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Spinal anesthesia for elective cesarean section is associated with shorter hospital stay compared to general anesthesia

Elektif sezaryen ameliyatlarında spinal anestezi genel anesteziye kıyasla hastanede kalış süresini kısaltmaktadır

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Summary

Objectives: This prospective study aims to compare maternal and neonatal effects of spinal and general anesthesia for elective cesarean section.

Methods: Term parturients receiving routine spinal (Group SA, n=95) or general (Group GA, n=93) anesthesia and standard postoperative analgesia for elective cesarean section were included in this study. Operation time, incision-hysterotomy (T_{S-H}) and hysterotomy-umbilical cord clamping (T_{H-U}) intervals, oxytocine requirement, intraoperative fluids, ephedrine requirement, incidence of hypotension, time to first analgesic requirement (T_{analg}), pethidine consumption, adverse events, time to first breastfeeding, oral food intake (T_{OI}), flatulence (T_F), defecation (T_D), mobilization, and postoperative hospital stay were compared between the groups. Newborn Apgar scores, umbilical venous blood gas analysis, incidence of hypoglycemia, nutritional support, phototherapy and ventilatory support were also analyzed.

Results: Spinal anesthesia was associated with longer T_{S-H} and T_{H-U} durations, lower oxytocine requirements, higher incidence of hypotension, increased ephedrine and fluid consumption, and delayed T_{analg}. Furthermore, T_{OI}, T_F, T_D and postoperative hospital stay was shorter in patients given spinal anesthesia when compared with patients given general anesthesia (48h vs. 52 h, respectively; p<0.01). No difference in postoperative analgesic consumption and neonatal outcomes, except 1st min Apgar scores and umbilical blood gas analysis, was detected.

Conclusion: Spinal anesthesia, when compared to general anesthesia shortens postoperative hospital stay with early return of gastrointestinal functions in elective cesarean section.

Key words: Cesarean section; gastrointestinal motility; general anesthesia; hospital stay; spinal anesthesia.

Özet

Amaç: *Bu prospektif çalışmada elektif sezaryen ameliyatlarında spinal ve genel anestezinin anne ve yenidoğan üzerine etkilerinin kıyaslanması amaçlanmıştır.*

Gereç ve Yöntem: *Elektif sezaryen ameliyatı için rutin spinal (Grup SA, n=95) veya genel anestezi (Grup GA, n=93) ile standart postoperatif analjezi uygulanan miyadında gebeler çalışmaya alınmıştır. Ameliyat süresi, cilt insizyonu-histerotomi (T_{S-H}) ve histerotomi-umbilikal kordona klemp konması arası geçen süre (T_{H-U}), oksitosin gereksinimi, intraoperatif sıvı, efedrin gereksinimi, hipotansiyon gelişen hasta sayısı, ilk analjezik gereksinimine dek geçen süre (T_{analg}), petidin tüketimi, yan etkiler, ilk emzirme, annenin oral gıda alımı (T_{OI}), gaz çıkarma (T_F), defekasyon (T_D), mobilizasyon ve hastanede kalış süresi gruplar arasında kıyaslanmıştır. Yenidoğanın Apgar skorları, umblikal venöz kan gazı, hastanede kaldığı süre boyunca hipoglisemi gelişimi, ek gıda, fototerapi ve solunum desteği gereksinimi karşılaştırılmıştır.*

Bulgular: *Spinal anestezide genel anesteziye oranla daha uzun T_{S-H}, T_{H-U} süreleri gözlenmiş, oksitosin gereksinimi azalmış, hipotansiyon insidansı, efedrin ve sıvı gereksiniminde artış saptanmış, T_{analg} süresi uzamıştır. Ayrıca spinal anestezi sonrası T_{OI}, T_F, T_D ve hastanede kalış süresinin genel anesteziye oranla (sırasıyla 48 ve 52 saat, p<0.01) kısaldığı saptanmıştır. Postoperatif analjezik tüketimi ve 1. dak Apgar skoru ile umbilikal kan gazı sonuçları dışında neonatal veriler açısından gruplar arasında fark bulunmamıştır.*

Sonuç: *Elektif sezaryen ameliyatlarında spinal anestezi genel anesteziye oranla daha hızlı gastrointestinal derlenmeyi sağlamakta, hastanede kalış süresini kısaltmaktadır.*

Anahtar sözcükler: Sezaryen; gastrointestinal motilite; genel anestezi; hastanede kalış süresi; spinal anestezi.

