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Research Article

A comparative study of general anesthesia versus combined spinal–epidural anesthesia on the fetus in cesarean section

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KEYWORDS

Combine spinal–epidural;
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Abstract *Background:* Obstetric anesthesia guidelines recommend regional over general anesthesia for most caesarean sections to decrease the risk for both fetus and mother.
Aim of the work: To determine the effects of combined spinal epidural anesthesia and general anesthesia on the newborns and the mother undergoing elective cesarean section.
Subjects: A total of 60 consecutive women with uncomplicated singleton pregnancies at term and scheduled to undergo elective cesarean section at Kasr Al-Aini obstetric hospital participated in this prospective study. The women were divided into 2 groups (each 30), a general anesthesia group (A) and combined spinal–epidural anesthesia group (B).
Methods: Umbilical artery blood gas analysis and Apgar scores were assessed at 1 and 5 min after delivery in the newborn while systolic and diastolic blood pressure, heart rate, oxygen saturation and (capnography in general anesthesia) were measured preoperative and after 5, 10 and 15 min of induction of anesthesia in the mothers. In addition, the time from induction of anesthesia till delivery of the fetus and duration in operative room were measured.
Results: Apgar score recorded statistically significant differences between the 2 groups at 1 min and 5 min, where with combined spinal–epidural anesthesia the Apgar score readings were higher than with general anesthesia. HCO_3 readings showed a statistically significant difference between the 2 groups after 1 and 5 min, where the newborns in general anesthesia group had a statistically significant lower HCO_3 compared to the newborns in combined spinal–epidural group. Patients in

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general anesthesia group were significantly more tachycardic compared to patients in combined spinal–epidural group.

Conclusion: Combined spinal–epidural anesthesia is safer on the newborn than general anesthesia regarding the APGAR scores and acid–base balance.

1. Introduction

Mother and fetus well-being should be taken into account while planning for anesthetic for cesarean delivery. Regional anesthesia is safer for the mother than general anesthesia and the most common method of anesthesia for delivery because it allows the mother to be awake and immediately interact with her baby [1].

Spinal and combined spinal epidural anesthesia are more commonly used than epidural anesthesia because it has a more rapid onset and lower incidence of failed block than pure epidural techniques. The use of spinal anesthesia for cesarean delivery was facilitated by the popularization of pencil-point needles, which dramatically reduced the incidence of postdural puncture headache [2].

In contrast to regional anesthesia, general anesthesia offers a very rapid and reliable onset, control over the airway and ventilation and potentially less hypotension. The major adverse fetal effect of regional anesthesia and its sympathetic blockade is utero-placental hypo-perfusion which leads to an acute fall in intervillous blood flow with the potential for fetal acidemia [3].

The question posed regarding the effect of general versus regional anesthesia on neonatal Apgar scores is an interesting one. This subject has been studied by many investigators over the years, most commonly retrospectively and in the setting of elective cases. Some have shown no difference in Apgar scores between the groups. Some have reported lower Apgar scores and worse outcomes with the use of general anesthesia, suggesting that these differences are a result of transient sedation secondary to anesthetic agents [4]. Others have suggested an increased degree of acidosis in neonates delivered under regional anesthesia, possibly due to greater incidence of maternal hypotension and need for ephedrine to support maternal blood pressure [5].

Although the safety of regional anesthesia is evidenced based yet it is not properly positioned during anesthesiologist decision making in our country due to false cultural believes. Also the familiarity for working under regional anesthesia among surgeon is still lacking in our country.

The aim of this work is to compare the effects of Combined Spinal Epidural anesthesia and general anesthesia on the newborns and the mother undergoing elective cesarean section to highlight the safety of regional techniques.

2. Patients and methods

2.1. Type of the study

This is a cross-sectional observational prospective study.

2.2. Ethical consideration

The study was conducted after approval of the ethical and scientific committee of the department of anesthesia Kasr El Aini hospitals-Cairo University.

