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Main subject [Anesthesia and Intensive Care]\*



## Original article

### Spinal versus General Anesthesia for Elective Cesarean Section: Immediate Outcome

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Received at: August 29, 2019; Revised at: May 23, 2020; Accepted at: May 23, 2020; Available online at: May 23, 2020

DOI: [10.21608/ijma.2020.16397.1026](https://doi.org/10.21608/ijma.2020.16397.1026)

#### ABSTRACT

**Background:** Recent interest has focused on the influence of obstetric anesthesia types on the immediate neonatal and maternal outcome.

**Aim of the work:** The study was intended to assess the immediate neonatal and maternal outcome in relation to the maternal anesthesia type during cesarean section.

**Patients and Methods:** The present study included 200 full term neonates whose mothers underwent elective cesarean section [CS]. They were grouped according to type of anesthesia given to mothers into group 1: included 100 newborns whose mothers had general anesthesia and group 2: included 100 newborns whose mothers had spinal anesthesia. Each newborn evaluated for short-term outcome including Apgar score, need for NICU admission and blood gas analysis. Mothers assessed for postoperative outcome.

**Results:** No significant differences were discovered between the types of anesthesia used in regard to the general maternal characteristics. Neonatal outcomes on the other hand showed no significant differences as regard Apgar score [P=0.33] and NICU admission [P= 0.57], PaCO<sub>2</sub>, HCO<sub>3</sub>, Na and K; while PH and PaO<sub>2</sub> were significantly lower with spinal anesthesia [P= 0.02 and 0.008 respectively]. Additionally, spinal anesthesia was associated with rapid recovery of bowel and less need for postoperative analgesia.

**Conclusion:** The type of anesthesia used in mothers undergoing full term elective cesarean deliveries does not seem to affect the immediate neonatal outcome. Both may be safely used in full term elective cesarean deliveries. However, spinal anesthesia had the advantage of lower need for postoperative analgesia with rapid recovery of bowel.

**Keywords:** Anesthesia; Cesarean; Neonatal; Morbidity; Outcome.

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Please cite this article as: Sarhan TS, Diab AA, Abdel-Aal MA. Spinal versus General Anesthesia for Elective Cesarean Section: Immediate Outcome. IJMA 2020; 2[3]: 487-492.

\* Main subject and any subcategories have been classified according to the research topic.

## INTRODUCTION

Cesarean section is considered among the most commonly performed abdominal operations in women worldwide<sup>[1]</sup>. Globally, a progressive increase in cesarean delivery rates have been observed in the last few years<sup>[2]</sup>.

Both general anesthesia [GA] and regional anesthesia [RA] are frequently used in cases of cesarean sections and each type has its advantages and disadvantages. So, it is essential to illuminate what type of anesthesia is more efficacious<sup>[3]</sup>.

For several years, general anesthesia has been the preferred kind of anesthesia in CS<sup>[4]</sup>. Although, its several advantages like rapid induction, superior cardiovascular stability and excellent control of ventilation, anesthetic drugs used in GA possess the ability of crossing the placental barrier inducing neonatal depression<sup>[5]</sup>. On the other side, SA has many advantages such as reduced estimated blood loss<sup>[6]</sup>, shorter hospital stay<sup>[7]</sup>, fewer surgical site infections<sup>[8]</sup> and fewer neonates requiring intubation<sup>[9]</sup>. There are variable results regarding the short-term effect of type of anesthesia used on the immediate neonatal outcome<sup>[3]</sup>.

## AIM OF THE WORK

Our study target was to assess immediate neonatal morbidities in relation to the type of maternal anesthesia during cesarean section.

## PATIENTS AND METHODS

The current comparative study included 200 full term neonates delivered by elective CS, which were grouped into two groups according to type of anesthesia given to their mothers. group 1 [n= 100]: mothers were given general anesthesia and group 2 [n= 100]: mothers were given spinal anesthesia.

All newborns were selected from obstetric department of Al-Azhar University hospitals over a period of one year from April 2017 to April 2018. The inclusion criteria were full term singleton uncomplicated pregnancy with elective cesarean section. Mothers with Complicated pregnancy [gestational diabetes, pre-eclampsia, placenta previa, etc.], disease [diabetes, hypertension, known chronic disease as TB, chronic renal failure etc.] or congenital malformation known antenatally in the newborn were excluded.

Maternal age, parity, gestational age [calculated from the date of the last menstrual period] and vital data were obtained from each mother. Each newborn was submitted for complete general and local examination. Neonatal outcome was evaluated by documentation of Apgar score, need for respiratory support, markers of tissue damage [aspartic aminotransferase, alanine aminotransferase and creatine kinas], and blood gas analysis. Samples had been withdrawn from umbilical cord artery to assess acid-base status, PO<sub>2</sub> and PCO<sub>2</sub>. In addition, the secondary outcome included maternal hemodynamics [mainly measurement of mean arterial pressure and heart rate before and during surgery], postoperative oxygen saturation, the duration to open bowel, duration of postoperative analgesic request and total analgesic requests.

