

**Original Research Article****Leg elevation decreases the incidence of post-spinal hypotension in cesarean section: a randomized controlled trial**

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Email: sumitabikash2015@gmail.com**Abstract****Background:** Maternal hypotension is a typical confusion after spinal anesthesia for cesarean segment (CS). In this examination we researched the job of leg height (LE) as a strategy for counteractive action of post-spinal hypotension (PSH) for cesarean segment.**Materials and Methods:** An aggregate of 60 full-term parturients with an uncomplicated pregnancy having a place with American Society of Anesthesiologists I or II were allotted haphazardly (30 in each gathering) to have their legs raised after spinal anesthesia is given. All patients got intravenous (IV) crystalloid (20 ml/kg) 15 min preceding spinal infusion and were set in left sidelong position. Electrocardiography and oxygen immersion was observed

Ceaselessly and pulse, circulatory strain was estimated each 2 min until conveyance of child and each 5 min from there on until end of cesarean segment. Critical hypotension was treated with IV phenylephrine 50 µg bolus dosages.

Results: There was factually noteworthy contrast in level of hypotension found between the two gatherings. Rate of hypotension in Group A (leg wrapped) is 10% where as in gathering B (leg not wrapped) is 66.66%..**Conclusions:** Height of lower furthest points was a basic, simple, and a successful strategy for diminishing scenes of hypotension and vasopressor necessity after spinal anesthesia in cesarean patients and should be polished routinely**Keywords:** Caesarean section, leg elevation, spinal anaesthesia.**Introduction**

Cesarean section has become the most common operative procedure. The central neuraxial blockade has become the preferred anesthesia

technique for cesarean sections, and the use of general anesthesia has drastically decreased¹. Risk of general anesthesia includes failed endotracheal intubation, failed ventilation, aspiration

pneumonitis, postoperative nausea and vomiting, and neonatal depression^{2,3}. Even though spinal anesthesia provides excellent anesthesia, it is commonly associated with adverse effects like hypotension. The hypotension caused depends on the level of block achieved⁴. The commonly used methods to prevent hypotension are preloading with crystalloids or colloids, use of wedge below the right hip, use of vasopressors, and mechanical compression devices (the easiest one being leg wrapping)⁵. In addition to fluids, technique currently in use for preventing hypotension is the administration of vasopressors. The commonly used ones are ephedrine, phenylephrine, and mephentermine. Vasopressors have adverse effects such as anaphylaxis, hypertension, tachyphylaxis, and cardiac dysrhythmias^{6,7}. Uncontrolled use can even lead to impaired uteroplacental circulation caused by vasoconstriction^{8,10}. Mechanical compression of legs is a simple technique and found to be comparable with use of vasopressors in the prevention of postspinal hypotension in cesarean patients. Leg wrapping being a simple, nonpharmacological and cost-effective technique can be used on a daily basis to prevent hypotension^{11,12}. In this study, we evaluated the efficacy of leg wrapping with crepe bandage before spinal anesthesia in pregnant female undergoing cesarean section.

Materials and Methods

This prospective, double-blinded, and randomized controlled trial was undertaken after the approval by Institutional Ethics Committee. A written informed consent was obtained from each patient for participation in the study. As reported by previous studies a sample size of 27 in each group was necessary to detect a difference of this magnitude (39%) with 81% power in a two-tailed test at alpha error of 0.05. We recruited additional 10% patients keeping in view a possibility exclusion, failed block, etc. 60 full term pregnant patient with singleton uncomplicated pregnancy belonging to American Society of