2.3. Patients

A total of 60 consecutive pregnant women at term (> 37 completed weeks) was scheduled to undergo elective CS participated in this study. The women were allocated into two equal groups (each 30), a general anesthesia group (A) and a combined Spinal Epidural anesthesia group (B). They fulfilled the following inclusion criteria: women who had uncomplicated singleton cephalic pregnancies with birth weights greater than 2500 g who were indicated to undergo elective caesarean section due to previous Caesarean delivery, precious baby and history of primary infertility. They were consenting to participate at the study. Exclusion criteria were the following: pregnancies with any medical complications, pregnancies with obstetric complications such as hypertension, oligo-hydramnios, poly-hydramnios, ante-partum hemorrhage, suspected fetal abnormality and multiple pregnancies, any coagulopathies, infection at site of regional anesthesia and any sensitivity to used drugs. Preoperative evaluation for both groups included a detailed history, physical examination and investigations (hemoglobin level, platelet count, random blood glucose, serum creatinine, liver function tests, prothrombin time (PT) and international normalized ratio (INR), prothrombin concentration, urea and creatinine). Preoperative medications: ranitidine 50 mg intravenously (H_2-blocker), and metoclopramide 10 mg intravenously. Women in both groups were kept in the left 15° lateral tilt position till delivery to protect against supine hypotension syndrome.

2.4. Technique

On arrival to the operating room all patients received standard continuous monitoring in the form of 5 leads electrocardiography (ECG), automated non-invasive blood pressure monitoring (NIBP), pulse oximetery and capnography (after induction for group A patients) and 18 guage intravenous canula was inserted in cephalic vein then. *For group A*: (General anesthesia): Pre-induction oxygenation regimen of 4 or 5 vital-capacity breaths of pure oxygen was followed by 5 mg/kg of thiopental intravenously and administration of 1 mg/kg of succinylcholine chloride, endotracheal intubation then maintenance of anesthesia was done by 0.5 mg/kg of atracurium, Controlled mechanical ventilation with 100% oxygen, and 1.0 minimum alveolar concentration of isoflurane. End tidal carbon dioxide pressure kept at 35 mm Hg. *For group B*: (Combined spinal–epidural anesthesia): After IV intravascular fluid administration with 8 mg/kg ringer acetate, the epidural space was identified at the L2-3 interspace with an 18-gauge Touhy needle using the loss-of-resistance to saline technique. A 20-gauge epidural catheter was positioned 4 cm into the epidural space. Then Spinal anesthesia was performed using a 25-gauge Sprotte needle introduced in the midline and placed in the L3–L4 intervertebral space. At this step, 12 mg bupivacaine with 25 μg fentanyl was administered (total

volume 3 ml). The patient was positioned supine with 15° left lateral tilt. A 15° Trendelenburg position was assumed to optimize cephalic spread of the anesthetic drugs.

Epidural volume extension was performed to improve local anesthetic spread using 10 mL saline 5 min after initiation of anesthesia. Adequate anesthesia was defined as an upper sensory spread (absence of sensation to cold) to a level of T4 and not requiring epidural supplementation. Anesthesia was supplemented using epidural lidocaine 2% when pain occurred or if the T4 dermatome was not reached within 15 min. after delivery of the fetus fentanyl 1 μg/kg was given to the group A and oxytocine was given for both groups. Emergency drugs for both groups were prepared, Atropine 1 mg/ml, and Ephedrine hydrochloride (Ephedrine) 3 mg/ml.

Post-operative analgesia was given to all patients from both groups in the form of: Group (A): Pethidine given at dose 1 mg/kg intra-muscular every 8 h. Group (B): epidural analgesia with plain bupivacaine 0.25% epidural with top up doses when needed (every two hours). The systolic and diastolic arterial blood pressure and heart rate were measured preoperatively, after 5 min, after 10 min and after 15 min of induction of anesthesia then every 15 min till end of the operation and every 1/2 h in recovery room till discharge. The time from induction of anesthesia till delivery of the fetus, duration of surgery were measured.

2.5. New born management

All newborns were attended at the time of delivery by a pediatrician. Pediatricians who assessed the Apgar scores and determined the presence of hypotonia were blind to the anesthetic technique used. All neonates were assessed regarding: neonatal APGAR scores at 1 and 5 min. Umbilical artery blood gas for PH, PCO_2 and HCO_3 were compared between the 2 groups.

2.6. Statistical analysis

Data were presented as mean ± SD. Categorical variables were assessed using chi-square or Fischer exact test when appropriate. Normally distributed data are presented as mean ± (SD) and were analyzed using Student's *t* test and two-way analysis of variance with repeated measures and post hoc Dunnett test as appropriate. Data not normally distributed (tested by Kolmogorov–Smirnov test) are presented as median (range) and were analyzed with Mann–Whitney *U* test or the Kruskal–Wallis test as appropriate. The software SPSS v 15.0 for Windows (SPSS. Inc, Chicago, I1, United States) was used for statistical analysis.