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Introduction

Neuraxial anesthesia is the preferred method in cesarean section as general anesthesia is associated with airway related adverse outcome, aspiration risk, intraoperative awareness and increased uterine atony leading to higher blood loss.[1] General anesthesia is performed in cases of contraindication to neuraxial anesthesia, failure of neuraxial technique or patient request for elective cesarean section.[2] The favorable effects of neuraxial anesthesia on newborns has been demonstrated previously,[3,4] yet there is limited evidence on the effect of anesthetic techniques for maternal outcomes such as length of postoperative hospital stay and return of gastrointestinal functions.[5] This prospective study aims to compare the effects of spinal and general anesthesia on mother and neonate with length of hospital stay as primary outcome.

Materials and Methods

Following approval by the Institutional Clinical Research Ethics Committee and patients' informed consents, parturients undergoing elective cesarean section were included in this prospective study. Patients with gestation weeks <36 weeks, body mass index (BMI) ≥35 kg/m^2, ASA status ≥ III, preeclampsia, multiple pregnancy, Rhesus immunization, fetal compromise or anomaly and patients in need of emergency operation have not been enrolled.

Following preoperative anesthetic evaluation, patients were divided into two groups: spinal anesthesia (Group SA) and general anesthesia (Group GA). Noninvasive blood pressure, ECG and SpO_2 were monitored and data were recorded prior to anesthesia induction and thereafter at 3 min intervals. All patients received 500 mL of lactated Ringer solution. Spinal anesthesia was performed in sitting position at L3-4 or L4-5 interspinous levels with 25G spinal needle (Quincke tip, Braun). Fentanyl 20 µg combined with hyperbaric bupivacaine 8-10 mg were injected intrathecally to achieve a sensorial block at T4 level. General anesthesia was induced after preoxygenation with thiopental 5-7 mg/kg, succinylcholine 1 mg/kg. Following orotracheal intubation, patients were ventilated to achieve an $ETCO_2$ of 32-35 mmHg. Anesthesia was maintained with 1.5% sevoflurane in oxygen. After delivery, fentanyl 2 µg/kg, midazolam 0.03 mg/kg and rocuronium 0.15 mg/kg were administered intravenously and sevoflurane was continued at 1% in 50% oxygen-50% N_2O mixture. Anesthesia was discontinued at the end of surgery and patients were extubated with reversal of muscle relaxation.

All patients were positioned supine with left lateral uterine displacement during operation. Following delivery, they received iv ampicillin/sulbactam 1 gr, ranitidine 20 mg and oxytocine 25 IU infused over 30 minutes. If uterine tone assessed by surgical palpation was inadequate, supplemental oxytocine was utilized. In case of hypotension, defined as decrease in systolic blood pressure (SAP) of ≥30% of baseline or a value of SAP <100 mmHg, rate of iv fluid infusion was increased. If hypotension persisted in the next consecutive measurement, an ephedrine bolus of 5 mg was administered. Heart rate <60 bpm was planned to be treated with atropine.

Postoperative pain was evaluated using verbal rating scale (VRS; 0=no pain...10=worst possible pain). Analgesia was started when patients complained of a pain score ≥4 with 10-15 mg iv pethidine bolus at 7 min intervals at postoperative care unit (PACU). Maintenance analgesia in the ward was achieved with im diclofenac 75 mg bi-daily and iv patient controlled analgesia (PCA) with pethidine. PCA pump was programmed to deliver pethidine 0.05 mg/kg/h basal infusion, 0.1 mg/kg PCA bolus with 7 min lock-out. Patients were advised preoperatively for free oral intake and breast feeding following surgery as soon as possible.

