

Original Article

Apgar scores and cord blood gas values on neonates from cesarean with general anesthesia and spinal anesthesia

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Abstract

Introduction: The incidence of cesarean section has increased in most countries in recent years. Anesthetic methods used during cesarean section have some advantages and disadvantages to both mother and neonate. In this study, for comparison of general and spinal anesthesia we evaluated the short-term outcome of neonates born through cesarean section.

Methods: Retrospectively, we studied 324 mothers undergoing cesarean section with general or spinal anesthesia. Data were obtained including maternal age, gravidity, parity, and reason of cesarean section. Maternal systolic and diastolic blood pressure, neonatal Apgar score 1st and 5th minutes, the biochemical status and blood gases of arterial samples withdrawn from the cord. Furthermore, we evaluated the relation between the maternal blood pressure changes with neonatal Apgar score and the sample of cord pH (Power of Hydrogen).

Results: Of 324 mothers undergoing cesarean section, 117 subjects (36.1%) had general and 217 (63.9%) had spinal anesthesia. There were no statistical significant differences between the two groups regarding the demographic characteristic. The one minute Apgar score group in the spinal anesthesia group was significantly higher than the general anesthesia group ($P = 0.01$). But there were no divergence between the two groups in five minute Apgar score. Mean fetal acidity in general anesthesia group was higher than the spinal anesthesia group, but their differences were not statistically significant. There were no statistical significant correlation between the maternal blood pressure and cord's arterial blood pH or neonatal Apgar score.

Conclusion: The one minute Apgar score in spinal anesthesia group was better and fetal acidosis was lower than the general anesthesia group, but there was not any significant difference between the two groups regarding systolic and diastolic pressure, and there was no significant correlation between the maternal mean blood pressure, Apgar score and pH of arterial cord samples. Thus, possibility of maternal hypotension and decreased uteroplacental perfusion should not prevent the use of spinal anesthesia for cesarean section.

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Introduction

Today, cesarean delivery accounts for in more than 30% of all births and is the most common surgical procedure performed in the United States, 1 million performed per year; in other developed countries the cesarean delivery rate varies between 15% and more than 30%.

Since 1970s, a progressive increase in the cesarean delivery rate has been observed

worldwide.^{1,2} Selection of an appropriate anesthesia for cesarean section have been discussed since a long time and depends upon surgical indications, emergency status, the maternal status and patient's tendency, and also with regard to its effect on uterine blood flow, with the effects on uterine vascular resistance and placental perfusion pressure can affect the outcome of pregnancy.

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The most appropriate anesthetic technique for cesarean delivery depends on maternal, fetal and obstetric factors; also the anticipated duration of the operation plays an important role in the selection of anesthetic technique. Although each anesthesia method for cesarean section has advantages and disadvantages to both mothers and neonates, and may result in short-term and long-term neonatal effects,³ the anesthesiologist must choose the safest method for mother and the least depressant technique for neonate. Internationally, obstetrics guidelines recommended spinal and epidural anesthesia for cesarean sections.^{4,5}

The primary reason to recommending regional blocks is the risk of intubation failure and aspiration of gastric contents in pregnant women under general anesthesia⁶ that is mentioned as the most important cause of maternal mortality due to anesthesia with the rate of 16.2 times greater than the spinal anesthesia.¹ However, general anesthesia can be considered as the quickest anesthesia method, in emergency cases.

While there is some evidence that general anesthesia is associated with an increasing requirement of neonatal resuscitation,⁶ the reasons for the specific indications of delivery and details of neonatal outcomes for resuscitation are limited.

On the other hand, with spinal anesthesia, the fetus is not exposed to the depressant effects of anesthetic drugs, but high incidence of hypotension after spinal anesthesia that is followed by the reduction in uteroplacental blood flow and impairment in perfusion can have side effects on fetus. It should be considered that drugs affect the fetus in two ways i.e. directly by passing through the placental transmission such a state being used in general anesthesia, and this effect is negligible in spinal anesthesia and indirectly through the maternal biochemical and physiological changes that is more important.⁷

Selection the safest and most convenient method for mothers who have a minimum depressant effect on the fetus is the responsibility of anesthesiologists. Differences

in neonatal outcomes with different methods of anesthesia are not clear.

