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Effect of Anesthesia Methods During Elective Cesareans on Neonates: Ordu Province Example

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Abstract

Objective: To research the short-term effects on neonates of different anesthesia methods administered for elective cesareans.

Methods: Data obtained from files and electronic medical records of 157 singleton cesarean cases and neonates from January 2018 to December 2019 were retrospectively analyzed and 6 cases were excluded from the study. A total of 151 cases were divided into general anesthesia-propofol (n=30), spinal (n=100) and general anesthesia-pentothal (n=21) groups.

Results: A total of 151 cesarean cases that meet the inclusion criteria in the date interval of the study were assessed. Of cases, 100 (66%) were in the spinal anesthesia group, 30 (20%) were in the general anesthesia-propofol group and 21 (14%) were in the general anesthesia-pentothal group. There was no significant difference between the study groups in terms of demographic data. The umbilical cord pCO2 value was significantly low in the spinal anesthesia group (43.60±5.52) compared to the general-pentothal group (47.38±5.71). The umbilical cord HCO3 value was lower in the spinal anesthesia group (22.69±1.62) compared to the general-pentothal (23.48±1.53) and general-propofol groups (23.49±1.83). There was a significant variation in postnatal treatment types according to anesthesia method (p=0.012). The rate not requiring treatment was lowest in the general-propofol group (46.7%), while the rate of balloon-valve mask use (46.7%) was highest compared to the other groups. In terms of 5th minute Apgar scores, there was a significant difference between the groups (p=0.024). Patients in the general-propofol group had significantly lower 5th minute Apgar scores compared to patients in the spinal group.

Conclusion: The balloon-valve mask rate was highest for those with propofol general anesthesia. Additionally, it was identified that neonates in both general anesthesia groups had higher neonatal intensive care unit requirements compared to the spinal anesthesia group.

Key words: Cesarean section, neonatal outcome, pentothal, propofol, spinal anesthesia

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Introduction

For cesareans, the use of regional anesthesia (RA: spinal, epidural and combined spinal-epidural) methods as alternatives to general anesthesia (GA) methods has increased in recent years (1). Both anesthesia methods have advantages and disadvantages, with factors like the urgency of the cesarean, degree, presence of comorbid health problems, patient choice, anesthesiologist or surgeon choice and experience affecting the determination of anesthetic technique to be used. Advantages of GA are rapid induction, less hypotension, preserved cardiovascular balance, and better respiratory tract and ventilation control, while disadvantages are aspiration of stomach contents, intubation difficulty and respiratory depression of the neonate. Significant advantages of regional anesthesia are the mother being awake, seeing the neonate at birth, being able to breastfeed in the early period and lack of respiratory depression in the neonate (2). Disadvantages include headache in the mother linked to cerebrospinal fluid (CSF) leak after lumbar puncture, possibility of nausea-vomiting and limited duration of effect (3). Additionally, the sympathetic blockage induced by RA reduces uteroplacental perfusion and intervillous blood flow causing fetal acidemia via hypotension (4). Differences in choice of anesthetic method have caused an increase in research investigating the effects of these methods on fetus and neonate in recent years (5,6).

Apgar scoring is commonly used to rapidly assess the clinical status of neonates. Umbilical cord blood gas values are accepted as a more reliable marker of fetal oxygenation and neonatal clinical status (7).

The aim of the study is to assess the Apgar scores and umbilical cord blood gas, hemogram, aspartate aminotransferase (AST), and alanine aminotransferase (ALT) values, with neonate urine and meconium excretion times for cases undergoing cesarean administered GA with propofol or thiopental sodium or spinal anesthesia (SA).