Mothers were randomly allocated to spinal or general anesthesia after their informed consent. General anesthesia protocol included pre-induction oxygenation with 4 or 5 vital-capacity breaths of pure oxygen using an oro-facial mask, followed by the induction regimen of 5 mg/kg intravenous thiopental, then endotracheal intubation and administration of 1 mg/kg succinylcholine chloride. Finally, 0.5 mg/kg of atracurium besylate was administered after the cord had been clamped. Controlled mechanical ventilation was started using a mixture of 50% oxygen and 50% nitrous oxide, with a 0.5 minimum alveolar concentration of sevoflurane. Moderate maternal hyperventilation was maintained at a tidal volume of 10 mL/kg and a respiratory rate sufficient to achieve an end tidal carbon dioxide pressure between 30- and 32-mm Hg. Mothers were rested in the left 15° lateral tilt position until delivery.

Spinal anesthesia was performed in a flexed, sitting position using a 25-gauge Sprotte needle or a 27- gauge Whitacre needle placed in the L2–L3 or L3–L4 intervertebral space through which a 2 mL of hyperbaric 0.5% bupivacaine mixed with 0.2 mg of morphine sulfate was injected. The dose was reduced to 1.75 mL of hyperbaric 0.5% bupivacaine and 0.25 mL of morphine sulfate in patients with a height less than 1.55m.

Samples were obtained within 2 minutes after birth; using pre-heparinized 3ml syringe from the umbilical artery before ligation of the neonatal end of the cord. Blood gases were analyzed by automated

benchtop blood gas analyzer [ABL800 FLEX; Radiometer® Medical Global Inc, Copenhagen, Denmark]. The levels of aspartic aminotransferase [AST], alanine aminotransferase [ALT] and creatine kinase [CK] were measured using a Hitachi 7600 analyzer [Hitachi High-Technologies Corporation, Tokyo, Japan].

**Ethical consent:** written informed consent was taken from the parents of each baby after explanation of the aim of the study, its expected benefit for their infants and approved by the Hospital Ethics Committee in accordance with local research governance requirements. Statistical analysis: We used SPSS software for statistical analyses, version 25 [Chicago, IL, USA].

**Statistical analysis:** We used SPSS software for statistical analyses, version 25 [Chicago, IL, USA]. Quantitative data were expressed as the mean ± standard deviation [SD]. To compare between two means, the Student's t test was used. Qualitative data were presented as relative frequency and percent distribution. To compare between groups, Chi square test was used or Fisher's exact test in case of 2x2 tables and one cell is less than 5. A p value <0.05 was considered statistically significant<sup>[10]</sup>.

**RESULTS**

In the present work, there was no significant difference between types of anesthesia regarding

general maternal characteristics [table 1].

Regarding neonatal outcomes, there were no significant differences as regard Apgar score [P: 0.33] and NICU admission [P: 0.57], presence of meconium stained liquor and the need for respiratory support [table 2].

Regarding laboratory data, there were no significant differences as regard PaCO<sub>2</sub>, Hco<sub>3</sub>, Na and K; while PH and PaO<sub>2</sub> were significantly lower with spinal anesthesia [P: 0.02 and 0.008 respectively]. Also, no differences were observed as regard AST, ALT and CK [table 3].

Regarding maternal outcome, both groups were comparable as regard to mean arterial pressure and heart rate during surgery. In addition, no statistically significant difference was reported between both groups regard postoperative oxygen saturation or body temperature. However, there was statistically significant decrease of duration to open bowel in spinal when compared to general anesthesia groups [6.18±0.88 vs 9.31±1.13 hours respectively]. Also, the duration for first analgesic request was significantly longer in spinal when compared to general anesthesia group [331.50±53.30 vs 141.90±31.93 minutes respectively]. Finally, the number of total analgesic requests was significantly lower in spinal group [1.28±0.55] when compared to general anesthesia group [2.60±0.59] [Table 4].

