

EXAMINING MATERNAL AND FETAL OUTCOMES IN CESAREAN SECTION: A COMPARATIVE STUDY OF GENERAL VERSUS SPINAL ANESTHESIA AT JORDANIAN ROYAL MEDICAL SERVICES

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Abstract: This study investigates the impact of general versus spinal anesthesia on maternal and fetal outcomes in cesarean sections at the Jordanian Royal Medical Services. A total of 100 singleton pregnant women, aged 18-35, undergoing elective cesarean sections were included in this retrospective randomized controlled clinical trial. Patients were divided equally between general anesthesia (n=50) and spinal anesthesia (n=50) groups. Key outcomes measured included Apgar scores, neonatal intensive care unit (NICU) admissions, maternal hemodynamic parameters, hematological profiles, and postoperative recovery markers. The results showed that the spinal anesthesia group had significantly better first-minute Apgar scores and lower postoperative hemoglobin drop compared to the general anesthesia group. NICU admission rates were similar between groups. Spinal anesthesia was associated with a higher incidence of intraoperative hypotension but demonstrated advantages in postoperative pain management and faster gastrointestinal recovery. The findings suggest that while both anesthesia types are viable, spinal anesthesia may offer benefits in specific maternal and neonatal outcomes, informing clinical practices in cesarean delivery anesthesia choices.

Keywords: Cesarean section, general anesthesia, spinal anesthesia, maternal outcomes, neonatal outcomes.

Introduction:

Cesarean section (CS) births have seen a significant increase globally, driven by various medical, social, and economic factors. This rise has been accompanied by concerns about the associated postoperative morbidity, which stands at 35.7% for cesarean deliveries (Holland, Sudhof, & Zera, 2020). The elevated rates of mortality and morbidity are often attributed not only to the surgical procedure itself but also to the choice of anesthetic technique used (Herman et al., 2021). As cesarean sections become more common, understanding the impact of different anesthesia methods on maternal and fetal outcomes is crucial. This comparative study aims to explore how general versus spinal anesthesia influences these outcomes, offering valuable insights for optimizing patient care in the context of the Jordanian Royal Medical Services.

For many years, general anesthesia was the preferred choice for cesarean sections (Guglielminotti, Landau, & Li, 2019), primarily due to its rapid onset and the ability to induce a controlled state of unconsciousness for both the mother and the fetus. However, over time, spinal anesthesia has gained popularity due to its unique benefits, including reduced maternal postoperative pain and faster recovery times. The choice of anesthesia for cesarean sections holds significant implications for both maternal and fetal outcomes. General anesthesia, while effective in providing complete unconsciousness, carries risks such as airway complications, prolonged recovery, and potential effects on the newborn due to the transfer of anesthetic

agents through the placenta (Augustin, 2023). On the other hand, spinal anesthesia, which involves injecting a local anesthetic into the spinal fluid, provides effective analgesia with fewer systemic effects, allowing the mother to remain awake and actively participate in the birth. However, it is not without drawbacks, including the risk of hypotension, prolonged labor if not managed correctly, and potential failure of the block, which may necessitate conversion to general anesthesia. Evaluating these factors is crucial in determining the most appropriate anesthetic approach for cesarean sections, aiming to balance the benefits and risks associated with each method.

Recently, there has been a notable increase in the use of regional anesthesia for cesarean sections, reflecting a shift toward this technique due to its potential to reduce maternal and fetal complications (Lim et al., 2018). Despite evidence suggesting that regional and general anesthesia have similar neonatal outcomes, regional anesthesia has become the preferred choice in elective cases among many anesthesiologists (Obi, & Umeora, 2018). This preference is based on its ability to minimize systemic effects and allow the mother to be awake during delivery. However, regional anesthesia is not without its challenges, including hypotension that can affect uteroplacental perfusion, cerebrospinal fluid leakage causing headaches and nausea, and the risk of inadequate anesthesia requiring conversion to general anesthesia. As the search for the optimal cesarean technique continues, the choice of anesthesia remains guided by the mother's preferences, obstetric considerations, and the anesthesiologist's expertise.

