Original Article

Maternal and foetal outcome after epidural labour analgesia in high-risk pregnancies

Address for correspondence:
Dr. Sukhen Samanta,
17, Dr. AN Paul Lane,
Bally, Howrah - 711 201,
West Bengal, India.
E-mail: dr.sukhensamanta@gmail.com

Sukhen Samanta, Kajal Jain[1], Neerja Bhardwaj[1], Vanita Jain[2], Sujay Samanta, Rini Saha[3]

Department of Critical Care Medicine, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, Departments of [1]Anaesthesia and Intensive Care and [2]Obstetric and Gynaecology, Post Graduate Institute of Medical Education and Research, Chandigarh, [3]Department of Ophthalmology, ASG Eye Hospital, Jodhpur, Rajasthan, India

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ABSTRACT

Background and Aims: Low concentration local anaesthetic improves uteroplacental blood flow in antenatal period and during labour in preeclampsia. We compared neonatal outcome after epidural ropivacaine plus fentanyl with intramuscular tramadol analgesia during labour in high-risk parturients with intrauterine growth restriction of mixed aetiology. **Methods:** Forty-eight parturients with sonographic evidence of foetal weight <1.5 kg were enrolled in this non-randomized, double-blinded prospective study. The epidural (E) group received 0.15% ropivacaine 10 ml with 30 μg fentanyl incremental bolus followed by 7–15 ml 0.1% ropivacaine with 2 μg/ml fentanyl in continuous infusion titrated until visual analogue scale was three. Tramadol (T) group received intramuscular tramadol 1 mg/kg as bolus as well as maintenance 4–6 hourly. Neonatal outcomes were measured with cord blood base deficit, pH, ionised calcium, sugar and Apgar score after delivery. Maternal satisfaction was also assessed by four point subjective score. **Results:** Baseline maternal demographics and neonatal birth weight were comparable. Neonatal cord blood pH, base deficit, sugar, and ionised calcium levels were significantly improved in the epidural group in comparison to the tramadol group. Maternal satisfaction ($P = 0.0001$) regarding labour analgesia in epidural group was expressed as excellent by 48%, good by 52% whereas it was fair in 75% and poor in 25% in the tramadol group. Better haemodynamic and pain scores were reported in the epidural group. **Conclusion:** Epidural labour analgesia with low concentration local anaesthetic is associated with less neonatal cord blood acidaemia, better sugar and ionised calcium levels. The analgesic efficacy and maternal satisfaction are also better with epidural labour analgesia.

Key words: Epidural, foetal acidaemia, growth retardation, high-risk, intrauterine, labour analgesia, maternal satisfaction, pregnancy, ropivacaine, tramadol

INTRODUCTION

Pregnancy is considered high-risk when there are potential complications that could affect the mother, the baby or both. It carries greater stress to the mother as well as her foetus than an uncomplicated pregnancy. Optimum uteroplacental circulation is necessary for normal intrauterine development of foetus.[1] Chronically compromised uterine perfusion can lead to placental insufficiency and subsequent intrauterine growth retardation (IUGR) from the high-risk pregnancies. These IUGR foetuses have a decreased physiological reserve and hence are at a higher risk of peripartum complications.[1] In addition, IUGR is also associated with prematurity, low Apgar scores and foetal distress.[2] Hence, antenatal surveillance for foetal biophysical profile and intensive intrapartum monitoring for better neonatal outcome is recommended in these pregnancies.[3] It has been

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shown in various studies that by sympathectomy, epidural analgesia reduces uterine and umbilical arterial vascular resistance and therefore improves uteroplacental blood flow. The improved perfusion leads to better foetal oxygenation and acid base balance.[4] Antenatal administration of epidural local anaesthetics is reported to have improved placental blood flow and resulted in increased duration of gestation and birth weight of the babies of severely preeclamptic mothers.[1]

Ropivacaine is a long acting amide local anaesthetic. In equipotent doses, it has analgesic potency similar to bupivacaine, but incidence of motor blockade, cardiovascular and central nervous system toxicity is less.[5] Ropivacaine infusion is associated with lower rate of instrumental delivery and also with better neonatal outcomes as compared to bupivacaine.[6] Intramuscular opioids are commonly used as an alternative to epidural local anaesthetics for labour analgesia.[7]

We compared two different techniques of labour analgesia-epidural ropivacaine with intramuscular tramadol in high-risk parturients with IUGR by measuring neonatal outcome using Apgar scores; cord blood gases, sugar, ionised calcium; any need for resuscitation or any adverse effects. We also compared maternal satisfaction, the duration of onset of analgesia, haemodynamic, sensory and motor block, duration of first stage of labour, modes of deliveries and maternal complications.

