

ORIGINAL ARTICLE

Type of anesthesia affects neonatal wellbeing and frequency of transient tachypnea in elective cesarean sections

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Abstract

Objective: We aimed to assess whether the type of anesthesia in cesarean section (C/S) (spinal anesthesia, SA versus general anesthesia, GA) has an effect or not on umbilical vein blood gas analysis and APGAR scores of term neonates and development of transient tachypnea of the newborn (TTN).

Methods: The data of 172 procedure (85, GA versus 87, SA) were collected retrospectively. Results of umbilical vein blood gas analysis, APGAR scores at first and fifth minutes and presence of TTN from in-hospital files of neonates were examined.

Results: Neonates in the SA group had significantly higher first and fifth minute APGAR scores (8, 7 versus 9, 2, $p < 0.001$ and 9, 3 versus 10, 2, $p = 0.017$, respectively). The pH value of umbilical vein samples were higher (7.30 ± 0.05 versus 7.32 ± 0.05 , $p = 0.029$) and pO_2 and SaO_2 levels were significantly lower in the SA group (34.8 ± 13.8 mmHg versus 27.6 ± 14.5 mmHg; $p = 0.001$ and $56.6\% \pm 18.7$ versus $49.8\% \pm 21.4$; $p = 0.029$, respectively) as compared to the GA group. Thirteen neonates in the GA group (15.3%) and five in the SA group (5.7%) were diagnosed as TTN ($p = 0.048$).

Conclusion: In our study, considerable determinants of fetal wellbeing was stated to be higher in C/S performed under SA in comparison to GA. Furthermore, our findings favor SA for avoidance of TTN.

Keywords

Cesarean section, spinal anesthesia, transient tachypnea of newborn

History

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Introduction

The type of anesthesia in cesarean section (C/S) is determined with respect to status of mother and fetus and urgency of the operation. In addition to the necessity of providing patient's safety and setting optimal surgical conditions, in C/S anesthesiologist should also consider the health of fetus which is substantially responsive to undulations of maternal hemodynamics [1].

C/S might be performed either with general or regional anesthesia. In the modern era, utilization of general anesthesia (GA) for C/S is limited to certain indications (e.g. fever, thrombocytopenia) and urgent situations (e.g. hypovolemia, excessive fetal distress). Regional anesthesia (RA) is the preferred technique for patients who do not carry the characteristics mentioned above due to its advantages like reduction of respiratory depression, uterine atony and tracheobronchial aspiration and maintaining consciousness [2].

Still, regardless of the type of anesthesia C/S was clearly demonstrated to be related with neonatal respiratory depression especially with transient tachypnea of the newborn (TTN) [3,4]. TTN is a self limiting and generally reversible cause of respiratory distress which disappears in 24 to 72 h after birth without requiring a specific therapy and resulting in a morbidity. Actual prevalence of TTN is estimated as 0.33–0.5%. Main risk factors for TTN development comprises C/S, preterm labor (less than 38 weeks), maternal asthma, maternal diabetes mellitus, twin births and male gender [5,6].

The goals of this study are to determine whether the type of anesthesia (general or regional) performed for C/S has an influence on fetal wellbeing determinants –APGAR score and umbilical vein blood gas analysis – or not and to compare these groups for TTN development frequencies.

Materials and methods

This study was established via collecting and investigating the perioperative data of C/S performed in our Obstetrics and Gynecology clinic between June 2009 to March 2010 and July 2010 to January 2011 and in-hospital records of the neonates retrospectively. It was approved by local ethical committee of University of Istanbul, Faculty of Medicine

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Table 1. Demographics of study population.

	GA Mean \pm SD	SA Mean \pm SD	<i>p</i> •
Age (years)	28.39 \pm 5.84	29.27 \pm 5.20	0.284
Height (cm)	161.96 \pm 4.34	161.20 \pm 4.76	0.320
Weight (kg)	76.84 \pm 11.05	76.91 \pm 8.23	0.963
Gestational week	38.72 \pm 1.17	38.71 \pm 1.17	0.945

•Student's *t* test.

on 28 February 2011. Parturients ranging between 18 and 40 years old, weighing over 50 kg, taller than 150 cm, at 37th weeks of gestation at least and classified in the ASA group I were included for data screening. Data of 172 cases were than analyzed after exclusion of inappropriate files. Selected cases were subsequently gathered under two groups – general anesthesia (GA, 85 cases) and regional anesthesia (RA, 87 cases) – according to the type of anesthesia performed during C/S. Demographics of these two groups are summarized in Table 1.