Objective:

The main objective of this study is to evaluate and compare the maternal and fetal outcomes associated with general versus spinal anesthesia during cesarean sections at the Jordanian Royal Medical Services. By analyzing these outcomes, the study aims to provide a clearer understanding of the impacts of each anesthetic technique on postoperative recovery and neonatal wellbeing. This comparison seeks to inform best practices for anesthesia in cesarean deliveries, enhancing patient safety and optimizing care protocols.

Method:

We will conduct a retrospective randomized, controlled clinical trial involving 100 singleton pregnant women, between 18 and 35 years of age, who delivered at term (37-40 weeks) by means of elective cesarean section, in Princess Haya Military Hospital between August 2023 and March 2024.

The study excluded patients who required emergency cesarean sections, were classified as American Society of Anesthesiologists status III or higher, or had multiple gestations. Additionally, those with more than four previous deliveries, babies weighing 4500 grams or more, excessive amniotic fluid (polyhydramnios), placental complications such as abruption or previa, and other high-risk factors for hemorrhage were not included. Cases with early or late deliveries (before 37 weeks or after 40 weeks), fetal anomalies, restricted fetal growth, insufficient amniotic fluid (oligohydramnios), high blood pressure during pregnancy (pre-eclampsia), gestational diabetes, and certain physical conditions (height under 150 cm, BMI of 30 kg/m² or higher) were also excluded. The study further excluded patients allergic to local anesthetics or with systemic diseases like thyroid disorders, diabetes, or significant anemia (hemoglobin below 8 g%).

Pregnancy dating was confirmed by the last menstrual period or adjusted via early ultrasound scans. Demographic data were collected from all participants, and informed consent was obtained after providing a detailed information sheet. No pharmacological premedication was given.

Participants were randomly assigned to either the general anesthesia group (n = 50) or the spinal anesthesia group (n = 50) using a lot-drawing method prepared prior to surgery. Intravenous lines were established for hydration with 1000 ml of colloid solution, and standard monitoring including ECG, blood pressure, and oxygen saturation was conducted.

In the general anesthesia group, pre-oxygenation with 100% oxygen was done for five minutes, followed by induction with 4-5 mg/kg of thiopental and muscle relaxation using 0.8 mg/kg of rocuronium. Intubation was performed with cricoid pressure. Anesthesia was maintained with 1-1.5% sevoflurane and 50% nitrous oxide in oxygen. Additional rocuronium (0.15 mg/kg) was administered as needed. Neuromuscular blockade was reversed with neostigmine (30 µg/kg) and atropine (15 µg/kg) at surgery's end, and patients were extubated once awake to reduce aspiration risks.

In the spinal anesthesia group, patients received rapid colloid solution infusion (1000 ml at 15 ml/kg) before anesthesia. A 25-gauge needle was used to administer 2.2 ml of 0.5% hyperbaric bupivacaine into the subarachnoid space. After positioning patients laterally and then supine with a 30-degree head elevation, the motor and sensory block levels were assessed using the Bromage scale and a hot/cold test, respectively. Surgery began once an adequate sensory block was confirmed, and sedation with midazolam was provided post-delivery if necessary.

Both groups were managed for anesthesia-related hypotension with 1.5 ml/kg of crystalloid solution and ephedrine hydrochloride (5-10 mg) as needed. Bradycardia (heart rate < 50 bpm) was treated with 0.5 mg of atropine sulfate. Oxygen saturation below 90% was managed with 100% oxygen at 4 l/min via face mask.

Standard cesarean section procedures included a lower-segment transverse uterine incision and manual placental removal. Post-delivery, patients received 0.2 mg/ml of methylergobasine maleate, 1 g of prophylactic second-generation cephalosporin, and 20 units of oxytocin in IV fluid. A pediatrician assessed the newborns, recording Apgar scores and other relevant details.