METHODS

This prospective study was conducted in the Department of Obstetrics and Gynaecology. A total of 48 parturients admitted to the labour room who met the inclusion criteria were enrolled in this study. Term high-risk pregnant women with IUGR, documented sonographic foetal weight ≤1500 g having singletone foetus with cephalic presentation and in active phase of labour were enrolled in our study. Patients who refused or had any contraindication to regional technique, congenital malformation of foetus, antepartum haemorrhage, coagulopathy/ thrombocytopaenia (platelets count <75,000/μl), intrauterine infection and any allergy to ropivacaine or tramadol were excluded from the study. A written informed consent was taken from all participating women before the onset of labour.

Information on maternal history of present pregnancy, relevant past history and routine investigations were received. Onset of labour was defined as the presence of regular painful uterine contractions, i.e. three regular painful contractions over 10 min together with at least one mucoid or blood show, cervical dilatation of ≥3 cm or spontaneous rupture of membrane. In the labour room, intravenous access was secured with 20/18-gauge cannula and 500 ml of lactated Ringer's solution was administered to all women 20 min before the start of analgesia.

On admission to the labour room and before the first request for pain relief, all women were divided into two groups non-randomly; group tramadol (T) or group epidural (E) for analgesia. In epidural group, all the procedures were conducted inside the operation theatre under monitoring with strict aseptic precautions. With the patient in flexed left lateral position and local skin infiltration with 2% lignocaine 2–3 ml, 18-gauge epidural Tuohy needle was inserted at $L_{2\text{-}3/3\text{-}4}$ interspace. Epidural space was identified using loss of resistance to saline technique. A multiorifice catheter was then inserted 3–4 cm inside the epidural space and secured at skin with a sterile dressing. No test dose was given. Epidural ropivacaine 0.15%, 10 ml plus 30 μg fentanyl bolus dose was given in incremental fashion (3 ml-4 ml-3 ml) after negative aspiration for blood or cerebrospinal fluid each time. This was followed by a continuous infusion of 0.1% ropivacaine plus 2 μg/ml fentanyl at 5–15 ml/h with a syringe pump. Analgesia was measured using visual analogue scale (VAS) at every 10 min interval for 1st hour, then hourly and if the VAS was >3, a rescue bolus of 5 ml of the same drug was administered through the syringe pump. Total dose of epidural infusion/boluses utilized was noted. Sensory block testing was conducted caudal to T_{10} dermatome with wooden tooth prick (sharp end) at the start of analgesia and repeated hourly. Motor block was assessed by modified Bromage scale hourly. All the epidurals were administered and monitored by the same anaesthesiologist. Patients in tramadol group received intramuscular tramadol hydrochloride 1 mg/kg (with maximum dose 400 mg/24 h) every 4–6 h. If additional doses were required, half of the initial dose was given. If patients complained of nausea or vomiting, antiemetic ondansetron 4 mg intravenous injection was administered.

Maternal monitoring was done using continuous electrocardiography, non-invasive blood pressure (BP) and pulse oximetry via multichannel monitor (CSI Criticare, Waukesha, Wisconsin, USA). BP was

recorded every 10 min initially for 1 h after test drug administration and thereafter at hourly interval. Maternal satisfaction was assessed within 24 h of delivery by an obstetrician (not participating in this study) on a four point descriptive score of excellent, good, fair or poor. Duration of the first stage, mode of delivery and the indication for caesarean section (if done) was also recorded. Maternal hypotension was defined as systolic BP <90 mmHg or reduction in arterial BP >30 mmHg from base line. For treatment of hypotension, boluses of phenylephrine 50 μg were used. Oxytocin was given as per American College of Obstetrics and Gynaecology (ACOG recommendations 1987). The foetuses were monitored using continuous cardiotocography (CTG) (Huntleigh Health Care monitor, United Kingdom). CTG was recorded every half hourly after contraction. In case of any foetal heart trace abnormality, adequate measures were taken for normalising foetal heart rate. Neonatal outcome was assessed by the attending paediatrician (blinded) with umbilical cord blood gases (arterial blood gas/venous blood gas): pH, base deficit, sugar, ionic calcium, Apgar score at 1 min and 5 min (perinatal asphyxia defined as an Apgar score of <7 at 5 min and evidence of encephalopathy within the first 6 h of life), any requirement for resuscitation such as oxygen supplementation, face-mask application, intubation, naloxone usage, admission to neonatal intensive care was also noted. All the women were monitored for 24 h postpartum period for complications such as hypotension, motor weakness, urinary retention, nausea or vomiting, allergy and fever.

