A Randomized Prospective Study on the Maternal and Neonatal Outcome of Epidural, Combined Spinal-Epidural and General Anesthesia for Elective Caesarean Sections

ELEKTİF SEZARYENLERDE EPİDURAL, KOMBİNE SPİNAL-EPİDURAL VE GENEL ANESTEZİNİN ANNE VE YENİDOĞANA ETKİLERİ ÜZERİNE RANDOMİZE PROSPEKTİF BİR ÇALIŞMA

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Abstract

Objective: The aim of this study was to compare the maternal and neonatal outcomes of epidural anesthesia (EA), combined-spinal epidural (CSEA) and general anaesthesia (GA) for elective caesarean section.

Material and Methods: Maternal haemodynamic parameters, umbilical artery and vein blood gassess, Apgar Scores at the 1st and 5th minutes of the newborn life were noted.

Results: Demographic data were similar among the groups. Systolic and diastolic pressures significantly decreased in EA and CSEA groups. Both heart rates and 1st minute Apgar Scores were significantly lower in GA group. 5th minute Apgar Scores were similar among the three groups.

Conclusion: CSEA appears to be superior to the other techniques for elective caesarean section.

Key Words: General anesthesia, obstetrical, cesarean section, epidural anesthesia

Özet

Amaç: Elektif sezaryen girişimlerinde epidural anestezi (EA), kombine spinal-epidural anestezi (CSEA) ve genel anestezi (GA)'nin anne ve yenidoğan üzerine olan etkilerini karşılaştırmayı planladık.

Gereç ve Yöntemler: Grup 1 (n= 22)'deki olgular EA, grup 2 (n= 20)'deki olgular CSEA, grup 3 (n= 20)'deki olgular ise GA aldılar.

Bulgular: Anneye ait hemodinamik parametreler, göbek kordonu arter ve kan gazları, 1.ve 5. dk APGAR Skorları kaydedildi. Gruplar arasındaki demografik veriler benzerdi. Sistolik ve diastolik kan basınçları EA ve CSEA grubunda, kalp hızı GA grubunda anlamlı olarak azaldı. 1. dk APGAR Skorları genel anestezi grubunda anlamlı olarak daha düşük olup, 5. dk APGAR Skorları gruplar arasında benzerdi.

Sonuçlar: Elektif sezaryen girişimlerinde CSEA diğer terkniklere göre daha üstündür.

Anahtar Kelimeler: Genel anestezi, obstetrik, sezaryen, epidural anetezi

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Caesarean section rates have been steadily increasing in recent years up to 25% of all deliveries. The choice of anaesthesia for caesarean section is determined by multiple factors including the indication for operations, its urgency, patients and obstetricians preferences and the skills of the anaesthetist.[1]

General anaesthesia (GA) offers rapid and reliable onset, better control of the airway and the ventilation, potentially less hypotension. However GA has the risks of pulmonary aspiration, failed intubation, maternal hyperventilation, neonatal depression, maternal awareness and uterine atony. Pulmonary aspiration of gastric contents and failed

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endotracheal intubation during general anaesthesia are major causes of maternal morbidity and mortality.[1,2]

Advantages of regional anaesthesia (RA) include an awake mother at the birth of her child, minimal newborn depression and avoidance of the risks of general anaesthesia.[1,2] A successful regional block reduces risk of thromboembolism, postoperative respiratory morbidity and peri-operative blood loss compared to general anaesthesia.[3] As both epidural and spinal blocks have advantages, there should be some benefit in combining the two techniques, provided there is no increase in the incidence of complications. This combination of techniques provides the rapid onset and reliability of spinal block with the facility to modify the analgesia if it is not effective.[1,2]

The aim of this study was to assess the maternal haemodynamic changes, 1st and 5th minutes neonatal APGAR scores, umbilical cord blood gasses and complications in patients undergoing epidural, general and combined spinal epidural anaesthesia for caesarean section.

Material and Methods

After Faculty Ethics Committee approval and informed consent were obtained, we studied 62 ASA I physical status patients, aged between 18-38 year-old, who were scheduled for elective caesarean section. Patients with multiple pregnandes, suspected fetal abnormality, or complicated pregnandes were excluded.

In this prospective study, patients were allocated randomly to one of the three groups and the procedure was explained to each subject. In the operating room, an iv cannula was inserted and 500-750 mL crystalloid fluid replacement was given to patients before anaesthesia. Monitorization included ECG, non invasive arterial blood pressure and peripheral oxygen saturation.

