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Original Research Article

Prophylactic Ephedrine to Prevent Hypotension Following Spinal Anaesthesia in Elective LSCS Patients: A Prospective, Double-Blind Case Control Study

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Abstract

Introduction: Spinal anaesthesia is most commonly used for obstetrics anaesthesia. It is commonly associated with hypotension, which is due to sympathectomy causing peripheral pooling of blood and reduced cardiac output. Exaggerated response to sympathectomy is seen in these obstetrics cases and hypotension itself has too many detrimental effects on maternal as well as on foetal outcome. So to combat this we planned this study to assess the incidence and prevention of postspinal hypotension after prophylactic ephedrine in patients undergoing elective cesarean section.

Methodology: In this randomised double blind case control study we recruited 70 parturients of 18-45 years with singleton pregnancy scheduled for lower segment caesarian section (LSCS) under spinal anaesthesia belonging to ASA grade II, who were randomly allocated into 2 groups of 35 each: Group 1 (nonprophylactic group) received 500 ml Ringer lactate IV and Group 2 (prophylactic group) received 10 mg ephedrine in 500 ml Ringer lactate IV prior to spinal anaesthesia. Inj. 0.5% Bupivacaine heavy 2ml (10mg) was used for spinal anaesthesia. We evaluated hypotensive episodes, rescue vasopressor (inj. Mephentermine 6 mg/dose) requirement and adverse effects.

Results: The incidence of hypotension was 40% and 17.14% in group 1 and group 2 respectively ($p<0.05$). The total requirement of rescue vasopressor drug, mephentermine was higher in group 1 (168mg) in comparison to group 2 (60mg) ($p=0.034$). Incidence of nausea & vomiting (Group 1 –3/35, Group 2-1/35) was similar, minimal and statistically comparable ($P=0.11$) among the two groups.

Conclusion: Prophylactic use of 10 mg ephedrine as intravenous (IV) infusion, effectively reduces the incidence of postspinal maternal hypotension without significant adverse effects.

Keywords: Hypotension, Spinal anaesthesia, Ephedrine, Mephentermine, Bupivacaine.

Introduction

Spinal anesthesia is a preferred regional anesthesia technique for scheduled lower segment caesarean delivery, as it provides fast and profound sensory and motor blockade with fewer side effects[1]. Additionally, spinal anesthesia allows the patient to remain awake and bond with their baby immediately after birth, while also facilitating post-operative pain relief. However, spinal anesthesia-induced maternal hypotension is a common side effect during caesarean delivery, resulting from sympathetic blockage and decreased cardiac output due to blood pooling in blocked areas of the body[2].

The incidence of hypotension can be lowered by various methods, including preloading with large doses of crystalloids and colloids, but these solutions may not be effective in expanding plasma volume[3]. Contemporary articles recommend the use of vasopressors such as ephedrine to maintain arterial blood pressure, as it increases cardiac output and heart rate[4,5]. Ephedrine is a potent sympathomimetic drug that acts directly and indirectly at the adrenergic nerve endings and has both α and β adrenergic agonist actions[6,7].

This study was designed to determine the effects of IV ephedrine in infusion on the incidence of hypotension in patients during cesarean section under spinal anesthesia1.

Material and Methods

This prospective, randomized, double blind case control study was conducted at Department of Anaesthesiology at tertiary care institute with approval of institutional ethical committee (RNT/Stat./IEC2020/03/Dated-01/04/2020), CTRI trial registration (CTRI/2021/09/036329) and informed written consent from the patients. Patients with singleton pregnancy, posted for elective caesarean section under spinal anaesthesia were included in the study and all the emergency caesarean and patient having contraindication to spinal anaesthesia and with severe comorbid condition were excluded from the study. All parturient under study were subjected to a detailed pre-anaesthetic examination and investigations and were randomly divided into two groups of 35 patients in each group using sealed envelope technique.

- Group 1(non-prophylactic group): patients received 500ml Ringer lactate IV prior to spinal anesthesia.
- Group 2(prophylactic group): patients received 10 mg ephedrine in 500ml Ringer lactate IV prior to spinal anesthesia.

In operation theatre standard monitoring including noninvasive blood pressure, pulse-oximetry and electrocardiography were applied. Baseline heart rate was determined with electrocardiography, blood pressure (systolic, diastolic and mean blood pressure) and peripheral oxygen saturation on air were also recorded. Baseline heart rate, blood pressure (BP), Spo2 was taken as average of three reading taken 2 minute apart on OT table. Group 1 patients received 500ml RL prior to spinal anesthesia & Group 2 patients received 10 mg ephedrine in 500ml RL prior to spinal anesthesia.

