



Original Article

Effect of epidural anesthesia in labor; pregnancy with cardiovascular disease

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ABSTRACT

Objective: We studied the effect and safety of epidural anesthesia during labor in pregnant women with cardiovascular disease.**Materials and methods:** In the pregnant women with cardiovascular disease, we compared maternal outcome and suppressive effect on blood pressure retrospectively between the epidural group (anesthetized epidurally during labor) and the no-epidural group (not anesthetized epidurally during labor). **Results:** A total of 277 patients were included in the analyses. Cardiovascular events decreased significantly in epidural group ($P < 0.05$). Cardiovascular events occurred in 12 (epidural group) and 2 (no-epidural group) of cases ($P < 0.05$). Cardiovascular events are all events related to arrhythmia. In the epidural group, the systolic blood pressure showed no increase in labor (110.5 mmHg, 95% CI; 95–132 mmHg vs. 110 mmHg, 95% CI; 91–130 mmHg). In the no-epidural group, the systolic blood pressure increased in labor (107.1 mmHg, 95% CI; 96–138 mmHg vs. 123 mmHg, 95% CI; 105–153 mmHg; $P < 0.05$).**Conclusion:** Epidural anesthesia had decrease of the cardiovascular events related to arrhythmia and the effect of significantly suppression raising the blood pressure during labor in pregnant women with cardiovascular disease. In pregnant women with the cardiovascular disease, epidural anesthesia during labor may be available.© 2018 Taiwan Association of Obstetrics & Gynecology. Publishing services by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

Hemodynamic status in labor fluctuates greatly depending on uterus contraction, pain for uterus contraction. Therefore, pregnant women with cardiovascular disease may need epidural anesthesia during labor, depending on the seriousness and type of cardiovascular disease they suffer from.

When the uterus contracts, the venous return increases by 300–500 ml and the cardiac output increases [1]. The sympathetic nerve becomes activated by the pain of the uterine contraction, and arteriolar vasoconstriction occurs so that endogenous catecholamines are secreted. The blood pressure increases due to these changes. Moreover, the increase in the venous return and the activation of the sympathetic nerve can easily cause arrhythmia. These changes continue repeatedly for several hours during labor.

Epidural anesthesia decreases the pain of the uterine contraction, controls the blood pressure increase. Additionally, the peripheral vessels are enhanced by the sympathetic blockade, and the cause of arrhythmia is reduced. Additionally, the sympathetic blockade causes peripheral vasodilation [2–4]. The indications are not still clear, although epidural anesthesia decreases the maternal risk during labor according to the kind of cardiovascular disease.

The indications for epidural analgesia in pregnant women with cardiovascular disease are given in the American College of Cardiology (ACC)/American Heart Association (AHA) 2008 Guidelines [5], the European Society of Cardiology (ESC) Guidelines on the management of cardiovascular diseases during pregnancy [6], and the Guidelines for Indication and Management of Pregnancy and Delivery in Women with Heart Disease (Japanese Circulation Society; JCS 2010) [7]. However, these guidelines contain fairly vague history of the development of these indications. In the JCS guidelines, the indications of epidural anesthesia in pregnant women with cardiovascular disease include the following: Tachyarrhythmia, ischemic heart disease, regurgitant valvular disease, and

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mitral stenosis are classified as “reasonable indications,” and aortic stenosis, obstructive hypertrophic cardiomyopathy, Eisenmenger's syndrome, and post-mechanical valve replacement status are considered “relative contraindications.”

Pregnancy in association with high-risk cardiovascular disease has been increasing with the increase in late-in-life pregnancies and the progress in the development of fertility treatments. Therefore, we believe that the indications of epidural anesthesia in pregnant women with cardiovascular disease should be clarified for the purpose of ensuring safe delivery. We managed about 1600 pregnancies with cardiovascular disease between 1995 and 2013 in the Department of Perinatology [8–10], National Cardiovascular Center, Japan. Epidural anesthesia was administered to 30% of these patients. While the indications of epidural analgesia during labor in pregnant women with cardiovascular disease should be outlined, the effect and safety of epidural anesthesia in labor should be demonstrated before the indications are provided. Thus, we studied the effect and safety of epidural anesthesia during labor in pregnant women with cardiovascular disease.

Materials and methods

We studied pregnancies with cardiovascular disease between 2008 and 2012 at the Department of Perinatology, National Cardiovascular Center, Japan. In the pregnant women with cardiovascular disease, we compared retrospectively the epidural group (anesthetized epidurally during labor) with the no-epidural group (not anesthetized epidurally during labor). Pregnancies in which delivery was made by elective cesarean section and preterm birth were excluded.

