ORIGINAL ARTICLE

Effect of Anesthesia Techniques on Pain Severity, Hemodynamic Changes, and Patients' Satisfaction in Elective Cesarean Section

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Abstract- The severity of postoperative pain and hemodynamic changes during and post-cesarean section have a direct effect on the neonatal and maternal condition. This study aimed to compare pain severity, hemodynamic changes, and patient satisfaction following two anesthesia techniques in elective cesarean section. In this blinded study, 60 women who were candidate for cesarean section were allocated into two equal groups of general anesthesia (GA) and spinal anesthesia (SA). Systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR), and O_2 Saturation at pre cesarean (T0), the uterine incision time (T1), end of surgery (T2), 6h (T3), 12h (T4), and 24 hours post-cesarean (T5) were measured. A Visual Analog Scale assessed post-cesarean pain, 6, 12, and 24 hours post-cesarean. Gender, birth weight, first- and fifth-minutes' apgar score was recorded in the checklists. The VAS score was significantly higher in the GA group at 6h, 12h, and 24 hours post-cesarean (P=0.014, P=0.002, P=0.017, respectively). SBP and DBP at T1 in the GA group were significantly higher than in the S.A group (P<0.001). The heart rate at T0 and T1 in the GA group was lower than the SA group (P=0.001, P=0.045 respectively). The difference between the apgar scores of the two groups was not significant. SA for cesarean section was associated with lower postoperative pain, systolic and diastolic blood pressure. However, the two groups had no significant difference in terms of patients' satisfaction and apgar scores.

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Keywords: Pain; Hemodynamic changes; Spinal anesthesia; General anesthesia; Cesarean section; Patient satisfaction

Introduction

Cesarean Section is the most common surgical procedure for pregnant women (1). The increasing incidence of cesarean sections in the world is a reminder of the importance of anesthesia and its various techniques in obstetrics and Gynecology (2,3). General anesthesia (GA) has some benefits such as lower incidence of hypotension, controlled ventilation, and rapid induction, but diffusion of anesthetic drugs from the placenta, respiratory aspiration, failure in tracheal intubation, postoperative nausea, and vomiting have been reported as complications of this technique (4-6). The usage of regional anesthesia (RA) for cesarean section has been increased to reduce these maternal and fetal problems (7,8). Among RA techniques, spinal anesthesia is more widely used because of the simplicity of performing and its cost-effectiveness (9). However, complications such as failure to accessing the subarachnoid space in first attempt, insufficiency of

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anesthesia level (10), nausea and vomiting, needle phobia, fear of permanent paralysis, asystole, post-operative headache (11), hypotension and hypotension induced neonatal depression have been reported (12,13).

Postoperative pain is an important factor affecting the hemodynamic status, patient satisfaction, and onset of breastfeeding. Nesek-Adam *et al*., evaluated postoperative pain in 40 patients undergoing peripheral vascular surgery and concluded that SA is preferable to GA (14). Sharaf *et al*., reported that SA was associated with a higher rate of postoperative pain relief after laparoscopic cholecystectomy than GA. They mentioned this was due to the addition of fentanyl to a local anesthetic agent during an intrathecal injection (15).

Naghibi *et al*., showed no significant difference between the SA and GA groups for postoperative pain scores at 6, 12 and 24 hours after the lower abdominal surgery (16). Many reports have shown RA and GA have the same index in terms of neonatal health (17-20), but today RA techniques are used more often in cesarean section (21). The present study was designed to compare patient satisfaction, postoperative pain severity, and hemodynamic changes following use of SA versus GA in elective cesarean section.

Materials and Methods

The Ethics Committee of the Rafsanjan University of Medical Sciences has approved the protocol for this randomized, blinded prospective study. Sixty women who were candidate for cesarean section in Niknafs hospital (Rafsanjan, southeastern Iran) were randomly allocated to GA (n=30) and SA (n=30) groups. The inclusion criteria were the American Society of Anesthesiologists physical status (ASA) I-II, single, and uncomplicated pregnancy. Exclusion criteria included co-existing diseases such as hypertension, diabetes, cardiovascular disease, medication taking, smoking, alcohol and opium addiction. To remove confounding variables, the gynecologist and the anesthesiologist were considered the same in all procedures.

The information such as age, weight, gravidity, history of cesarean section, indication of cesarean, gestational age, and duration of surgery were recorded. Systolic blood pressure (SBP) and diastolic blood pressure (DBP), heart rate (HR), and oxygen saturation of arterial blood (O_2sat) before the cesarean (T0), at the uterine incision time (T1), end of surgery (T2), 6 (T3), 12 (T4) and 24 hours (T5) post-cesarean were measured in both groups. Birth weight, neonatal gender, first and fifth minutes Apgar score was recorded too.