Patient was turned in left lateral position to avoid aortocaval compression, back was painted with povidone iodine and spirit. Taking all aseptic precautions lumbar puncture was performed in L_3 – L_4 interspace using a 25 gauge Quincke's spinal needle via midline approach and keeping bevel up. After getting free flow of cerebrospinal fluid, Intrathecal 10mg of 0.5% bupivacaine injection (hyperbaric) was administered and sterile dressing was applied. Patient was turned supine, and a wedge under right hip was placed to provide left lateral tilt to prevent aortocaval compression. End of spinal injection was taken as time zero (T0) for

all further data recording. Oxygen at a rate of 5L /min was administered via oxygen venti-mask. All data were recorded in a proforma. Sensory block was assessed by pin prick method using a short beveled 24G needle checked bilaterally in mid-clavicular line in hypochondrium region and no perception to pin prick was considered as sensory block. Motor block was assessed using modified Bromage scale[17] as follows: No motor block able to flex hips/ knees, ankles = 0, Inability to raise extended legs (partial motor block) = 1, Inability to flex knees (almost complete motor block) = 2, Inability to flex ankle joints (complete motor block) = 3

Surgery was allowed to start when sensory block of T_6 level and maximum Bromage score of 2 was achieved, which was the criteria to allow the start of surgery. NIBP, HR, and SpO2 were recorded at 2 min intervals after the SAB up to 20 min and then at 5 min intervals till the end of surgery. Post Spinal Hypotension**,** that occurs after administration of intrathecal local anesthetics and fall in mean blood pressure (MBP) of >25% from baseline value or below 65 mm of Hg and SBP falls below 90 mm of Hg considered as hypotension and treated with rescue vasopressure inj. Mephentermine 6 mg and repeated every 2 min till MBP returns to >75% of baseline. Bradycardia (HR <60 per min) treated with inj. atropine (0.4mg). Inj. dopamine, adrenaline, noradrenaline as infusion was considered to treat severe hypotension if needed. Requirement of rescue vasopressor (number of doses and amount) was recorded in each case. Time of delivery of baby, APGAR score, birth weight, condition of baby was recorded. Inj. Oxytocin10 IU IV infusion was administered after delivery of baby. Inj. Prostaglandin, Tranexamic acid was given on demand by surgeon. Other complications like nausea, vomiting was treated with inj. Ondansetron 4 mg, pruritus with antihistaminic chlorpheniramine, Occurrence of arrhythmia, headache or any other complications was noted and treated accordingly. Duration of surgery was defined as time from start of surgery to end of surgery. If postpartum hemorrhage or surgical complication occurs, was treated accordingly. Patients requiring additional oxytocin, vasopressures or additional surgical interventions excluded from the study. To compensate, another cases were enrolled for the study.

Statistical Analysis:

Data were entered in MS EXCEL and analyzed using SPSS (version 20.0). Categorical data was presented as number (proportion), and compared with chi-square test. Continuous variable was presented as Mean± SD and compared using student t-test. P< 0.05 was considered statistically significant.

Results

Table 1: Demographic distribution and Comparison of Duration of Surgery, Apgar Score & Baby Weight between two groups

Variable	Group 1 (Non-prophylactic)	Group 2 (Prophylactic)	P- value*
Demographic data			
Age (years)	27.74±1.97	27.40±3.80	0.637
Height (cm)	157.43±2.97	156.31±4.69	0.239
Weight (kg)	60.57±3.98	61.89±6.65	0.320
Gestational age (weeks)	37.77±0.84	37.71±1.07	0.166
Duration of surgery (min)			
Mean± SD	33.26±3.15	34.40±8.86	0.474
Weight of baby (kg)			
Mean± SD	2.854±0.27	2.82±0.34	0.739

Apgar score (min)			
Mean±SD (at 1 min)	7.60±1.14	7.86±0.70	0.259
Mean±SD(at 5 min)	8.97±0.95	8.97±0.82	1.000

*Test used – 't' test, Data expressed in Mean± SD

We enrolled 70 parturients in our study who fulfilled the study criteria. In each group 35 parturients were there and no difference was found with regard to age, weight, height, gestational age, duration of surgery, birth weight and APGAR score of baby in both the groups (P>0.05) (Table 1). All the patients completed the surgery without any intraoperative supplementation. The median peak sensory level recorded was T4 (T3-T5) in both the groups.