After delivery, the first and fifth minute Apgar scoring system and Euro-behavioral review are the relatively common criteria for evaluating the clinical status of the infant.³ Bio-chemically, umbilical cord blood analysis is a gold standard to assess the acid-base status and uterine placental performance. Furthermore, umbilical artery blood values of Be, HCO₃, Pco₂, pH showed a fetal condition at birth, especially during high-risk pregnancies, and the possibility of fetal depression.^{8,9}

The aim of this study was to evaluate the first and fifth minute Apgar scores and changes in biochemical parameters and umbilical arterial blood gas [pH, Pco₂, HCO₃, Be (base excess)] of neonate resulting from cesarean section with general or spinal anesthesia, and compare these two groups with regard to short-term outcome of neonates and find a significant correlation between the status of neonate after birth and selective anesthetic method (general or spinal anesthesia) during cesarean section according to the hemodynamic changes occurring in both methods.

Methods

In this cross-sectional study, patients were evaluated who were undergoing cesarean surgery during the period of a year from September 2009 to 2010 at Al-Zahra Obstetrics and Gynecology University Hospital of Tabriz, Iran, after the approval of study from Ethics Committee of Tabriz University of Medical Sciences. The records of all women who had cesarean section were retrieved. Data on maternal age, parity, gravidity, gestational age at delivery, Apgar scores, birth weight (g), maternal mortality and perinatal mortality were extracted. Of the total 662 cases, 190 cases had general anesthesia and 472 cases had spinal anesthesia. Spinal anesthesia was performed with 75-100 mg of lidocaine 5% plus 10 µg fentanyl in sitting position via 25 gauge needle from L4-L5 interspaced. General anesthesia was induced with 5-6 mg/kg

thiopental, 1 mg/kg succinylcholine and 1 m/kg lidocaine intravenously as rapid sequence induction. Since the number of population for the study was limited, all of the cases with inclusion criteria were included in this study.

After excluding 73 cases with general anesthesia and 265 cases with spinal anesthesia, 324 cases (117 cases with general anesthesia and 207 cases with spinal anesthesia) of cesarean section with normal pregnancies over 34 weeks with no age limit were investigated.

Exclusive criteria was included presence of underlying internal disease, coronary heart disease, respiratory or renal disease, diabetes, preeclampsia or eclampsia, cord prolepses, severe fetal bradycardia [fetal heart rate (FHR) < 100], intrauterine growth retardation and documented abnormalities.

Required data were obtained from the medical records. Demographic findings included maternal and gestational age, gravidity and caused of cesarean section. Mean maternal systolic and diastolic blood pressure, neonates 1st and 5th Apgar score, umbilical artery blood gas and neonates blood biochemistry compared between two groups. Presence or absence of an association between the maternal blood pressure changes and neonates Apgar scores and blood pH were also examined.

Obtained data were expressed as mean \pm SD and also frequency and percentage. To compare the quantitative data (demographic data) independent samples t-test, Pearson correlation coefficient test and for qualitative data the Fisher's exact test or chi square test were used, respectively. Data were analyzed by SPSS for Windows (version 17; SPSS Inc., Chicago, IL, USA). In all investigated cases, the results have been known statistically significant in case they were $P \leq 0.05$.

Results

One hundred and seventeen pregnant females of 324 cases by caesarean section under general anesthesia (36.1%) and 207 cases underwent spinal anesthesia (63.9%). In

terms of demographic features, there was no statistically significant difference between the two groups (Table 1).

Apgar score comparison showed that the mean first minute Apgar score in the general and spinal anesthesia groups were 7.1 and 7.3, respectively.

Table 1. Some descriptive demographic characteristic of mothers and neonates

| Variable | General anesthesia (n = 117) | Spinal anesthesia (n = 207) |
|--------------------------|------------------------------|-----------------------------|
| Age (years) | 30.60 \pm 6.20 | 27.19 \pm 5.80 |
| Gestational age (months) | 37.00 \pm 3.70 | 37.00 \pm 1.49 |
| Gravidity | 2.30 \pm 1.30 | 2.00 \pm 1.10 |
| Birth weight (grams) | 3011 \pm 554 | 3198 \pm 192 |

So the 1st minute Apgar score in the spinal anesthesia group was significantly higher than the general anesthesia group ($P = 0.01$) (Table 2). Mean Apgar score at 5th minute in general and spinal anesthesia groups were 9.3 and 9.1 respectively that had no significant difference between the groups ($P > 0.05$). The results of neonatal 1st and 5th Apgar scores according to the number of neonates score in each group are summarized in table 3. The highest 1st Apgar score in the two groups was 9 (73.3%) and afterward, were 8 (12.7%), 7 (7.4%) and 6 (3.4%) and 5 (1.2%), respectively (Table 3). The highest 5th Apgar score was number 10(95%) and the lowest was 8 (1.2%) (Table 4).

Umbilical artery blood gases and blood biochemistry values evaluation also showed that mean fetal acidity (low pH) in general anesthesia group was higher than spinal anesthesia group; it means that the embryos were more acidotic, although this difference was not statistically significant (Table 2).