Factors concerning the process of pregnancy itself (e.g. multiple parities, preterm labor, fetal abnormalities and intrauterine growth retardation, SGA, Rh incompatibilities), labor (e.g. umbilical cord entanglement, meconium or amniotic fluid aspiration, urgent operations, partial placental abruption) and mother (bleeding disorders, renal or hepatic insufficiency, preeclampsia and eclampsia) were taken into consideration for defining exclusion criteria. Epidural and combined regional anesthesia had been applied in a minority of patients due to preference of anesthesiologist and obstetrician. Thus, these cases were also excluded. Furthermore, files lacking the appropriate set of data and individuals to whom predefined medications and dosages had not been administered were dispensed as well.

Patients to whom the following drugs had been administered were involved in the GA group:

- 4 mg/kg of thiopental sodium and 0.6 mg/kg rocuronium bromide for induction.
- 2% MAC sevoflurane dissolved in 50% O₂ and 50% air after orotracheal intubation and 1 mcg/kg fentanyl citrate once birth had occurred for maintainance.

Whereas in SA group the circumstance of involvement was intrathecal injection of 8–12 mg bupivacaine hydrochloride. Mothers' demographic characteristics and perioperative hemodynamic status – heart rate (HR), mean arterial pressure (MAP) and oxygen saturation (SaO₂) – before and at 5th, 10th, 20th and 30th minutes of surgery were recorded from follow-up documentary. Umbilical vein blood gas analysis which is a component of routine evaluation of neonatal wellbeing in our hospital was reviewed for pH, partial oxygen pressure (pO₂), partial carbon dioxide pressure (pCO₂), oxygen saturation (SaO₂), bicarbonate concentration [HCO₃⁻] and base excess (BE) values. First and fifth minute APGAR scores evaluated by a pediatrician were recorded as well. Standard scoring system as recommended were utilized for this purpose [7]. Eventually, in-hospital data of neonates were revised and taking recommended criteria into account, cases who had been diagnosed as TTN or had clinical characteristics consistent with TTN and without an alternative definite diagnosis were noted [8].

Table 2. Perioperative hemodynamic recordings of GA and SA groups.

	GA Mean \pm SD	SA Mean \pm SD	<i>p</i> •
HR			
0	95.14 \pm 14.61	98.89 \pm 17.33	0.167
5	105.58 \pm 19.07	90.39 \pm 21.69	<0.001
10	102.51 \pm 15.89	95.96 \pm 19.44	0.030
20	101.50 \pm 16.41	96.89 \pm 17.32	0.117
30	101.86 \pm 17.17	98.98 \pm 14.35	0.300
MAP			
0	96.12 \pm 13.33	94.28 \pm 10.15	0.380
5	104.01 \pm 21.84	82.09 \pm 17.01	<0.001
10	92.21 \pm 16.56	77.95 \pm 16.75	<0.001
20	83.85 \pm 16.55	76.79 \pm 12.18	0.007
30	87.30 \pm 15.20	76.09 \pm 9.55	<0.001
SaO ₂			
0	98.39 \pm 0.77	98.25 \pm 0.67	0.250
5	98.68 \pm 0.77	98.12 \pm 0.81	<0.001
10	98.62 \pm 0.55	98.11 \pm 0.80	<0.001
20	98.74 \pm 0.54	98.14 \pm 0.84	<0.001
30	98.73 \pm 0.60	98.05 \pm 0.10	<0.001

•Student's *t*-test. SD, standard deviation. HR, heart rate. MAP, mean arterial pressure. SaO₂, oxygen saturation. Significant *p* values are displayed in bold fonts.

Statistical analysis

Mean and standard deviation or median and range were utilized for continuous variables and percentage for categorical ones. Unpaired *t*-test was used for comparing continuous variables with normal distribution between two groups. Normal distribution was authenticated with one sample Kolmogorov–Smirnov test. Variables which had not been normally distributed were compared by Mann–Whitney U-test. Fisher's exact test was used for comparing categorical variables. A *p* value of less than 0.05 was considered to be significant for all of the tests. Statistical Package for the Social Sciences (SPSS version 13.0, SPSS Inc., Chicago, IL) was utilized for these calculations.

Results

Hemodynamic data

Hemodynamic parameters (HR, MAP and SaO₂) of the cases in GA and SA groups recorded before and at 5th, 10th, 20th and 30th min of operation are listed in Table 2. Although the initial values were similar between two groups, HR and MAP of GA group ruled higher during the rest of the operation. Statistical significance was preserved throughout the procedure for MAP. On the other hand for HR values, two curves got closer at 20th min and the difference was not distinctive thereafter. Although SaO₂ values were obviously higher in the GA group, it is mandatory to denote that none of them was lower than 98%.