Patients in group I (n= 22) received EA. An 18 G Tuohy needle was inserted at the L_{3-4} interspace with the patient in the left lateral position. With the Tuohy needle in the epidural space, a 20 G epidural catheter was placed 3.0 cm deep into epidural space. After an initial 3ml 0.5% plain bupivacaine (0.5% marcaine, AstraZeneca) test dose, total 20 mL 0.5% plain bupivacaine was administered via catheter.

Patients in group II (n= 20) received CSEA. With patient lying in the left lateral position, an 18 G Tuohy needle was inserted at $L_{3-4.}$ With the Tuohy needle in the epidural space, a 25 G pencil-point spinal needle was guided through the spinal space. After correct placement of spinal needle, 1.25 mL 0.5% hyperbaric bupivacaine (0.5% marcaine spinal heavy, AstraZeneca) was administered intraspinally. Spinal needle was withdrawn and a 20 G epidural catheter was placed 3.0 cm deep into the epidural space. After the needle insertion, patients were turned to the supine lateral position and 5 mL plain bupivacaine was administered via epidural catheter.

Patients in group III (n= 20) received GA. After preoxygenation, 5 $mgkg^{-1}$ thiopental sodium (Pental, İ.E: Uluguay) and 100 mg succinylcholine (lysthenon, fako) were administered for induction of anaesthesia intravenously. For the maintenance of anaesthesia 1% sevoflurane (Sevorane, Abbott) and 50% nitrous oxide-oxygen mixture and 0.1 mg fentanyl (fentanyl citrate, Abbott) (after delivery of baby) were used.

Heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP) were recorded with 5 minutes intervals intraoperatively. The onset of sensory and motor blocks and the duration of sensory and motor block were noted in the EA and CSEA groups. For the determination of the onset of block, the first local anaesthetic administration time was considered as time zero. Onset of sensory and motor blocks were assessed continuously following local anaesthetic drug administration. The level of sensory block was tested using Pin-prick test and motor block was assessed using modified Bromage Scale. After delivery of babies, umbilical artery and vein blood pH, PaO_2, $PaCO_2$, HCO_3 and SaO_2 values (nova biomedical Stat Profile M, Waltham, Massachusetts, 19995) and APGAR Scores (1 and 5 minutes) were compared among the groups.

Hypotension and bradycardia were defined as 25% decrease of baseline measurements. Patients were also assessed with respect to other complications such as nausea and vomiting, headache, respiratory depression (SpO_2 <90%), neurological sequela.

For statistical analysis, parametric data were analyzed by using one-way ANOVA among three groups. For Post Hoc test, Student Newman Keuls was used for parametric variables and Benferroni test was used for non-parametric variables. The onset of blocks was analyzed by using Student t test. Mann-Whitney-U test was used to determine the level of block . Category data were analyzed by using the x^2 *test.*

A *P* value of <0.05 was considered statistically significant. Data are presented as mean ±SD.

Results

No significant differences were found regarding demographic data among the study groups (p> 0.05) (Table 1).

As haemodynamic changes were assessed; the decreases of SBP were significant in RE groups compared with GA group (p< 0.05) (Figure 1,2,3). The decreases of DBP at 10th, 50th min in RA groups were significant compared with GA group (p< 0.05). HR decreased in GA group when compared with the other groups (p< 0.05).

The onset of sensory and motor blocks, the time of maximal sensory block were significantly shorter in CSEA group than EA group (p< 0.05). The mean level of sensory block and the degrree of motor block were higher in CSEA than EA group (p< 0.05) (Table 2).

1st min APGAR scores were significantly lower in GA (7.38 ± 1.16) than RA groups (7.90 ± 0.68 in EA, 8.20 ± 0.64 in CSEA). There were no significant differences among the groups regarding 5th min APGAR scores (9.95 ± 0.21 in EA, 9.80 ± 0.61 in CSEA, 9.76 ± 0.53 in GA) (p> 0.05).

The umbilical artery blood pH was higher in the newborns receiving GA (p< 0.05). Umbilical artery pCO_2 was higher in EA than GA group (p< 0.05). The mean umbilical artery and vein SaO_2 values were higher in GA group than the others (p< 0.05) (Table 3). We didn't observe fetal acidosis (pH<7.2) in any group.

