differences in blood loss among the groups (Group A: 261.8 ± 33.7 mL, Group B: 198.4 ± 10.2 mL, and in Group C: 304.8 ± 43.6 mL). Hypotonic bleeding (600 mL) was seen in one (3%) patient of Group A [Table 2].

No significant difference was observed among the groups at phase 0 (before the onset of labor) in mean values of the pain syndrome severity according to VAS, hemodynamic parameters (MAP, HR), and RR of labor [Table 3]. The severity of pain with VAS at the time of epidural insertion was significantly higher in groups A and C who had previous CD (7.9 ± 0.2 cm) as compared to Group B (6.4 ± 0.2 cm) [Table 4].

The mean values of duration of the first stage of labor in all groups did not have significant differences. The duration of second stage of labor was significantly prolonged in parturients with previous CD (Groups A 22.6 ± 1.2min; Group C 25.0 ± 1.9min) as compared to the non CD Group (Group B 18.4 ± 1.1min) ($P < 0.0001$). Similarly, the third stage of labor was also prolonged significantly in Group A and Group C (10.1 ± 0.7, 10.2 ± 0.9) as compared to Group B (7.7 ± 0.6) ($P < 0.0001$). However, the total duration of labor was not significantly different among the three groups. ($P > 0.05$) [Table 5].

Vaginal delivery was conducted in 36/38 (95%) parturients of Group A, 32/32 (100%) of Group B, and 31/31 (100%) of Group C. Ninety-two childbirths were full term-birth (gestational age 37–41 weeks) while 9 childbirths were pre-term (before 37 weeks).

Two cases in Group A underwent CD, as the first case had an impending uterine rupture while the second case had acute fetal hypoxia, however, in both cases the labor outcomes for mother and neonate were favorable.

Figure 2 shows VAS and hemodynamic parameters at various phases (Phase 1, 2, 3, 4, 5) during contractions and intervals between contractions (period of relaxation).The mean values of MAP, HR, and RR at the 2–5 phases of the study in groups A and B have unidirectional changes and do not have significant differences both during contractions or relaxation. In Group C, the mean values of pain syndrome during contraction according to MAP, heart rate, and RR were significantly higher ($P < 0.001$) than in groups A and B [Figure 2]. The severity of motor blockade according to the Bromage scale at all phases of the study was equal to 0 in all the groups, and parturients were comfortable during movement.

No significant difference was observed in Apgar scores of neonates at 1 and 5 min among the groups. Apgar score was 7.8 ± 0.1, 7.8 ± 0.1, and 7.5 ± 0.2 in Group A, B, and C, respectively at 1 min. ($P = 0.7$). Scores at 5 min were 8.1 ± 0.1, 8.2 ± 0.1, and 8.2 ± 0.1 in Group A, B, and C, respectively ($P = 0.9$).

Discussion

Trial of labor in previous CD has been a contentious issue with reports of an overall success rate of having vaginal delivery being approximately 60%–80%.[11,15,16] Thus 20%–40% of TOLAC, which are unsuccessful, require close monitoring and may prove to be at a higher risk for adverse events.

The success rate of vaginal delivery (VD) after trial of labor is dependent on several factors, which includes cervical Bishop score at admission, spontaneous onset of labor, and epidural analgesia, which was found to be 2.027 times more successful as compared to nonepidural after TOLAC (epidural 85.55% vs nonepidural group 69.38%, $P < 0.001$).[17] Another study reported an incidence of 83.47%, which they attributed to a higher

Table 2: Comparison of demographic and obstetric characteristics between the groups

	Group A	Group B	Group C	*P*
Age	32.4 ±4.4	33.6± 4.5	33.9± 4.0	>0.05
Uterine inertia	21% (*n*=8)	31% (*n*=10)	29% (*n*=9)	
Dysfunctional labour	5% (*n*=2)	6% (*n*=2)	0% (*n*=0)	
Preterm rupture of membrane	18% (*n*=7)	19% (*n*=6)	16% (*n*=5)	
Number of patients (%) requiring oxytocin	5.3% (*n*=2)	6.2% (*n*=2)	3.2% (*n*=1)	
Blood loss (ml)	261.8±33.7	198.4±10.2	304.8±43.6	0.2 f ratio 1.3
Total consumption of Ropivacaine (mg) in Epidural Groups	29.6±1.2	28.1±1.6	Nil	<0.0001

incidence of multiparity in their study groups. They also reported a significant association between previous vaginal delivery and those who did not have a previous vaginal delivery (76.8% vs 41%; x2 = 20.143; *P* = 0.000).[18]