Sample size was calculated based on assumed difference of base deficit of cord blood of two groups with 80% power. For each group, 16 parturients were required in our study. Statistical evaluation was done using SPSS 18.0 software (SPSS Inc.Chicago. USA). Normally distributed data were expressed as mean ± SD and the two groups were compared for their means using the Student's *t*-test. Skewed data were expressed as median and interquartile range and the distribution between two groups was compared using the Mann–Whitney U-test. Haemodynamic data were compared by repeated measure ANOVA. Repeated ordinal data (VAS, modified Bromage score) was also analysed using two-way repeated measure ANOVA. Nominal data between the two groups were compared using Chi-square test or Fisher's exact test, whichever was applicable. A $P < 0.05$ was considered significant.

RESULTS

This prospective study was conducted in collaboration with the Departments of Obstetrics and Gynaecology in our institute (July 2010–June 2012). All pregnancies were hospital supervised and under strict antenatal surveillance with daily monitoring of biophysical profile as they were high-risk pregnancies. Co-morbidities associated with the enrolled parturients were rheumatic heart disease, hypothyroidism and anaemia with pregnancy-induced hypertension noted as the most common subclass [Table 1]. Demographic parameters of the parturients in both groups were comparable [Table 2].

The study included women of mixed parity, but majority were primigravidae. The mean gestational age of women was comparable in both the groups [Table 2]. Twenty-one women in Group E and 19 in Group T were induced with prostaglandin followed by oxytocin infusion for augmentation of labour in titrated doses according to institutional protocol. The time to onset of satisfactory analgesia was defined as time taken from the administration of analgesia to achieve adequate pain relief, i.e. VAS <3. In Group E, slightly faster onset of adequate analgesia was observed as compared to Group T (17.1 ± 2.3 min vs. 18.1 ± 2.1 min, respectively), not statistically significant ($P = 0.27$). Parturients in Group E experienced better pain control with lower VAS [Figure 1]. Mean cord blood pH was significantly better in Group E with less base deficit [Table 3].

Table 1: Co-morbidities in parturients of both groups

Aetiology	Group T (*n*=24)	Group E (*n*=24)	Total
Pregnancy-induced hypertension	12 (50)	11 (45.8)	23 (47.9)
Idiopathic	2 (8.3)	3 (12.5)	5 (10.4)
Rheumatic heart disease	6 (25)	4 (16.6)	10 (20.8)
Hypothyroidism	1 (4.2)	4 (16.6)	5 (10.4)
Anaemia	3 (12.5)	2 (8.3)	5 (10.4)

Value in number (percentage)

Table 2: Maternal demographic characteristics

Parameters	Group T (*n*=24)	Group E (*n*=24)	*P*
Age (years)	25.7±3.3	26.5±3.6	
Weight (kg)	54.7±12.5	58.9±10.8	
Height (cm)	156.3±3.7	157.3±6.4	
Number of primigravidae (%)	10 (67.7)	14 (93.3)	0.160
Gestational age (weeks)	36.8±0.9 (36-39)	36.9±1.2 (36-40)	0.870
Type of labour (%)			
Spontaneous	2 (13.3)	1 (6.7)	0.543
Induced	13 (87.7)	14 (93.3)	