Hypotension was 22,7% in EA and 25% in CSEA. We didn't observe hypotension in GA group. Hypotension was treated with rapid kolloid fluid replacement. The highest incidence of nause and vomiting was observed in GA group (4.5% in EA, 10% in KSEA, 23.8% in GA). Bradycardia was only recorded in CSEA group (15%). No patient experienced respiratory depression, headache or neurological sequela in the study groups.

Discussion

Obstetric anaesthesia has evolved substantially in the last two decades, with RA techniques becoming increasingly popular for caesarean section. Since the early 1980s, there has been an increasing trend towards the use of regional anaesthesia for caesarean section.[3] This has largely resulted from a clear association between GA and anaesthetic maternal mortality, with failure of tracheal intubation and aspiration of gastric contents, in particular, being direct causes of death.[3]

Table 1. Demographic datas among the groups.

	Group EA (n= 22)	Group KSEA (n= 20)	Group GA (n= 20)
Height (cm):	162.13 ±6.0	161.50 ±3.45	160.24 ±4.56
Age (years):	30.63 ±4.11	26.10 ±4.82	29.33 ±4.68
Time to start of surgery (min):	26.50 ±3.87	19.20 ±5.48	1.76 ±0.62

p> 0.05: No significant differences among the groups.

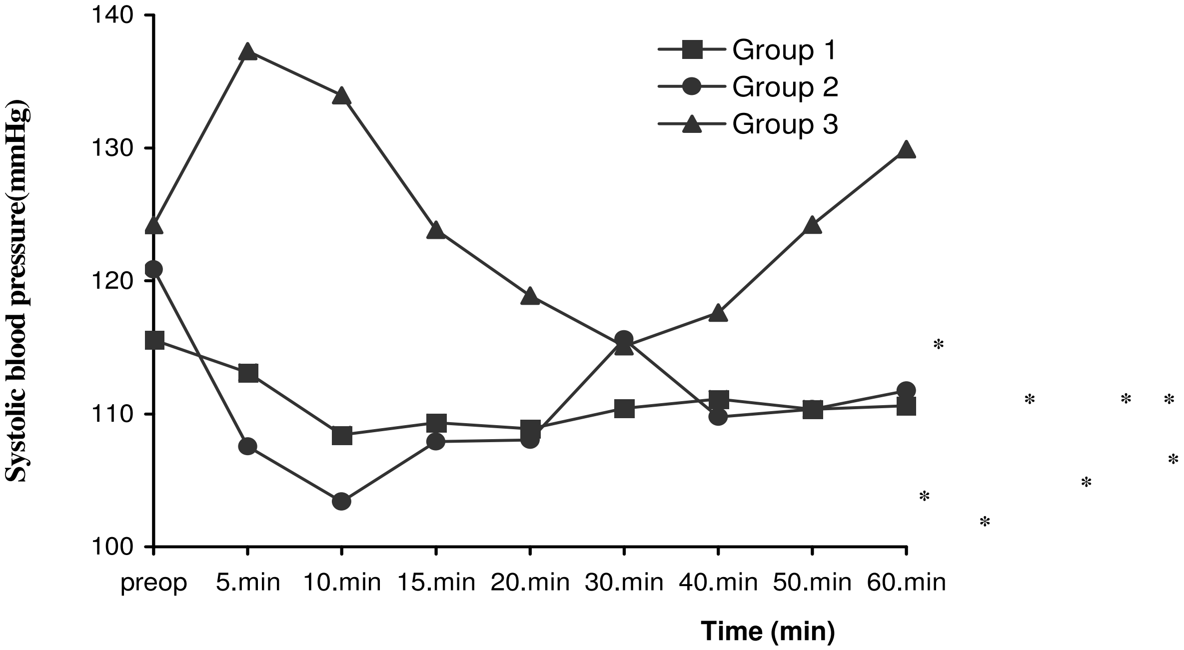

Figure 1. Systolic blood pressure, *(p< 0.05)

