

The value of programmed intermittent epidural bolus in labor analgesia

Abstract

Objective: To identify whether programmed intermittent epidural bolus analgesia is effective and safe to the parturients and neonates.

Methods: Sixty healthy ASA class I or II, term (≥ 37 weeks' gestation), nulliparous women were recruited in our study. Epidural analgesia was initiated with a solution of 0.15% ropivacaine 10 mL and maintained with 0.12% ropivacaine combined with fentanyl 2 μ g/mL by continuous epidural infusion at a rate of 5 mL/h and combined with a patient-controlled epidural analgesia bolus of 5 mL and intermittent bolus of 5 mL and combined with a patient-controlled epidural analgesia bolus of 5 mL, lockout interval was 20 minutes. After 20 minutes of the first dosage the VAS score was obtained in every 60 minutes. The maternal and fetal outcome, total consumption of analgesic solution and were oxytocin compared among the groups.

Result: There was no difference of the maternal and fetal outcomes among the groups. The dosage consumption of oxytocin in non-labor analgesia group was significant lower than analgesia groups, the first and second stage of labor in non-labor analgesia group was significant longer than two analgesia groups. There was a significant difference in the epidural ropivacaine total consumption between the two analgesia groups. (51.27 \pm 9.61 mg vs 70.44 \pm 12.78 mg, $P=0.00$)

Conclusion: The use of programmed intermittent bolus combined with PECA was more effective than continuous infusion combined with PECA, it could be useful as the mode of maintenance for epidural labor analgesia.

Keywords: Anaesthetic techniques; Epidural; Analgesia; Obstetric; Regional anaesthesia

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Introduction

Labor pain is a special pain for parturients, in the past people regarded it as normal and unavoidable. As the development of anesthesia from 1846, and people's demand for quality of life being improved, a feasible labor analgesia mode had been searched for one and a half centuries. And in 1995 WHO made up a determination that to the year 2015 everyone can enjoy reproductive health as a global target, pregnancy and delivery is an important part of reproductive health,¹ so that in many countries and many modes for labor analgesia are using in clinical. Labor analgesia means to reduce parturients' pain during the delivery by different methods, including drugs,² local anesthesia and epidural analgesia.³ etc. It can decrease adverse impacts on maternal and fetal which resulting from labor pain.⁴ Recent year's neuraxial labor analgesia is a hot issue for labor analgesia, and randomized controlled trials suggested that neuraxial labor analgesia is the most feasible and acceptable labor analgesia method.³ Though it does not increase the risk of cesarean delivery, its impact on operative vaginal delivery and other parturient safety outcomes are still controversial.⁵ Our study was to evaluate the impact of the introduction of programmed intermittent epidural bolus or continuous epidural infusion combined with patient controlled epidural analgesia (PCEA) in labor analgesia on parturients and neonates.

Methods

General informations

Our study had been approved by the Ethical Committee of Human Research of the first Affiliated Hospital of Guangxi Medical University. Sixty healthy ASA physical status I or II, term (≥ 37 weeks'

gestation), nulliparous women in early spontaneous labour pain with at least one uterine contraction in 5 minutes who had requested neuraxial block were recruited in our study. All the participants were gave written informed consent to participate. Exclusion criteria included the presence of systemic disease (e.g., Diabetes Mellitus, hypertension, pre eclampsia) and chronic analgesic use, multiple pregnancies or preterm. At the time of request for labor analgesia the cervix was examined by the midwife. If cervical dilation was between 2 to 4cm, after ruled out the exclusion criteria the parturients were enrolled in our study, and were randomized (randomly allocated using a sealed envelope technique) to receive maintenance of analgesia by either intermittent epidural bolus or continuous epidural infusion combined with PCEA. The subjects and other attendants were blinded to group assignment. When the cervical dilation completed, all of the parturients stop using epidural analgesia.

Anesthesia

Epidural puncture was initiated in the left lateral decubitus position at the L3-4 interspace. Using loss-of-resistance technique to identify the epidural space. Epidural catheter was placed 3 to 3.5cm into the epidural space in cephalic direction. After the placement of the epidural catheter, an IV infusion of 500mL Ringer lactate solution was started, meanwhile the visual analog scale (VAS) score for baseline pain of uterine contraction was determined. Baseline maternal heart rate, noninvasive arterial blood pressure, and fetal heart rate tracing were recorded.