Maternal age, BMI, gestation week, operation duration, time from skin incision to hysterotomy ($T_{S\text{-}H}$) and hysterotomy to umbilical cord clamping ($T_{H\text{-}U}$), oxytocine consumption were documented. Intraoperative fluid, number of patients with ephedrine requirement, ephedrine consumption and number of patients with intraoperative hypotension were recorded. Time to first analgesic requirement (T_{analg}), pethidine consumption at PACU, pethidine-PCA consumption at ward and VRS scores as well as side effects like postoperative nausea, vomiting (PONV), pruritus and postdural puncture headache were also documented. Time to first breast feeding (T_{BF}), oral intake (T_{OI}), flatulence (T_F), defecation (T_D), mo-

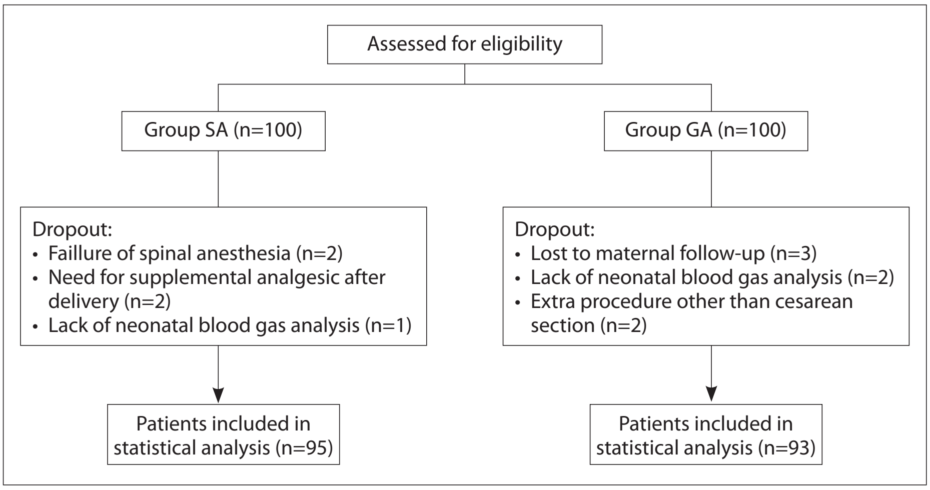

Figure 1. Study flowchart.

bilization (T_M) and postoperative hospital stay were noted. Fetal gestation age, newborn height, weight, umbilical venous blood gas analysis, 1st and 5th min Apgar scores, presence of hypoglycemia, need for phototherapy, nutritional and ventilatory support were recorded.

Statistical analysis

In our institution, patients can be discharged at daytime between 8:00 am - 4:00 pm. Patients ready to be discharged after 4:00 pm have to wait a maximum of 16 hours. To determine a difference of 16 hours in actual hospital stay between the groups with a standard deviation of 32 hours (alpha 0.05, beta 0.1), we calculated a sample size of 85 patients per group. For possible dropouts, we collected the data of first 100 consented patients in each group.

Data are presented as mean±SD, median [min-max] or number (percentage). Student's t-test and Mann-Whitney U-test were used for parametric and non-parametric quantitative data respectively. Chi-square or Fisher's exact test was utilized for comparing distributions of categorical data. A p value <0.05 was accepted as statistically significant.

Results

Patient flow through the study is shown in Figure 1. Patients' demographics, operation data and oxytocine consumption are given in Table 1. More patients in Group GA required oxytocine supplementation (≥26 IU) than those in Group SA (52 vs. 31 respectively, p=0.001). The number of hypotensive patients, total amount of fluid given and ephedrine requirement was higher in Group SA when compared to Group GA (Table 2). Ephedrine in addition to fluids was given to two hypotensive patients in Group GA secondary to rapid oxytocine infusion because of uterine atony. The number of hypotensive episodes observed were 0[0-7] in Group SA and

Table 1. Demographics, operation data and oxytocine consumption

	Group SA n=95	Group GA n=93	p
Age (year)	31.4±4.8	31.2±5.2	0.689
BMI (kg/m²)	29.83±5.2	29.18±4.7	0.374
Gestation weeks (week)	38.2±0.9	38.3±0.9	0.839
Operation duration (min)	38 [19-82]	35 [17-85]	0.149
T_{S-H} (min)	4 [1-11]	3 [1-11]	0.002
T_{H-U} (sec)	60 [20-265]	45 [10-371]	0.004
Oxytocine (IU)	25 [25-40]	30 [25-65]	0.003

BMI: Body mass index; T_{S-H}: Time from skin incision to hysterotomy; T_{H-U}: Time from hysterotomy to umbilical cord clamping. Data are expressed as mean±SD or median [min-max].