Table 2: Comparison of incidence and duration of hypotension between two groups

Variable		**Group 1 (Non-prophylactic)**	**Group 2 (Prophylactic)**	**P-value**
Incidence of hypotension	Present	14(40%)	6(17.14%)	**0.034***
	Absent	21(60%)	29(82.86%)	
Episode distribution	1 episode	6	3	**0.006***
	2 episode	2	2	
	3 episode	6	1	
Total episodes of hypotension		28	10	
No. of hypotensive episodes per patient	Mean±S.D	0.8±1.16	0.286±0.710	**0.0053#**
	Range	0-3	0-3	
Duration of episodes (Patient distribution)	2 min	5	1	
	4 min	3	4	
	6 min	2	1	
	8 min	4	0	
Total duration (mins)		66	24	
Duration of hypotension per patient (min)	Mean±S.D	1.89±2.826	0.69±1.529	**0.0055#**
	Range	0-8	0-8	

*Test used – 'Chi square' test, # Test used- 't' test. Data expressed as % or Mean± SD.

Table 3: Requirement of rescue vasopressors (mephentermine) between two groups

Variable		**Group 1 (Non prophylactic)**	**Group 2 (Prophylactic)**	**P value**
No. of patient receiving vasopressors	No of patient received Mephentermine	14(40%)	6(17.14%)	**0.034***
	1 dose	6	3	
	2 doses	2	2	
	3 doses	6	1	
Mephentermine requirement	Total no. of doses	28	10	
	Total Rescue requirement (Mg)	168	60	
	No. of dose requirement per patient	0.8±1.16	0.286±0.710	**0.0053#**
	Rescue dose requirement per patient (Mg)	4.8±6.948	1.74±4.260	**0.0052#**

*Test used – 'Chi square' test, # Test used- 't' test. Data expressed as % or Mean± SD.

Table 4: Comparison of intraoperative complication between two groups

Variable	Group 1 (Non-prophylactic)	Group 2 (Prophylactic)	P-value*
Bradycardia	-	-	-
Nausea &vomiting	3(8.5%)	1(2.6%)	0.11
Shivering	-	-	-
Others	-	-	-

*Test used -'chi square' test, Data are expressed as n (%).