All parturients received a test dose of 1% lidocaine 4mL; five minutes later added the initial loading dose consisting of 0.15% ropivacaine 10mL. Parturient whose VAS score was not at least 1

lower than her baseline within 30 minutes after the epidural injection or who requested a PCEA bolus within 30 minutes was deemed to have a failed block and was excluded from the study and subsequent statistical analysis. After the first dosage was given and the exact effect of epidural analgesia was ensured, a sequentially numbered, opaque envelope containing the group assignment was opened by an unblinded researcher who set up the 2 epidural pumps according to group allocation. The subjects and other study personnel were blinded to the group assignment and all the observations and assessments were performed by a researcher blinded to the mode of drug administration. The infusion pumps were put into an opaque, portable bag. The maintenance epidural solution for 2 groups was consisted of 0.12% ropivacaine combined with fentanyl 2 µg/mL; two pumps were prepared for each subject with the same epidural solution. One pump was programmed to administer with continuous epidural infusion at a rate of 5 mL/h and combined with a PCEA bolus of 5 mL whenever the parturient felt uncomfortable because of uterine contraction, lockout interval was 20 minutes. The second pump was programmed a hourly intermittent bolus of 5 mL and combined with a PCEA bolus of 5 mL, lockout interval was 20 minutes, basal infusion rate 0 mL/h, maximum total dose of all pumps was 15 mL/h. All the parturients were instructed to push the PCEA demand button whenever she felt uncomfortable. After 20 minutes of the first dosage the VAS score was obtained in every 60 minutes. Meanwhile the other thirty parturients (randomize collected) undergone non-labor analgesia vaginal delivery in the same period were observed with the same items in the two analgesia groups.

Observation items

The records of the epidural infusions including delivered PCEA boluses, and total epidural infused volumes from the infusion pumps. Observed items of all three groups including the active intervals of labor, the delivery time, ways of delivery (vaginal delivery and vaginal midwifery, cesarean delivery), postpartum blood loss volume and the fetal heart rate during the delivery and Apgar score for 1 min, 5 min and 10 min after born. VAS score was obtained in the beginning (baseline) and every 60 minutes in the later time.

Table 1 Subjects characteristics

	Intermittent group	Continuous group	Non-labor analgesia group	P Value
Age (y)	27.45±4.61	28.16±4.79	28.46±4.59	0.69
Gestational Age (wk)	39.12±0.81	38.84±0.76	38.91±0.72	0.34
Body Mass Index (kg/m ²)	28.35±1.42	28.54±1.51	28.74±1.58	0.61
Cervical dilation at initiation of analgesia (cm)	2.93±0.21	3.02±0.30	3.07±0.34	0.17
Baseline VAS Scores	7.21±0.52	6.94±0.55	7.20±0.49	0.08

Values were presented as mean±standard error or number of patients. There were no significant differences between groups. VAS, visual analog scale.

Table 2 Maternal and fetal outcome

	Intermittent group	Continuous group	Non-labor Analgesia group	P Value
Dosage Consumption of Oxytocin (mg)	10.35±0.72	11.04±0.78	6.12±0.32	0.00*
Delivery Mode (cesarean/instruments/NSVD)	2/7/2020	1/6/2021	2/5/2023	-
First Stage of Labour (min)	482.35±20.29	502.51±19.09	587.37±31.29	0.00*
Second Stage of Labour (min)	98.31±9.71	95.53±8.19	118.36±12.35	0.00*
Apgar 1	8.62±0.29	8.57±0.16	8.59±0.13	0.64
Apgar 5	9.03±0.18	9.13±0.16	9.07±0.15	0.06
Apgar 10	9.56±0.10	9.60±0.11	9.54±0.09	0.07
Postpartum Blood Loss Volume (mL)	157.67±26.72	162.79±28.64	159.85±31.79	0.79

Values were presented as mean±standard error or number of patients. Asterisks indicated a statistically significant difference ($p < 0.05$) when the groups were compared.

Statistics

Data were processed using SPSS version 13.0 (SPSS Inc., Chicago, IL, USA). The values were expressed as mean ± standard error of mean for all data. Differences between groups were analyzed by Student's t-test. Results were considered significantly with $p < 0.05$.