Table 2. Number of patients experiencing hypotension, total intraoperative fluid and ephedrine requirements

	Group SA (n=95)	Group GA (n=93)	p
Hypotensive patients (n)	43 (45.7%)	3 (3.2%)	<0.001
Fluid (ml)	2090 ± 553	1535±508	<0.001
Ephedrine requiring patients (n)	40 (42.6%)	2 (2.2%)	<0.001
Ephedrine (mg)	0 [0-50]	0 [0-10]	<0.001

Data are expressed as mean±SD, median [min-max] or number of patients (%).

Table 3. Intraoperative systolic blood pressure and heart rate values

	Systolic Blood Pressure (mmHg)			Heart Rate (beat/min)		
	Group SA (n=95)	Group GA (n=93)	p	Group SA (n=95)	Group GA (n=93)	p
Baseline	135.6±15.2	138.6±16.5	0.671	107.1±15.5	97.8±14.2	0.158
1st min	121.3±16.8	147.4±15.8	0.001	100.4±17	106.1±18.2	0.455
3rd min	110.67±11	132.7±9.7	<0.001	80.6±12.4	96.4±10.5	0.04
6th min	105.6±10.6	127±12.6	<0.001	90.7±11.4	89.4±13.8	0.803
9th min	108.5±8.1	122.1±11.6	0.004	89.7±7.9	88.9±9.9	0.832
12th min	116.3±9.6	119.6±9.3	0.425	93.2±8.3	87.6±6.4	0.09
15th min	113.7±10.2	118.8±12.2	0.301	91.3±6.6	86.1±9	0.138
End of operation	122.1±7.4	145.9±14.4	<0.001	83.3±5.3	97.2±9.1	<0.001
PACU entry	117.8±11.5	132.9±13.2	0.010	86.8±4.4	91.5±9.9	0.172

Data are expressed as mean±SD. PACU: Postoperative care unit.

0[0-2] in Group GA (p<0.001). Intraoperative nausea and/or vomiting were observed in 21 patients (22.1%) and intraoperative pruritus was seen in 37 patients (38.9%) in Group SA. None of the parturients had postdural puncture headache or complained of intraoperative recall postoperatively.

Table 3 presents intraoperative course of SAP and heart rate values during the first 15 minutes as the shortest operation duration was 17 minutes. SAP during the first nine minutes, at the end of operation and PACU entry were significantly higher in Group GA compared to Group SA. Likewise heart rate values were significantly higher at 3rd minutes and at the end of the operation in Group GA.

Maternal postoperative data are demonstrated at Table 4. Although T_{analg} was shorter in Group GA with higher pethidine consumption at PACU, no statistical difference was noted in pethidine consumptions at ward between the groups. Postoperative pain scores during the first hour were significantly higher in Group GA than Group SA and similar thereafter (Figure 2). T_{BF} was equal in both groups. T_{OI}, T_P, T_D was significantly shorter in Group SA. One patient in Group GA had paralytic ileus with first oral in-

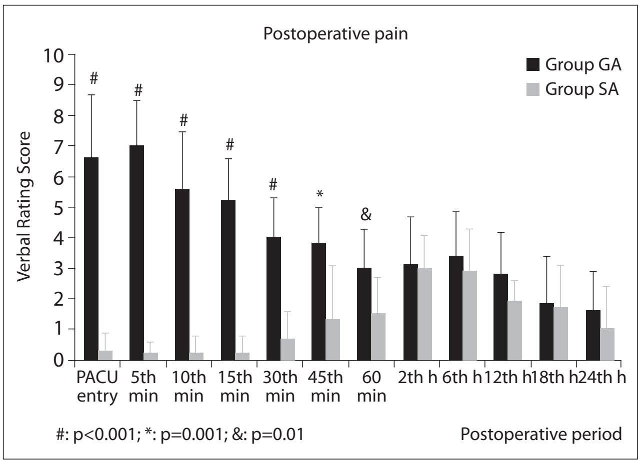

Figure 2. Postoperative pain scores (mean±SD).