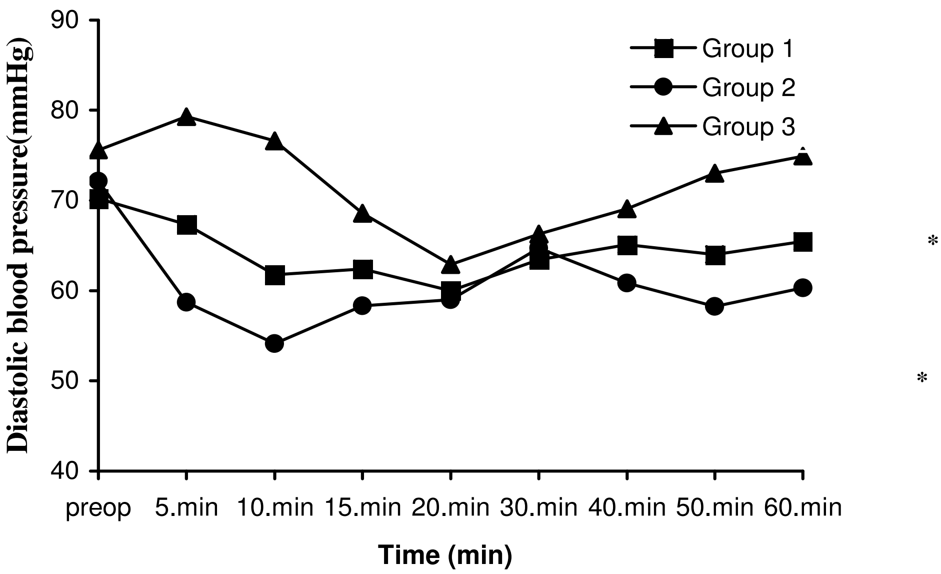

Figure 2. Diastolic blood pressure *(p< 0.05).

In spite of large doses, EA may be inadequate in up to 25% of patients. Due to requirement of large doses of local anaesthetics for EA, there is a high risk of toxic complications.[4-6] Spinal anaesthesia is more reliable than epidural anaesthesia because of its more intense motor and sensory block capasity. Spinal block has variable parameters and may be hazardous for the fetus, if

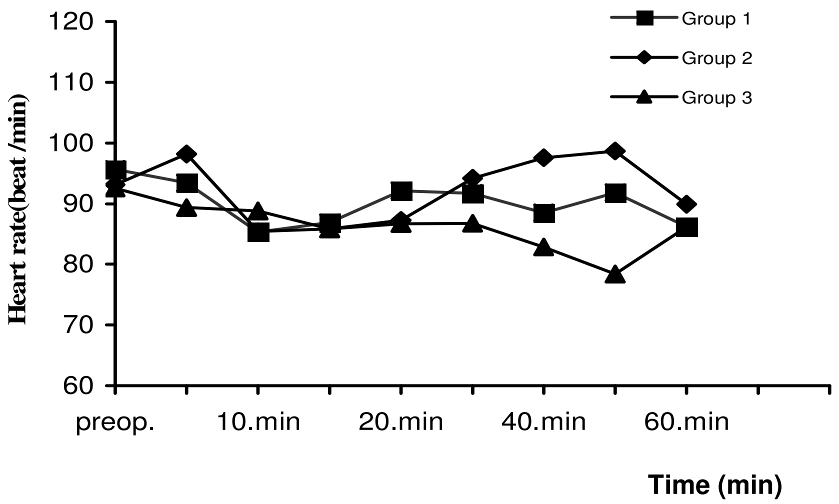

Figure 3. Heart rate, *(p< 0.05).

Table 2. The parameters of sensory and motor blocks.

	Group EA (n= 22)	Group KSEA (n= 20)
The onset of sensory block (min):	5.77 ±2.36	2.30 ±1.21*
The mean level of sensory block (Thoracal):	6.22 ±1.82	5.00 ±1.02*
The time to maximal level of sensory block (min):	14.81 ±5.02	11.05 ±4.54*
The duration of sensory block (min):	107.18 ±29.47	99.75 ±30.58
The onset of motor block (min):	9.23 ±5.96	2.26 ±0.65*
The duration of motor block (min):	98.30 ±21.40	98.94 ±31.33
The degree of motor block (Bromage scale):	1.59 ±1	2.85 ±0.67*

(*) p<0.0<5: The significant differences.