3. Results

Regarding the maternal medical history, it was free in both groups. There were no statistically significant differences between the two groups regarding the maternal age and the gestational age of the newborn. (Table 1). Apgar score recorded a statistically significant higher scores at 1 and 5 min in combined spinal epidural group (B) compared to group (A) (Table 2). As regards PH and PCO_2 they were both comparable in the two groups at 1 and 5 min. There was a statistically significant lower HCO_3 level in group A compared to group B at 1 and 5 min (Table 2). Differences in the heart rate between the 2 groups were statistically significant at all readings where group (A) patients were significantly more tachycardic compared to group (B) patients except preoperative reading (Table 3).

Differences in systolic blood pressure values between the 2 groups were statistically significant lower in group (B) compared to group (A) at 2 points: after 5 min & after 10 min from induction of anesthesia (Table 3).

Differences in diastolic blood pressure values between the 2 groups were statistically significant lower in group (B) compared to group (A) at all times except preoperative reading (Table 3). There were no statistically significant differences between the 2 groups regarding the time of anesthesia (from induction of anesthesia till delivery of the fetus) and as regarding the total time operation (Table 4).

4. Discussion

Regional anesthesia is highly recommended nowadays for the mother over general anesthesia being safer for both mother and fetus, allows the mother to be awake and immediately interact with her baby.

This study emphasized mainly on the new born outcome. It showed that 1 and 5 min Apgar score were higher in newborns of parturients who received combined spinal epidural anesthesia. It could be explained by the effect of transient sedation secondary to the general anesthetic agents. These results go with the study done by Mancuso and colleagues [6] who compared the effect of general and spinal anesthesia on One hundred seventy-nine pregnant women undergoing elective cesarean section were allocated randomly to general or spinal anesthesia, Umbilical cord artery pH, Apgar score and need for assisted ventilation were evaluated and found spinal anesthesia superior to general in fetal outcome.

In another study done by Kavac and colleagues [7], who investigated the short term outcome of the fetus in parturients undergoing elective cesarean section under spinal versus general Anesthesia, in addition to apgar score and acid base measurement they assessed the perinatal stress by measuring serum creatine kinase (the myocardial-specific), alanine and aspartate aminotransferase, and total cortisol levels to rule out any neonatal asphyxia. They found all parameters normal and comparable in both general and spinal anesthesia.

On the contrary to the current study results, Maghsoudloo and colleagues [8] study the effect of general anesthesia on the

Table 1 Demographic data.

	Group (A) $N = 30$		Group (B) $N = 30$		P
	M	SD	M	SD	
Maternal age (years)	26.93	±6.11	26.87	±5.22	0.96
Gestational age (weeks)	38.77	±.86	38.87	±.90	0.66

Data are expressed as number, mean and standard deviation. (P-value of statistical significance $\leqslant 0.05$).

Table 2 Newborn outcome: Apgar score at 1 and 5 min, ABG at birth and after 5 min: 2-newborn outcome.

	Group (A) $N = 30$		Group (B) $N = 30$		P
	M	+SD	M	+SD	
APGAR score at 1 min	6.3	±1.12	7.5	±1.7	<0.05*
APGAR score at 5 min	8.9	±1.12	9.53	±0.97	<0.05*
ABG at birth					
PH	7.24	±0.11	7.28	±0.11	0.13
PCO_2	44.93	±4.38	46.03	±4.95	0.37
HCO_3	20.30	±3.27	21.80	±2.49	<0.05*
ABG after 5 min					
PH	7.33	±.10	7.37	±.07	0.061
PCO_2	39.90	±1.84	40.27	±2.97	0.568
HCO_3	22.27	±2.70	23.50	±1.68	<0.05*

Data are expressed as number, mean and standard deviation.
* P-value of statistical significance $\leqslant 0.05$.

Table 3 Maternal vital sign: Heart rate, systolic blood pressure, diastolic blood pressure: 3-maternal vital sign.