Postoperative monitoring was conducted in the anesthesia intensive care unit, tracking vital signs, urine output, and pain levels using the Verbal Rating Scale (VRS). Pain management included diclofenac sodium for VRS scores of 5 or higher. Patients were mobilized and allowed to consume liquids within the first 24 hours. Gastrointestinal function recovery was monitored, and hemoglobin and hematocrit levels were checked before and after surgery.

Statistical analyses were performed using SPSS software, with continuous variables analyzed using Student's t-test and categorical variables with the chi-square test. Multivariate logistic regression accounted for potential confounders, with significance defined at $P < 0.05$.

Results:

The study included 100 patients, divided equally into two groups: one receiving general anesthesia and the other spinal anesthesia. The primary reason for cesarean delivery was a previous cesarean section, accounting for 51% of cases. Table 1 details the maternal demographics and perinatal outcomes for both groups.

It was found that, aside from higher parity and better first-minute Apgar scores in the spinal anesthesia group, the results between the two groups were generally similar. In the general anesthesia group, only two infants had a first-minute Apgar score below 5, and no infant had a fifth-minute Apgar score below 7. Even after adjusting for confounding variables, the difference in first-minute Apgar scores remained significant ($P = 0.005$).

The rates of NICU admission were comparable between the two groups, at 8% and 12%, respectively ($P = 0.744$). The spinal anesthesia group had a 1.223 times greater risk of NICU admission compared to the general anesthesia group, which increased to 1.529 times after adjusting for confounders, although this was not statistically significant ($P = 0.543$). In the spinal anesthesia group, one newborn was admitted to the NICU due to meconium aspiration, with respiratory issues being the primary reason for NICU admissions overall. No newborns stayed in the NICU for more than six days.

Table 1 also compares the hematological and hemodynamic parameters of the patients. Preoperative hemoglobin and hematocrit levels were similar across both groups ($P = 0.262$ and $P = 0.171$, respectively). However, 24 hours postoperatively, these values were significantly lower in the general anesthesia group ($P < 0.003$ and $P = 0.007$, respectively). The change in hemoglobin levels from pre- to post-operation was more pronounced in the general anesthesia group (1.82 ± 0.95 versus 1.17 ± 0.87 ; $P = 0.001$). Only two patient in the general anesthesia group required a blood transfusion due to postpartum hemorrhage. Notably, the spinal anesthesia group experienced significant hypotension following anesthesia induction (4% versus 16%, $P = 0.004$; relative risk [RR]: 4.24; 95% CI: 1.15-15.60). The hazard ratio (HR) for maternal hemodynamic parameters at 30 minutes post-anesthesia was significantly higher in the spinal anesthesia group (74.7 ± 11.5 versus 78.9 ± 12.1 ; $P = 0.005$). Additionally, urine output at 60 minutes post-operation was notably lower in the general anesthesia group (251 ± 255 versus 577 ± 408 ; $P < 0.001$).

While VRS scores did not differ significantly between groups, they were lower in the spinal anesthesia group (6.3 ± 1.6 versus 5.9 ± 1.9 ; $P = 0.315$). However, total analgesic use was lower in the general anesthesia group (0.47 ± 0.84 versus 0.9 ± 0.76 ; $P = 0.305$). The spinal anesthesia group required analgesics for a significantly longer period compared to the general anesthesia group (198 ± 353 versus 353 ± 414 ; $P = 0.047$).

The initiation of bowel sounds (667 ± 338 versus 525 ± 304 ; $P = 0.038$) and gas passage (1442 ± 566 versus 1242 ± 669 ; $P = 0.053$) occurred significantly later in the general anesthesia group compared to the spinal anesthesia group. Even after adjusting for confounders, the difference in the timing of bowel sounds remained significant ($P = 0.05$), though the time until gas passage did not ($P = 0.103$). Smoking was identified as a potential factor contributing to the significant difference observed ($P = 0.003$).