Table 4. Maternal postoperative data

	Group SA (n=95)	Group GA (n=93)	p
T_{analg} (min)	59 [1-200]	14 [1-69]	<0.001
Pethidine PACU (mg)	20 [0-50]	30 [0-60]	<0.001
Pethidine-PCA (mg)	191 [49-350]	167.5 [50-375]	0.883
Postoperative PONV* (n)	18 (18.9%)	15 (16.1%)	0.099
T_{BF} (min)	110 [10-465]	130 [24-1374]	0.256
T_{OI} (min)	105 [10-485]	430 [180-7200]	<0.001
T_F (h)	19 [6-77]	24 [6-70]	0.001
T_D (h)	24 [6-51]	32.5 [9-96]	<0.001
T_M (h)	8 [3.1-25.5]	8.9 [2.3-28]	0.052
Hospital discharge (h)	48 [21-144]	52 [23-168]	<0.001

T_{analg}: Time to first analgesic requirement; PONV: Postoperative nausea and/vomiting; T_{BF}:Time to first breast feeding; T_{OI}: Time to first oral intake; T_F: Time to first flatulence; T_D: Time to first defecation, T_M: Time to first mobilization. Data are expressed as median [min-max] or number of patients (%).

take five days after surgery and she left the hospital at postoperative 7th day. When length of stay was classified into two categories (<49 hours and ≥49 hours), 49 patients (55.7%) in Group SA stayed less than 49 hours, whereas only 29 patients (31.6%) in Group GA stayed less than 49 hours.

Neonatal data are given at Table 5. The number of neonates with 1st min Apgar score <7 was three vs. zero in group GA and SA respectively (p=0.12). Neonates with low Apgar scores of six, six and five had T_{H-U} intervals of 330, 370 and 203 seconds respectively. All neonates had a pH higher than 7.2 with the exception of three neonates (two in Group SA and one in Group GA) (p=1). The first neonate in Group SA with a pH value of 7.13 was delivered from a mother with hypotension, and the second one with a pH value of 7.16 had a T_{H-U} interval of 197 seconds. First minute Apgar scores of both babies were nine. Neonate in Group GA with pH of 7.11 was small for gestational age with birth weight of 2370 g. There was no statistical difference between the groups in terms of neonates with hypoglycemia or requiring nutritional support. Also no differences were observed in requirements for respiratory support and phototherapy.

Table 5. Neonatal data

	Group SA (n=95)	Group GA (n=93)	p
Weight (gr)	3241±401	3226±552	0.84
Height (cm)	48±1.8	48±2	0.785
APGAR 1st min	9±0.8	8.5±1.1	0.001
APGAR 5th min	9.9±0.4	9.8±0.5	0.105
pH	7.344±0.051	7.327±0.045	0.019
PO_2	28.1±8.8	38.1±15	<0.001
PCO_2	44±6.8	47.4±7	0.002
Respiratory support requirement (n)	4 (4.2%)	4 (4.4%)	1
Hypoglycemia (n)	4 (4.2%)	3 (3.2%)	1
Nutritional support (n)	17 (17.9%)	18 (19.4%)	0.853
Phototherapy (n)	2 (2.1%)	3 (3.2%)	0.681

Data are expressed as mean±SD or number of patients (%).

Discussion

According to the results of this prospective study, spinal anesthesia for elective cesarean section is associated with a shorter length of postoperative hospital stay. It also enables early oral intake and recovery of gastrointestinal functions with lower oxytocine consumption, prolonged interval to first analgesic requirement. On the other hand, general anesthesia offers shorter delivery intervals with stable hemodynamics, less fluid and ephedrine requirements. Neonatal outcome was similar between the groups except 1st min Apgar score and umbilical blood gas results.

Surgery and anesthetic technique employed has been shown to effect postoperative outcomes, specifically effecting the length of hospital stay.[6] Rapid recovery after cesarean section should not only aim for an early return to normal daily life but also for the mother's bonding and nursing of the newborn. Spinal anesthesia has been shown to be superior to general anesthesia in previous studies in terms of maternal mortality and morbidity due to lack of airway instrumentation, avoidance of regurgitation and intraoperative awareness.[7-11] However evidence on the effect of neuraxial anesthesia on hospital stay and discharge is missing.