Methods

The study began after receiving permission from Ordu University Clinical Research Ethics Committee. Cases giving birth with elective cesarean indications from January 2018 to December 2019 in the Ministry of Health Ordu University Education and Research Hospital Obstetrics and Gynecology Clinic, aged from 18-45 years, with pregnancy week ≥37, singleton pregnancy and no chronic disease or medication use history were assessed. All cesarean interventions were performed by experienced obstetricians. In terms of neonates, infants born electively, singleton, at term, with birth weight above 2500 g, and no fetal anomalies, growth retardation, meconium or amniotic fluid aspiration were included in the study. Patient files and automation records were retrospectively assessed. From a total of 157 cases, 6 had missing data and were excluded. The remaining 151 cases were analyzed. Cases were divided into three groups according to anesthetic method as general anesthesia-propofol (G-propofol, n=30), general anesthesia-pentothal (G-pentothal, n=21), and spinal anesthesia (SA, n=100).

Patients undergoing elective cesareans in our hospital are primarily recommended central regional blocks (spinal and epidural anesthesia), patients who do not choose these are administered GA. All patients undergoing elective cesarean surgery have preoperative anesthesia assessment performed before entering the operating room. Oral intake is stopped 6-8 hours preoperatively. Before entering the operating room, patients are administered 15 ml/kg intravenous (iv) balanced crystalloid solution. After preoperative checks, patients are prepared according to the anesthesia type chosen. Those choosing regional anesthesia mainly choose spinal anesthesia. In our spinal anesthesia practice, after routine monitoring, patients are given oxygen support (mask/nasal cannula) and then a 25 gauge (G) quincke spinal needle is used to administer 10-13.5 mg hyperbaric bupivacaine in the lumbar 2-3 and 3-4 interval. Patients administered spinal anesthesia are given 5-10 mg ephedrine (iv) if systolic arterial pressure is <100 mmHg in spite of iv fluid treatment to prevent maternal hypotension. After routine monitoring and 3 minutes of preoxygenation, when the surgery team is ready for the operation, general anesthesia is administered with iv 2-2.5 mg/kg propofol or 4-5 mg/kg thiopental sodium. After administering 0.6-1 mg/kg rocuronium bromide muscle relaxant, and then endotracheal intubation, maintenance is provided by inhalation of 50% O2 + 48-49% N2O and 1-2% sevoflurane.

Demographic data (maternal age, pregnancy week, birth weight), preoperative hemoglobin values, skin incision-birth duration, 1st and 5th minute Apgar scores of the neonate (assessed by pediatric health and diseases specialist), blood gases, AST and ALT in samples taken from the umbilical cord, full blood counts, neonatal balloon-valve-mask (BVM), intubation and neonatal intensive care unit (NICU) requirements in the first 24 hours (those with low Apgar score, those with respiratory distress, those with low blood glucose) and urination and meconium excretion times were retrospectively recorded from patient files and the hospital data system.

Findings obtained in the study had statistical analysis performed using SPSS ("Statistical Package for Social Sciences") v26 (IBM, Armonk, NY, USA). Comparison of groups used one-way ANOVA for continuous variables and Kruskal-Wallis test for score variables. Analysis of categoric variables used the chi-square test. If expected frequencies on the chi-square test were ≥5, the Pearson value was calculated; if <5, the likelihood ratio value was calculated. Statistical significance level was taken as 5%.

Statistical analysis

Findings obtained in the study had statistical analysis performed using SPSS ("Statistical Package for Social Sciences") v26 (IBM, Armonk, NY, USA). Comparison of groups used one-way ANOVA for continuous variables and Kruskal-Wallis test for score variables. Analysis of categoric variables used the chi-square test. If expected frequencies on the chi-square test were ≥5, the Pearson value was calculated; if <5, the likelihood ratio value was calculated. Statistical significance level was taken as 5%.

Results

A total of 151 cesarean cases that meet the inclusion criteria were assessed in the date interval for the study. Of cases, 100 were in the SA group (66%), 30 in the G-propofol group (20%) and 21 in the G-pentothal group (14%). There were no significant differences between the study groups in terms of demographic data ($p>0.05$) (Table 1).

