Effect of nonpharmacological methods on incidence of postspinal hypotension during cesarean delivery: a comparative study

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Introduction Hypotension is caused by upward spread of anesthetic into the subarachnoid space; this results in venous pooling in the capacitance vessels of the lower limbs as a result of block of sympathetic tone and unopposed activity of parasympathetic tone. It also may be caused by aorto-caval syndrome and is accompanied by bradycardia, nausea, and vomiting. Hypotension may have deleterious effects on mother and fetus and may result in uteroplacental hypoperfusion, as placental perfusion is pressure dependent, and lack of autoregulation of placental blood vessels, if persisted, may threaten the life of the fetus.

Aim The primary aim of the work is to compare incidence of intraoperative hypotension between the three groups. The secondary outcome is to assess Appearance, Pulse, Grimace, Activity, Respiration (Apgar) score, vasopressor consumption, and occurrence of complications (nausea, vomiting, and bradycardia).

Patients and methods A total of 150 patients undergoing cesarean delivery under spinal anesthesia were included. Patients were divided into three equal groups, using simple randomization method, with 50 patients each: group S, in which the patient will sit for 1 min after induction of spinal anesthesia and then will lie down; group E, in which patient's legs will be elevated to 30° from the horizontal plane; and group C in which the patient will lie down immediately after induction of spinal anesthesia as a control group. Then, heart rate, systolic blood pressure, diastolic blood pressure, and mean blood pressure were measured every 2 min until delivery of fetus and then every 5 min until the end of surgery. Sensory level was assessed before start of surgery, subsequently after lying down, and every 1 min using hot and cold test until it reaches T6 sensory level. Fetal well-being was assessed by Appearance, Pulse, Grimace, Activity, Respiration (Apgar) score measured by a pediatrician blinded to the study protocol at 1 and 5 min after delivery. Incidence of hypotension is defined as 'at least one episode of decrease in systolic blood pressure to less than 90 mmHg or decrease in systolic pressure more than 20% from the baseline till the end of surgery'. It was treated immediately by 200 ml intravenous bolus fluids and injection of 5 mg ephedrine intravenous bolus every 2 min until elevation of blood pressure, and the total of ephedrine consumption was calculated. Duration of surgery and intraoperative complications was recorded as bradycardia, defined by heart rate below 60 beats/min, which was treated by 0.5 mg atropine sulfate, and nausea and vomiting, which were treated by ondansetron intravenous 4 mg after correction of hypotension.

Results A total of 150 cesarean delivery patients between 22 and 34 years of age were included in the study. Regarding basic clinical and demographic data, it was found that the median age of all cesarean delivery patients was 30 years. The median BMI of all cesarean delivery patients was 32.5. Regarding the surgery duration, the median surgery duration of all cesarean delivery patients was 40 min. Regarding level of sensory block, most patients had sensory block at T6 (70%), and 30% at T4 in groups C, E, and S, correspondingly. Regarding primary outcome (incidence of hypotension mean arterial blood pressuer (MAP)$<$70 mmHg), there was a highly significant increase in incidence of hypotension in group C compared with other groups of patients, with highly significant statistical difference (P=0.0092). The incidence of hypotension in group C was 70%, in group E was 50%, whereas in group S was 40% (P=0.0092). Regarding secondary outcomes (ephedrine consumption, Apgar scores, and complications), there was a highly significant increase in ephedrine consumption in group C compared with other groups (P=0.000002). The median value of ephedrine consumption in group C was 7.5 mg, in group E was 2.5 mg, whereas no ephedrine was consumed in group S (P=0.000002). Moreover, there was a nonsignificant difference regarding Apgar score at 1 min ($P>0.05$). There was a highly significant increase in Apgar score at 5 min in group S compared with other groups (P=0.0047). There was a highly significant increase in bradycardia in group C compared with the other groups (P=0.0015). There was a highly significant increase in nausea in group C compared with the other groups (P=0.0008). There was a highly significant increase in vomiting in group C compared with the other groups (P=0.0008).