Table. 1: Comparison of demographic characteristics and perinatal, maternal hematological and postoperative monitoring outcomes

#	Characteristics	General anesthesia	Spinal anesthesia	P
1	Birth weight (g)	3517.9 ± 545.9	3523.2 ± 487.8	0.131
2	Apgar score in the first minute	8 (3-10)	9 (7-10)	< 0.0004
3	Apgar score in the first minute < 7	5/50 (10%)	2/50 (4%)	< 0.001
4	Apgar score in the fifth minutes	10 (8-10)	10 (9-10)	0.153
5	Postoperative hemoglobin (g/100 ml)	11.1 ± 1.3	11.7 ± 1.8	< 0.003
6	Preoperative hemoglobin (g/100 ml)	12.2 ± 1.5	12.5 ± 1.5	0.262
7	Female sex of newborn	21 (42%)	27 (54%)	0.317
8	Male sex of newborn	33 (66%)	29 (58%)	0.315
9	Parity	1.8 ± 0.9	2.1 ± 0.9	0.047
10	Prior abdominal surgery	4 (8%)	5 (10%)	1
11	Smoking	7 (14%)	4 (8%)	0.439
12	Gravidity	3 ± 1.5	2.7 ± 1.8	0.147
13	Body mass index at delivery (kg/m ²)	28.1 ± 3.8	26.2 ± 3.0	0.131
14	Gestational age at delivery (weeks)	38.17 ± 0.71	38.64 ± 0.79	0.671
15	Maternal age at delivery (years)	30.1 ± 4.2	30.1 ± 3.7	0.871
16	NICU admission	6 (12%)	7 (14%)	0.744
17	30th postop minute MBP, mmHg	94 ± 10.8	90.7 ± 12.6	0.091
18	60th postop minute MBP, mmHg	89 ± 9.1	88.7 ± 11.9	0.286
19	30th postop minute maternal HR	74.7 ± 11.5	78.9 ± 12.1	0.005
20	60th postop minute maternal HR	76.6 ± 9.7	82.5 ± 9.65	0.096
21	60th postop minute urine volume (cm ³)	251 ± 255	577 ± 408	< 0.001
22	Hemoglobin variation (g/100 ml)	1.82 ± 0.95	1.17 ± 0.87	0.001
23	Postoperative hematocrit (%)	23.3 ± 3.6	32.6 ± 4.4	0.007

24	Preoperative hematocrit (%)	34.7 ± 3.5	35.3 ± 3.8	0.171
25	Hematocrit variation (%)	4.6 ± 3.1	3.4 ± 3.5	0.071
26	Hypotension frequency	4 (8%)	16 (32%)	0.004
27	Postoperative SpO ₂	99.1 ± 1.5	98.9 ± 1.5	0.117
28	Verbal rating scales (first postoperative hour)	6.3 ± 1.6	5.9 ± 1.9	0.315
29	Surgical time (minutes)	42.1 ± 12.9	40.9 ± 12.5	0.789
30	Nausea/vomiting at 60th postoperative minutes	3 (6%)	6 (12%)	0.383
31	First requirement for analgesia (minutes)	198 ± 353	353 ± 414	0.047
32	Total requirement for analgesia	0.47 ± 0.84	0.9 ± 0.76	0.305
33	Gas discharge (minutes)	1442 ± 566	1242 ± 669	0.053
34	Bowel sounds (minutes)	667 ± 338	525 ± 304	0.038

Discussion:

Despite advancements in medical knowledge and surgical skills, cesarean delivery continues to pose higher risks of maternal and perinatal mortality and morbidity compared to vaginal delivery (Gee, Dempsey, & Myers, 2020). These risks are not solely due to the emergency nature of the surgery or the surgical technique but are also influenced by the anesthetic methods used. Currently, there is no universally accepted ideal technique for cesarean delivery or a single best anesthetic method, although the global trend is moving towards regional anesthesia. A study from the UK highlighted this shift, with the use of regional anesthesia increasing from 69.4% in 1992 to 94.9% in 2002 (Jia, 2021).