In the SA group, all patients received 500 ml Ringer solution. The electrocardiogram (ECG), noninvasive blood pressure (NIBP), heart rate (HR), and peripheral oxygen saturation (SpO_2) were monitored. After explaining the procedure, the SA was performed in sitting position using a 25G spinal needle (Quincke Needle, Japan) and 2.5 ml Marcaine 0.5% (AstraZeneca, Sweden) in the lumbar 3-4 interspace (22). Then the patient was placed in the trendelenburg position, and the required anesthesia level was induced (T4-T6). Blood pressure, HR, and SpO_2 were recorded immediately after SA and every 5 minutes thereafter.

GA was induced by 4-6 mg/kg sodium pentothal and 1-1.5 mg/kg succinylcholine. After tracheal intubation (tube No. 7) and cuff inflation, oxygen and nitrous oxide were administrated (each one 50%) (23). Muscle relaxation induced by 0.2-0.3 mg/kg atracurium. In order to increase the depth of GA, 1-2 µg/kg fentanyl was given after clamping the umbilical cord and disconnecting the mother and newborn.

The protocol for post-cesarean pain relief was similar. Patients in both groups received 50 mg pethidine I.M 4 h after the surgery, and two hours later, diclofenac sodium suppository was prescribed and repeated every 6 hours three times.

Postoperative pain was measured using the Visual Analog Scale (VAS) 6, 12, and 24 hours post-cesarean. In this method, the patient's pain intensity is measured using a graded ruler (0 to 10 cm), which the zero number represents the absence of pain, and the number 10 indicates the most severe pain. In the present study, scores ≤ 2, 3-6 and 7-10 were considered as painless, moderate, and severe pain, respectively (24). All patients were asked about the first post-cesarean day satisfaction. Data were analyzed using SPSS software version 20. To compare the results, independent t-test, Chi-square, one-way ANOVA, and Fisher exact test were used. $P<0.05$ was considered as significant.

Results

The mean±SD of participants' age was 32.52±4.69 years. Most of the participants were in the 31-35 years age group. The demographic characteristics of the participants in the GA and SA groups were compared in table 1. Results show that there was no significant difference between the two groups in terms of demographic variables, and the groups were matched with each other.

In 94.1% of cases, the cause of cesarean section was repeated cesarean, which Chi-square test showed no

significant difference between two groups (P=0.595). In the SA group, 13 neonates (43.3%) and in the GA group, 12 neonates (42%) were female. Fisher's exact test did not show a significant difference between these two groups. The mean±SD apgar score of neonates in the SA in the 1st and 5th minute was 8.97±0.18 and 10.00±0.00, and in the GA group, 8.90±0.31 and 10.00±0.00 respectively (P>0.05). The mean±SD neonatal weight in the SA group was 3278.78±425.08 g and in the GA group 3312.76±402.42 g (P>0.05).

Table 1. The demographic characteristics of the participants and duration of surgery in the general and spinal anesthesia groups

Variable	Spinal Anesthesia group Mean±SD	General Anesthesia group Mean±SD	*P*
Age (year)	32.06±5.06	33.21±4.89	0.432
Weight (Kg)	81.97±8.23	85.10±12.80	0.265
Gestational age (week)	38.77±0.57	38.97±0.49	0.150
Gravidity (Number)	2.37±0.61	2.57±0.73	0.255
Previous CS (Number)	1.20±0.48	1.33±0.48	0.288
Duration of surgery (Minute)	37.67±5.83	35.67±8.07	0.276

Independent t-test

The mean±SD VAS score in 6h, 12h, and 24 hours after surgery in the SA group were 5.87±2.16, 5.17±2.07, 3.43±1.96, and in the GA group, 7.10±1.56, 6.70±1.62, and 4.70±2.02, respectively. The independent t-test showed a significant difference between the two groups, meaning that the VAS score was significantly higher in the GA group (P=0.014, P=0.002, P=0.017, respectively). The ANOVA test revealed a significant difference in trend of changes in VAS score at different times in both groups (P<0.001). VAS scores in SA and GA groups were significantly reduced at 24 hours, post-cesarean section compared to 12 hours (P=0.002 and P<0.001, respectively) and 6 hours post-cesarean section (<0.001). In the GA group, the VAS score 12 hours, post-cesarean was significantly lower than the 6 hours post-cesarean. However, in the SA group, this decrease was not significant. In figure 1, pain severity 6, 12 and 24 hours, post-cesarean was compared between the groups. There were no cases of mild pain in the GA group.