Conclusion Incidence of hypotension in patients undergoing cesarean delivery under spinal anesthesia markedly decreased in patients who sat for 1 min after induction of spinal anesthesia and then lied down (group S) compared with patients who lied down immediately after induction of spinal anesthesia.

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Introduction

Anesthesia for cesarean delivery is always challenging, whether under regional or general anesthesia [1].

A lot of complications may face the anesthetists during induction of general anesthesia, which may have deleterious effects on the mother and fetus, for example, the anesthetist may be faced with difficult intubation, and at this time, the mother is at risk of aspiration and hypoxemia, which affect the lives of both mother and fetus [2].

Therefore, many clinicians prefer regional anesthesia especially spinal anesthesia as it avoids any complications, and the anesthetists and surgeons are satisfied as patient is awake [3].

Spinal anesthesia is now considered the standard for cesarean delivery, but unfortunately, spinal anesthesia for cesarean delivery is usually accompanied by hypotension, which may reach up to 60–80% in some instances during cesarean delivery [2,4,5].

Hypotension is caused by upward spread of anesthetic in subarachnoid space. This results in venous pooling in the capacitance vessels of the lower limbs as a result of block of sympathetic tone and unopposed activity of parasympathetic tone. It also may be caused by aorto-caval syndrome and is accompanied by bradycardia, nausea, and vomiting [6].

Hypotension may have deleterious effects on mother and fetus and may result in uteroplacental hypoperfusion, as placental perfusion is pressure dependent, and lack of autoregulation of placental blood vessels, if persisted, may threaten the life of the fetus [5].

For these reasons, attention turned for nonpharmacological methods for prevention of hypotension in cesarean delivery, as some authors have suggested that the position of the patients during and after spinal anesthesia may affect occurrence of hypotension [7].

Leg elevation is a simple method for prevention of postspinal hypotension in cesarean delivery by preventing blood stasis in leg vessels because of sympathetic block, which leads to increase in the venous return from the lower limbs (auto transfusion). It is physiological and nonpharmacological, as it is devoid of adverse effects [8].

When the patient lies down immediately after injection of the local anesthetic in the subarachnoid space, aorto-caval compression leads to engorgement of epidural venous system and compression of dural sac, which may lead to spread of the local anesthetic cephalad that results in high level of spinal anesthesia and its associated complications, so, keeping the patient in the sitting position for 1 min may have beneficial effects on incidence of hypotension and delay spread of the local anesthetic to higher levels in the subarachnoid space [9].

This study compares the incidence of hypotension in cesarean delivery by putting the patients in sitting position for 1 min after injection of local anesthetic in subarachnoid space versus elevation of the legs for 30° after induction of spinal anesthesia.

Aim

The primary aim of the work is to compare incidence of intraoperative hypotension between the three groups. The secondary outcome is to assess Appearance, Pulse, Grimace, Activity, Respiration (Apgar) score, vasopressor consumption, and occurrence of complications (nausea, vomiting, and bradycardia).

Patients and methods

Patients

This is a prospective randomized controlled study carried out in Al-Azhar University Hospitals on 150 patients after approval from the Institutional Ethical Committee. A written informed consent was taken from all participants after proper explanation of the study.

Inclusion criteria were as follows:

(1) Pregnant ASA I or II, elective cesarean delivery patients.
(2) Age between 22 and 34 years

Exclusion criteria were as follows:

(1) Any contraindication or refusal of spinal anesthesia.
(2) Emergency cesarean delivery.
(3) Hypertensive disorders of pregnancy (preeclampsia, eclampsia, and pregnancy-induced hypertension).
(4) Gestational diabetes.
(5) BMI more than 40.
(6) Fetal distress.

Methods

On admission, the participants were informed about the study design, objectives, as well as tools and techniques and provided a written informed consent regarding the maneuvers of this study. All patients fasted according to fasting guidelines from 6 to 8 h.

Proper preoperative assessments for history, physical examination including airway examination and

laboratory investigations, and also fetal well-being were assessed by ultrasonography and tocodynamometer.