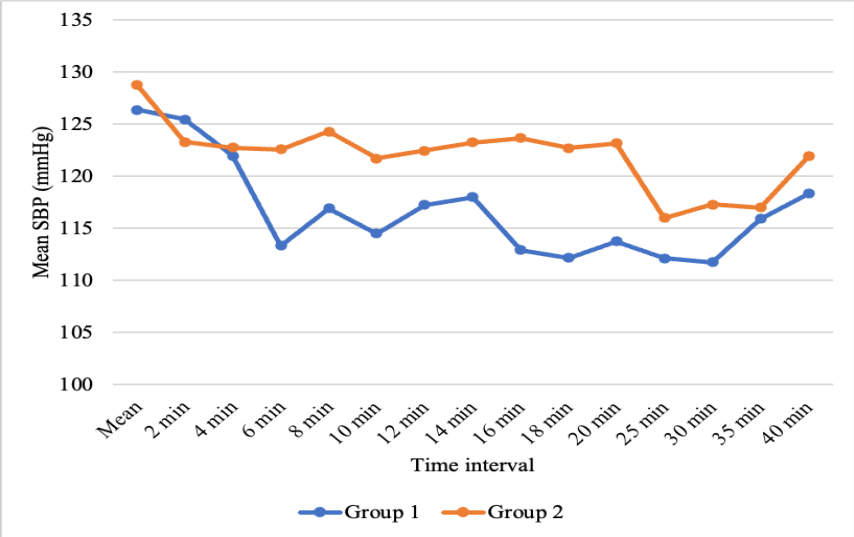

Figure 1: Comparison of systolic blood pressure in two groups

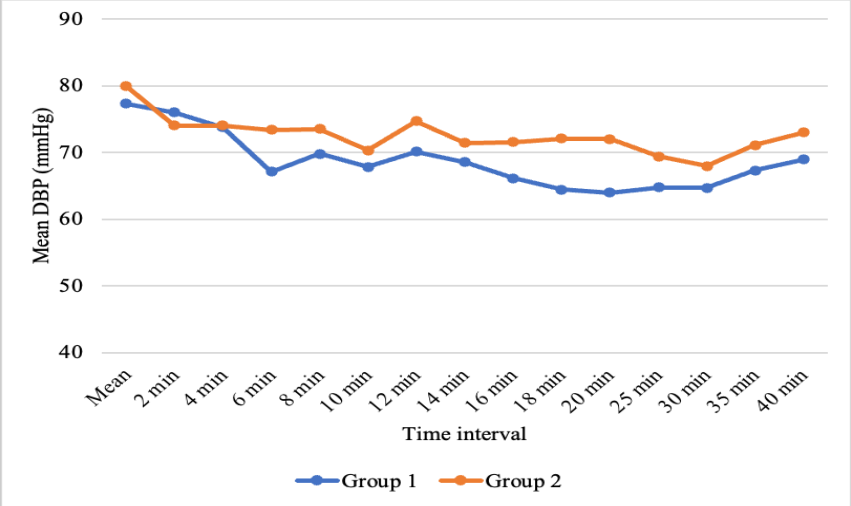

Figure 2: Comparison of diastolic blood pressure in two groups

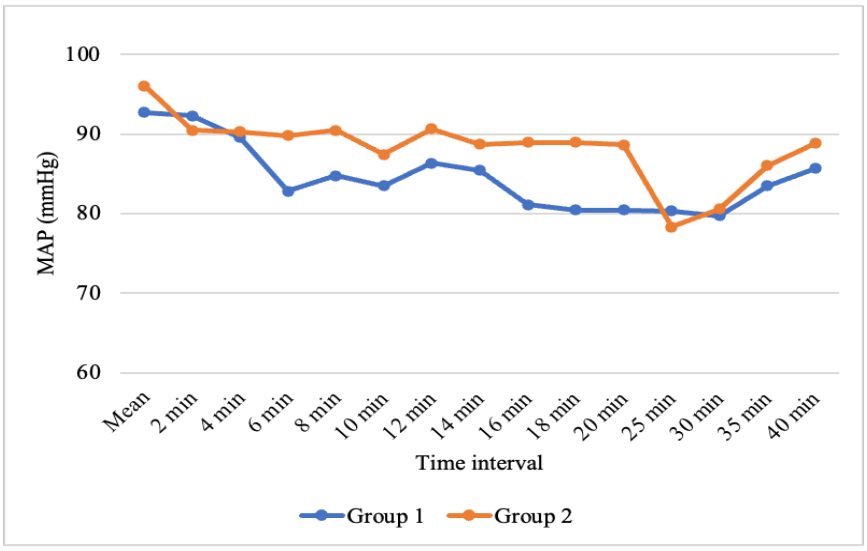

Figure 3: Comparison of mean blood pressure in two groups

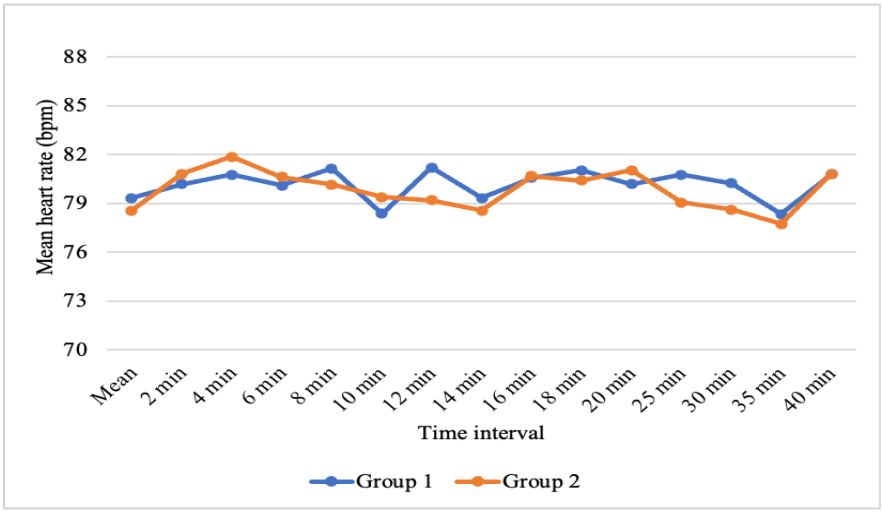

Figure 4: Comparison of heart rate in two groups

There was no statistically significant difference between the groups in regard to baseline values of mean systolic, diastolic, mean blood pressure and heart rate (P>0.05). There was significant difference in mean systolic blood pressure from 6 to 20 minutes in both the groups(P<0.05). Similarly, significant difference was found in mean diastolic, mean blood pressure most of the time from 6 to 20 minutes in both the groups(P<0.05). Mean systolic, diastolic and mean blood pressure was higher in prophylactic (ephedrine) group compared to nonprophylactic group (Fig.1,2,3,4). Mean heart rate was comparable between two groups at all time interval intraoperatively (P>0.05). The incidences of hypotensive episodes, the total number of rescue doses of mephentermine, per patient incidence and requirement of rescue mephentermine and nausea or vomiting are summarized in (Table 2,3,4). There was significantly lower incidence of hypotension in the prophylactic group compared with the nonprophylactic group (6[17.14%] vs.14 [40%]) (P<0.05). There were significant decrease total doses and number of rescue mephentermine required in the prophylactic group (P<0.05) (Table 3). There were comparable incidences of nausea and vomiting in the prophylactic and nonprophylactic group (1 [2.6%] vs. 3 [8.5%]) Table 4 (P>0.05).

