Original Article/*Özgün Araştırma*

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Does Leg Raising Prevent Spinal-Induced Hypotension in Elective Cesarean Sections? A Randomized Controlled Study

Elektif Sezaryenlerde Bacak Kaldırma Spinal Kaynaklı Hipotansiyonu Önler mi? Randomize Kontrollü Bir Çalışma

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ABSTRACT

Objective: We aimed to investigate the effectiveness of the leg raising (LR) method in preventing spinal anesthesia-induced hypotension in elective cesarean section (C/S) operations.

Methods: One hundred and forty term pregnant women were included in the study. The patients were divided into two groups as leg raising group (Group L, n=70) and the control group (Group C, n=70). After spinal anesthesia, a cushion was placed under the heels of the patients in Group L at an angle of 30 degrees with the horizontal plane. No intervention was made in Group C. The patients' hemodynamic and operation data were recorded at determined intervals.

Results: In Group L, hypotension was observed in 29 (41.4%) patients while 54 (77.1%) patients developed hypotension in Group C (p<0.001). Systolic and diastolic blood pressure values at the 2nd and 3rd minutes after spinal anesthesia were found to be higher in Group L (p<0.05). Furthermore, compared to Group C, the amount of ephedrine used in Group L was found to be lower (9.9±14.2 mg vs. 15.9±11.9 mg, p=0.007).

Conclusion: The LR method applied in C/S operations reduces spinal anesthesia-induced hypotension and thus causes the need for less vasopressor.

Keywords: Cesarean section, spinal anesthesia, leg raising, hypotension

ÖZ

Amaç: Elektif sezaryen (C/S) ameliyatlarında spinal anesteziye bağlı hipotansiyonu önlemede bacak kaldırma (LR) yönteminin etkinliğini araştırmayı amaçladık.

Yöntem: Çalışmaya 140 term gebe dahil edildi. Hastalar bacak kaldırma grubu (Grup L, n=70) ve kontrol grubu (Grup C, n=70) olarak iki gruba ayrıldı. Spinal anestezi sonrası Grup L'deki hastaların topuklarının altına yatay düzlemle 30 derecelik açı yapacak şekilde yükseklik yerleştirildi. Grup C'de herhangi bir müdahale yapılmadı. Belirlenen aralıklarla hastaların hemodinamik ve operasyon verileri kaydedildi.

Bulgular: Grup L'de 29 (%41,4) hastada hipotansiyon görülür iken, Grup C'de 54 (%77,1) hastada hipotansiyon gelişti (p<0,001). Spinal anestezi sonrası 2. ve 3. dakikalardaki sistolik ve diyastolik kan basıncı değerleri Grup L'de daha yüksek bulundu (p<0.05). Ayrıca Grup L'de kullanılan efedrin miktarı Grup C'ye göre daha düşük bulundu (9,9±14,2 mg'a karşı 15,9±11,9 mg, p=0,007).

Sonuç: Sezaryen ameliyatlarında uygulanan LR yöntemi spinal anesteziye bağlı hipotansiyonu azaltmakta ve dolayısıyla daha az vazopressör ihtiyacına neden olmaktadır.

Anahtar sözcükler: Sezaryen seksiyo, spinal anestezi, bacak kaldırma, hipotansiyon

INTRODUCTION

For avoiding the devastating effects of general anesthesia on both pregnant women and fetuses, neuraxial anesthesia and particularly spinal anesthesia are often preferred in cesarean section (C/S) operations (1-5). However, spinal anesthesia induced-hypotension is observed at a ratio up to 60 to 70% in pregnant women (6,7). Untreated resistant hypotension may lead to severe risks of morbidity and mortality in the mother and fetus (8).

The methods such as fluid and/or vasopressor therapy are routinely used in anesthesia practices to prevent spinal anesthesia-induced hypotension. Also, different techniques have been used, such as bandaging or elevating the lower extremity (7,9).

In leg raising (LR) method, the legs of the patient are enabled to be positioned at a determined angle in the horizontal plane using a cushion or a similar object (Figure 1). Thus, the

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blood pounding in the lower extremities is directed to the thorax increasing venous return. This leads to an increase in the stroke volume and thus in cardiac output (7,10,11).

Although the LR method is easy to apply, non-invasive, and reversible, the number of relevant studies in this area is quite limited. Therefore, we aimed to investigate the efficacy of the LR method in preventing hypotension after spinal anesthesia in pregnant women undergoing C/S.