All patients were transferred to operating room in supine position with left lateral tilt to avoid aorto-caval compression. A peripheral intravenous cannula (18-G) was inserted and secured well in the nondominant hand, and premedication was given in the form of ranitidine 50 mg and ondansetron 4 mg 30 min before induction.

Bedside monitoring was applied in the form of SpO_2%, noninvasive blood pressure, and five-lead ECG utilizing Life Scope (Nihon Kohden Corporation, Tokyo, Japan).

Preload in the form of normal saline 0.9% was infused at a rate of 10 ml/kg over 20 min.

In all groups, preparation of skin of the back by povidone iodine (Betadine 10%, Povidine Iodine, Nile Pharma, Company Cairo, Egypt) was done. All patients received 12.5 mg (2.5 ml) 0.5% hyperbaric bupivacaine (Marcaine; AstraZeneca Pharmaceuticals, Wedel, Germany).

Spinal anesthesia was initiated in the sitting position through a 25 G Quincke spinal needle (Spinocan; Braun Melsungen, Germany) at level of L3–L4 or L4–L5 interspace via para-median approach.

At this point, patients were divided into three equal groups, using simple randomization method, utilizing closed envelops, which included 50 cases in each group:

(1) Group S, in which the patient will sit for 1 min after induction of spinal anesthesia and then will lie down.
(2) Group E, in which patient's legs will be elevated to 30° from the horizontal plane.
(3) Group C, in which the patient will lie down immediately after induction of spinal anesthesia as a control group.

Then, the patients was placed in supine position with 15° left lateral tilt. Fluid infusion was run throughout the procedure with normal saline 0.9%. Heart rate, systolic blood pressure, diastolic blood pressure, and mean blood pressure were measured every 2 min until delivery of fetus and then every 5 min until the end of surgery.

Sensory level was assessed before the start of surgery, subsequently after lying down and every 1 min using hot and cold test until it reaches T6 sensory level; if the sensory level does not reach T6 within 10 min, general anesthesia with rapid sequence induction will be commenced and the case was excluded from the study. Overall, 20 IU of oxytocin was infused at a rate of 5 IU/h after delivery of the fetus. Fetal well-being was assessed by Apgar score, measured by a pediatrician blinded to the study protocol, 1 and 5 min after delivery.

Incidence of hypotension is defined as 'at least one episode of decrease in systolic blood pressure to less than 90 mmHg or decrease in systolic pressure more than 20% from the baseline till the end of surgery'. It was treated immediately by 200 ml intravenous bolus fluids and injection of 5 mg ephedrine intravenous bolus every 2 min until elevation of blood pressure, and the total of ephedrine consumption will be calculated.

Duration of surgery and intraoperative complications were recorded, such as bradycardia, which is defined by heart rate below 60 beats/min and was treated by 0.5 mg atropine sulfate, and nausea and vomiting, which were treated by ondansetron intravenous 4 mg after correction of hypotension if present.

Statistical analysis

Data entry, processing, and statistical analysis were carried out using MedCalc version 15.8. (MedCalc, Ostend, Belgium). Tests of significance (Kruskal–Wallis, χ^2, factorial analysis of variance tests, Spearman's correlation coefficient, and logistic and multiple regression analyses) were used. Data were presented, and suitable analysis was done according to the type of data (parametric and nonparametric) obtained for each variable. P values less than 0.05 (5%) were considered to be statistically significant.

Results

In this study, 150 cesarean delivery patients between 22 and 34 years were included. Regarding describing basic clinical and demographic data such as age, height, weight, and level of sensory block, we found no significant statistical difference, as shown in Table 1.

Regarding surgery duration, the median surgery duration in group C was 40 min, in group E was 45 min, whereas in group S was 40 min, with significant statistical difference, as shown in Table 1.