Results

A total of 90 patients recruited in the study and randomized to either the intermittent group, continuous group or the non-labor analgesia group. Three subjects were excluded from the analysis because of unplanned epidural catheter drawing. There were no statistically significant differences between the three groups with regard to patient characteristics (Table 1). There were no significant differences in the maternal and fetal outcome among intermittent bolus group and continuous infusion group (Table 2). But the dosage consumption of oxytocin in non-labor analgesia group was significant lower than other two groups and duration time of the first and second stage of labor in non-labor analgesia group was significant longer than other two groups (Table 2).

There was a significant difference in the epidural ropivacaine total consumption between the two analgesia groups. (51.27±9.61 mg in the intermittent group vs 70.44±12.78 mg in continuous group, $P=0.00$) (Table 3) (Figure 1). But the consumption of epidural ropivacaine of two groups was within the dose range. The baseline VAS scores and time of pain relief and bilateral block to T10 obtained after the initial bolus were no significant difference, but in the later time, the VAS scores of intermittent group were lower than continuous group and non-labor analgesia group (Figure 2). The blood pressure, heart rates were indistinguishable between the two analgesia groups during this same period of time, but they were lower than the non-analgesia group. None of the parturients had a decline of SBP > 20% of the preblock value prior to time end. There was no significant difference in the fetal heart rate during the delivery (Figure 3).

Table 3 Characteristics of Labor Analgesia

	Intermittent group	Continuous group	P Value
Eosage Consumption of Ropivacaine (mg)	51.27±9.61	70.44±12.78	0.00*
Rescue Medication by PCEA	1.27±0.26	5.71±1.03	0.00*
Maximum Blocked Space	T10	T10	-

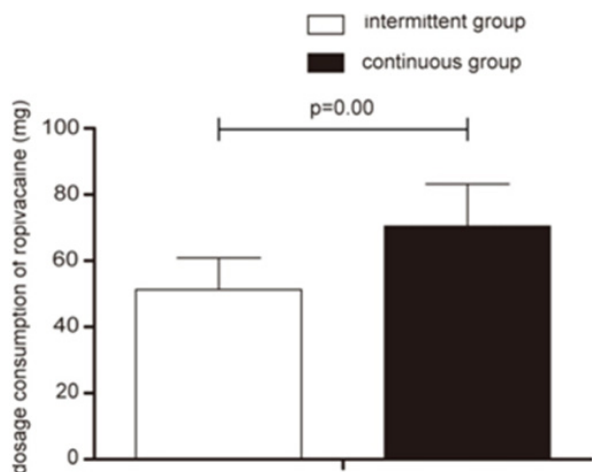


Figure 1 Dosage consumption of ropivacaine in two analgesia groups.

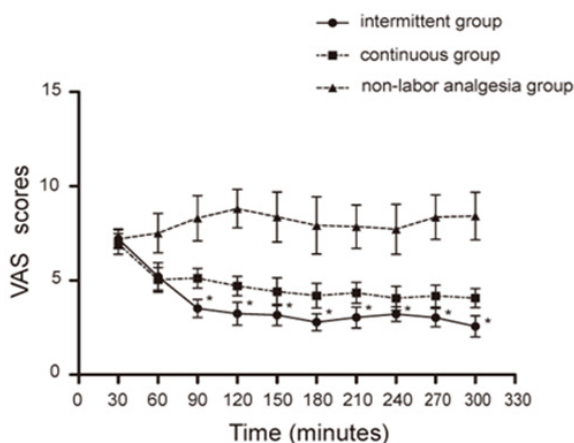


Figure 2 The VAS score for the groups. Asterisks indicated time points of a statistically significant difference ($p < 0.05$) when the groups were compared.

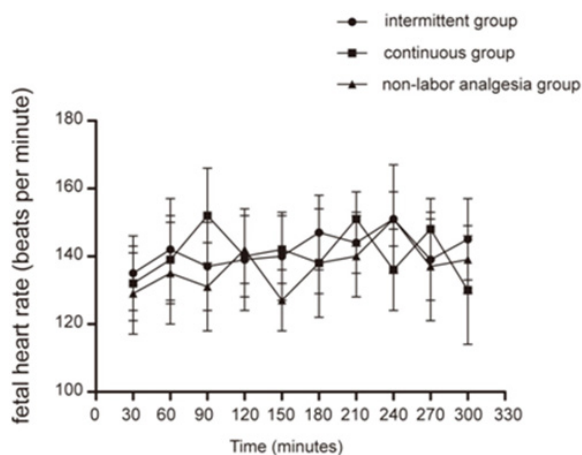


Figure 3 The fetal heart rate for the groups.