Epidural analgesia for TOLAC has been found to increase the chances of normal vaginal delivery.[19] EA has not been found to mask the signs and symptoms of uterine rupture and the success rates of VBAC are also similar to "epidural nonusers" or in women who receive other types of anesthesia.[11,16,20] In contrast, Sun J *et al*.[17] found a higher rate of repeat CD in nonanalgesia group (49/160, 30.63% vs 38/263, 14.45%; *P* = 0.00153) due to fetal distress, stagnation of labor, fever or uterine infection, unbearable pain, and change in fetal station. The incidence of CD in "epidural users" was found to be 8.7% vs "nonusers" 11.8%, *P* < 0.0001 with a parallel increased rate of instrumental delivery. In other studies, no difference was found in the rates of emergency CD or instrumental vaginal delivery in the epidural group.[21,22] In our study, none of the cases required instrumental vaginal delivery. There were two cases of emergency CD due to fetal distress and another had an impending uterine rupture in Group A with 98% VBAC while in the other two groups all patients underwent normal vaginal delivery. Epidural analgesia was not found to impact the rates of CD in our study. It is found to be a safe and effective technique for TOLAC.

Table 3: Mean values of the pain syndrome severity according to VAS, MAP, heart rate, respiratory rate (Phase 0)

	VAS (cm)	MAP (mm Hg)	HR (per min)	RR (breaths per min)
Group A	0.8±0.83	85,2±1,3	74.16±0.7	14.5±1.50
Group B	0.4±0.54	84,1±1,5	74.66±2.6	14.6±1.51
Group C	0.6±0.89	83,5±2,1	74.16±2.2	13.6±1.63
P	0.7, f ratio 0.3	0.9, f ratio 0.08	0.8, f ratio 0.11	0.5, f ratio 0.7

*P**>0.05 - no significant difference observed

Table 4: Comparison of cervical dilation and pain severity on admission in maternity ward

Parameters	Group with previous scar Group A and C	Group without previous scar Group B	*P*
Cervical dilation (cm)	4.1±1.0	4.0±1.0	0.6
VAS (cm)	7.9±0.2	6.4±0.2	<0.0001

Success rates for VBAC were similar in all groups, which was consistent with studies from other authors.[17,23]

Significant prolongation of the duration of labor can also lead to an increase in the incidence of uterine rupture especially in TOLAC, and can lead to a decrease in uteroplacental perfusion due to uterine contractions resulting in adverse events in the neonate (asphyxia, neurological injury, and intrauterine death). Apart from uterine contractions, the reasons attributed to the prolongation of second stage of labor with epidural analgesia includes, weakening of pelvic floor muscles and increased abnormal fetal position during delivery.[20] Thus, long duration of labor should be avoided in TOLAC and ideally shortened by assisted vaginal delivery to reduce the chances of fetal distress.[17,24]

Sun J *et al*,[17] in their prospective multicentric study found a significant prolongation of first and second stages of labor following EA in the TOLAC study group as compared to the control group (I: 334.14 ± 225.94 vs 526.93 ± 266.85, *P* < 0.001; II: 28.09 ± 31.62 vs 46.14 ± 32.64; *P* < 0.001). However, there was no difference in maternal or neonatal outcomes.

Similarly, in our study, the duration of second and third stage of labor was significantly prolonged in parturients who received epidural analgesia [Table 4] though the total duration of labor was similar in all the three groups. Dystocia was observed in groups receiving epidural analgesia (Group A, 5%; Group B, 6%) while there were no cases of dysfunctional labor in Group C.

In contrast, Miller *et al*.,[19] observed that women in TOLAC only group had a significantly longer duration of labor as compared to women with previous vaginal delivery. In TOLAC only group more women who had epidural analgesia tend to deliver vaginally as compared to those who did not receive EA (*P* = 0.09). For women who delivered vaginally, second-stage duration (95th percentile) was prolonged in epidural nonusers in TOLAC only group (3.40 h vs 1.4 h) and in previous VD and TOLAC group the difference between users and nonusers was 2.3 h vs 0.9 h. However, recently, Xiao Feng Shen *et al*., 2017[25] has found no difference in the duration of the second stage of labor (epidural 52 ± 27 min compared with saline 51 ± 25 min; *P* = 0.52). The spontaneous vaginal delivery rate was also similar [epidural 193 (96.5%) compared with saline 198 (99%), *P* = 0.17]. Pain scores