APGAR score and umbilical vein blood gas analysis

First and fifth minute APGAR scores were significantly lower in the GA group. In the GA group, umbilical vein blood was more acidotic but oxygenation was better. We did not observe any evident difference between other parameters. Statistical data regarding these are demonstrated in Table 3.

Observed events

Due to retrospective examination of the files of newborns, 18 of 172 cases were diagnosed as TTN. Thirteen (13/85, 15.3%) of these neonates were born with C/S under general anesthesia and five (5/87, 5.7%) under spinal anesthesia. When two groups were compared according to the frequency of events observed there was a significant difference favoring SA ($p=0.048$). Distribution of the patients in each group is represented in Figure 1.

Discussion

Constantly increasing rates of C/S in developing countries appear to be a remarkable health issue. Patient's choice, repeated C/S without an attempt of vaginal delivery, physician's ease and concerns about punitive sanctions might be counted as major preliminary factors of this situation [9,10]. General anesthesia had become the technique of choice in C/S for many years, thus far. However, the potential detrimental effects of anesthetic agents on neonatal respiration, reports declaring increased rates of CPR, raise in maternal mortality due to difficulties in endotracheal intubation and increased risk of aspiration of the gastric content in GA favored the use of regional anesthesia in recent years [11]. In 1989, an original article published by Evans *et al.* [12] reported that GA had possibly depressed newborns and accused the systemic effect of anesthetic agents crossing the placental barrier. Subsequently, it was suggested that inhaling

oxygen with high concentrations had also contributed to the status of respiratory depression by not only increasing fetal oxygen levels but also oxidized free radicals [13]. By taking the set of data into consideration, international guidelines of obstetric anesthesia emphasizes the necessity of preferring epidural or spinal anesthesia for C/S rather than general anesthesia [14].

Rates of neonatal depression after C/S with general or regional anesthesia varies in several investigations. Most commonly used indices of neonatal depression are first and fifth minute APGAR scores. In a study designed by Mancuso *et al.* [15] involving 185 patients, neonatal depression (1st minute APGAR score <7) rates were compared between spinal and general anesthesia groups and for patients to whom general anesthesia had to be administered when intention to perform spinal anesthesia had failed. For depression rates, significant differences were observed between general versus transition and transition versus spinal anesthesia groups revealing the former the higher. In this statement, median fifth minute APGAR scores were determined to be lower merely in general anesthesia group. One of the most comprehensive studies about this issue was designed by Algert *et al.* [16] comprising assessment of 50 806 cases of mild, moderate and high risk C/S. Authors established the need of intubation or resuscitation of the newborn and APGAR score lower than 7 at fifth minute as end-points and stated the superiority of SA over GA. It is essential to denote the fact that the quantity of patients getting poor APGAR scores at fifth minute rarely reaches to statistically comparable levels in the literature. Moreover, due to limitations of a lack of clear C/S indication and emergency/elective status of the operation, utilization of 5th minute APGAR score as an end-point is controversial. In the Cochrane database analysis – comparing various maternal and neonatal parameters in regional and general anesthesia for C/S – there are only two studies including sufficient sample population to draw a conclusion [17,18]. And also there are conflicting results about first minute APGAR scores of neonates regarding the type of anesthesia in C/S. Neither Petropoulos *et al.* nor Cochrane database analysis reported any significant difference between regional and spinal anesthesia groups by means of APGAR scores and need of oxygen supplementation, bag valve mask ventilation or transfer to intensive care units [18,19]. Still, in several studies, lower APGAR scores particularly at the first minute were more frequently observed in RA [15,20]. Although this discrepancy of the findings complicates the assessment of

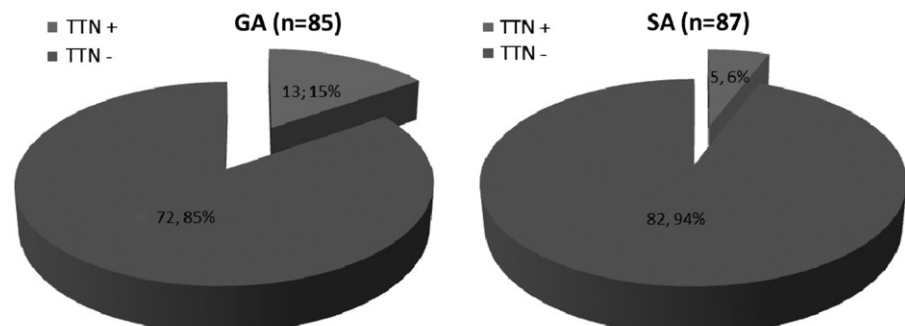
Table 3. First and fifth minute APGAR scores and umbilical vein blood gas analysis of sample groups.