Data expressed as mean±SD (range) and number (%). SD – Standard deviation

Neonatal acidosis was seen in three neonates in Group T with a cord pH 7.09, 7.16, and 7.14 and base deficit of −9.4, −8.4, and −8.5 mmol/L. All those mothers suffered from severe pre-eclampsia. Baseline cord blood sugar and ionic calcium were on lower side of normal level, but it was better before starting breast feeding in Group E [Table 3]. Mean birth weight of the neonates in the both groups was comparable. Mean 1-min Apgar score was significantly low in Group T [Table 3], but was comparable at 5-min. Low 1-min Apgar score, i.e., <5 were seen in 5 neonates (n = 4 in Group T and n = 1 in Group E). Of these, one baby in Group E and one in Group T received oxygen supplementation using oxygen hood (head box). The other neonate of Group T with low 1-min Apgar score required short-term intubation and positive pressure ventilation. The mean duration of the 1st stage of labour in the two groups was comparable (P = 0.19). Forty-six percentage of women in Group T compared to 33% in Group E underwent emergency caesarean delivery due to non-reassuring foetal heart trace pattern. The mode of delivery including vaginal and caesarean were comparable between the two groups (P = 0.55, P = 0.27). There were no instrumental deliveries. Maternal haemodynamic during labour analgesia was more stable in Group E. Heart rate fluctuation was also less [Figure 2]. Baseline systolic and diastolic BPs were comparable between the parturients of both groups. Lower but within normal range of BP reading was recorded in Group E. There was no incidence of hypotension observed in any patient during the study period. None of the women required rescue vasopressor, i.e. phenylephrine. No incidence of significant motor block (assessed by modified Bromage score <3), respiratory depression (respiration rate <8/min), pruritus or fever was observed in any of the study patients. Nausea and vomiting was observed in five women for single episode in Group T and one in Group E although this difference was not statistically significant (P = 0.19). Higher satisfaction rates were reported with the use of epidural analgesia (P = 0.0001) [Figure 3].

DISCUSSION

In our study, we found favourable neonatal cord blood gas and other parameters in continuous epidural labour analgesia in high-risk pregnancies with IUGR of mixed aetiologies. There may be possibilities of transient hypoperfusion of placental units during uterine contraction but this does not cause any deleterious effects on foetuses. Fratelli *et al*. reported a transient decrease in placental blood flow during uterine contraction in epidural labour analgesia in normal

Table 3: Neonatal parameters

Parameter	Group T	Group E	*P*
Birth weight (kg)	1.3±0.1	1.3±0.2	0.65
Apgar score at 1 min	6±2.2	7.3±0.8	0.009
Apgar score at 5 min	8.5±0.7	8.7±0.4	0.15
Cord pH	7.24±0.07	7.32±0.03	0.001
Base deficit (mmol/L)	−4.9±2.2	−3.1±1.2	0.002
Blood sugar (mg/dl)	57.7±5.4	65.9±3.9	0.001
Ionised calcium (mmol/L)	0.56±0.15	0.73±0.18	0.002

Data expressed as mean±SD. SD – Standard deviation

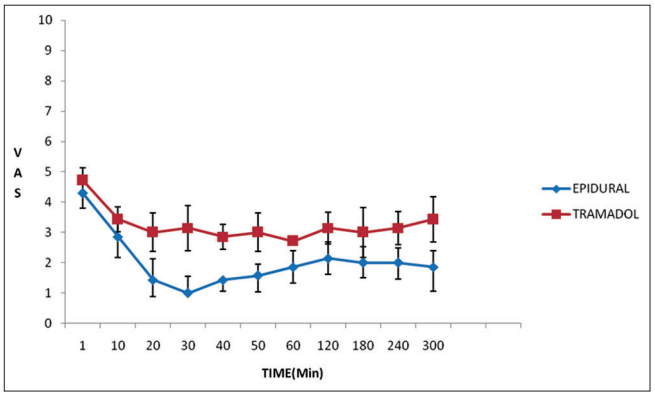

Figure 1: Mean visual analogue scale for pain in parturients between the two groups

