



## Original Article

# Cesarean under general or epidural anesthesia: Does it differ in terms of regional cerebral oxygenation?



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## ABSTRACT

**Objective:** It is aimed to evaluate whether there is a difference in regional cerebral saturation of newborns measured by near infrared spectroscopy born either by general anesthesia or combined spinal epidural anesthesia during elective cesarean deliveries.

**Methods:** After approval from the ethics committee of our hospital, and informed consents of the parturients were taken, 68 patients were included in the study. The regional cerebral oxygen saturations (RcSO<sub>2</sub>) of newborns were measured by near infrared spectroscopy (NIRS) measurements at 1st, 5th min after birth. In group I (n=32), general anesthesia was performed for the cesarean operation and in group II (n=36), combined spinal epidural anesthesia (CSEA) was the anesthetic management. The age of the mother, gestation, the problems related to the pregnancy, heart rate, blood pressure, oxygen saturation (SpO<sub>2</sub>) of the mother had been recorded. The measurements of the newborn were; SpO<sub>2</sub> of right hand, RcSO<sub>2</sub> measured by NIRS, the delivery time (from incision to the cessation of circulation in the placental cord), Apgar score. Data were analyzed using GraphPad Prism 5.0 (GraphPad Software, La Jolla, California) and presented as mean  $\pm$  SD. Results obtained in different groups were compared using unpaired *t*-test. Differences were statistically significant at  $p < 0.05$ .

**Results:** There were no significant differences between the groups related to the mother's age, gestation week and baseline blood pressure. Both the systolic and diastolic blood pressures measured at 1st and 5th min after induction or start of the spinal block were significantly lower in the mothers who had undergone combined spinal epidural anesthesia. The heart rates of the mothers who had been under CSEA were significantly higher than the general anesthesia group. The Apgar at the 1st min were observed significantly higher in Group II. Oxygen saturation of the newborns were significantly higher in Group II. Regional cerebral oxygenation measured by NIRS were significantly higher in CSEA group.

**Conclusion:** Combined spinal epidural anesthesia, besides other known advantages, had been shown to be superior to general anesthesia as a means of regional cerebral oxygenation of the newborns.

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## 1. Introduction

It is well known that the transition from fetus to newborn is a complex and critical physiological process. The newborn

undergoing normal postnatal transition needs >5 minutes to attain an arterial oxygen saturation >80% and almost 10 minutes to reach 90%.<sup>1</sup> Several studies have studied the effects of methods of anesthesia management on the newborn. Following elective cesarean delivery newborn babies have lower arterial oxygen saturation values during transition compared with infants after vaginal delivery.<sup>1–3</sup> Either hypoxia or hyperoxia is known to be detrimental during neonatal resuscitation. Measurement of peripheral oxygen saturation (SpO<sub>2</sub>) and regional cerebral oxygen saturation (rSO<sub>2</sub>) may be helpful regarding the evaluation of the transitional status of the neonate.

Conflicts of interest: The authors declare that they have no actual or potential conflicts of interest.

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Noninvasive monitoring of rSO<sub>2</sub> has been introduced in clinical settings for estimation of cerebral perfusion and cerebral blood flow (CBF).<sup>4</sup> Near infrared spectroscopy (NIRS) can be used as a noninvasive monitoring technique for cerebral oxygenation and hemodynamics. NIRS is based on the transparency of the tissue to infrared light (spectrum 700–1000 nm) and its subsequent absorption by oxygenated hemoglobin (O<sub>2</sub>Hb) and deoxygenated hemoglobin (HHb) in the cerebral blood vessels, which are within the infrared beam. Absorption changes in near infrared light can then be converted into concentration changes of O<sub>2</sub>Hb and HHb.<sup>5</sup>

There are several articles regarding SpO<sub>2</sub> immediately after birth, however literature regarding the changes in neonatal cerebral oxygenation immediately after birth is very limited.<sup>6–8</sup> In a study investigating the effect of the mode of delivery on cerebral oxygenation, it was stated that the mode of delivery had a marked influence on cerebral oxygenation immediately after birth.<sup>8</sup> It was shown that dynamic changes in postnatal cerebral oxygenation occurred with time in healthy term infants by vaginal delivery and elective cesarean section (CS). To the best of our knowledge, there is no study comparing the neonatal cerebral oxygenation immediately after birth with elective CS performed under general anesthesia (GA) or epidural anesthesia.

The aim of our study is to compare the rSO<sub>2</sub> of neonates born by CS performed under epidural anesthesia and GA.

## 2. Methods

An appropriate standard of ethics was applied in carrying out our investigation. We followed the *Ethical Principles for Medical Research Involving Human Subjects* outlined in the Declaration of Helsinki. The research protocol was approved by our institutional ethics committee and written consent was obtained from all participants. Sixty-eight parturients, classified as American Society of Anesthesiologists (ASA) I/II, scheduled for elective CS, were included in the study. The indications for CS were decided by the obstetrician and emergency operations were not included in the study. Thirty-two CS patients were allocated to surgery under general anesthesia (GA; Group I,  $n = 32$ ) and 36 patients agreed to be operated under combined spinal epidural anesthesia (CSEA; Group II,  $n = 36$ ). The indications for either GA or CSEA were decided by the anesthesiologist and the obstetricians according to clinical guidelines and patient approval of the method. GA was induced with propofol 2.5–3 mg/kg, muscle relaxation with rocuronium bromide 0.6 mg/kg, and maintained by sevoflurane 1% in O<sub>2</sub>/N<sub>2</sub>O 40/60%, 4 L/minute. CSEA was applied at the left lateral position, with a 27-gauge (G) spinal needle inserted through an 18-G Touhy epidural needle. Heavy bupivacaine 0.5% 12.5 mg and fentanyl 30 mcg were applied to the subarachnoid space after which an epidural catheter was inserted for post-operative analgesia. The patients who had CSEA were given O<sub>2</sub> 2 L/minute with a mask after the uterine incision just prior to the birth.