Table 3. The parameters of umbilical artery (UA) and umbilical vein (UV) blood gasses:

Groups	PH	pO_2	pCO_2	HCO_3	SpO_2
EA - (UA)	7.31 ±5.39	16.89 ±3.71	51.20 ±7.17	25.97 ±2.65	20.87 ±7.22
EA- (UV)	7.36 ±5.13	29.37 ±9.21	41.38 ±7.08	23.62 ±2.49	51.20 ±18.05
CSEA- (UA)	7.30 ±3.49	17.66 ±5.00	48.64 ±4.96	24.57 ±2.01	22.88 ±10.45
CSEA- (UV)	7.34 ±3.99	25.85 ±5.87	40.98 ±5.11	22.49 ±2.36	43.95 ±14.95
GA- (UA)	7.34 ±3.16	19.29 ±5.59	46.28 ±5.84	24.97 ±2.29	29.34 ±14.23
GA- (UV)	7.38 ±3.04	32.00 ±9.21	41.10 ±5.89	24.67 ±2.42	57.67 ±16.94

uncontrolled maternal hypotension develops.[4,5] CSEA combines the rapidity, density and reliability of the spinal block with the flexibility of continuous epidural block to extend duration of analgesia.[5,6]

In our study, we attained adequate thorocal level of sensory block with EA and CSEA. However, CSEA was significantly quicker in onset of sensory and motor block and the amount of local anaesthetic was significantly lower than EA.

Rawal et al administered 1.5-2 mL 0.5% bupivacaine spinally in CSEA for cesarean section.[6] After the spinal block was fixed (about 15 min), they administered a fractione of 0.5% 5 mL

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bupivacaine via epidural catheter. The mean dose of spinal bupivacaine was 1.7 ± 0.2 mL in their study. We administered only 1,25 mL bupivacaine spinally and 5 mL bupivacaine epidurally and we reached adequate sensory block levels in our cases.

Skovbon et al compared CSEA with EA in a retrospective review.[7] They found that CSEA had a high frequency of intermittent hypotension (75%) and post-dural puncture headache (15%). In contrast, we observed 25% hypotension. However, it was not clinically severe. No patient had post-dural puncture headache in our study.

Rawal et al compared CSEA with EA for caesarean section.[8] All patients receiving CSEA had a good to excellent surgical analgesia while 11 patients (74%) receiving epidural had similar pain relief. They observed that muscular relaxation was also better following CSEA. The total dose of bupivacaine for T_4 block was three times much in patients receiving only EA. Apgar scores and newborn blood gasses didn't show any differences between EA and CSE anaesthesia groups. The incidence of maternal hypotension was higher in epidural group. In contrast, we observed the higher risk of hypotension in CSE group. Similarly, we observed good to excellent surgical analgesia and muscle relaxation in CSE group.

Controversy exists on the optimal regional anaesthetic technique for elective Caesarean section.[5] The haemodynamic changes associated with RA represent the greatest potential hazard of these techniques for mother and fetus.[1,2] Relatively little is known about the changes in cardiac output during RA for Caesarean section. Studies during epidural anaesthesia have suggested that cardiac output does not decrease unless hypotension develops.[9-11] Several studies have reported a lower mean umbilical artery pH after RA complicated by hypotension.[12-14]

Neonatal Apgar sores were found higher following regional anaesthesia in another study comparing regional and general anaesthesia.[15] We observed lower 1st min Apgar scores in patients receiving GA than the others. No statistical differences were found among the groups regarding 5th min Apgar scores.

Several investigators have described the effects of passive maternal hyperventilation during GA. This phenomenon include: uterine atony, vasoconstriction secondary to maternal hypocarbia and alkalosis, vazoconstriction of umbilical vessels secondary to fetal alkalosis, altered maternal haemodynamics secondary to increased intrathoracic pressure during hyperventilation, shift of the maternal oxyhemoglobin-dissociation curve to the left with alkalosis and a subsequent lessened release of oxygen by maternal blood.[16]

In our study, umbilical artery and vein pH values was higher in GA groups than RA groups. Umbilical artery and vein pO_2 and HCO_3 values were similar among the groups. No newborn had fetal acidemia. These results were similar with Sendag's study.[17]

Present anesthetic techniques, however, limit the dose of intravenous agents such that fetal depression is usually not clinically significant with general anesthesia. Long skin incision-to-delivery (>8 minutes) and uterine incision-to-delivery times (>180 seconds) have been associated with fetal hypoxia and acidosis regardless of the type of anesthesia.[1]

CSEA may increase the risk of epidurally administered drugs disseminating in the subarachnoid space through the dural hole.[18] Suziki et al. found that dural puncture using a 26 G whitacare spinal needle before epidural injection increases caudal spread of analgesia by epidural local anaesthetics.[19] In our study, unexpectedly high level of anaesthesia was not found.

As a result, CSEA is superior to the other anaesthetic techniques for elective caesarean section.

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