Table 5: Duration of various stages of labour

	I stage labor (min)	II stage labor (min)	III stage labor (min)	Total duration of labor (min)
Group A	368.6±14.7	22.6±1.2	10.1±0.7	401.4±15.1
Group B	340.6±21.1	18.4±1.1	7.7±0.6	369.2±21.2
Group C	337.6±23.7	25.0±1.9	10.2±0.9	370.3±24.4
P	>0.05	<0.0001	<0.0001	0.09 f ratio 2.8

Note: Highly significant difference (*P*<0.0001) was found in second and third stage of labour when Group A and C (women with previous CD) were compared with Group B (Women with previous vaginal delivery). Though total duration of labour was same in all three groups (*P*>0.05)

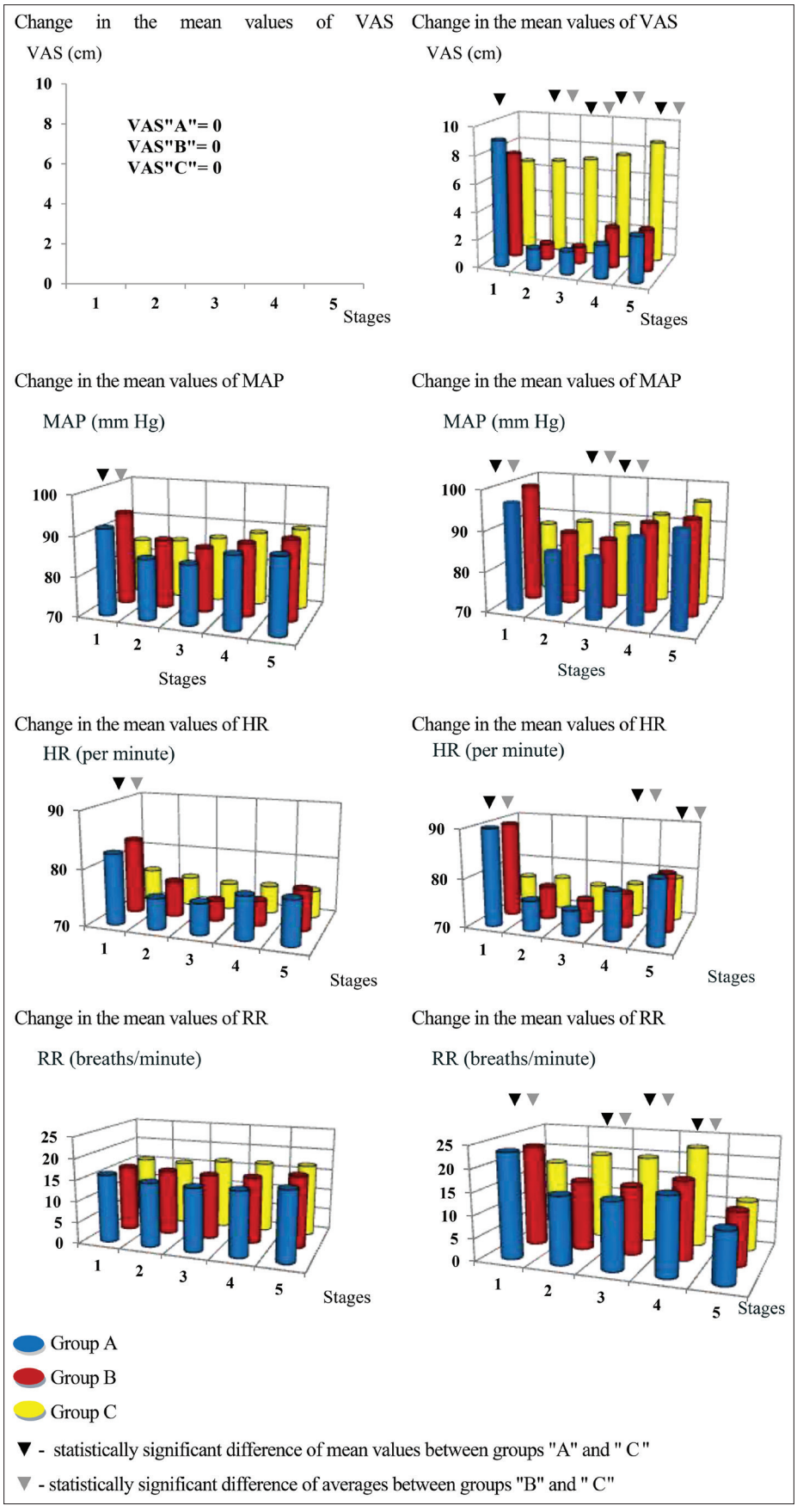

Figure 2: Comparison of VAS, MAP, HR, and RR at various stages of labour during contraction and relaxation periods