Regarding primary outcome (incidence of hypotension), follow-up data revealed the following:

(1) There was an increase in the incidence of hypotension in group C compared with other

Table 1 Basic clinical data

Variables	Group C (50) [median (IQR)]	Group E (50) [median (IQR)]	Group S (50) [median (IQR)]	Kruskal–Wallis (*P*)
Age (years)	30 (26–30)	30 (26–30)	30 (26–30)	1.000
Height (cm)	165 (160–170)	165 (160–170)	165 (160–170)	1.000
Weight (kg)	87.5 (80–95)	87.5 (80–95)	87.5 (80–95)	1.000
BMI	32.5 (31–35)	32.5 (31–35)	32.5 (31–35)	1.000
Surgery duration (min)	40 (40–45)	45 (40–45)	40 (45–45)	0.0089**
Variable	Group C (50) [*n* (%)]	Group E (50) [*n* (%)]	Group S (50) [*n* (%)]	χ^2 (*P*)
Level of sensory block				
T4	15 (30)	15 (30)	15 (30)	1.000
T6	35 (70)	35 (70)	35 (70)	

IQR, inter qurtile range. **means highly significant.

Table 2 Comparison among the three groups regarding primary outcome data

Variable	Group C (50)	Group E (50)	Group S (50)	χ^2 (*P*)
Incidence of hypotension	35 (70)	25 (50)	20 (40)	0.0092**

**means highly significant.

groups: in group C was 70%, in group E was 50%, whereas in group S was 40%, with a highly significant statistical difference (*P*=0.0092), as shown in Table 2.

Regarding secondary outcomes (ephedrine consumption, Apgar scores and complications), follow-up data revealed the following:

(1) There was increase in ephedrine consumption in group C compared with other groups: in group C was 7.5 mg, in group E was 2.5 mg, whereas no ephedrine was consumed in group S, with highly significant statistical difference (*P*=0.000002), as shown in Table 3.
(2) There was no significant difference regarding Apgar score at 1 min (*P*>0.05), as shown in Table 3.
(3) There was an increase in Apgar score at 5 min in group S compared with other groups, with highly significant statistical difference (*P*=0.0047), as shown in Table 3.
(4) There was an increase in the incidence of bradycardia in group C compared with other groups: in group C was 40%, in group E was 20%, whereas in group S was 10%, with highly significant statistical difference (*P*=0.0015), as shown in Table 3.
(5) There was an increase in the incidence of nausea and vomiting in group C compared with other groups: in group C was 50% of patients, in group E was 20% of patients, and in group S was also 20% of patients, with highly significant statistical difference (*P*=0.0008), as shown in Table 3.

Table 3 Comparison between the three groups as regards secondary outcome data

Variables	Group C (50) [median (IQR)]	Group E (50) [median (IQR)]	Group S (50) [median (IQR)]	Kruskal–Wallis (*P*)
Ephedrine consumption (mg)	7.5 (0–10)	2.5 (0–10)	0	0.000002**
Apgar score (1 min)	7 (6–7)	7 (7–7)	7 (7–7)	0.50028
Apgar score (5 min)	9 (9–9)	9 (9–10)	9.5 (9–10)	0.0047**

Variables	Group C (50)	Group E (50)	Group S (50)	χ^2 (*P*)
Bradycardia	20 (40)	10 (20)	5 (10)	0.0015**
Nausea	25 (50)	10 (20)	10 (20)	0.0008**
Vomiting	25 (50)	10 (20)	10 (20)	0.0008**

Apgar: Appearance, Pulse, Grimace, Activity, Respiration score.
IQR, inter qurtile range. **means highly significant.

Correlation studies regarding incidence of hypotension revealed the following:

(1) Logistic regression analysis shows that after applying the Forward method and entering some predictor variables, the increase in age and ephedrine consumption had an independent effect on increasing the probability of hypotension occurrence, with significant statistical difference (*P*<0.05, correspondingly), as shown in Table 4.
(2) Logistic regression analysis shows that after applying the Forward method and entering some predictor variables, the decrease in surgery duration had an independent effect on increasing the probability of hypotension occurrence, with significant statistical difference (*P*<0.05, correspondingly), as shown in Table 4.