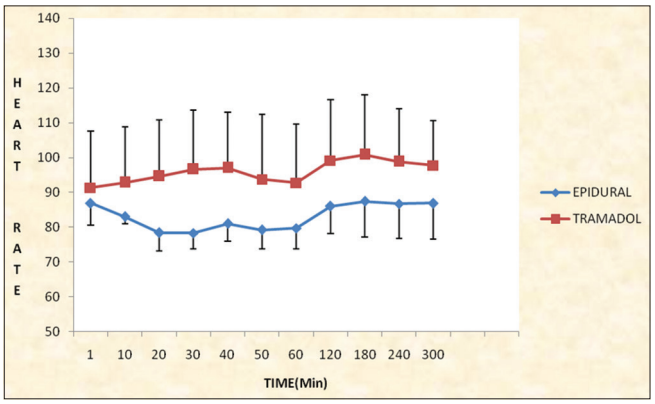

Figure 2: Mean heart rate (beats per min) in parturients of both the groups

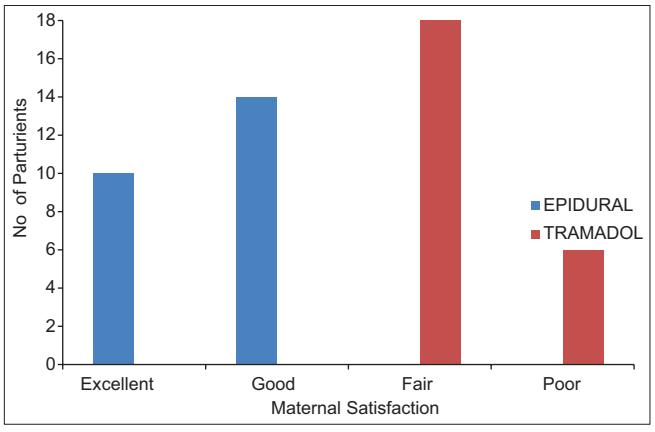

Figure 3: Maternal satisfaction regarding labour analgesia in both groups

term pregnancies. This decrease was not associated with neonatal acidosis or low Apgar at birth.[8]

Various studies have shown that tramadol provides adequate analgesia when compared to epidural analgesia. Comparable analgesia between epidural tramadol and pethidine have been reported.[7] In a Cochrane data base, Elbourne *et al*. assessed the effects of different opioids administered intramuscularly in labour. Sixteen trials were included. There was no evidence of difference between pethidine or tramadol in terms of pain relief, interval to delivery or instrumental or operative delivery.[9] So, we considered tramadol for one group for our study. Long and Yue concluded that although tramadol is useful alternative when patients do not opt for neuraxial anaesthesia, it may not provide satisfactory analgesia.[10] In the present study, VAS scores were lower in epidural group. Maternal satisfaction was also rated higher as most of them desired epidural analgesia in future. This is similar to other reported studies where better pain relief and higher maternal satisfaction has been reported with epidural analgesia.[7,11,12] Studies show that antepartum epidural local anaesthetics induce uterine vasodilatation directly as well as redistribute blood away from competing vessel in favour of uteroplacental blood flow.[13] Unlike systemic vasodilators, epidural anaesthesia induces segmental dilatation. Probably, from the value of neonatal data, it appears that the effect of tramadol analgesia is not favourable for improving placental circulation.

There are a few reports in literature where authors reported foetal acidosis with the use of regional anaesthesia for caesarean delivery. In a population based cohort study of very preterm babies (27–32 weeks), investigators found a significantly higher risk of mortality in neonates of mothers who received spinal anaesthesia (SA) for caesarean delivery as compared to general anaesthesia probably due to inadequate maternal haemodynamic control and undetected placental hypoperfusion.[14] Foetal acidosis with SA in severely pre-eclamptic parturients undergoing emergency caesarean delivery has been reported; a significantly greater mean arterial base deficit indicating anaerobic metabolism due to metabolic acidosis in the foetus was observed in the study.[15] Since data are limited in this sub-group of maternal population receiving labour analgesia, we need further studies with larger sample size to know the neonatal effects of labour analgesia in pregnancies with IUGR. Unlike the above mentioned studies, we tried to maintain good haemodynamic during labour analgesia.

In our study, Apgar scores were comparable in both the groups at 5 min. Studies have shown that significant elevation in blood flow resistance indicates loss of effective foetal–maternal exchange area in the placenta.[16] Raised Doppler indices may reflect serious deterioration in foetal growth associated low Apgar and cord gas values.[17]

Though baseline neonatal cord blood sugar and ionic calcium level in both groups were on lower side, they were significantly better before starting breast feeding in epidural group. Probably, this resulted due to reduction of stress and catecholamine by epidural local anaesthetics. In our study, none of the women developed significant hypotension, motor blockade, urinary retention or pruritus. Similar stable maternal haemodynamic following continuous infusion of epidural local anaesthetics was reported in Chen's study.[18]

CONCLUSION

Well-controlled and effective epidural blockade may provide improved neonatal cord blood gas parameters probably resulting from better uteroplacental perfusion along with adequate intrapartum pain relief in parturients with IUGR. Additional bonus is good maternal satisfaction.

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Conflicts of interest
There are no conflicts of interest.

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