The umbilical cord blood gas, ALT and AST values are given in Table 2. Umbilical cord pCO2 values were statistically lower in the SA group (43.60±5.52) compared to the G-pentothal group (47.38±5.71) ($p<0.05$). Umbilical HCO3 values in the SA group (22.69±1.62) were statistically lower compared to both the G-pentothal (23.48±1.53) and G-propofol (23.49±1.83) groups ($p<0.05$). However, there was no statistical differences between the groups in terms of umbilical cord pH values ($p>0.05$) and as pH values were in the normal interval they were not accepted as clinically significant (Table 2). There were no statistically significant differences between the groups in terms of AST and ALT ($p>0.05$).

The distribution of postnatal treatment, urine and meconium times for neonates according to group are given in Table 3. There was a significant change in postnatal treatment types according to anesthesia method ($p=0.012$). The rate not requiring treatment in the G-propofol group (46.7%) was lower compared to the SA and G-pentothal groups (79% and 81%, respectively); while the BVM rate (46.7%) was higher compared to the other groups (18% and 9.5%, respectively). The NICU requirements in the G-pentothal and G-propofol groups (9.5% and 3.3%, respectively) were higher compared to the spinal group (2%). One neonate in each of the G-propofol and SA groups required endotracheal intubation (ETI) and mechanical ventilation (MV).

There was no difference between the groups in terms of urine and meconium excretion times ($p>0.05$). In all groups, nearly three quarters of neonates excreted urine and meconium within the first 12 hours postnatal.

Descriptive statistical values for the 1st and 5th minute Apgar scores in the groups are given in Table 4. There were no significant differences between the groups in terms of 1st minute Apgar scores ($p>0.05$). In terms of 5th minute Apgar scores, there was a significant difference between the groups ($p<0.05$). Patients in the G-propofol group had significantly lower 5th minute Apgar scores compared to patients in the SA group ($p=0.024$). The 5th minute Apgar scores for patients in the G-pentothal groups were not statistically different to patients in both the G-propofol and SA groups ($p>0.05$).

Table 1. Demographic data in groups

	G-Propofol (n=30)		SA (n=100)		G-Pentotal (n=21)		p
	Mean	SD	Mean	SD	Mean	SD	
Maternal age at delivery (years)	29.20	5.77	30.69	5.00	29.81	5.28	0.355
Preoperative hemoglobin (g/100 ml)	11.62	1.41	12.04	1.21	11.60	1.07	0.144
Gestational age at delivery (weeks)	38.37	0.76	38.69	0.85	38.62	0.67	0.163
Birth weight (gram)	3512.67	499.02	3427.60	441.23	3492.86	545.21	0.628
Surgical time (seconds)	226.33	63.71	264.30	322.42	227.19	55.32	0.714

One-way ANOVA

Table 2. Descriptive statistics for cord blood parameters of neonates

	G-Propofol (n=30)		SA (n=100)		G-Pentotal (n=21)		p
	Mean	SD	Mean	SD	Mean	SD	
Umbilical cord							
pH	7.32	0.03	7.33	0.04	7.32	0.04	0.210
pCO2	45.86 [ab]	4.91	43.60 [b]	5.52	47.38 [a]	5.71	0.006**
HCO3	23.49 [a]	1.83	22.69 [b]	1.62	23.48[a]	1.53	0.023*
AST (IU/l)	26.10	8.11	29.29	13.48	28.67	10.34	0.456
ALT (IU/l)	9.70	3.43	10.72	5.40	11.38	4.13	0.452

One-way ANOVA
*:<0.05,**:<0.01
AST: Aspartate aminotransferase, ALT: Alanine aminotransferase

Table 3. Distribution according to group for treatment, urine and excretion times among neonates after birth