Immediately after birth, neonates were transferred to a radiant warmer. SpO<sub>2</sub> and rSO<sub>2</sub> measurements were carried out between 1 minute and 2.5 minutes after birth. The Apgar (Appearance, Pulse, Grimace, Activity, Respiration) scores at 1 minute and 5 minutes were recorded. The age of the mother, the gestational week, the problems related to the pregnancy and comorbidities, heart rate (HR), systolic/diastolic blood pressure (SBP/DBP), and oxygen saturation (SpO<sub>2</sub>) of the mothers were recorded. The measurements recorded for the neonates were: the SpO<sub>2</sub> of the right hand using a pulse oximeter (Nellcor N-55 Neonatal SpO<sub>2</sub> Sensor; Covidien IIC, Mansfield, MA, USA), rSO<sub>2</sub> measured by NIRS (Foresight Dual Sensor Kit Small; Casmed, Bradford, CT, USA), the delivery

time (from incision to the cessation of circulation in the placental cord), HR, and Apgar scores. The surgery times (from incision to the closure of skin) were also noted.

All infants born with congenital malformations, prematurity, intrauterine hypoxia or asphyxia, early membrane rupture, fetal distress, meconium aspiration, abruptio placenta, or placenta previa were excluded. Only infants with uncomplicated transitional periods were included in the analysis. The neonates born to the parturients who had CSEA and were given O<sub>2</sub> prior to birth were excluded. In 13 infants, either SpO<sub>2</sub> or rSO<sub>2</sub> could not be accurately read due to motion, skin, or probe problems—these infants were also excluded from the analysis.

All newborns were dried and wrapped with warm towels. Immediately after arrival to the newborn resuscitation table, while the pediatrician performed initial newborn resuscitation, the anesthesia technician applied the NIRS transducer to the left and right forehead (rSO<sub>2</sub>) and transcutaneous pulse oximetry (SpO<sub>2</sub>) was measured at a preductal level (right hand). The transducers were covered with a towel and the hand and the forehead of the newborn were held still in order to minimize light and motion artifacts. The infant was positioned supine and was breathing room air. The pediatrician observed the transition of the newborn and recorded Apgar scores at 1 minute (T1) and 5 minutes (T5).

Data were analyzed using GraphPad Prism 5.0 (GraphPad Software, La Jolla, CA, USA) and presented as mean  $\pm$  standard deviation (SD). Results obtained in different groups were tested for normal distribution of data sets and compared using an unpaired *t* test and repeated measures analysis of variance (ANOVA)—Tukey post hoc test for consecutive measurements. Differences were considered statistically significant at  $p < 0.05$ .

## 3. Results

There were no significant differences between the groups according to the indications for CS, the ASA physical status of the patients, and comorbidities. There were no significant differences between the groups related to the mother's age, gestational week, and baseline SBP/DBP (Table 1). There were no differences between the surgery times (Group I,  $33.3 \pm 11.6$  minutes vs. Group II,  $38.8 \pm 14.8$  minutes), however, the delivery time (from incision to the cessation of circulation in the placental cord) for Group II was significantly longer than the delivery time in Group I ( $14.2 \pm 6.4$  minutes vs.  $7.1 \pm 2.0$  minutes; Table 2).

Both the SBP and DBP measured at 1 minute and 5 minutes after induction or start of the spinal block were significantly lower in the mothers who had undergone CSEA (Table 1; Fig. 1).

The HR of the mothers who were under CSEA was significantly higher than the GA group (Table 1; Fig. 1).

The Apgar scores at 1 minute and 5 minutes were observed to be significantly higher in Group II (Table 2).

The oxygen saturation of the newborns was significantly higher in Group II (Table 2;  $76.0 \pm 10.6$  vs.  $70.8 \pm 10.5$ ,  $p < 0.05$ ). There were no statistically significant differences in the HRs of the newborns.

Regional cerebral oxygenation measured by NIRS was significantly higher in the CSEA group (Table 2; right rSO<sub>2</sub>:  $57.5 \pm 15.2$  vs.  $49.7 \pm 12.3$ ; left rSO<sub>2</sub>:  $55.2 \pm 14.2$  vs.  $48.3 \pm 12.4$ ,  $p < 0.05$ ).

**Table 1**  
Maternal characteristics of the study groups.

	Group I ( $n = 32$ )	Group II ( $n = 36$ )
Age (y)	$32.2 \pm 3.9$	$32.9 \pm 3.3$
Gestation (wk)	$38.7 \pm 0.6$	$38.6 \pm 0.8$

Data are presented as mean  $\pm$  SD.

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