**Table [1]:** Maternal characters in relation to the type of anesthesia

	General [n=100]	Spinal [n=100]	Test	P
<b>Mother's age [year]</b>	26.3±3.5	25.5±3.7	1.57	0.12
<b>Parity [No. %]</b>				
Primipara	37 [52%]	28 [28%]	1.46	0.23
Multipara	63 [48%]	72 [72%]		
<b>Systolic BP [mmHg]</b>	122.5±9.5	121.9±10.3	0.42	0.67
<b>Diastolic BP [mmHg]</b>	76.3±6.3	77.3±8.3	0.96	0.34
<b>Gestational age [wks]</b>	39.29±0.8	39.15±0.9	1.24	0.21

**Table [2]:** Clinical outcomes of studied newborns

	General [n=100]	Spinal [n=100]	P
<b>Apgar score</b>			
< 7	3 [3%]	7 [7%]	0.33
≥ 7	97 [98%]	93 [93%]	
<b>NICU admission</b>	5 [5%]	8 [8%]	0.57
<b>Respiratory support [No., %]</b>	3 [3%]	2 [2%]	1
<b>Meconium staining liquor</b>			
Positive	3 [3%]	5 [5%]	0.72
Negative	97 [97%]	95 [95%]	

**Table [3]:** Laboratory data among studied neonates

	General [n=100]	Spinal [n=100]	Test	P
PH	7.31±0.05	7.29±0.07	<b>2.3</b>	<b>0.02*</b>
PaCO <sub>2</sub> [mmHg]	48.6±8.7	48.5±9.9	0.07	0.94
PaO <sub>2</sub> [kPa]	29.6±6.2	27.2±6.5	<b>2.67</b>	<b>0.008*</b>
SaO <sub>2</sub> , %	54.62±18.78	49.87±21.44	1.67	0.097
HCO <sub>3</sub> [mmol/L]	21.2±3.3	22.2±5.1	1.6	0.1
Base excess	- 3.57±1.23	- 3.36±1.08	1.28	0.2
Creatine kinase [IU/l]	234.45±96.77	218.23±87.14	1.24	0.21
Aspartate aminotransferase [IU/l]	52.78±12.67	51.07±10.91	1.62	0.1
Alanine aminotransferase [IU/l]	19.34±6.52	18.49±7.19	0.87	0.38

\*: significant

**Table [4]:** Hemodynamic data and postoperative outcome among studied females

		General [n=100]		Spinal [n=100]		Test	p
		Mean	SD	Mean	SD		
Mean arterial pressure	Initial value	94.41	8.76	93.37	8.47	0.85	0.40
	At 10 minutes	79.43	8.17	78.38	8.33	0.90	0.36
	At 20 minutes	84.12	8.14	83.47	8.53	0.55	0.58
	At 30 minutes	86.61	7.27	85.61	7.75	0.94	0.34
Heart rate	Initial value	92.78	4.61	92.45	4.59	0.50	0.61
	At 10 minutes	90.71	4.57	90.01	4.67	1.07	0.28
	At 20 minutes	87.72	4.57	87.15	4.34	0.90	0.36
	At 30 minutes	82.89	4.85	82.21	4.50	1.02	0.30
Postoperative outcome	O <sub>2</sub> saturation	98.93	0.70	98.80	0.70	1.31	0.18
	Temperature	37.27	0.43	37.26	0.44	0.17	0.85
	Time to open bowel	9.31	1.13	6.18	0.88	<b>21.79</b>	<b>&lt;0.001*</b>
	First analgesic request [min]	141.90	31.39	331.50	53.30	<b>30.65</b>	<b>&lt;0.001*</b>
	Total analgesic requirements	2.60	0.59	1.28	0.55	<b>16.39</b>	<b>&lt;0.001*</b>

## DISCUSSION

In the present work, significant variations were observed regarding the frequency of low Apgar score [ $< 7$ ] at first minute. Furthermore, at 5<sup>th</sup> minutes, all cases had a score  $\geq 7$ . Thus, there is no type of anesthesia has been shown to be superior to the other, as far as the determination of asphyxia is concerned. These results are in agreement with a meta-analysis done by Afolabi and Lesi<sup>[3]</sup>, who reported that there were no differences in Apgar score measurements between the intervention comparison groups. Low Apgar score was more frequent among SA. In contrast, Havas et al.<sup>[7]</sup> reported that the mean values of Apgar scores at the first [P: 0.001] and fifth minutes [P: 0.105] were higher in the groups receiving SA, compared with the group receiving GA. In the present work, mean pH values were significantly lower with SA than GA. The differences found may not be clinically significant as the mean figures were within normal neonatal limits [7.11 to 7.45]. The explanation for this acidemia remains obscure. Factors, such as magnitude and duration of maternal hypotension have been

proposed<sup>[11]</sup>. These results are in agreement with a cohort study and a large epidemiological study that showed an increased risk of fetal acidemia after SA as compared to GA<sup>[12,13]</sup>. The explanation for this acidemia remains obscure. Factors, such as magnitude and duration of maternal hypotension have been proposed<sup>[14]</sup>.