SBP and DBP, HR, and O_2sat in the two groups at preoperative (T0), the uterine incision time (T1), end of surgery (T2), 6 (T3), 12 (T4) and 24h post-cesarean (T5) were compared in Table 2.

Independent T-tests showed SBP and DBP at T1 for the GA group was significantly higher compared to the SA group. However, the heart rate at T0 and T1 in the GA group was lower. In addition, the increase in SBP and DBP at T1 in the GA group was significant in comparison with T0.

In the SA group, 36.8% and in the GA group, 35.3% had a history of cesarean section. The previous cesarean section anesthesia method was similar to the current cesarean section in 80% of participants. They were satisfied with the method of anesthesia and consciously selected anesthesia in the current cesarean section. Of the remaining 20%, the anesthesia method in the current cesarean section was different from previous cesarean section. One participant in each group stated that it was more satisfied with the previous cesarean section anesthesia method.

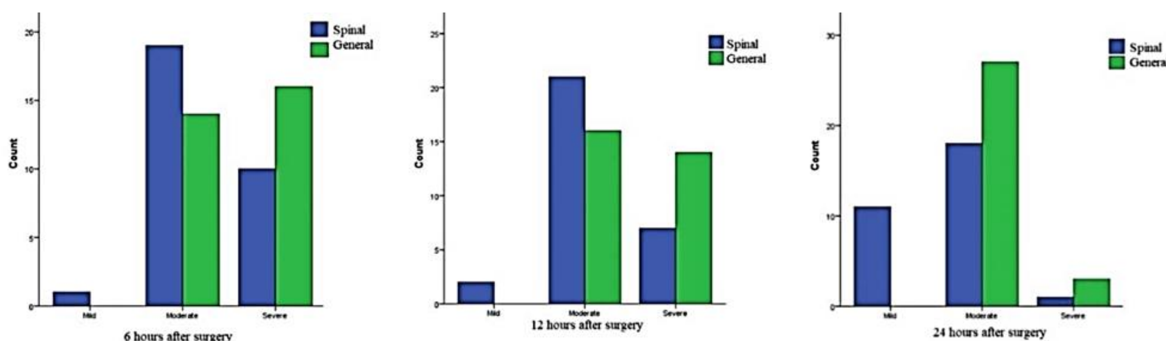

Figure 1. Comparison of pain intensity of 6, 12, and 24 hours, post-cesarean in S.A and G.A groups

Table 2. Systolic blood pressure, diastolic blood pressure, heart rate, and arterial oxygen saturation in the two groups.

		Spinal Anesthesia group Mean±SD	General Anesthesia group Mean±SD	*P*
SBP(mmHg)	T0	126.13±17.11	121.17±4.89	0.132
	T1	112.53±19.20	135.97±23.20	<0.001*
	T2	109.17±13.17	114.00±7.12	0.082
	T3	109.10±10.02	111.83±9.33	0.279
	T4	108.47±9.75	109.93±7.64	0.519
	T5	111.17±12.84	108.20±9.77	0.318
DBP(mmHg)	T0	79.73±12.87	74.80±6.99	0.070
	T1	66.60±15.86	82.73±13.34	<0.001 *
	T2	67.80±9.76	69.00±8.24	0.609
	T3	64.27±8.56	65.33±6.42	0.587
	T4	64.80±5.59	65.98±4.63	0.376
	T5	66.93±7.48	67.80±5.91	0.620
HR(bpm)	T0	100.00±13.92	90.20±8.03	0.001 *
	T1	98.03±18.76	89.07±14.88	0.045 *
	T2	88.77±14.14	83.23±7.29	0.062
	T3	80.53±9.19	77.17±6.43	0.106
	T4	73.23±6.09	72.43±6.21	0.616
	T5	77.53±9.29	80.10±5.50	0.198
O2Sat	T0	97.47±1.52	98.40±1.52	0.021
	T1	97.80±1.73	97.37±3.38	0.534
	T2	97.37±1.38	97.17±0.70	0.481
	T3	97.10±0.99	96.90±0.48	0.326
	T4	96.73±0.98	97.00±0.58	0.206
	T5	96.77±0.93	97.00±0.64	0.265

Systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR), oxygen saturation (O2Sat). Preoperative (T0), uterine incision time (T1), end of cesarean (T2), 6h post-cesarean (T3), 12h post-cesarean (T4) and 24h post-cesarean (T5). *=significant between two groups.