Anesthesiologists (ASA) Class I or II, scheduled for elective cesarean section under spinal anesthesia were randomly assigned by opening sealed envelope to either Group A (non-leg wrapping) (n= 30) or Group B (leg wrapped) (n= 30). An experienced anesthesiologist blinded to the leg wrapping, or the control group recorded the physiological variables. Patient characteristics, including age, height, weight, and gestational age was recorded. All the patients were kept fasting for 10-12 h before surgery. For all patients an intravenous (IV) line was secured using an 18G cannula in the left forearm and was premeditated with ranitidine 50 mg and metoclopramide 10 mg IV injections 30 min prior to the cesarean section. Baseline blood pressure and heart rate were measured in the left supine wedged position. Baseline values were taken as the average of three successive readings. IV fluid preloading was then done with around 20 ml/kg of warmed ringer lactate solution over 15-20 min just prior to the spinal anesthesia. Group A patients had their lower limbs neither raised nor wrapped, but they were simply covered to hide them from anesthesiologist recording hemodynamics. Group B patients (n= 30) had their lower limbs elevated immediately after the administration of the subarachnoid block. All patients had their leg elevated by the same person in around 5 min to eliminate bias introduced by method. Intrathecally all patients received 12.5 mg (volume 2.5 ml) 0.5% hyperbaric bupivacaine. Spinal anesthesia was performed in the sitting position using a 25G Quincke's needle in the L3-L4 or L4-L5 interspace through midline approach under all aseptic condition. Thereafter, the patients were placed supine with 15° left lateral tilt. Fluid replacement was maintained with ringer's lactate solution. Electrocardiography and oxygen saturation was monitored continuously and the heart rate and blood pressure was measured every 2 min until delivery of baby and every 5 min thereafter until the end of cesarean section. Duration of surgery and any intraoperative complications were recorded. Hypotension was

defined as fall in systolic blood pressure to ≤ 90 mmHg. Hypotension was treated immediately by increasing the rate of IV ringer lactate administration and by bolus 50 μ g phenylephrine intravenously

Parameters recorded intraoperatively for the study are

- Heart rate every 2min for 10 minutes after subarachnoid block and thereafter every 5min till end of surgery.
- Systolic blood pressure (SBP), Diastolic blood pressure (DBP) and Mean arterial pressure (MAP) every 2min for 10 minutes after subarachnoid block and thereafter every 5min till end of surgery by using NIBP.

- Time to reach maximum block height.
- Total duration of surgery.

Statistical analysis

The data generated were analyzed statistically. Parametric data were presented as mean \pm standard deviation for unpaired student t test and numbers (percentage) for chi-square test. Comparison of quantitative data between the two groups was done by Unpaired Student's *t*-test. Chi-square test was used for comparison of qualitative data between the two groups. The level of statistical significance was set at $P < 0.05$.

All statistics were performed on a windows based computer using the program SPSS 20.0.

Results

Demographic data

Table 1: By using unpaired t test, both the groups were found to be comparable with respect to age, weight and height and gestational age.

Variables	Group A (n= 30)	Group B (n= 30)	P value
Age (years)	29.8 \pm 4.54	27.53 \pm 5.33	0.918
Height (cm)	168.2 \pm 2.6	167.1 \pm 2.47	0.320
Weight (kg)	60.6 \pm 3.39	59.93 \pm 4.0	0.563
Gestational age (weeks)	37.9 \pm 0.85	38.16 \pm 0.88	0.432

*P value < 0.05 – significant

Table 2: Comparison of baseline heart rate and systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP) in patients of both groups

Variables	Group A (n= 30) Mean \pm SD	Group B (n= 30) Mean \pm SD	P value
HR	83.8 \pm 5.67	82.3 \pm 4.9	0.33
SBP	122.7 \pm 5.83	122.6 \pm 4.43	0.86
MAP	85.7 \pm 5	86.3 \pm 3.9	0.84
DBP	65.1 \pm 4.9	66.37 \pm 3.9	0.28

*P value < 0.05 – significant

Table 3: Comparison of time to reach maximum block height and total duration of surgery in both the groups

	Group A (n= 30) Mean \pm SD	Group B (n= 30) Mean \pm SD	P value
Time of max Block height (min)	6.45 \pm 0.72	6.33 \pm 0.78	0.68
Total duration of surgery (min)	43.5 \pm 9.68	45.0 \pm 6.69	0.76

*P value < 0.05 – significant

Table 4: Comparison of heart rate (HR) change after spinal anesthesia in both the groups

Time (min)	Group A (n= 30)	Group B (n= 30)	P value
2	88.2±6.5	87.7±5.4	0.58
4	90.6±5.7	94.2±6.1	0.01*
6	91.2±4.8	103.8±5.2	<0.001**
8	94.5±3.9	107.3±5.6	<0.001**
10	97.2±5.5	108.7±5.1	<0.001**
15	99.4±6.4	102.6±5.9	0.04*
20	98.1±5.3	99.8±5.7	0.08
25	96.4±5.3	98.0±4.9	0.12
30	95.8±3.7	97.3±4.0	0.19
35	94.4±4.1	96.8±4.6	0.38
40	92.0±3.9	93.4±3.7	0.29
45	89.5±4.2	90.8±3.7	0.25

**P value <0.001- highly significant, * P value <0.05 – significant

By using unpaired t test, there was no statistically significant difference found in above parameters between the two groups (Table 2).

