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CLINICAL INVESTIGATIONS

The Effects of Epidural Anesthesia and General Anesthesia on Newborns at Cesarean Section

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Abstract: We compared Apgar scores and umblical arterial and venous blood gas samples of infants following the application of general anesthesia or lumbar epidural anesthesia during cesarean section. Sixty-two pregnant women whose babies were to be delivered at term by cesarean section were recruited for this study and randomized to receive either general anesthesia (GA) (n = 31), or lumbar epidural anesthesia (EA) (n = 31). Following delivery, a segment of the umbilical cord was doubly clamped, and arterial and venous blood gas samples were taken. In both groups, Apgar scores were recorded at 1 and 5 min. There were no significant differences between the 2 groups for 1 min Apgar scores ($P > 0.05$). In the GA group, 5 min Apgar scores were significantly lower than those of the EA group ($P < 0.05$). However, no treatment was required. In addition, when comparing the groups, no significant difference in umbilical cord arterial and venous blood gas analyses was noted ($P < 0.05$).

Key Words: Epidural anesthesia, general anesthesia, cesarean section, newborn

Introduction

Obstetric anesthesia may affect uterine blood flow by changing uterine vascular resistance or by changing perfusion pressure, either directly through changes in vascular tone or indirectly by altering uterine contractions or uterine muscle tone (1).

Anesthetic methods used during cesarean section have advantages and disadvantages to both mothers and neonates, and may result in short- and long-term neonatal effects. The anesthesiologist must choose the safest and most comfortable method for the mother, and the least depressant process for the newborn (2).

The advantages of regional anesthesia include an awake mother, minimal newborn depression and avoidance of the risk of general anesthesia (GA). Flexibility for the duration of anesthesia for surgery and control of block height are other advantages of epidural anesthesia (EA) (3).

On the other hand, GA has the advantages of rapid induction, less associated hypotension and cardiovascular instability, and better control of the airway and ventilation. However, potential problems during GA may occur including pulmonary aspiration of gastric content, failed intubation, maternal hyperventilation, neonatal depression, maternal awareness and uterine atony (2).

Umbilical cord blood gas and pH values should always be obtained in high-risk delivery and whenever newborn depression occurs (4).

After delivery, the Apgar score at 1, 5 and sometimes at 10 min is the most widely used method to evaluate the clinical condition of the newborn (5).

The purpose of this study was to compare Apgar scores and umbilical arterial and venous blood gas samples of infants delivered through cesarean section with GA and lumbar EA.

Materials and Methods

After institutional review board approval and written informed patient consent were obtained, 62

uncomplicated parturients classified as American Society of Anesthesiologists physical status I or II who were to give birth at term by cesarean section were recruited for this study and randomized to receive either GA (n = 31), or lumbar EA (n = 31). All patients were monitored with electrocardiography, pulse oxymetry and non-invasive blood pressure measurements.

The patients in whom EA was performed were prehydrated with 10 ml kg^{-1} of lactated Ringer's solution and placed in the left lateral position. After raising a midline wheal with 1% lidocaine, the epidural space was identified using loss of resistance to saline (2 ml) at the L2-L3 or L3-L4 level, and a multiport epidural catheter was advanced 3 cm into the epidural space. After catheter placement, patients were placed in the supine position with left uterine displacement and 30° elevation of the head of the bed. The injectate was given within 5 min. After 5 min from the administration of the test dose of 0.5% bupivacaine plain, 3 ml, 0.5% bupivacaine plain 15 ml was given via epidural catheter. In addition, oxygen at approximately 6 l min^{-1} was given via a transparent face mask during the operation. None of the patients received any other medication until delivery.

Patients undergoing GA, after pre-oxygenation for 4-5 min, received vecuronium bromide 0.02 mg kg^{-1} i.v. for a priming dose, thiopental 5 mg kg^{-1} i.v. for induction and suxamethonium 1.5 mg kg^{-1} i.v. for endotracheal intubation. Anesthesia was maintained with O_2 100% and isoflurane 0.3 vol% until delivery of the baby. After delivery, maintenance of anesthesia was performed with an inhaled mixture of nitrous oxide 4 l min^{-1}, oxygen 2 l min^{-1} and isoflurane 0.5-0.6 vol%. At the same time, analgesia and neuromuscular blockage were maintained with incremental doses of fentanyl citrate and vecuronium bromide.

Immediately following delivery, neonates were evaluated with umbilical arterial and venous blood gas analyses obtained from a doubly clamped segment of umbilical cord, and Apgar scores at 1 and 5 min.

Results were analyzed by the Student's t and Mann-Whitney U tests as appropriate (SPSS 10 for Windows). A value of $P < 0.05$ was regarded as significant.

Results

In the EA group, all patients had successful EA and no one was excluded from the study.

There were no significant differences between the 2 groups with respect to maternal age, weight and height and the birth weight of neonates (Table 1).

The mean values of the 1 min Apgar score were 7.19 ± 0.70 for the GA group, and 7.38 ± 0.55 for the EA group; and 5 min Apgar score values were 9.54 ± 0.67 for the GA group, and 9.87 ± 0.42 for the EA group. There were no significant differences between the 2 groups for 1 min Apgar scores ($P > 0.05$; Table 2). In the GA group, 5 min Apgar scores were significantly lower than those of the EA group ($P < 0.05$; Table 2). However, this difference did not require the application of any kind of treatment. When comparing umbilical cord arterial and venous blood gases, no statistically significant differences between the 2 groups were noted ($P > 0.05$; Table 3).

Discussion

Umbilical cord gas and pH values for the umbilical artery can be affected by alterations in cord blood flow with the delivery process (6).