MATERIAL and METHODS

The study was started after the approval of the local ethics committee (date: 11.12.2020 and No: 17/15). In total, 140 term pregnant women, aged 18 to 40, scheduled to undergo an elective C/S operation, who were ASA (American Society of Anesthesiologists) II and whose written and verbal informed consents were obtained were included in the study.

Pregnant women with pregnancy-induced hypertension or preeclampsia, cardiovascular disorder, fetal anomaly, BMI >40 kg m^{-2}, hypotension before spinal anesthesia (systolic arterial pressure <80 mmHg), and who were not given spinal anesthesia or who were switched to general anesthesia during the operation were not included in the study. The closed envelope method was used for randomization. The patients were divided into two equal groups as leg raising (Group L) and control (Group C).

Vascular access was established in all patients using a standard 18 G cannula and a balanced crystalloid solution co-load was administrated at a rate of 10 mL kg^{-1} h^{-1} Patients' demographic data were recorded and they were placed on the operating table in the supine position with a 15-degree left tilt. Subsequently, a standard anesthetic monitoring consisting of electrocardiography, non-invasive arterial blood pressure, peripheral oxygen saturation, and heart rate was monitored. Then, baseline systolic blood pressure (SBP), diastolic blood pressure (DBP), mean blood pressure (MBP), peripheral oxygen saturation (SpO_2), and heart rate values were recorded. Spinal anesthesia was perfomed in all pregnant women in sitting position. After inserting into the spinal space using a 27 G Quincke type needle from the level of L4-5, 2 mL 0.5% bupivacaine (Marcaine® Spinal Heavy 0.5% ampoule) was administrated. Following spinal anesthesia, the patients were brought back to the supine and 15 degrees left tilt position. A cushion was placed under the heels of the patients in Group L at an angle of 30 degrees with the horizontal plane (Figure 1). No intervention was performed in Group C. Then, standard anesthesia management was applied to all patients. Using the Pinprick test, the sensory block level was checked. The cases under a block level of T4 were accepted as a failed spinal block and excluded from the study.

Arterial blood pressure, heart rate, and SpO_2 data were recorded at 1^{st}, 2^{nd}, 3^{rd}, 4^{th}, 5^{th}, 7^{th}, 9^{th}, and 11^{th} minutes following spinal anesthesia. Afterward, the data were recorded every three minutes until the umbilical cord was clamped. Also, the time from the spinal block to the umbilical cord clamping, urine output of the patients, and the overall consumption of ephedrine and atropine were recorded.

The systolic arterial pressure under 90 mmHg or a 20% decrease from the onset value was defined as hypotension. Hypotensive parturients were intravenously administrated 5 mg ephedrine. Bradycardia was defined as a heart rate under 60 beats per minute and 0.5 mg atropine was intravenously administered. The doses were repeated when blood pressure and heart rate values did not reach a sufficient level.

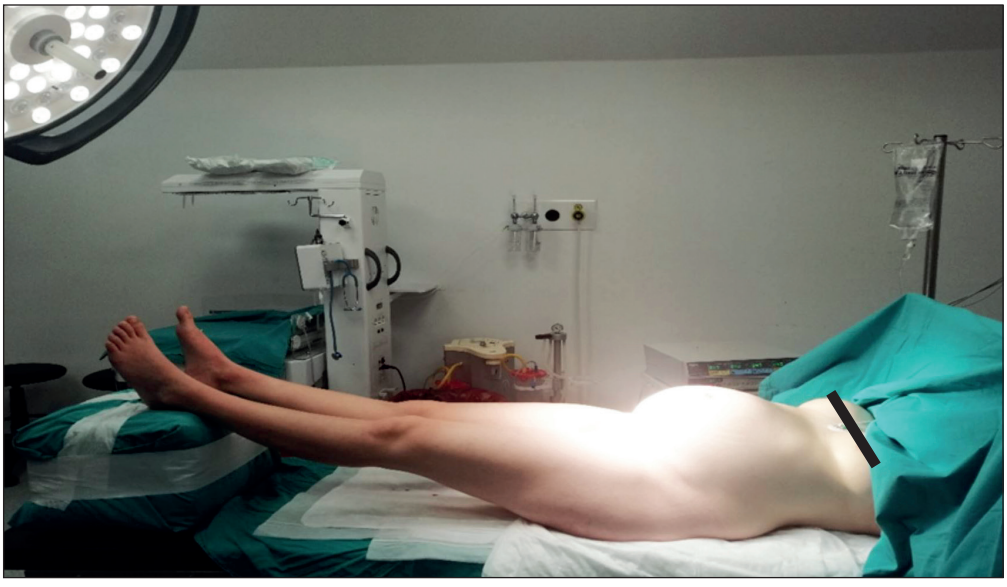

Figure 1. Leg raising method (Patient permission was obtained for the photo).