As a result, various measures have been suggested and implemented to minimize fetal acidosis, including the use of an appropriate vasopressor agents to minimize maternal hypotension, intravenous fluid loading, maternal positioning and shortening of the uterine incision-delivery interval<sup>[15]</sup>. In addition, Reynolds and Seed<sup>[16]</sup> included 27 studies in their analysis and concluded that the use of SA was associated with significantly lower umbilical pH and higher base deficit than were both GA and EA. The authors however included both randomized and non-randomized trials and combined both umbilical vein and artery pH data in their analysis of cord pH.

On the other hand, Afolabi et al.<sup>[17]</sup> investigated several measures of maternal and neonatal outcome

in 16 prospective studies, of which only three studies comparing umbilical artery pH were included [and excluded base deficit] in SA and GA, which did not confirm the results of the present work. In addition, Afolabi and Lesi<sup>[3]</sup> reported that, neither umbilical artery nor vein pH was affected by spinal anesthesia when the indications for surgery are not urgent. Furthermore, Shek et al.<sup>[15]</sup> reported that GA was associated with a lower pH in the umbilical artery [UA] and vein. They found that fetuses born under general anesthesia had the lowest Base excess in the UA. In the present study, Po<sub>2</sub> was higher with GA when compared to SA. On the other hand, there was non-significant difference between different anesthetic techniques as regard to PaCO<sub>2</sub>, HCO<sub>3</sub>, Na or K. In a recent study, umbilical vein blood had better oxygenation in the GA group. There was no evident difference between other parameters [pCO<sub>2</sub>, HCO<sub>3</sub> and base excess] <sup>[18]</sup>. The higher PaO<sub>2</sub> associated with GA could be attributed to ventilation of the mothers with 100% O<sub>2</sub> until delivery<sup>[19]</sup>. This could also have contributed to the higher PCO<sub>2</sub> in other studies associated with GA, as it has been postulated that maternal hyperoxia could cause hypoventilation and consequent CO<sub>2</sub> retention in the mother and placental vasoconstriction<sup>[20]</sup>.

In the present work, cases need NICU admission was slightly increased among SA than the GA with non-significant difference. These results are in agreement with Shek et al.<sup>[15]</sup> who reported that, no significant variations in the admissions rates to NICU among both groups were observed, the incidences being 19.4 % and 11.1 % for SA and GA respectively.

On the other hand, Tonni et al.<sup>[21]</sup> reported that, the need for assisted ventilation was higher among neonates born under general rather than spinal anesthesia [P=0.01]. No differences were observed regarding other intermediate neonatal outcomes. There were no significant variations as regard ALT, AST and CK. Similarly, Kavak et al.<sup>[22]</sup> reported that all primary outcomes were similar in the neonates born both by spinal and general anesthesia including creatine kinase, AST and ALT [P>0.05].

Results of the present work revealed the superiority of spinal anesthesia in rapid recovery of the bowel and less need for postoperative analgesia. However, both groups were comparable as intraoperative hemodynamic parameters. This could be attributed to the strict selection criteria with

exclusion of any mother with any disease condition which could affect patient hemodynamics. In addition, strict monitoring and intervention with any deviation could be responsible for the non-significant difference regarding intraoperative maternal hemodynamics. Results of our work come in agreement with Madkour et al.<sup>[23]</sup> who reported that, mean time until bowel to be opened was significantly shorter in spinal group [6.8±1.6 vs. 9.7±1.3 h, P=0.001], and the first requirement for analgesia was significantly longer in spinal group [5.33±4 vs. 2.91±2.16 h, P=0.004]. Also, the total dose of required analgesia needed was significantly higher in the general anesthesia group [P=0.001]. They also reported that, the intraoperative blood pressure was not significantly different between groups, and attributed this to good preoperative hydration with 1000 ml of colloid solution. On the other side, Abdallah et al.<sup>[24]</sup> found a higher incidence of intraoperative tachycardia with general anesthesia and they explained this by the stress of rapid-sequence induction and inadequate analgesia which was postponed till delivery of the fetus. In favor of spinal anesthesia, Ghaffari et al.<sup>[25]</sup> concluded that, spinal anesthesia should be the technique of choice for cesarean section as it not only avoids a drawbacks of general anesthetic and risk of failed intubation, but it also offers effective pain control, mobility and fast return to the usual daily activities.

The strengths of the current study include the relatively high number of subjects. However, the shorter duration of the follow up represents one limiting step of the current work

**Conclusion:** The type of Anesthesia used does not seem to affect the immediate outcome of full-term newborn delivered by elective cesarean sections; however, general anesthesia associated with better oxygenation and decreasing frequency of lower PH, while spinal anesthesia was associated with shorter duration to open bowel, and low postoperative analgesia with longer duration for first analgesic request. Both types of anesthesia; spinal and general could be safely performed in elective cesarean deliveries.

#### **Financial and Non-Financial Relationships and Activities of Interest**

*None declared by the authors*

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