	GA	SA	p^*
	Median, Range	Median, Range	
APGAR 1	8, 7	9, 2	<0.001
APGAR 5	9, 3	10, 2	0.031
	Mean \pm SD	Mean \pm SD	p^\bullet
pH	7.29 \pm 0.48	7.31 \pm 0.52	0.030
pO ₂ , mmHg	34.75 \pm 13.80	27.63 \pm 14.47	0.001
pCO ₂ , mmHg	47.45 \pm 12.30	44.81 \pm 8.23	0.098
SaO ₂ , %	56.60 \pm 18.78	49.80 \pm 21.44	0.029
[HCO ₃ ⁻], mEq/l	22.37 \pm 2.73	21.91 \pm 2.30	0.226
BE, mmol/l	2.81 \pm 2.50	3.14 \pm 2.16	0.364

*Mann–Whitney U-test.

•Student's *t*-test. SD, standard deviation. BE, base excess. Significant p values are displayed in bold fonts.

Figure 1. Distribution of TTN patients among GA and SA groups. 15.3% of newborns in the GA group and 5.7% in the SA group had the diagnosis of TTN. The difference was significant when frequencies have been compared ($p=0.048$).



overall picture, APGAR score is speculated to be a minor contributor of clinical outcome because of its subjectivity and weak correlation to asphyxia and poor neurologic prognosis [21]. There were no cases with a fifth minute APGAR score lower than 7 and 12 cases – all in the GA group – with a first minute APGAR score of 7 or less (12/85, 14.1%) in our study. Moreover, first and fifth minute APGAR scores were significantly lower in the GA group.

Umbilical cord blood gas analysis is another frequently used determinant of fetal wellbeing assessment. Nevertheless, results of randomized and non-randomized investigations and even meta-analysis are contradictory when comparing anesthesia techniques for fetal pH values is the case. In the Cochrane database meta-analysis according to three studies, umbilical vein blood pH values of the SA groups are established to be higher than GA groups without statistical significance. On the contrary, this difference reaches to significance in favor of epidural anesthesia as compared to GA [18]. Besides, it was concluded that type of anesthesia did not affect umbilical arterial pH. Pathologic values that could be considered as acidosis had not been encountered in any of the studies involved in this meta-analysis. Whereas, in various other reports umbilical cord blood pH was found to be lower in regional anesthesia [19,22]. Regional anesthesia associated hypotension was incriminated for development of fetal acidemia via reduction of uteroplacental blood flow [23,24]. Still, in several other studies umbilical cord blood pH were similar in general and regional anesthesia [12,20]. We assume that factors like procedural diversity in anesthesia techniques, utilizing umbilical artery or vein blood for sampling and difficulties in standardizing operative risks and perioperative hemodynamic stability cause the discrepancy about this data. In our study, umbilical vein blood pH was higher in the SA group comparable to the Cochrane analysis.

TTN prevalence which was major end point of our registry, had been reported in a range of 0.33 to 3.9% in various population studies [5,25]. TTN is obviously related with C/S [26,27]. Kolås et al. [28] reported a two-fold increase in frequency of TTN in elective C/S as compared with vaginal labor. Particularly, C/S performed before initiation of labor increases its frequency up to 7% [25]. Furthermore, lower first minute APGAR score and umbilical arterial pH less than 7.25 were established as indicators of poor prognosis for TTN in a recent study [27]. In a registry published by Gunaydin et al. [29], predictors of TTN occurrence in neonates born with C/S under spinal anesthesia were investigated and time interval from spinal block to the onset of surgery was stated as a relevant parameter. The authors emphasized the importance of expeditious action.

Unfortunately, due to our literature review there is only one study specifically investigating the association of type of anesthesia with TTN frequency. In the retrospective analysis performed by Keleş et al. [30], frequency of TTN was higher in general anesthesia; however, the difference was not statistically significant. To the best of our knowledge, our study is the first to establish a significant superiority of SA over GA by means of TTN occurrence.

Limitations

Retrospective nature of the study and relatively minor sample populations are the most prominent limiting factors of precise decision making. Epidural and combined spinal anesthesia were not preferred for C/S by anesthesiologists and surgeons in our facility therefore we could not constitute a distinct group.

Conclusion

In this publication, we shared our retrospective data about well-recognized but controversial parameters of fetal wellbeing – APGAR scores and umbilical vein blood gas analysis – and drafted a brief review of the literature. We also stated a relationship between the type of anesthesia and TTN occurrence. Spinal anesthesia might reduce the frequency of TTN, which is potentially an outstanding health issue when increasing rates of elective C/S all-over the world are considered. Finally, authors emphasize the necessity of performing prospective, randomized investigations with larger sample populations to authenticate their argument.

Declaration of interest

The authors report no declarations of interest.

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