Information on maternal background was collected including age, gestational age, parity, cardiovascular disease. Cardiovascular disease was categorized into congenital heart disease, arrhythmia, valvular disease, aortic disease, cardiomyopathy, ischemic disease, and others.

Maternal outcomes were examined including vaginal delivery rate, cardiovascular disease, duration of labor, blood loss associated with delivery, mechanical delivery, and augmentation of labor. Neonatal outcomes were examined including Apgar score at 5 min and pH of umbilical artery (UA pH).

In both groups, systolic blood pressure before labor and maximum systolic blood pressure during labor were examined. We contrasted the systolic blood pressure measured before labor with that measured during labor.

In the epidural group, complications associated with anesthetizing epidurally during labor were examined.

Univariate analysis was performed using the chi-squared test, and the Mann–Whitney U test and paired t-test were used for the statistical analysis. P-values <0.05 were considered significant.

Indication of epidural anesthesia in the study

The indications of epidural anesthesia in the study are shown in Table 1. Group A was not allowed to deliver without epidural anesthesia during labor. The cardiovascular diseases present in Group A include connective tissue disease, ectasia of the ascending aorta, cardiac hypofunction, unrepaired or palliated cyanotic congenital heart disease, uncorrected coarctation of the aorta, and cardiac failure. In Group B, epidural anesthesia was adopted aggressively during labor. However, when patients in Group B chose not to receive epidural anesthesia during labor, vaginal delivery without epidural analgesia was allowed. The cardiovascular diseases occurring in Group B were tachyarrhythmia; ischemic heart disease; mitral, aortic, tricuspid or pulmonary valve stenosis

Table 1

Cardiovascular disease; Indication for epidural analgesia in labor (Our institution criteria).

Group A: Patient should absolutely be given an epidural analgesia
1. Connective tissue disease (Marfan syndrome etc.)
2. Ectasia of the ascending aorta (≥ 35 mm)
3. Cardiac hypofunction (ejection fraction < 40%)
4. Unrepaired or palliated cyanotic congenital heart disease
5. Uncorrected coarctation of the aorta
6. Cardiac failure
Group B: Patient should be given an epidural analgesia
1. Tachyarrhythmia
2. Ischemic heart disease
3. Mitral, aortic, tricuspid or pulmonary valve stenosis and regurgitation
4. Unrepaired autistic spectrum disorder and ventricular septal defect
5. Cardiomyopathy
Group C: Follow a patient's wishes
Other disease

and regurgitation; unrepaired autistic spectrum disorder; ventricular septal defect; and cardiomyopathy.

Method of epidural anesthesia in labor

Lactated Ringer's solution (500 ml) was infused at the start of labor. Tubing epidurally is started at the end of infusion solution, and 1% lidocaine (3 ml) was administered in the epidural space. The part of puncture is collected between third lumbar spine and fourth lumbar spine. When patients showed no ill effects after the administration of 1% lidocaine, continuous dosing was started into the epidural space. The drug solution used in continuous dosing was 0.1% ropivacaine (50 ml) plus fentanyl 2 μ g.

The drug administration was performed at the rate of 6–8 ml/1 h. The patient's blood pressure was checked at 5-min intervals during labor. Epidural anesthesia was stopped at 2 h after delivery.

Results

We examined the pregnancy outcomes with cardiovascular disease in 416 pregnancies between 2008 and 2012 at the Department of Perinatology, National Cerebral and Cardiovascular Center, Japan. A total of 136 women, who delivered selectively by cesarean section due to obstetric or cardiovascular indications, and delivered preterm were excluded. Pulmonary hypertension, mechanical valve replacement, Eisenmenger syndrome was selected caesarean section. Maternal background data are shown in Table 2

Table 2

Background in the study. No significant differences in maternal background were found between epidural group and non epidural group.

	Epidural group (n = 128)	Non epidural group (n = 149)
Age (yr.)	32.3 \pm 5.2	32.0 \pm 5.0
Gestational weeks (week)	38.4 \pm 3.8	38.2 \pm 3.3
Birth weight (g)	2914.3 \pm 412.1	2844.2 \pm 509.1
Primipara	64 (48%)	72 (48%)
Cardiovascular disease		
Congenital heart disease	53 (42%)	56 (37%)
Arrhythmia	41 (33%)	51 (34%)
Valve disease	14 (11%)	16 (11%)
Aortic disease	8 (6%)	5 (3%)
Cardio myopathy	7 (5%)	7 (5%)
Ischemic disease	3 (2%)	7 (5%)
Other	2 (1%)	7 (5%)
Indication for epidural analgesia in labor		
Group A	16 (12%)	0 (0%)
Group B	51 (40%)	10 (7%)
Group C	61 (48%)	139 (93%)
Apgar score (5 min)	8.5 \pm 0.7	8.4 \pm 0.8
pH of UA	7.34 \pm 0.26	7.31 \pm 0.07