Statistical Analysis

The primary outcome of our study was to find the incidence of spinal anesthesia-induced hypotension occurring in patients using LR. The secondary outcomes of our study are to determine the incidence of bradycardia and the consumption of ephedrine used in patients undergoing LR. In a study conducted by Hasanin et al. examining the spinal anesthesia-induced hypotension in C/S cases, the rate of hypotension was found to be 58.7% in the control group while 34.7% in the leg raising group (7). Concerning this data, we calculated type I error = 0.05 and the power of the test to be 80%, and 67 patients for each study group in our study. Considering potential losses, we decided to include 70 patients in each study group. SPSS statistical package program was utilized for statistical evaluation (version 15.0; SPSS, Chicago, IL). The data obtained were evaluated using descriptive statistics (arithmetic, mean, standard deviations, and percentage distributions). The Chi-square test was used to compare the categorical variables. Kolmogorov-Smirnov test was performed for the normality of continuous variables. For the continuous variables with an abnormal distribution, the Mann-Whitney U test was used while the t-test was employed for normally distributed continuous variables. A p value <0.05 was accepted statistically significant.

RESULTS

In the study, 140 patients meeting the inclusion criteria were evaluated. No patient was excluded (Figure 2). Study groups were comparable in terms of demographic and operational data (Table I).

Of 140 patients, hypotension developed in 83 (59.3%) following spinal anesthesia. While hypotension was seen at the ratio of 41.4% (n=29) in Group L, this ratio rose to 77.1%