Correlation studies regarding Apgar score revealed the following:

(1) Multiple regression analysis shows that after applying the Forward method and entering

Table 4 Logistic regression model for the factors affecting hypotension occurrence using the Forward method

Predictor factor	Coefficient	SE	*P* value
Constant	0.5742		
Age	0.02097	0.006873	0.0027**
Duration of surgery	–0.02295	0.01030	0.027*
Ephedrine consumption	0.07901	0.005035	<0.0001**

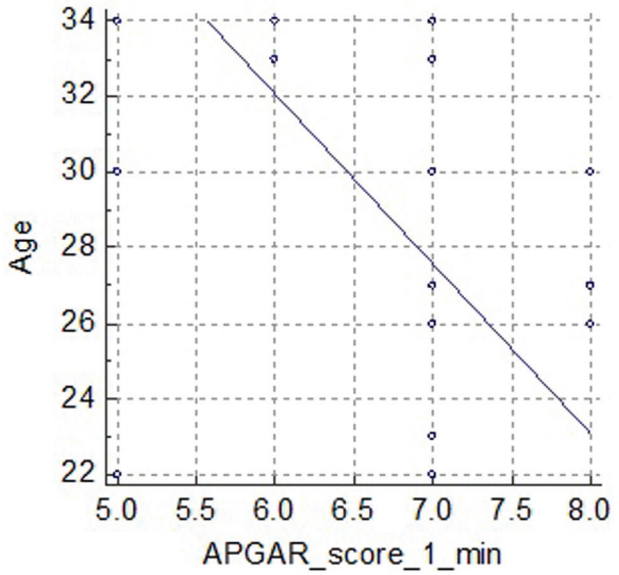
Excluded from the model if $P>0.1$. *means significant. **means highly significant.

Table 5 Multiple regression model for the factors affecting Appearance, Pulse, Grimace, Activity, Respiration score using forward method

Predictor factor	?	SE	*P*
Constant	13.8535		
Age	–0.1080	0.01791	<0.0001**
BMI	–0.1105	0.02390	<0.0001**
Ephedrine consumption	–0.09287	0.01036	<0.0001**

Excluded from the model if $P>0.1$. **means highly significant.

Figure 1



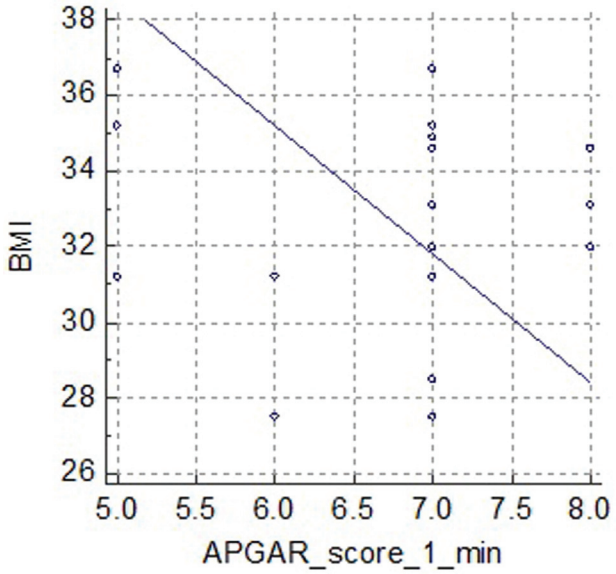
Correlation between Appearance, Pulse, Grimace, Activity, Respiration score and age.

some predictor variables, the decrease in age, BMI, and ephedrine consumption had an independent effect on increasing Apgar score, with significant statistical difference ($P<0.01$, correspondingly), as shown in Table 5 and Figs 1–3.