In other blood gas parameters (P_{CO_2} , HCO_3 , Be) there was no difference between the two groups; although the mean P_{CO_2} in the general anesthesia and spinal anesthesia groups were 38.48 ± 89.16 and 24.56 ± 15 respectively, and there was not any difference between the two groups, it indicates that neonates of general anesthesia group were more hyperbaric (Table 2).

Table 2. The first and fifth minute Apgar values and umbilical artery blood gas and blood biochemistry

| Variable | General anesthesia (n = 117) | Spinal anesthesia (n = 207) | P |
|--------------------|------------------------------|-----------------------------|-------------------|
| First minute Apgar | 7.19 ± 0.70 | 7.38 ± 0.55 | 0.01* |
| Fifth minute Apgar | 9.30 ± 0.90 | 9.10 ± 0.70 | 0.14 [†] |
| pH | 7.27 ± 0.13 | 7.21 ± 0.13 | 0.20 [†] |
| PCO ₂ | 48.38 ± 16.89 | 56.24 ± 15.00 | 0.62 [†] |
| HCO ₃ | 20.93 ± 3.44 | 21.95 ± 2.60 | 0.15 [†] |
| Be | -5.84 ± 3.76 | -6.50 ± 3.43 | 0.21 [†] |

*P-values were significant ($P \leq 0.05$); [†]P-values were not significant ($P > 0.05$); Data are presented as mean ± SD
pH: Hydrogen ion concentration; PCO₂: Partial pressure of carbon dioxide; HCO₃: Bicarbonate; Be: Base excess/deficit

Table 3. Comparison of the 1st Apgar score in the two groups

| Group | Apgar | 9 | 8 | 7 | 6 | 5 | P |
|--------------------|-------|------------|-----------|-----------|---------|---------|--------|
| General anesthesia | | 77 (65.8) | 14 (12.0) | 13 (11.1) | 9 (7.7) | 4 (3.4) | < 0.01 |
| Spinal anesthesia | | 167 (80.7) | 27 (13.0) | 11 (5.3) | 2 (1.0) | 0 (0.0) | |

Data are presented as number (percentage)

Table 4. Comparison of the 5th Apgar score in the two groups

| Group | Apgar | 10 | 9 | 8 | P |
|--------------------|-------|------------|-----------|---------|------|
| General anesthesia | | 77 (65.8) | 36 (30.8) | 4 (3.4) | 0.01 |
| Spinal anesthesia | | 167 (80.7) | 40 (19.3) | 0 (0.0) | |

Data are presented as number (percentage)

The mean systolic and diastolic blood pressure of mothers in general anesthesia group were 105.2 ± 10 and 85.7 ± 14 , respectively; while this values in the spinal anesthesia group were 100.3 ± 21 and 78.9 ± 20 , respectively. This indicated that the decrease in diastolic blood pressure was greater in the spinal anesthesia group but this difference was not significant statistically ($P > 0.05$). In addition, the mean systolic blood pressure was lower in the spinal anesthesia group, but this difference was not statistically significant ($P > 0.05$). Results showed that there was no significant correlation between the changes in maternal systolic blood pressure and infants first and fifth minute Apgar score ($r = 0.24$; $r = 0.11$; $P > 0.05$).

Fetal acidosis was a little higher in the spinal anesthesia group, but not statistically significant (pH = 7.27 ± 0.13 vs. 7.21 ± 0.13). In statistical analysis between the blood acidity of umbilical artery and maternal systolic blood pressure in two groups there was not any significant correlation ($r = 0.03$; $r = 0.22$; $P > 0.05$).

Discussion

The results of this study indicate that the first

minute Apgar score of neonates in the spinal anesthesia group was better than general anesthesia group, but there was no statistical significant difference in 5th Apgar score and umbilical artery biochemical values between two groups ($P > 0.05$), although fetal acidosis was a little higher in the spinal anesthesia group, it was not statistically significant (pH = 7.27 ± 0.13 vs. 7.21 ± 0.13).