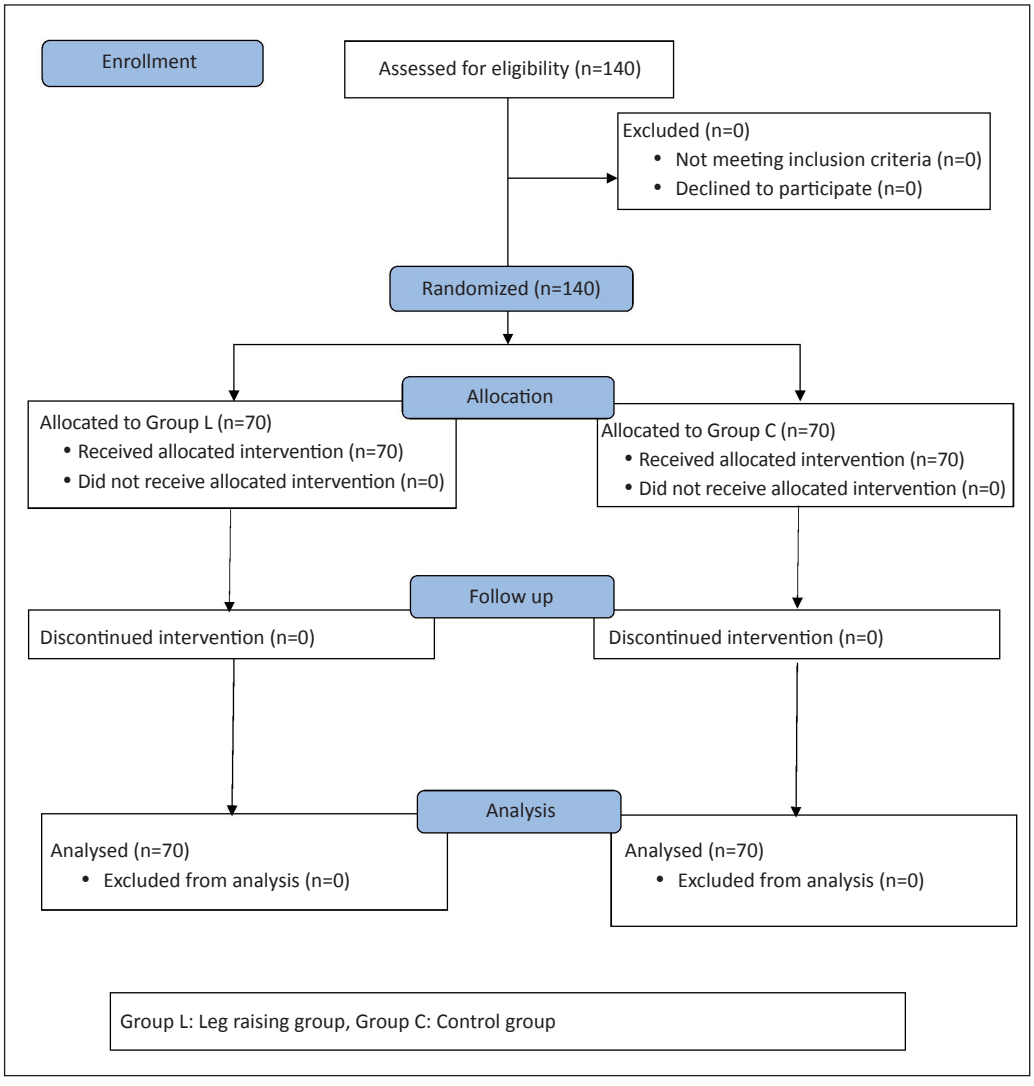

Figure 2. Consort flow diagram of the study.

(n=54) in the control group (Figure 3). Following the anesthesia administration in Group L, the odds ratio for hypotension development was 0.236 (0.101 - 0.436) with a confidence interval of 95%. Furthermore, the intraoperatively used ephedrine amount was less in Group L compared to Group C (9.9 ± 14.2 mg vs. 15.9 ± 11.9 mg, p=0.007) (Table I).

Basal hemodynamic parameters of the study groups were similar. However, we detected higher SBP and DBP values in Group L at the 2nd and 3rd minutes after spinal anesthesia. No intergroup difference was observed at other time intervals (Figure 4). Also, the heart rate values of the study groups were similar (Figure 5).

DISCUSSION

In this study, we applied LR to prevent hypotension in pregnant women who underwent spinal anesthesia for elective C/S operation. The incidence of hypotension due to spinal anesthesia was lower in the Group L, compared to the control group (41.4% vs. 77.1%). Therefore, patients in the Group L needed less vasopressor.

The number of studies conducted on the LR application in pregnant women is quite limited in the literature. The first research on this subject was carried out on 97 pregnant women by Rout et al. in 1993 (12). In this research, the patients were divided into 3 groups: LR, Esmarch bandage, and control group. In the group dressed using an Esmarch bandage, the hypotension incidence was found to be lower compared to the control group (15% vs. 53%, p= 0.004). However, although the hypotension incidence in the group administrated with a 30-degree LR was lower compared to the control group, it was not statistically significant (39% vs. 53%, p>0.05). Unlike, according to the study conducted by Assen et al., the hypotension incidence in the group administrated with a 45-degree LR in the horizontal plane was determined to be lower than

Table I. Demographic and Operational Data of Study Groups

	Group L (n=70)	Group C (n=70)	p
Age (years)	29.9 ± 5.2	31.5 ± 4.9	0.057
Height (cm)	162.2 ± 5.2	160.7 ± 6	0.122
Weight (kg)	77.2 ± 11.6	78.7 ± 11.6	0.445
Body mass index (kg m^{-2})	29.3 ± 4.4	30.4 ± 3.9	0.128
Cord clamping time (min)	8.6 ± 1.7	9.3 ± 2.7	0.068
Surgery time (min)	43.4 ± 2.7	44.5 ± 5.4	0.141
Anesthesia time (min)	48.3 ± 2.2	49.5 ± 5.7	0.101
Infused fluid volume (mL)	1284.3 ± 99.1	1319.3 ± 144.5	0.097
Urine output (mL)	242.1 ± 68.4	258.6 ± 46.6	0.099
Ephedrine consumption (mg)	9.9 ± 14.2	15.9 ± 11.9	**0.007***

Data are expressed as mean ± SD. *Statistically significant.