General anesthesia due to its quick induction is preferred in obstetrics when urgent induction of surgery and delivery of the fetus is needed. This feature of general anesthesia is also observed in our study of elective cesarean section patients with shorter T_{S-H} and T_{H-U} intervals. One contributing factor for these short intervals in general anesthesia is the use of muscle relaxants and volatile anesthetics that can decrease abdominal muscle tone and facilitate delivery. The other is probably due to faster surgical dissection when neonatal depressive effects of general anesthetics are considered. Furthermore, when T4 sensorial level is reached in spinal anesthesia, abdominal muscle tone could still be higher than general anesthesia, as motor block routinely tested in spinal anesthesia is only for lower extremities. Studies about the effects of different anesthesia techniques on neonatal outcome do not include detailed data like skin incision-delivery or uterine incision-delivery times. Kamat et al. studied the effect of induction-delivery and uterine-delivery on neonatal Apgar scores and found shorter induction-delivery and uterine incision-delivery intervals in general anesthesia compared to spinal anesthesia (57 vs 68 sec respectively).[12] On the other hand Tonni et al. compared the effects of general and neuraxial anesthesia on neonatal status and reported longer uterine incision-delivery times in general anesthesia than spinal anesthesia group (59 vs 45 sec respectively) without statistical difference.[13] However both authors failed to comment about these findings.

Uterine relaxing effects of volatile anesthetics is previously reported in literature.[14] General anesthetic effect on uterine tonus is dose-dependent and reversible. In our study, although sevoflurane dose is decreased immediately after delivery with N_2O, midazolam and fentanyl supplementation, Group GA had increased oxytocine requirements compared to Group SA.

When hemodynamic changes are compared, the finding that hypotension is more frequent in Group SA is not surprising. Conventional crystalloid preloading prior to regional anesthesia is no longer recommended due to lack of efficacy.[15,16] As the need for intravascular volume expansion starts with sympathetic blockade of spinal anesthesia, coloading is to be more beneficial to decrease vasoconstrictor requirement.[17] Parturients in this study were cohydrated with the start of spinal anesthesia as reflected in increased fluid consumption in Group SA. However, we still encountered hypotension which was treated with ephedrine boli. Hypotension can lead to maternal discomfort due to nausea, vomiting, light headedness and most important placental hypoperfusion and fetal compromise. Ephedrine can also lead to neonatal acidosis.[18] Yet, our treatment of hypotension seems to be effective both for the parturient and newborn as reflected by similar neonatal Apgar scores and umbilical blood pH values in both groups.

The time to first postoperative analgesic requirement in Group SA was longer as sensorial block duration overextends surgical operation time. This also led to decreased pethidine consumption at PACU. However after the sensorial block recovery of the single-shot spinal anesthesia, patients required similar analgesic amounts as reflected by PCA-pethidine delivery. To our knowledge there is no study in the literature comparing spinal and general anesthesia in terms of first analgesic requirement time. Kessous et al., who described meperidine as a rescue in severe pain, reported higher number of meperidine requiring patients in the first 24 h following general anesthesia compared to spinal anesthesia for cesarean section.[19]

One interesting result is that there was no difference between the groups in terms of breastfeeding. This may be due to the time needed by the neonatology team to examine the newborn as well as staff inadequacies resulting in a delayed meeting of the baby with the mother. Sener et al. compared epidural with general anesthesia for cesarean section and reported similar first breast feeding time for epidural anesthesia whereas prolonged duration for first breast feeding following general anesthesia (107.4 vs 228.07 min respectively).[20]

One of the most important findings of this study is the early recovery of gastrointestinal functions following spinal anesthesia. One important reason for early return of flatulence and defecation in Group SA is the sympathetic blockade. Sympathetic flow is the dominating inhibitory control for gastrointestinal system. When sympathetic flow is blocked and unopposed parasympathetic stimulation remains, motility in stomach, small bowel and proximal colon is increased.[21,22] Another reason may be late oral intake observed in Group GA. This late intake may be due to residual sedative effects of general anesthetics. There is no study comparing the effects of different anesthesia techniques for cesarean section on gastrointestinal function. However a recent meta-analysis of studies focus on early oral intake which may promote gastrointestinal recovery.[23] Ambulation, postoperative opioid consumption and PONV may further affect bowel recovery; however TM interval, pethidine consumption and PONV incidence were similar between the groups in this study.