Martin et al. in a retrospective study from 2000 to 2003 that was conducted in one hospital and included a number of 948 cesarean sections, compared 64 cases underwent spinal anesthesia and 425 cases underwent general anesthesia. The rates of maternal hemorrhage need transfusion, and neonates' birth weight, first and fifth minute Apgar scores and care in a neonatal intensive care unit (NICU) were investigated, and the results showed that bleeding and the number of transfusion was low in mothers who had spinal anesthesia. Besides, in those infants whose mothers had cesarean section under spinal anesthesia, first and fifth minute Apgar scores were higher than those who underwent general anesthesia and the difference was significant.¹⁰

In Yegin et al. study, the first and fifth

minute Apgar scores of neonates in the general anesthesia group was lower than the regional anesthesia group, and the difference of fifth minute Apgar score was statistically significant.³

Zahir et al. compared maternal and neonatal outcome between spinal and general anesthesia groups and resulted that newborns born to mothers who underwent spinal anesthesia had significantly better Apgar scores and lower NICU admission than babies from general anesthesia.¹¹

Evans et al. showed that the 1st and 5th Apgar scores of neonates delivered from general anesthesia were lower than neonates delivered from mothers underwent elective cesarean section with regional anesthesia including epidural and they concluded that general anesthesia, rather than asphyxia or aortocaval compression, is responsible for most of the depressed neonates delivered by cesarean section.¹²

In a study, Solangi et al. also found satisfactory pH (pH > 7.30) was found high, 75 (93.7%) in spinal group as compared to general anesthesia group 67 (83.7%) and unsatisfactory pH (pH < 7.30) was low, 5 (6.3%) in spinal as compared to general anesthesia group 13 (16.3%). They observed that Apgar score and umbilical artery blood pH of neonates whose mothers received general anesthesia were lower than neonates whose mothers received spinal anesthesia.¹³

In our study, the neonates mean first minute Apgar score in spinal anesthesia group was significantly higher than the general anesthesia group ($P = 0.01$), but regarding the fifth minute Apgar score there was no difference between the two groups. This can be demonstrated that the general anesthesia has short-term effect on newborns and has no long term effect on the neonates.

Some studies showed that regional anesthesia decreased uterine blood flow in placenta and thus impaired fetal acidic-base condition even in an existence of a normal placental store.^{14,15}

In this study, we compared the maternal

blood pressure in two groups and umbilical artery blood gas and biochemical values in neonates of two groups and the relationship between maternal hemodynamic and neonatal acid-base parameters. Although the most useful parameter in umbilical venous blood is blood pH, because arterial blood is more indicative of fetal metabolic status and maybe there is arterial acidemia despite normal venous pH, therefore, analysis of umbilical venous blood samples alone is not recommended. A complete analysis of blood gases may reveal important information about the cause of acidemia and both arterial and venous samples provide a more clear assessment. However values of Be, Pco₂ and pH will change at different sampling techniques. Additional heparin or air in the syringe or remaining of the sample in room temperature is also impressive. The difference in timing of cord clamping should also be considered.

In a meta-analysis of 27 studies that were conducted by Reynolds, the neonate's acid-base information with different types of anesthesia have been reported, and umbilical vein or artery pH and BE [Base Excess] were compared. In this study, the umbilical cord pH with spinal anesthesia was significantly lower than general and epidural anesthesia, and the fetal acidosis was greater than two other methods.⁷ On the other hand, Kavak et al. revealed that the arterial pH, bicarbonate, pAO₂ (partial pressure of oxygen) and pCO₂ (partial pressure of carbon dioxide) of neonates born both under spinal or general anesthesia, were similar, they resulted that anesthesia type does not influence the short-term outcome of newborns in elective cesarean section.¹⁶ Ngan Kee and Lee in their analysis concluded that the large decrease in maternal systolic pressure is an important factor in the umbilical artery pH, but had no effect on umbilical artery Be [Base Excess]. Maternal blood pressure cannot be a representative for fetal outcome and its changes is short-term. Furthermore, placental blood flow, alone, does not depend on maternal blood pressure, but also depends

on mother's cardiovascular records. Problem of maternal hypotension after spinal anesthesia and the possibility of reduction in blood supplement to the fetus however, are treating with appropriate and timely use of vasopressor drugs. But sometimes it prevents the routine use of this method for caesarean section.¹⁷ In our study, umbilical artery blood pH of neonatal in spinal anesthesia group was a little lower than the others, but the difference was not significant ($P = 0.20$). Besides, other umbilical artery parameters such as pCO_2 , HCO_3 and BE [Base Excess] had no significant differences between the two groups. And finally, there was no difference in maternal systolic and diastolic blood pressure in the two groups. Therefore, we could not find any statistical significant correlation between the

maternal mean blood pressure changes with neonatal Apgar scores and umbilical artery acid-base status.

Conclusion

Therefore it can be said that both general and spinal anesthesia are safe for cesarean section, but it seems that using the spinal anesthesia is more appropriate and healthy method for mothers and for neonate's outcomes than the general anesthesia. Further evaluations in future by large studies on emergency cesarean sections are recommended, with having all grades of anesthesia risk factors.

Conflict of Interests

Authors have no conflict of interest.

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