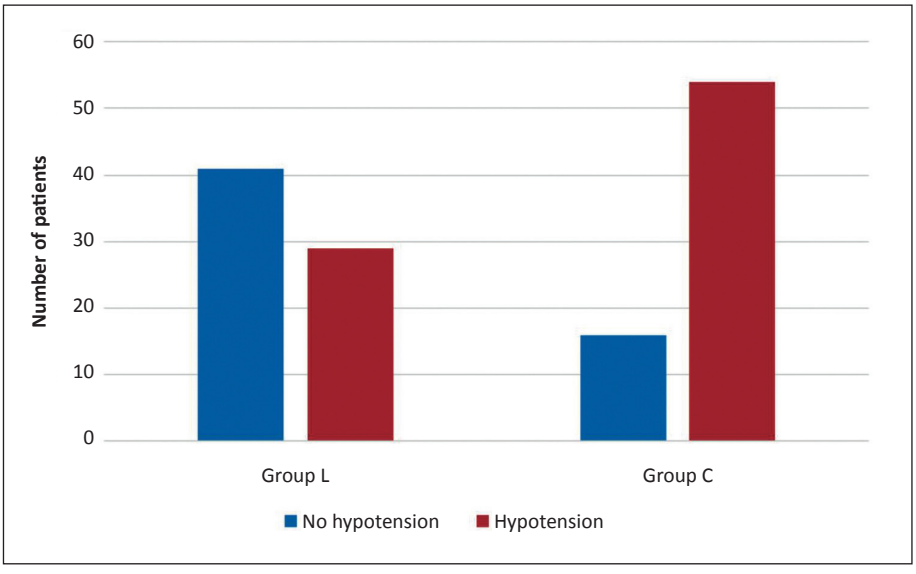

Figure 3. Comparison of study groups in terms of spinal anesthesia-induced hypotension.

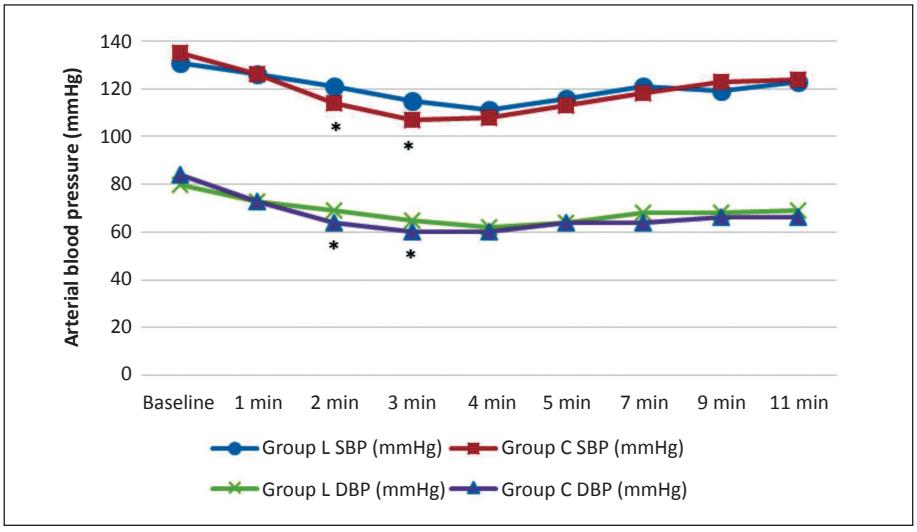

Figure 4. Comparison of study groups in terms of systolic and diastolic blood pressures.

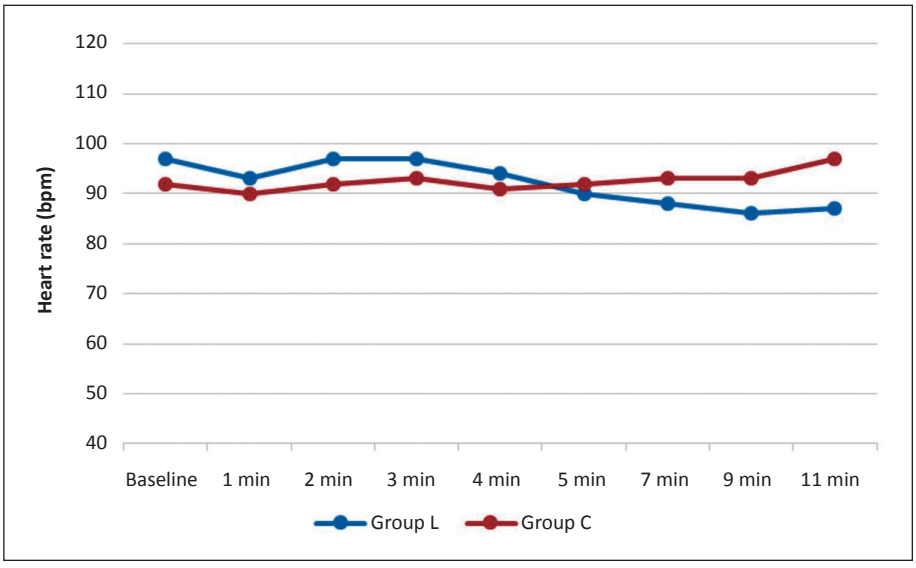

Figure 5. Comparison of study groups in terms of heart rate.