	Group (A) $N = 30$		Group (B) $N = 30$		P value
	Mean	±SD	Mean	±SD	
Preoperative					
Heart rate	106.00	±11.095	101.63	±14.288	1.191
Systolic blood pressure	124.16	±14.51	123.16	±8.56	0.746
Diastolic blood pressure	75.00	±9.737	74.50	±10.368	0.848
After 5 min					
Heart rate	118.00	±12.36	88	±19.055	<0.05*
Systolic blood pressure	127.83	±15.68	95.66	±14.13	<0.05*
Diastolic blood pressure	79.50	±14.284	51.16	±9.530	<0.05*
After 10 min					
Heart rate	113.50	±14.45	86.33	±16.4	<0.05*
Systolic blood pressure	121.83	±9.142	98.66	±12.793	<0.05*
Diastolic blood pressure	72.50	±8.977	53.50	±11.828	<0.05*
After 15 min					
Heart rate	116.66	±14.99	90.66	±16.6	<0.05*
Systolic blood pressure	115.50	±14.991	111.00	±9.595	0.172
Diastolic blood pressure	71.33	±10.416	64.83	±11.852	<0.05*
After 30 min					
Heart rate	93.4	±11.05	89	±9.8	<0.05*
Systolic blood pressure	115.3	±11.18	112	±11.3	<0.05*
Diastolic blood pressure	75	±10.9	68	±15.3	<0.05*
After 45 min					
Heart rate	85.4	±10.5	80	±9.4	<0.05*
Systolic blood pressure	113.2	±11.3	112	±11.3	<0.05*
Diastolic blood pressure	77	±13.4	64	±14.7	<0.05*
1 h Postoperative					
Heart rate	80	±14.5	83	±10.4	<0.05*
Systolic blood pressure	115	±12.2	110	±9.5	<0.05*
Diastolic blood pressure	73	±10.7	67	±11.4	<0.05*
2 h Postoperative					
Heart rate	82	±13.4	78	±16.3	<0.05*
Systolic blood pressure	118	±12.9	112	±13.2	<0.05*
Diastolic blood pressure	75	±14.1	64	±11.5	<0.05*

Data are expressed as mean and standard deviation.
* Statistically significant. (P-value of statistical significance $\leqslant 0.05$).

Table 4 Time of anesthesia and total time of surgery: Time of anesthesia and total time in operating room.

	Group (A)		Group (B)		*P*-value
	Mean	±SD	Mean	±SD	
Time of anesthesia(min)	15.00	±2.94	14.67	±3.20	0.676
Total time of surgery (min)	45.00	±0.18	44.00	±0.23	0.902

Data are expressed as mean and standard deviation. * = statistically significant. (*P*-value of statistical significance ⩽0.05).

newborn Apgar scores and blood gases analysis with and without fentanyl intravenous and the results were comparable and did not affect the newborn outcome. They explained their results that fentanyl has short acting effect and rapid metabolism.

In the current study no statistically significant difference was present between the two groups regarding newborns PH and CO_2 while HCO_3 which was statistically significant lower in parturients of general anesthesia group compared to combined spinal epidural group but which reflected neonatal metabolic acidosis in the group received general anesthesia but this was not significant clinically. This can be explained by the presence of fetal respiratory depression and accumulation of CO_2 which was promptly corrected.

The current results went into agreement with moslemi and colleagues who studied the effect of spinal anesthesia in severe preeclampsia on both maternal hemodynamic and neonatal Apgar score and umbilical arterial PH and CO_2 and showed spinal a preferable over general anesthesia [9].

In contrary *Reynolds* and *Seed*, performed a meta-analysis on different types of anesthesia and found Cord pH was significantly lower with spinal than with both general and epidural anesthesia and concluded that spinal anesthesia cannot be considered safer than epidural or general anesthesia for fetus [10].

As regards maternal hemodynamics, the study results showed, there was a higher incidence of intra-operative tachycardia with general anesthesia patients compared to combined spinal epidural anesthesia patients could be attributed to the stress of rapid sequence induction and inadequate analgesia as we postponed giving analgesic drugs till delivery of the fetus. On the other hand, carefully administrated regional anesthesia in the form of low dose sequential combined spinal epidural anesthesia as previously explained avoids stress of general anesthesia, moreover regional anesthesia with caution to avoid sudden onset of blockade of sympathetic nervous system provide better hemodynamic stability when compared with general anesthesia or even with other techniques of regional anesthesia. Also in this study, there was a lower systolic and diastolic blood pressures in combined spinal epidural parturients compared to general anesthesia group this could be due to the sympathetic block associated with regional anesthesia, it was rapidly and successfully treated by fluid bolus and ephedrine shots, it can be explained by the augmenting effect of epidural injection of saline from the start.