were similar among groups at each measurement during the second stage. These could be attributed to different patient groups, their ethnicity, the use of oxytocics, and technique of epidural analgesia.

Smith GS *et al*.,[26] in their study have predicted that parturients whose cervix is >4 cm and the cervical canal opens more than 25% in TOLAC had a higher chance of VD. Sun J *et al*.[17] have also found a positive correlation between cervical Bishop score and successful vaginal delivery. Similarly, in our study, the mean values of cervical dilatation on admission to the maternity ward were 4.1 ± 1.0 cm (Group A and C) in parturients with a previous history of CD while in Group B cervical dilatation was 4.0 ± 1.0 cm [Table 4].

Most of the large studies in the literature[7,17,19,21] on VBAC trial have shown a higher incidence of maternal and perinatal morbidity associated with TOL and failed trial. Uterine rupture and subsequent hemorrhage are one of the commonest observed causes of maternal morbidity and mortality and failure of TOL. The diagnosis of uterine rupture is a clinical one that depends on observant attendants who maintain a high index of suspicion. Nonreassuring fetal heart rate tracings, significant variable decelerations, and bradycardia are characteristic findings, and bradycardia is the pattern most diagnostic of uterine rupture. Other less frequent findings include abdominal pain, most commonly in the area of the prior cesarean incision, the recession of the presenting vertex, and vaginal bleeding. With concealed intraperitoneal bleeding, the patient may exhibit shoulder pain, anxiety, restlessness, dizziness, and shock. The reported prevalence of rupture ranges from 0.5% to 1.0% and can be found even in patients where all the conditions are favorable for VBAC.[18,24] However, our study did not reveal any significant increase in maternal morbidity associated with TOL other than a single case of impending uterine rupture (1/69; 1.44%) with a positive maternal and neonatal outcome. Balachandran *et al*.[18] reported a 0.86% incidence of scar dehiscence in the trial group, which is consistent with our results and is the same as that reported worldwide. The incidence being slightly higher than previous reported cases, but the maternal and neonatal outcomes were positive.[18,24]

Women with previous CD and a uterine scar experienced stronger pain (VAS 7.9 ± 0.2 cm, $P < 0.05$) as compared to those who had undergone a normal vaginal delivery (VAS 6.4 ± 0.2 cm). In our opinion, this difference can be explained by the fact that women with previous CD had undergone a planned CD and thus were never exposed to labor pain, thus the fear of severe pain in childbirth could be a contributing factor.[17] As expected, women in the nonepidural group experienced more pain with mean values of pain syndrome 2–4 times higher than the epidural group. The mean values of MAP, HR, and RR in phases 2–5 among groups had unidirectional changes and did not show significant differences ($P > 0.05$) both during contractions and pushing.

A decrease in uteroplacental perfusion due to uterine contraction following significant prolongation of the duration of labor, especially in TOLAC can lead to adverse events in neonates. In our study, Apgar score at 1 and 5 min did not show any adverse events in all the three groups.

Limitations of our study

There were several limitations in our study. First, the sample size was not calculated to make our study adequately powered to accept or reject our null hypothesis accurately. Second, a correlation was not made between patients' age and body mass index (weight and height) with the success of trial of labor. Thirdly, the analysis of neonatal umbilical cord pH would have given a better estimation of neonatal status.

Conclusions

Epidural analgesia was not found to impact successful vaginal delivery following TOLAC (Trial of labor in previous cesarean delivery). Epidural analgesia does not mask the signs of impending uterine rupture. There was an increase in the duration of labor during the second and third stages of labor, but the total duration of labor was within the acceptable range with positive maternal and neonatal outcomes. Thus, giving a trial of labor, especially in the previous CD with EA can be safe for both mother and neonate.

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Nil

Conflicts of interest

There are no conflicts of interest.

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