the control group (33.3% vs. 62.5%, p=0.02) (9). Also, in line with the results of the study conducted by Hasanin et al., the hypotension incidence in the group administrated with a 40-degree LR in the horizontal plane was observed to be much lower than in the control group (34.7% vs. 58.7%, p=0.005) (7). In this study, we applied LR at an angle of 30 degrees with the horizontal plane. Similar to the studies of Assen and Hasanin, the incidence of hypotension was lower in the LR group than in the control group (41.4% vs. 77.1%, p=0.001) (Figure 3). Nevertheless, in the study conducted by Rout et al., the LR application was found ineffective probably due to the use of a different hypotension definition (12).

When the studies were evaluated based on the hemodynamic data, in the study carried out by Hasanin et al., SBP and DBP values in the LR group were found to be higher than in the control group in the 1st and 2nd minutes following spinal anesthesia (p<0.05) (7). According to Assen et al., SBP and DBP values in the LR group were found to be higher than in the control group in the 1st, 3rd, 6th, and 9th minutes following spinal anesthesia (p<0.05) (9). Furthermore, in both studies, no intergroup difference was detected in terms of heart rate. In our study, SBP and DBP values were found to be higher in the LR group in the 2nd and 3rd minutes following spinal anesthesia when compared to the control group (p<0.05). We found no difference between groups at other measurement times (Figure 4). Furthermore, similar to the other studies, we did not detect differences between groups in terms of heart rate values (Figure 5). In our study, the effect of the LR disappeared from 3 minutes after spinal anesthesia, while in the study conducted by Assen et al. it sustained until the 9th minute. This may be due to the 30-degree LR application in our study while Assen et al. applied a 45-degree LR.

According to this theory, using a higher degree of LR with a horizontal plane may be more effective in preventing hypotension. However, in the current literature, no study proves this. On the other hand, we believe that the LR application at higher degrees will complicate the operation and disturb the patient's comfort. Additionally, we did not observe any intergroup differences in terms of SBP and DBP values after 3 minutes following spinal anesthesia. The reason for this may be the our vasopressor administration to the hypotensive patients.

A decrease in the amount of vasopressors used in the LR application was previously revealed (7). Similarly, in our study, the amount of ephedrine consumption was found to be lower in the LR group than in the control group (9.9 ± 14.2 vs. 15.9 ± 11.9, p=0.007) (Table I).

Our study has some limitations. We did not carry out the measurements such as stroke volume, and cardiac output that allow more accurate measurements for evaluating the effect of the LR on hemodynamic parameters. We also did not conduct arterial blood pressure monitoring for a real-time blood pressure measurement. However, to make such a monitoring, central vein and arterial catheterization are required. We think that such interventions are extremely unnecessary and uncomfortable for patients who will undergo elective C/S surgery. Furthermore, we could not use devices that measure stroke volume variation and cardiac output noninvasively, since they were not available in our clinic. Additionally, we only recorded the patients' hemodynamic data until the umbilical cord was clamped. Since the administered medications such as oxytocin and methylergonovine maleate after the umbilical cord clamping could affect the hemodynamic parameters.

CONCLUSION

Hypotension is prevalently encountered after spinal anesthesia in C/S operations. We found that LR application in C/S was effective in reducing the incidence of hypotension, although it could not fully prevent post-spinal hypotension. In addition, the need for vasopressors decreased with this method. Leg raising is a practical, reversible, and non-invasive method that requires no specific materials. It will be useful in the anesthesia management of C/S operations under spinal anesthesia.

AUTHOR CONTRIBUTIONS

Conception or design of the work: EO, MDS

Data collection: EO, MDS

Data analysis and interpretation: EO, MDS

Drafting the article: EO, MDS

Critical revision of the article: EO, MDS

Other (study supervision, fundings, materials, etc): EO, MDS

All authors (EO, MDS) reviewed the results and approved the final version of the manuscript.

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