These results were in agreement with a study comparing spinal and combined spinal epidural and found the latter technique associated with more stable maternal hemodynamic [11].

In another studies which compared the effect of combined spinal epidural anesthesia (CSEA) versus epidural anesthesia and found CSEA had greater efficacy and fewer side effects than epidural alone when administered for Cesarean section. And this was consistent with the present study results [12,13].

On the contrary another study compared spinal anesthesia and (CSEA) and concluded that both techniques were comparable and with no difference on either maternal hypotension and fetal outcome provided maternal hypotension which occurred early in spinal anesthesia is rapidly managed and corrected [14].

Limitations of the study are discussed as:

- Although the research comparing general versus regional anesthesia is well studied during the development of anesthesiology yet the new era of debate between both techniques and needs further research.
- Although the sample size is representative yet the number is still low due to patient refusal owing to perceived myths of both parturients and obstetricians related to regional anesthesia.

5. Conclusion

Combined spinal – epidural anesthesia is safer on the newborn than general anesthesia regarding the APGAR scores and acid–base balance.

Conflict of interest

No conflict of interest.

References

[1] Bloom SL, Spong CY, Weiner SJ, et al. Complications of anesthesia for cesarean delivery. Obstet Gynecol 2005;106:281–7.
[2] Ranasinghe JS, Steadman J, Toyama T, Lai M. Combined spinal epidural anaesthesia is better than spinal or epidural alone for Caesarean delivery. Br J Anaesth 2003;91:299–300.
[3] Yegin A, Ertug Z, Yilmaz M, Erman M. The effects of epidural anesthesia and general anesthesia on newborns at cesarean section. Turk J Med Sci 2003;33:311–4.
[4] Solangi SA, Siddiqui SM, Khaskheli MS, Siddiqui MA. Comparison of the effects of general vs spinal anesthesia on neonatal outcome. Anaesth Pain Intens Care 2012;16(1):18–23.
[5] Afolabi BB, Lesi FE, Merah NA. Regional versus general anaesthesia for caesarean section. Cochrane Database Syst Rev 2006:CD004350.
[6] Mancuso A, De Vivo A, Giacobbe A, Priola V, et al. General versus spinal anaesthesia for elective caesarean sections: effects on neonatal short-term outcome. A prospective randomised study. J Matern Fetal Neonatal Med 2010;23(10):1114–8.
[7] Kavak ZN, Başgül A, Ceyhan N. Short-term outcome of newborn infants: spinal versus general anesthesia for elective cesarean section. A prospective randomized study. Eur J Obstet Gynecol Reprod Biol 2001;1(100):50–4.

[8] Maghsoudloo M, Eftekhar N, Ashraf M, Khan H, et al. Does intravenous fentanyl affect apgar scores and umbilical vessel blood gas parameters in cesarean section under general anesthesia? Acta Medica Iranica 2011;49(8):517–22.
[9] Moslemi F, Rasooli S. Comparison of spinal versus general anesthesia for cesarean delivery in patients with severe preeclampsia. J Med Sci 2007;7:1044–8.
[10] Reynolds F, Seed PT. Anaesthesia for Caesarean section and neonatal acid-base status: a meta-analysis. Anaesthesia 2005;60(7):636–53.
[11] Petropoulos G, Siristatidis C, Salamalekis E, Creatsas G. Spinal and epidural versus general anesthesia for elective cesarean section at term: effect on the acid-base status of the mother and newborn. J Matern Fetal Neonatal Med 2003 Apr;13(4):260–6.
[12] Karaman S, Akercan F, Akarsu T, Firat V, et al. Comparison of the maternal and neonatal effects of epidural block and of combined spinal–epidural block for Cesarean section. Eur J Obstet Gynecol Reprod Biol 2005 Jul 1;121(1):18–23.
[13] Choi DH, Kim JA, Chung IS. Comparison of combined spinal epidural anesthesia and epidural anesthesia for cesarean section. Acta Anaesthesiol Scand 2000 Feb;44(2):214–9.
[14] Uysallar E, Karaman S, Günüşen I, Uyar M, Fırat V. Comparison of the maternal and neonatal effects of combined spinal–epidural block and spinal block for cesarean section. Agriculture 2011 Oct;23(4):167–73.