Discussion

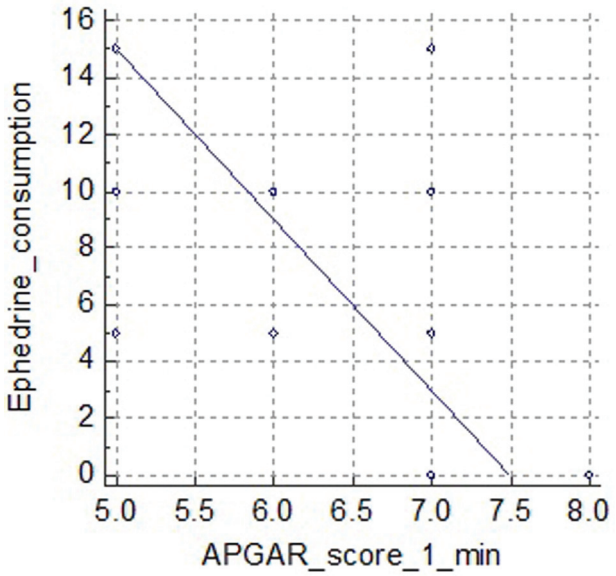
Hypotension may have deleterious effects on mother and fetus and may result in uteroplacental hypoperfusion, as placental perfusion a pressure dependent, and if persisted, may affect the life of the fetus. The use of nonpharmacological method to decrease the incidence of postspinal hypotension may decrease the use of drugs.

Figure 2



Correlation between Appearance, Pulse, Grimace, Activity, Respiration score and BMI.

Figure 3



Correlation between Appearance, Pulse, Grimace, Activity, Respiration score and ephedrine consumption.

As regards primary outcome (incidence of hypotension), follow up period revealed highly significant increase in incidence of hypotension, in C-group; compared to other groups of patients; with highly significant statistical difference which came in agreement with Sakata *et al.* [10], reported that, the postural change test with heart rate variability analysis may be used to predict the risk of hypotension during spinal anesthesia for cesarean section [13].

As regards secondary outcomes (Ephedrine consumption, APGAR scores and complications), follow up period revealed the following:

Highly significant increase in Ephedrine consumption in C-group; compared to other groups of patients; which came in agreement with Hasanin *et al*. [14] which compare between LE group and control group as a method for prevention of post spinal hypotension for cesarean section in which LE group show less ephedrine consumption (4.9±7.8 mg vs 10±11 mg) [14]. and disagreement with Hajian, Nikooseresht, and Lotfi [11] reported that The ephedrine requirement in group (T) was higher than the other two groups (S1 and S2) respectively nevertheless, the difference was not statistically significant [15].

Also there was non-significant difference as regards APGAR score at 1-minute which came in agreement with Obasuyi, Fyneface-Ogan, and Mato in 2013 [16].

Also there was highly significant increase in APGAR score at 5-minutes, in S-group; compared to other groups of patients; which came in disagreement with Hajian, Nikooseresht, and Lotfi [11] Reported that In addition, there was no significant difference in the Apgar score between the groups at 1 and 5 minutes after birth [14].

Also there was highly significant increase in incidence of bradycardia in C-group; compared to other groups of patients; which came in disagreement with Obasuyi, Fyneface-Ogan, and Mato [12] reported that, there was no difference in the incidence of complications. No episodes of bradycardia were observed [15].

Also there was increase in incidence of nausea and vomiting in C-group; compared to other groups of patients; with highly significant statistical differenc which came in disagreement with Xu *et al*. [13] reported that, the incidence and total dose of phenylephrine supplement as well as the incidence of nausea or vomiting in the sitting position group were significantly higher than the other two groups [16].

Correlation studies regarding incidence of hypotension revealed the following:

Logistic regression analysis shows that; the increase in age and Ephedrine consumption; had an independent effect on increasing the probability of hypotension occurrence; with significant statistical difference ($p < 0.05$ respectively), which came in agreement with Mercier in 2013 [2].

Logistic regression analysis also shows that; the decrease in surgery duration; had an independent effect on increasing the probability of hypotension occurrence; with significant statistical difference which came in agreement with Minj *et al*. [15].

Correlation studies regarding APGAR score revealed the following:

Multiple regression analysis shows that; the decrease in age, BMI and Ephedrine consumption; had an independent effect on increasing APGAR score; with significant statistical difference which came in agreement with Huang in 2015 [16].

Conclusion

The incidence of hypotension, bradycardia, nausea, and vomiting in 'group S' markedly decreased compared with the other two groups after induction of spinal anesthesia.

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Conflicts of interest

There are no conflicts of interest.

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