Discussion

Labor pain is normal physiology phenomenon; it's mainly caused by uterine contraction and cervical dilation. In the past, a healthy parturient who usually had the ability to withstand the pain threshold and had to endure such pain. But researches showed that long time continuous pain will cause a series of influences on maternal and infant, such as maternal adrenal hormone level increases in the body, which can cause the uterine artery contraction, placental blood flow decreases, then leads to fetal hypoxia.^{5,6} Labor analgesia can eliminate maternal tension by blocking the pain stimulus and descendants of the sympathetic efferent nerve.⁷ Pelvic floor muscles relaxation help cervical dilation and fetal head drop, all at the same time because of pain relief, lower the maternal physical consumption, more physical promotion for the process of delivery, and improve the vaginal births, reduce the complications incidence of the mother and neonate, which is benefit for mother and neonate.⁸⁻¹⁰ Labor analgesia had been used for many years, doctors and researchers had wondered which mode is better for clinical practice.¹¹

In our study pain relief was satisfied in both the two labor analgesia groups when compared with the non-analgesia group, while there was a significant difference in the epidural ropivacaine total consumption between the two analgesia groups. The programmed intermittent bolus (hourly bolus) group is less epidural drug use, the VAS scores were obviously lower in two analgesia groups, but in the latter time the programmed intermittent bolus groups were lower when compared with continuous infusion group with the same solution of ropivacaine and fentanyl. This maybe associate with rate of injection which is one of the factors influencing epidural blocked space.¹² Researches on both cadaveric dissection and clinical study showed that a greater efficacy of bolus injection of local anesthetics outcomes with a quicker rate of injection.¹³ Another probability is a greater spread of infusate from a multi-orificed catheter.¹⁴ Experiment showed that when intermittent boluses were used instead of a continuous infusion, despite a similar rate of infusion, a greater spread of infusate from a multi-orificed catheter was found in intermittent boluses.¹⁵ Moreover, when using a continuous infusion, there was practically no flow through the distal hole, whereas when intermittent bolus was used, the infusate would flow out from all the holes. And in Hogan's and Lim's study on cryomicrotome sectioning also shown uniform spread of liquid in the epidural space, through the intervertebral foraminae and along the nerve sheaths when using large volumes of injection, and a high injection pressure was observed.^{13,16} This theory maybe the supporting theory for lower VAS scores in the intermittent bolus group in our study. Basing on this theory we hypothesized that intermittent bolus injecting local anaesthetic can achieve a better epidural blocked space than the continuous infusion group and a slower sensory block regresses. This was consistent with lower VAS scores and less requirement of rescue medication by PCEA in the intermittent bolus group (1.27±0.26 VS 5.71±1.03). In our study parturients self administered local anaesthetic according to their levels of pain by PCEA. Patients will demand a bolus when developing pain as the sensory block regresses. In our study the intermittent bolus administration group seldom needed PCEA, it maybe attribute to the programmed intermittent bolus (hourly bolus) which can provide a better block space and slower sensory block regresses.

In some researchers showed that epidural prolonged labor stage and increased instruments.¹⁷ But in our study two analgesia groups, labor stages were shorten and there was no significant difference in labor instruments usage when compared with the non-labor analgesia group. We assumed that it maybe attribute to oxytocin during the delivery and stop using analgesia during the second stage. There was no significant difference in the maternal and fetal outcomes delivery mode and neonatal Apgar score among groups, but there were significant difference in parturients' blood pressure and heart rates when compared with non-analgesia group. Though there was sensory block, there was no motor block in two analgesia groups. One reason was attribute to the low concentration of local anesthetic (0.12% ropivacaine) and rate of epidural infusion or bolus used may have been responsible for the overall lack of change of blood pressure and the low incidence of motor block in our study, another reason was because of the characteristics of sensory and motor isolation of ropivacaine.

Conclusion

In conclusion, in our study two modes of labor analgesia (programmed intermittent bolus or continuous infusion) were safe and effective to parturients and neonates, while the programmed intermittent bolus group required significantly less rescue medication and total epidural infused volumes than the continuous infusion group in delivery parturients. The use of programmed intermittent bolus combined with PECA was more effective than continuous infusion combined with PECA, it could be useful as the mode of maintenance for epidural labor analgesia.

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None.

Conflicts of interest

The authors declare that there are no conflicts of interest.

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