		Anesthesia type				p
		G-Propofol	SA	G-Pentotal	Total	
Postpartum treatment	No	14(46.7%)	79(79.0%)	17(81.0%)	110(72.8%)	*0.012**
	BVM	14(46.7%)	18(18.0%)	2(9.5%)	34(22.5%)	
	ETI	1(3.3%)	1(1.0%)	0(0.0%)	2(1.3%)	
	NICU	1(3.3%)	2(2.0%)	2(9.5%)	5(3.3%)	
Time to urinate (hours)	0-12	30(100.0%)	96(96.0%)	19(90.5%)	145(96.0%)	*0.160*
	13-24	0(0.0%)	4(4.0%)	2(9.5%)	6(4.0%)	
Meconium extraction time (hours)	0-12	25(83.3%)	78(78.0%)	16(76.2%)	119(78.8%)	*0.913*
	13-24	5(16.7%)	20(20.0%)	5(23.8%)	30(19.9%)	
	25-36	0(0.0%)	1(1.0%)	0(0.0%)	1(0.7%)	
	37-48	0(0.0%)	1(1.0%)	0(0.0%)	1(0.7%)	

Chi-square test (Likelihood Ratio)
*:<0.05
BVM: Balloon-valve mask ETI: Endotracheal intubation NICU: Neonatal intensive care unit

Table 4. 1st and 5th minute Apgar scores in the groups

	G-Propofol (n=30)				SA (n=100)				G-Pentotal (n=21)				p
	Mean	Median	IQR	Mean Rank	Mean	Median	IQR	MeanRank	Mean	Median	IQR	MeanRank	
1-min Apgar	7.90	8.00	0.0	64.48	8.26	8.00	1.0	80.79	8.05	8.00	0.5	69.64	0.081
5-min Apgar	8.87	9.00	1.0	58.60[b]	9.24	9.00	1.0	80.80[a]	9.19	9.00	1.0	78.00[ab]	0.024*

Kruskal-Wallis test, *:<0.05

Discussion

Spinal anesthesia generally is more practical and more reliable for the mother compared to other techniques and as a result is used widely. Similarly, for cesareans SA is assumed to be better than GA for neonates. The basis of this assumption is that GA lowers the Apgar score, maternal hypotension that may occur with SA can be controlled by suitable vasopressors and the low medication dose required for SA induction does not cause systemic effects in neonates (8). Patients with contraindications for RA are administered GA for cesareans; at this point, the greatest concern is the effect of anesthetic agents on the neonates (9).

The Apgar score, developed by Virginia Apgar in 1952, ensures rapid and practical assessment of the clinical status of neonates. This scoring, performed in the 1st and 5th minutes and rarely 10th minute after birth, examines the neonate's cardiac rhythm, respiration, muscle tone, reflex response and skin color (10). A study by Mueller et al. investigating the effects of regional (spinal and epidural) and GA on neonates found the 5th minute Apgar scores were higher in the RA groups (both spinal and epidural groups) compared to the GA group (11). Sener et al. in studies investigating the effects of general and epidural anesthesia on fetal well-being reported the 1st minute Apgar scores were high in the epidural anesthesia group, while 5th minute Apgar scores were similar in both groups (12). Studies by Dyer et al. and Hodgson et al. researched the effect of spinal anesthesia and GA on Apgar scores and in conclusion, found the 1st minute Apgar scores were lower in the GA groups and 5th minute Apgar scores were similar in both groups (13,14). A study by Kavak et al. found the 1st and 5th minute Apgar scores were similar in spinal and general anesthesia groups (15). This may be due to the use of perioperative fluid and ephedrine in regional anesthesia to prevent maternal hypotension. Cochrane database analyses showed the 5th minute Apgar scores performed to determine resuscitation response and asphyxia were similar in anesthesia groups. Thus, when determination of asphyxia is required, it was concluded that one anesthetic method was not superior to others (16).

In our study, there was no difference between the groups in terms of 1st minute Apgar scores. In the G-pentothal group, the 5th minute Apgar score was not statistically different compared to the G-propofol and spinal groups. The general-propofol group had 5th minute Apgar score that was statistically significantly low compared to the SA group (p<0.024). However, all groups had mean Apgar score above 8 so this was not clinically significant.