A total of 128 pregnancies involved epidural anesthesia during labor (epidural group). A total of 149 pregnancies involved no epidural anesthesia during labor (no-epidural group). The mean (SD) ages were 32.3 (5.2) years in the epidural group and 32.0 (5.0) in the no-epidural group. No significant differences in maternal background were found between patients delivering with epidural anesthesia and those who delivered without. In both groups, congenital heart disease was the most frequent cardiovascular disease, arrhythmia was second, and valve disease was third. All of the others were pregnancies with coronary aneurysm due to Kawasaki disease. The mean gestational weeks were 38.4 (3.8) in the epidural group and 38.2 (3.3) in the no-epidural group. The mean birth weights were 2914 g (412.1) and 2844.2 g (509.1) in the epidural and no-epidural groups, respectively. The percentage of primipara mothers was 48% in both groups.

Maternal outcome in the study (Table 3)

Vaginal delivery occurred in 85% (epidural group) and 88% (no-epidural group) of cases, but this was not a significant difference. The all indications for Caesarian section were obstetric problems. Cardiovascular events occurred in 12 (epidural group) and 2 (no-epidural group) of cases ($P < 0.05$). Cardiovascular events significantly occurred during labor in no-epidural group ($P < 0.05$). All cardiovascular events are events related to arrhythmia. The mean delivery times (min) were 536.5 ± 197.8 (epidural group) and 416.2 ± 259.8 (no-epidural group). The epidural group showed a significantly extended delivery time compared to the no-epidural group ($P < 0.05$). The mean blood loss (ml) amounts were 584.2 ± 32.8 (epidural group) and 670.7 ± 509.7 (no-epidural group). The difference in blood loss between groups was not significant. The percentages of mechanical delivery and augmentation during labor were 19% and 27% in the no-epidural group and 1% and 36% in the epidural group, respectively. The method of augmentation was continuous infusion of oxytocin in all cases.

Neonatal outcome in the study (Table 3)

The difference in low Apgar score and low pH of UA between groups was not significant. No significant differences were found between groups in neonatal outcome.

Blood pressure rise controlling effect

A comparison of systolic blood pressure before labor with the maximum systolic blood pressure during labor is shown in Fig. 1. In

Table 3

Maternal and neonatal outcome in the study. Significant differences in cardiovascular event, delivery time, forceps delivery, augmentation rate were found between epidural group and non epidural group. No significant differences in neonatal outcome were found between both group.

	Epidural group (n = 128)	Non epidural group (n = 149)	P value
Maternal outcome			
Vaginal delivery	110 (85%)	132 (88%)	N.S.
Cardiovascular event	2 (1%)	12 (9%)	< 0.05
Delivery time (min)	536.5 ± 197.8	416.2 ± 259.8	< 0.05
Blood loss (ml)	584.2 ± 326.8	670.7 ± 509.7	N.S.
Forceps delivery	53 (41%)	22 (19%)	< 0.05
Augmentation	46 (36%)	41 (27%)	< 0.05
Neonatal outcome			
Apgar score (5 min) was more than 7	2 (1.5%)	2 (1.3%)	N.S.
pH of UA was more than 7.10	3 (2%)	4 (3%)	N.S.

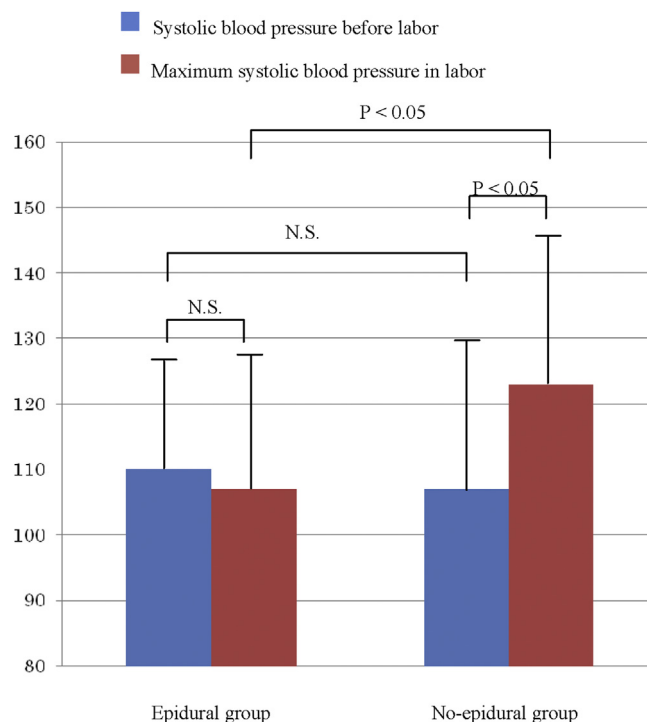


Fig. 1. Comparing systolic blood pressure before labor with maximum systolic blood pressure in labor.