Several factors have contributed to the growing preference for regional anesthesia. These include increased experience among anesthesiologists, the reduced exposure of newborns to the depressant effects of inhalation agents, lower risk of pulmonary aspiration, rising sociocultural levels, and the ability of mothers to be awake and bond with their newborns immediately after birth. General anesthesia remains the preferred choice in emergency situations, such as umbilical cord prolapse, where rapid and reliable induction is critical, or in cases of bleeding placenta previa and uterine inversion (Vrachnis, Pergialiotis, & Ugwumadu, 2021).

Regional anesthesia can be further categorized into epidural and spinal anesthesia (Suresh, Polaner, & Coté, 2019). A review of the literature reveals no significant differences in maternal side effects between these two methods. Epidural anesthesia is favored for its unlimited duration and postoperative pain management capabilities, whereas spinal anesthesia is preferred for its quicker implementation, faster onset, reduced medication requirements, and the ability to establish a strong sensory and motor block. Contraindications for regional anesthesia include severe maternal hypotension, skin infections, and maternal coagulopathy (Mcquaid et al., 2018). The incidence of conversion from regional to general anesthesia is approximately 1 in 100 cases.

In recent years, our clinic has seen a rise in the use of regional anesthesia over general anesthesia for elective cesarean deliveries. One of the most common complications associated with spinal anesthesia is intraoperative hypotension (Ferré et al., 2020). This condition is exacerbated by factors such as increased sympathetic tone, advanced maternal age, obesity, high-level nerve block, inadequate fluid volume administration prior to induction, standardized drug dosing rather than patient-specific adjustments, and elevated cerebrospinal fluid pressure. While ephedrine has been recommended to mitigate hypotension, recent studies suggest that phenylephrine is more effective, particularly in maintaining higher umbilical cord blood pH levels (Adams, 2018).

In our clinical practice, we use colloid solutions for pre-hydration and supplement with crystalloid solutions in cases of hypotension. If these measures are insufficient, we administer ephedrine. Current

literature indicates that administering crystalloid coload is more effective than preload in preventing hypotension post-spinal anesthesia (Chen et al., 2023).

The critical question is whether maternal intraoperative hypotension impacts neonatal mortality by compromising uteroplacental perfusion. While maternal hypotension is common during cesarean sections, Maayan-Metzger et al. found that term infants generally tolerate these conditions without significant adverse effects (Shitemaw et al., 2020).

Our study revealed that the frequency of intraoperative hypotension in the spinal anesthesia group was 26%, lower than reported in existing literature. Table 1 provides a detailed comparison of demographic characteristics and maternal hematological and postoperative monitoring outcomes between the general and spinal anesthesia groups. Notably, the spinal anesthesia group had better Apgar scores in the first minute and lower postoperative hemoglobin and hematocrit levels (Sung et al., 2021). Additionally, maternal heart rate at 30 minutes post-operation was higher in the spinal anesthesia group, and they experienced a more significant drop in hemoglobin levels (Mulu, 2020). These findings underscore the complexity of choosing the optimal anesthesia method, which should be tailored to individual patient circumstances.

Conclusion:

In our view, spinal anesthesia offers better outcomes for fetal wellbeing compared to general anesthesia. For pregnancies with fetal concerns, spinal anesthesia seems preferable, particularly when considering the Apgar scores at one minute (Edipoglu et al., 2018). Additionally, due to its delayed need for postoperative pain relief and quicker gastrointestinal recovery, spinal anesthesia is considered the optimal choice for cesarean deliveries (Roofthoof et al., 2021).

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