Primary outcome of this study, length of postoperative hospital stay, was shorter in Group SA when compared to Group GA. There are only two studies from the same authors looking at the effect of anesthesia type on hospital stay.[24,25] Our finding are similar to Fassoulaki et al. who reported postoperative hospital stay between years 2002-2005. They showed a progressive decrease during this period of time and especially after neuraxial (combined spinal-epidural or epidural) anesthesia when compared to general anesthesia.[24] However, compared to our results (median 2 days) they reported a longer hospital stay (median 4 days) following neuraxial anesthesia, even in the final year of the study period. This may depend on the late oral intake allowed only after the removal of urinary and epidural catheters. It may also be attributed to the differences in institutional obstetric team policy. The large volume of obstetric patients in our institution accelerates bed turnover. According our obstetric team, uncomplicated patients following cesarean section with recovered bowel function, tolerance of oral intake, lack of micturition problems and ability to take care of the baby can be discharged.

In terms of neonatal outcome, the lower 1st min Apgar scores in Group GA can be the result of neonatal depression by general anesthesia.[1] Also when neonates with Apgar scores <7 are examined, three neonates in Group GA had corresponding T_{H-U} intervals>180 seconds which may be responsible for this result.[26] However, the small difference in 1st min Apgar scores between the groups is clinically insignificant as the 5th minute scores are similar. Kavak et al.[27] reported similar 1st and 5th minute Apgar scores, whereas Tonni et al.[13] and Mancuso et al.[4] observed more depressed newborns in general compared to spinal anesthesia. Neonates of mechanically ventilated mothers in Group GA had also higher PCO_2 values. Pregnant patients have physiologically higher respiratory frequencies during spontaneous breathing. We ventilated our patients receiving general anesthesia to keep $ETCO_2$ between 32-35 mmHg and they had possibly higher PCO_2 levels compared to spontaneous breathing patients under spinal anesthesia. As the removal of neonatal PCO_2 occurs via maternal lungs, these neonates had also slightly higher CO_2 values. The lower pH values of neonates in Group GA are the result of slightly higher PCO_2. Hodgson and Wauchob also reported slightly lower pH values of newborns with T_{H-U} less than three minutes in general anesthesia.[28] The higher PO_2 values of the neonates in Group GA is expected due to positive pressure ventilation of the mothers with 100% O_2 until delivery similar to Ochiai et al.[29] Early outcomes of neonates in terms of respiratory and nutritional support, incidence of hypoglycemia and need for phototherapy were similar between the groups. Tonni et al. found similar incidence of hypoglycemia in spinal and general anesthesia groups too.[13] Ozcakir et al. observed no differences between epidural and general anesthesia in terms of phototherapy needs.[30]

The lack of other neuraxial techniques can be seen as a limitation of the study. But we aimed to compare the two routine anesthesia methods, namely general and spinal anesthesia of our daily practice. We also think that spinal anesthesia was more comparable with general anesthesia rather than a neuraxial technique with catheter, for it was applied as single shot and did not include long-acting opioids.

The use of high inspired oxygen concentration until delivery can be seen as a drawback of the study. We administered 100% oxygen to increase fetal oxygenation during this period as hysterotomy causes an interruption in oxygen delivery to the fetus. This may help to overcome a decrease of fetal oxygen reserve in unexpected prolonged hysterotomy to delivery periods. Pregnancy leads to a decrease in minimum alveolar concentration of volatile anesthetics up to 40% (60% MAC of sevoflurane ≈ 1.2%).[31,32] As N_2O is omitted we used a higher inspiratory sevoflurane fraction to avoid intraoperative awareness. The reported incidence of awareness in cesarean section is 0.1-0.3%, therefore this study is underpowered to comment about awareness. However we did not encounter recall in the postoperative period.

One other limitation is that umbilical venous instead of arterial blood gas analysis was obtained. Although umbilical venous sampling is easier, arterial samples would better reflect fetal acid-base status.

Fast-tracking in elective cesarean section is not well studied in terms of anesthetic technique as most western countries employ regional anesthesia.[33] However this is not the case in Turkey, where a recent survey of obstetric anesthesia practice has shown relatively low ratio of regional anesthesia (36.1%) for cesarean section when compared with western countries.[34] Other than unavailability of obstetric anesthetic care, patients' choice and obstetric team preference may play a role in these low numbers. Demonstrating the beneficial effect of spinal anesthesia on hospital stay can further convince both the parturient to choose and the obstetric team to promote neuraxial anesthesia.

In conclusion spinal anesthesia when compared to general anesthesia for elective cesarean section allows faster discharge from the hospital. Fast recovery and return of the mother to the family offers social benefits as well as quick turnover of hospital beds in heavily occupied clinics.

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