Discussion

In this study, patient satisfaction, pain severity, and hemodynamic changes following SA versus GA in the elective cesarean section were compared. In 94.1% of cases, the cause of cesarean delivery was repeated cesarean. Cesarean section is performed for various reasons such as higher maternal age, maternal obesity, and fetal distress (25) and is related to several factors such as socioeconomic factors, physician's preference, and fear of physical injury, high age of mothers in the first delivery and the determination of the specific baby's birth date. In Qarekhani and Sadatian (2009) study, the most common cause of cesarean delivery was a previous cesarean section (26), which is in accordance with the present study. Encouraging women to vaginal delivery after cesarean delivery (VBAC) is the best way to reduce the frequency of repeat cesarean section (27).

In the present study, the mean ± SD of VAS score in the GA group at 6, 12, and 24 hours post-cesarean were significantly higher than the SA group. However, in Havas *et al*., study, there was no significant difference between the severity of pain at 6, 12, and 24 hours post-surgery in the cesarean section with GA and SA (28). It should be noted that in the Havas et al., study, IV patient-controlled analgesia (PCA) with pethidine was used for postoperative analgesia. This method has a significant role in pain reduction and no significant difference in pain severity in the two groups.

Based on the ANOVA test, intragroup difference in VAS score was significant at different times in both groups. This means that during the time, the intensity of pain was significantly reduced. In the SA and GA groups, VAS scores 24 hours post-cesarean compared with 12 and 6 hours post-cesarean were significantly reduced. Immune system reactions are well known in reduction of inflammation caused by tissue damage and postoperative pain intensity. For example, Interleukin 6 is a major pro-inflammatory cytokine that is released very early in response to tissue damage. Hong and colleagues stated that interleukin 6; one-hour post-surgery was detectable in the blood and peaked at 4 to 6 hours later (29). Herroeder *et al*., also reported a maximum plasma IL-6 level between 4 and 6 hours post-surgery (30). Some studies have shown that plasma levels of interleukin 10 increase after major surgery (31,32). Interleukin 10 is a cytokine with potent anti-inflammatory properties (33) that suppresses the expression of inflammatory cytokines such as interleukin 6 (34). The main function of interleukin 10 is

to reduce immune responses and limit tissue damage. One of the major causes of significant decrease in pain intensity over time may be related to the release of anti-inflammatory cytokines and inhibition of inflammatory cytokines. In addition, less post-cesarean pain in the spinal anesthesia group allow patients to start walking earlier. Gastrointestinal tract function is improved by walking therefore, constipation, abdominal distension, and pain will be reduced.

The present study showed pain severity in the GA group was significantly higher compared to the SA group at 24 hours, post-cesarean, however, did not lead to a significant difference in the mean±SD of SBP, DBP, HR, and O2Sat between the two groups. Therefore, none of these techniques might be preferred regarding post-cesarean hemodynamic status.

The results of the present study showed that SBP and DBP were significantly higher in the GA group than the SA group at the uterine incision time. Sympathetic nerve blockade caused by spinal anesthesia leads to reduction of peripheral vascular resistance and blood pressure decreases. The increase in SBP and DBP at T1 in the GA group was significant compared to T0. Stimulation of proprioceptors during laryngoscopy in GA induces impulse dependent increases of SBP and DBP.

In the present study, there was a significant difference between the groups in terms of SBP at the uterine incision time. However, there was no significant difference in the first minute apgar score in two anesthesia methods. In a review study done by Kim *et al*., 46 clinical trials were studied to compare the effects of GA, SA, epidural anesthesia, and spinal-epidural anesthesia during cesarean section. In their study, there were significant differences in first minute apgar score between SA versus GA (35). In Martin *et al*., study, neonates who born underwent GA had significantly lower first and five-minute Apgar scores. In their research, emergency cesarean section was also studied, while in the present study only elective cesarean section was examined. This may lead to differences in results.

In our study, the heart rate at T0 and T1 in the GA group was lower than the SA group. Considering that the average of SBP in the SA group at these times was less than the GA group, the higher heart rate in the SA group maybe was a defensive reaction to compensate for the drop in blood pressure.

The major limitation of this study included: the severity of pain in two groups was not compared immediately after surgery because, in this period, the general anesthetic agents affected the patients, and the use of VAS criteria was not possible.

The findings of this study showed that spinal anesthesia in comparison to general anesthesia is associated with lower pain intensity, lower systolic and diastolic blood pressure in the post-cesarean period. However, these two methods did not differ significantly in terms of apgar scores and patient satisfaction. Spinal anesthesia improved postoperative conditions of patients due to decreasing pain and need for analgesia.

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