Studies in the past have stated there is a hypotension risk caused by sympathetic blockage in RA and the use of RA techniques should be avoided due to the dangers of the vasopressor agents or large volumes of fluids required to correct this (11). Due to this concern, a study by Roberts et al. in 1995 found that RA was associated with fetal academia (17). Studies about this topic increased due to the diversity of anesthetic methods administered and anesthetic agents chosen. Umbilical cord blood pH and acid-base balance are the most accurate markers of neonatal well-being. If there is no metabolic acidosis in umbilical cord blood, asphyxia is not possible and if cord blood gas pH is lower than 7.20 it is assessed as pathologic acidosis (18). In studies where the primary focus point is adjustment of the fetus and maternal variables (like anesthesia studies), no large difference was observed between pH values of the umbilical artery (UA) and umbilical vein (UV) and both are accepted as directly related to the acid-base balance (8).

A study by Gunusen et al. in the last 10 years did not identify a difference between mean pH values of the UA and UV between the groups (19). A study by Petropolus et al. found the UA pH was higher in the GA group compared to the combined spinal-epidural group; however, fetal acidemia was not identified in any group (1). A 2014 study by Kirecci et al. found umbilical cord pH value was low in the GA group; however, they stated this was not clinically significant as pH values were in normal intervals in the general and spinal anesthesia groups (6). The probable reason for this situation is effect of the general anesthetic on the infant. In our study, the umbilical cord pCO2 values were lower in the spinal group compared to the G-pentothal group and the HCO3 values were lower in the spinal group compared to both the G-pentothal and G-propofol groups ($p<0.05$). However, this was not assessed as clinically significant due to pCO2 and HCO3 values being within the normal range and the lack of significant difference between the three groups in terms of umbilical cord mean pH values.

To exclude perinatal stress, apart from Apgar and cord blood gas, there are studies assessing some enzymes and hormones. Of these, Kavak et al. studied ALT, AST, total cortisol and creatine kinase enzymes in cord blood and did not find statistically significant differences in enzyme values in the general and spinal anesthesia groups (15). Another similar study found ALT and total cortisol values were statistically significantly high in the GA group (20). A 2014 study by Karadogan et al. found the 4th hour ALT value in neonates was significantly high in cases with epidural anesthesia compared to other groups (21). In our study, there were no statistically significant differences found between groups in terms of cord blood AST and ALT values. Although there was a statistically significant difference in biochemical test results in some studies, the results were found to be within normal limits. Therefore, we believe there is a need to perform more studies to interpret whether or not there are differences between groups in terms of enzyme values.

A study assessing the postnatal BVM, ETI or NICU requirements of neonates found that no neonate in the general and spinal anesthesia groups required BVM or ETI (6). A study of 230 cases by Petropolus et al. similarly stated there was no difference between general, epidural and spinal-epidural anesthesia groups in terms of mask ventilation and NICU admissions (1). Another study found a significantly high number of neonates required BVM in the GA group; however, there was no difference in terms of ETI and NICU requirements (19). In our study, BVM use was highest in the G-propofol group. Additionally, both GA groups (propofol and pentothal) had higher NICU admission rates compared to the spinal anesthesia group.

The sympathetic nervous system has physiological effects like reducing the motility and secretions in the gastrointestinal system, relaxing the bladder detrusor muscle and causing contractions of the internal sphincter (22). Hypotension related to sympathetic blockage caused by regional anesthesia may affect short-term outcomes in neonates by disrupting uteroplacental perfusion (23). In our literature screening, we did not encounter a study investigating the effects of the anesthesia method administered to cesarean cases on neonatal urine and meconium excretion times. In our study, there was no difference between the groups in terms of neonatal urine and meconium excretion times ($p>0.05$). Nearly three-quarters of neonates in all groups had urine and meconium excretion within 12 hours of birth.

Conclusions

All three anesthesia methods for elective cesareans do not have much superiority to each other in terms of short-term effects on the neonate. However, due to the higher rate of BVM and NICU requirements in GA groups, we think it is more appropriate to choose SA for pregnant cases in terms of neonatal health

Ethics Committee Approval: Ethics committee approval was received for this study from Clinical Research Ethics Committee of Ordu University (Decision date and number: 2019-18).

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Author Contributions:

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