By using unpaired t test there was no statistically significant difference found in above parameters between the two groups (Table 3).

There are significant heart rate changes from 4 min to 15 min with highly significant from 6-10 min after spinal

Anesthesia in Group B patients compared to Group A patients (Table 4).

Table 7: Comparison of mean arterial pressure (MAP) change in both the groups

Time (min)	Group A (N=30) Mean MAP ± SD	Group B (N = 30) Mean MAP ± SD	P value
2	88.3±4.6	89.6±4.2	0.40
4	85.5±5.3	80.6±5.8	0.03*
6	80.7±3.7	71.7±3.5	<0.001**
8	77.8±3.9	68.5±3.8	<0.001**
10	73.8±4.3	65.7±4.5	<0.001**
15	69.2±4.8	65.0±4.7	0.04*
20	72.8±5.4	69.6±5.4	0.09
25	76.1±5.4	73.4±5.4	0.12
30	78.7±5.4	77.8±5.4	0.86
35	81.3±5.4	82.5±5.4	0.74
40	84.7±5.4	83.8±5.4	0.68
45	87.6±5.4	86.5±5.4	0.7

**P value <0.001- highly significant, * P value <0.05 – significant

There is significant Mean arterial Pressure change from 4 min to 15 with highly significant from 6-

10 min after spinal anesthesia in Group B patients compared to Group A patients (Table 7)

Table 8: Comparison of incidence of hypotension in both the groups was calculated by using chi-square test.

	Group A	Group B	P value
Hypotension	3	20	0.01*
Nil	27	10	
Total	30	30	

* P value <0.05 – significant

There was statistically significant difference in degree of hypotension found between the two groups. Incidence of hypotension in Group A is 10

% where as in Group B is 66.66 % which is statistically significant (Table 8)

Table 9: Comparison of phenylephrine doses (in mics) in both the groups

	Group A (Mean±SD)	Group B (Mean ± SD)	P value
Doses of phenylephrine (mics)	16.6 ± 32.38	45.89 ± 41.63	0.1*

*P value <0.05 – significant, by using unpaired t test there was statistically significant difference in requirement of phenylephrine found between both the groups.

Above table showing Group A patients required only 16.6mics of phenylephrine while Group B patients required 45.89mics of phenylephrine which is statistically significant.

Table 10: Comparison of no. of patients required rescue phenylephrine

	Group A	Group B	P value
No. of patients required rescue phenylephrine	3	16	0.007*
Nil	27	14	
Total	30	30	

* P value <0.05 – significant, Chi square for No. of patients required rescue phenylephrine

Table above showing significant number of patients required rescue phenylephrine in Group B than Group A. 10% of patients from Group A and 53.33% of patients from Group B required rescue phenylephrine which is statistically significant.

being used to prevent postspinal hypotension but there is no ideal established technique.¹³⁻¹⁸

Accordingly one would expect that compression would somehow decrease the magnitude and prevalence of post spinal hypotension. During spinal anesthesia relaxation of calf muscles due to sympathetic blockade leads to loss of pumping action of calf muscles and the vascular distensibility of the calf vessels has been shown to increase by 17%.¹³ Leg elevation alone or in combination with leg wrapping might cause cephalic displacement of hyperbaric solution due to flattening of the lumbar curvature of the spine resulting in a higher level of sensory, motor and sympathetic blockade. Parturients at term have more blood trapped in the lower extremities and spinal anesthesia induced vasodilatation will increase the pooling of blood even more. Vasodilatation induced by spinal anesthesia increases the proportion of blood that runs to periphery (systolic run off) during systole.

Discussion

Spinal anesthesia-induced hypotension is caused by an increase in venous capacitance because of sympathectomy causing venodilatation in the lower part of the body.⁴ This decrease in arteriolar and venous tone secondary to sympathetic block causes a reduction in systemic vascular resistance and redistribution of central blood volume up to 500–600 ml to the peripheral compartment. The situation is further aggravated in pregnancy by aortocaval compression.¹² This aortocaval compression decreased by left uterine displacement by placing wedge beneath right buttock. Placental blood flow is pressure dependent, so prolonged maternal hypotension is detrimental to the fetus and can lower fetal apgar score.⁵ A significant contribution to hypotension is made by venous pooling in the lower limbs and abdomen. Hence, lots of techniques are in practice to prevent hypotension, but there is no established ideal method. Prophylactic fluid preloading/coloadng, use of vasopressors such as ephedrine, mephentermine, or phenylephrine and use of varying mechanical interventions to increase central blood volume such as Esmarch bandages, compressive leg stocking, and crepe bandage

In the current study intraoperative monitoring from 4 min to 15 min shown the significant increase in heart rate in group B compared to group A (P<0.05) with highly significant from 6 min to 10 min (P<0.001). Conflicting results found by Goudie et al and Adsumelli N et al. Goudie et al. found heart rate changes are inconsistent, some patients had increase in heart rate with the onset of hypotension while others a decrease.