Dildy et al. (7) found that fetal oxygen saturation decreased during the course of normal labor. In a trial

Table 1. Maternal and neonatal characteristics expressed as mean ± SD. No significant differences.

Group	GA	EA
Number	31	31
Age (y)	27.92 ± 3.22	27.23 ± 3.87
Height (cm)	160.92 ± 5.99	163.38 ± 4.13
Weight (kg)	74.26 ± 8.92	71.57 ± 10.86
Neonatal weight (kg)	3.36 ± 0.29	3.31 ± 0.23

Table 2. Apgar scores and incidence of meconium (Mean ± SD; significant at $P < 0.05$ by paired t test).

Group	GA	EA	P value
Number	31	31	
Apgar 1 min	7.19 ± 0.70	7.38 ± 0.55	0.235
Apgar 5 min	9.54 ± 0.67	9.87 ± 0.42	0.028

Table 3. Umbilical cord blood gas values (Mean ± SD; significant at P < 0.05 by paired t test).

Group	GA	EA	P value
Number	31	31	
Umbilical vein			
PO_2 (mmHg)	28.3 ± 4.1	24.7 ± 3.7	0.276
PCO_2 (mmHg)	40.1 ± 5.5	41.5 ± 5.9	0.625
pH	7.31 ± 0.04	7.33 ± 0.03	0.203
HCO_3 (mmol l^{-1})	22.7 ± 1.8	22.4 ± 1.6	0.910
Umbilical artery			
PO_2 (mmHg)	16.1 ± 3.7	16.9 ± 3.4	0.592
PCO_2 (mmHg)	52.4 ± 5.8	51.6 ± 7.2	0.216
pH	7.25 ± 0.07	7.27 ± 0.08	0.375
HCO_3 (mmol l^{-1})	21.3 ± 4.5	21.0 ± 3.2	0.053

randomizing patients to oxygen therapy or no oxygen therapy in the second stage of labor, oxygen administration may increase mean arterial cord pH when used for a short duration of time; however, prolonged use of oxygen (10 l/min by mask) can result in a deterioration of cord blood gases at birth. It was hypothesized that prolonged oxygen therapy may have induced placental artery vasoconstriction (8).

In our study, we administered 6 l min^{-1} oxygen (by mask) in the EA group and 100% oxygen in the GA group until delivery of the baby.

The most significant complications of EA are hypotension, convulsions induced by local anesthetics, total spinal anesthesia with resulting respiratory arrest, nerve injury and headache secondary to failed dural puncture. The most frequent complication is hypotension (15-44%) (9). Maternal hypotension does not usually cause maternal or neonatal morbidity if it is recognized and treated immediately (2,10). In our study, none of the patients had hypotension and no treatment was required.

The general anesthetics used for cesarean delivery cross the placenta and can cause neonatal depression (3). Under normal maternal and fetal conditions, GA and EA are almost identically useful with respect to neonatal well being after cesarean section. Some studies have demonstrated that the comparison of neonatal outcome after elective cesarean delivery with either GA or EA do not show important differences in neonatal outcome (11).

Kolatat et al. have shown that the Apgar scores of the neonates whose mothers received GA for cesarean section were lower than those in whose EA was applied (12). In our study, 1 and 5 min Apgar scores for the GA group were lower than those for the EA group. However, only 5 min changes in Apgar scores were statistically significant.

Previous studies demonstrated that regional analgesia or anesthesia may reduce uteroplacental blood flow and cause a significant deterioration in fetal acid-base status, even when normal placental reserve exists (13,14).

The most useful umbilical cord blood parameter is arterial pH. However, because arterial blood is more representative of the fetal metabolic condition, and arterial acidemia may occur with a normal venous pH, the analysis of umbilical venous blood samples alone is not recommended. A complete blood gas analysis may reveal important information about the cause of acidemia and arterial and venous samples together may provide a clearer evaluation (4).

Roberts et al. demonstrated that the rate of fetal acidemia was significantly higher after the gravida received regional anesthesia. Approximately 18% of infants exposed to regional anesthetics had umbilical artery blood pH values of 7.19 or less (14). Similarly, Mueller et al. have shown that regional anesthesia for elective cesarean delivery was associated with fetal acidemia (13).

In our study, we determined that 22.6% of EA group infants had umbilical artery blood pH levels lower than 7.19, and 16.1% in the GA group reported similar values.

Sendag et al. compared the effects of lumbar EA and GA on the Apgar score and acid-base status of the newborn, and they showed that lumbar EA is associated with lower umbilical artery blood pH values, and occasionally with severe fetal acidemia (15).

These studies attributed the increase in cord blood acidemia associated with regional anesthesia to reduced uteroplacental perfusion that was a result of maternal hypotension.

In contrast to the studies mentioned above, earlier studies demonstrated that EA had reduced levels of cathecholamines in the maternal circulation, which may be beneficial to the fetus (16,17). In addition, it was

shown that compared with GA, regional anesthesia is unlikely to produce drug-induced depression in the fetus or mother. In cases featuring a compromised fetus, EA may be more beneficial than GA (11).

Sendag and colleagues demonstrated that the mean umbilical artery blood $PaCO_2$, PaO_2 and HCO_3 values had no statistically significant differences between lumbar EA and GA groups (15). In our study, the mean umbilical artery and venous blood pH, $PaCO_2$, PaO_2 and HCO_3 values did not show any significant difference between the 2 groups.

Conclusion

Our findings suggest that neither EA nor GA are superior to one another for fetuses delivered by cesarean section with respect to umbilical cord blood gas analysis.

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