the epidural group, the systolic blood pressure showed no increase, as it was 110 mmHg (95% CI; 95–132 mmHg) before labor and 110 mmHg (95% CI 91–130 mmHg) in labor. In the no-epidural group, the systolic blood pressure increased from 107 mmHg (95% CI; 96–138 mmHg) before labor to 123 mmHg (95% CI; 105–153 mmHg) during labor. Systolic blood pressure in labor rose more in the no-epidural group than in the epidural group.

Complications of anesthetizing epidurally in the study (Table 4)

Respiratory depression, vascularly injected anesthetic agent, nerve injury, and epidural hematoma did not occur. Puncture into the subarachnoid space occurred in 2 pregnancies, and although the patients developed headaches, their conditions improved on their own. In one other pregnancy, was the epidural tube remained in the patient, but the follow-up observation is complete because there have been no symptoms.

Discussion

Pregnancy and the delivery have a large impact on cardiovascular disease in the mother. Pregnant women with cardiovascular disease may need epidural anesthesia during labor, depending on the seriousness and type of cardiovascular disease they exhibit.

Table 4

Complications of anesthetizing epidurally in the study.

	Epidural group (n = 128)
Respiratory depression	0 (0%)
Vascularly injected anesthetic agent	0 (0%)
Nerve injury	0 (0%)
Puncture into the subarachnoid space	2 (0.015%)
Epidural hematoma	0 (0%)
Other	1 (0.007%)

Delivery time, mechanical delivery, and mechanical delivery, augmentation of labor were increased as a result of epidural anesthesia. Complications occurred in three cases. There were no events that adversely affected the maternal outcome. The vaginal delivery rate, blood loss during delivery, and neonatal outcome were not affected by epidural anesthesia. Cardiovascular events significantly occurred during labor in no-epidural group. This study showed that epidural analgesia significantly increased blood pressure during labor.

Previous studies have shown that the vaginal delivery rate is affected by epidural anesthesia [11,12]. In this study, the vaginal delivery rate was also affected by epidural anesthesia, consistent with the previous studies. A prolongation of the second stage of labor due to epidural analgesia has been reported [11]. In the present study, the first and second stages of labor were not investigated separately, but the delivery time (first-stage labor plus second-stage labor) was found to have been prolonged. A weakening of straining during delivery due to epidural anesthesia and an increase in mechanical delivery has been reported [11]. The present study showed the same findings, but this is a no significant problem because these do not cause any increase in cardiovascular events or blood loss during delivery, nor do they affect the neonatal outcome.

The increase of venous return associated with uterine contraction could be controlled by epidural anesthesia. On the one hand, activation of the sympathetic nerve is controlled by decreasing the pain of the uterine contractions, and the rise in blood pressure and induced arrhythmia can be controlled. Extreme fluctuation in blood pressure can lead to a breakdown of hemodynamic status. Therefore, we have compared systolic blood pressure before labor with the maximum systolic blood pressure during labor. In the epidural group, the maximum systolic blood pressure was not rose, cardiovascular event was not occurred. Thus, we conclude that epidural anesthesia is effective.

Complications of epidural anesthesia including the vascular injection of an anesthetic agent, nerve injury, puncture into the subarachnoid space, and epidural hematoma have been reported. Puncture into the subarachnoid space and the leaving behind of the epidural tube in the patient occurred in this study, but these complications were asymptomatic.

One points should be noted in this study. All pregnancies with cardiovascular disease are not included, because collecting cesarean section. In the present study, pregnancy with serious cardiovascular disease showed the tendency to select the caesarean section.

In the future, we will measure cardiac output, cardiac index, stroke volume, and systemic vascular resistance during labor by means of a non-invasive cardiac output monitor. The effectiveness of epidural anesthesia in labor will be shown in a prospective study.

Delivery time, mechanical delivery, and augmentation of labor were increased due to epidural anesthesia. However, the vaginal delivery rate, blood loss during delivery, and neonatal outcome were affected by epidural anesthesia. Epidural analgesia is

decreased cardiovascular event related to arrhythmia during labor, and significantly decreased blood pressure during labor. In cases of pregnancy with cardiovascular disease, epidural anesthesia was found to be effective during labor. And, significant complications of epidural anesthesia were not occurred.

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Conflicts of interest statement

None of the authors have any conflicts of interest to declare.

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