This absence of significant heart rate increase could be because of different levels of autonomic blockade between the groups and vagal reflexes due to surgical manipulation. No significant difference in heart rate between case and control group found by Adsumelli N et al. could be due to different levels of autonomic blockade. But Similar result was observed by Kunal Singh et al who found significant difference in change in heart rate at 6th and 8th min (before delivery) whereas no significant difference was observed after delivery.

Mean arterial pressure was noted in both the groups over study of time course 45min after spinal anesthesia and compared by using "unpaired student t test". In this study, in Group B, there was a decrease in mean arterial pressure following spinal anesthesia, which was significantly lower than the baseline value at 4th, 6th, 8th, 10th and 15th min and was not significant thereafter.

Leg wrapped patients had a non-significant decrease in mean arterial pressure when compared with baseline. In leg wrapped group, the mean arterial pressure remained consistently above that of control and the difference in between the groups was significant at 4th, 6th, 8th, 10th and 15th min with highly significant between 6th to 10th minutes. Similar study done by Goudie et al in where they found fall in diastolic and mean arterial pressure was greater in control group than leg wrapped group which correlates with the current study.¹⁹

Bhagawanje S et al. in 1990 11 found Systolic arterial pressure was significantly less in control subjects at 4min, 5min, 6min following spinal injection which correlates with the current study. They also found leg wrapped patients had significant lower incidence (16.7%) of hypotension than control (83.3%). Only 2 patients in leg wrapped group required ephedrine compared to 10 patients in control (P = 0.0033) which correlates with the current study.

Adsumelli et al in their study they used sequential compression device for the study and found,

greater than 20 % decrease in mean arterial pressure (MAP) occurred in 52% of patients in sequential compression device group Vs 92% in the control group (p=0.004, odds ratio=0.094, 95% CI = 0.018-0.488) which correlates with the current study.¹⁴ They also found no significant difference in heart rate between case and control group which don't correlate with this study this could be due to different levels of autonomic blockade.

Kunal Singh et al found significant difference in change of systolic and mean arterial blood pressure between the two groups (leg wrapped and unwrapped) at 4th to 12th min, highly significant between 4th, 6th, 8th min and no significant difference was observed after delivery. Leg wrapped group had higher mean arterial blood pressure throughout the measured interval.¹² Their results correlates with the current study. They also found significant difference in change in heart rate at 6th and 8th min (before delivery) whereas no significant difference was observed after delivery which correlates with the current study. They found 43.33% in non-leg wrapped patients and 10% in leg wrapped patients developed hypotension (P=0.009) which is statistically significant and this correlates with the current study. They found 3 patients (10%) in leg wrapped patients and 10 patients (33.33%) in non-leg wrapped patients require rescue phenylephrine, which is statistically significant and this correlates with the current study.

In the current study, in group A 3 patients out of 30 (10%) required phenylephrine as compared to 16 patients out of 30 (53.33%) is showing significant difference of requirement of phenylephrine in both the groups. The mean dose for Group A patients was 16.6 mics. While mean dose of group B patients was 45.89 mics showing significant difference

Conclusion

From the current study it can be concluded that elevation of lower limb just after spinal anesthesia is an effective method to prevent hypotension

during spinal anesthesia for elective caesarean section without any unwanted side effect like hypotension, tachycardia, or any other maternal side effects. As leg elevation is cheap, easy, readily available, non-invasive, and non-pharmacological method, it can be recommended in addition with preload and left uterine displacement for preventing post spinal hypotension and its subsequent adverse effect on the mother as well as on a baby.

Hence leg elevation is simple, safe and effective method of preventing hypotension in patients posted for caesarean section and can be great value in routine practice.

Limitations of the study

The sample size was small for more accuracy, study need to be conducted with larger sample size. We did not study changes in cardiac output due to leg wrapping, as cardiac output is a better indicator of uteroplacental blood flow than upper arm blood pressure measurement.⁵

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Bibliography

1. Paez LJ, Navarro JR. Regional versus general anesthesia for caesarean delivery. *Rev Colomb Anesthesiol* 2012; 40:203-6.
2. Fassoulaki A, Staikou C, Melemenis A, Kottis G, Petropoulos G. Anaesthesia preference, neuraxial vs general, and outcome after caesarean section. *J Obstet Gynaecol* 2010; 30:818-21.
3. Hawkins JL, Chang J, Palmer SK, Gibbs CP, Callaghan WM. Anesthesia-related maternal mortality in the United States: 1979-2002. *Obstet Gynecol* 2011; 117:69-74.
4. Langesaeter E, Dyer RA. Maternal haemodynamic changes during spinal

anaesthesia for caesarean section. *Curr Opin Anaesthesiol* 2011; 24:242-8.

5. Mitra JK, Roy J, Bhattacharyya P, Yunus M, Lyngdoh NM. Changing trends in the management of hypotension following spinal anesthesia in cesarean section. *J Postgrad Med* 2013; 59:121-6.
6. Ngan Kee WD, Khaw KS, Ng FF. Prevention of hypotension during spinal anesthesia for cesarean delivery: An effective technique using combination phenylephrine infusion and crystalloid cohydration. *Anesthesiology* 2005; 103:744-50.
7. Kluger MT. Ephedrine may predispose to arrhythmias in obstetric anaesthesia. *Anaesth Intensive Care* 2000; 28:336.
8. Mohta M, Janani SS, Sethi AK, Agarwal D, Tyagi A. Comparison of phenylephrine hydrochloride and mephentermine sulphate for prevention of post spinal hypotension. *Anaesthesia* 2010; 65:1200-5.
9. Chan WS, Irwin MG, Tong WN, Lam YH. Prevention of hypotension during spinal anaesthesia for caesarean section: Ephedrine infusion versus fluid preload. *Anaesthesia* 1997; 52:908-13.
10. Ngan Kee WD, Khaw KS, Tan PE, Ng FF, Karmakar MK. Placental transfer and fetal metabolic effects of phenylephrine and ephedrine during spinal anesthesia for cesarean delivery. *Anesthesiology* 2009; 111:506-12.
11. Sujata N, Arora D, Panigrahi BP, Hanjoora VM. A sequential compressions mechanical pump to prevent hypotension during elective cesarean section under spinal anesthesia. *Int J Obstet Anesth* 2012; 21:140-5.
12. Singh K, Payal YS, Sharma JP, Nautiyal R. Evaluation of hemodynamic changes after leg wrapping in elective cesarean section under spinal anesthesia. *J Obstet Anaesth Crit Care* 2014; 4:23-8.

13. Lee A, Ngan Kee WD, Gin T. Prophylactic ephedrine prevents hypotension during spinal anesthesia for cesarean delivery but does not improve neonatal outcome: A quantitative systematic review. *Can J Anaesth* 2002; 49:588-99.
14. Adsumelli RS, Steinberg ES, Schabel JE, Saunders TA, Poppers PJ. Sequential compression device with thigh-high sleeves supports mean arterial pressure during caesarean section under spinal anaesthesia. *Br J Anaesth* 2003; 91:695-8.
15. Kansal A, Mohta M, Sethi AK, Tyagi A, Kumar P. Randomised trial of intravenous infusion of ephedrine or mephentermine for management of hypotension during spinal anaesthesia for caesarean section. *Anaesthesia* 2005; 60:28-34.
16. Allen TK, Muir HA, George RB, Habib AS. A survey of the management of spinal-induced hypotension for scheduled cesarean delivery. *Int J Obstet Anesth* 2009; 18:356-61.
17. Loubert C. Fluid and vasopressor management for cesarean delivery under spinal anesthesia: Continuing professional development. *Can J Anaesth* 2012; 59:604-19.
18. Rout CC, Rocke DA, Gouws E. Leg elevation and wrapping in the prevention of hypotension following spinal anaesthesia for elective caesarean section. *Anaesthesia* 1993; 48:304-8.
19. Goudie TA, Winter AW, Ferguson DJ. Lower limb compression using inflatable splints to prevent hypotension during spinal anaesthesia for caesarean section. *Acta Anaesthesiol Scand*. 1988; 32:541-4.