Discussion

Neuraxial block, specifically spinal anesthesia, is the preferred anesthetic technique for parturients undergoing lower segment cesarean section due to its ease of use, rapid onset, high quality of surgical anesthesia, and cost-effectiveness. However, it is important to note that spinal anesthesia may be associated with various complications such as nausea, vomiting, and significant hemodynamic changes1.

One known complication associated with spinal anesthesia is maternal hypotension, with an incidence of up to 80% and may result in adverse maternal and fetal outcomes such as nausea, vomiting, reduced uteroplacental blood flow, and increased risk of fetal acidosis[1,2]. There are several proposed mechanisms for maternal hypotension after spinal anesthesia, including the height and intensity of sensory block, increased sensitivity to local anesthetics due to increased progesterone levels, aortocaval compression due to the gravid uterus, and peripheral pooling of blood as a result of sympathetic blockade.

Spinal anesthesia induces sympathectomy, which results in vasodilation of arteries and veins and subsequent decline in systemic vascular resistance. This rapid decrease in systemic vascular resistance is associated with a compensatory increase in heart rate and stroke volume or cardiac output1. To minimize the risk of complications associated with spinal anesthesia, it is important to use the appropriate technique and dosage, closely monitor hemodynamic changes, and implement appropriate interventions to manage maternal hypotension[2,8].

According to a study by Dyer RA et al. (2009)[9], spinal anesthesia causes a 55% increase in cardiac output and a 35% decrease in systemic vascular resistance, which is a major factor leading to maternal hypotension. This reduction in arteriolar tone explains the hypotension observed in many patients. As a result, vasopressors have become the standard treatment for managing spinal-induced hypotension[10].

Ephedrine is agonist at α and β receptors and act indirectly by causing release of norepinephrine from sympathetic neu-rons. β1 effect increases the heart rate and cardiac contractility, whereas α effect causes peripheral vaso-constriction.[10]

The present study was designed to evaluate the effectiveness of prophylactic ephedrine to prevent spinal induced hypotension in parturients undergoing elective LSCS.

In this study, Demographic data were comparable in terms of mean age, weight, height, gestational age in both the groups.

There was significant fall in mean systolic, diastolic, mean blood pressure from baseline upto 20 min in both the groups which was statistically significant ($P<0.05$) and rest of other time it was comparable ($P> 0.05$). Similar results were seen in a study by Kol IO et al[1], Panda BK et al[11], Shitemow et al[12] and Zunic M et al[13] where significant fall in SBP from 5 min to 20 min after spinal anaesthesia which is due to multiple factors as described above. Hemodynamic stability was better in prophylactic group compared to nonprophylactic group as evidenced by serial measurement of SBP, DBP and MBP.

Mean duration of surgery was 33.26±3.15 min in the non-prophylactic group and 34.40±8.86 min in the prophylactic group ($p= 0.474$). Combined incidence of maternal hypotension was 28.57% in both the groups. However, in a study by Tsen LC et al[14] the incidence of hypotension was 70%. This might be due to the hypotension criteria, which was more than 20% fall compared to 25% fall from the baseline values in our study. In a comparative study done by Iqbal MS et al[15] incidence of hypotension was 53.3% in patients receiving 10 mg ephedrine as compared to 15 mg dose.

Maternal hypotension seen in 17. 14% & 40% in prophylactic and non-prophylactic group individually ($p<0.05$) in our study. Similar results were seen by Shitemaw et al[12] (22.7% and 60%), Vercauteren MP et al[16] (25% versus 58%), Loughrey JP et al[17] (27% and 50%) (p value< 0.05) and Panda BK et al[18] (20% and 46.66%).

Mean weight of the baby was 2.85±0.27 & 2.82±0.34 kg in non-prophylactic and prophylactic group respectively. Mean APGAR score at 1 and 5 min was 7.60±1.14 & 8.97±0.95 and 7.86±0.69 & 8.97±0.822 in prophylactic and nonprophylactic group respectively. Our results coincide with the studies done by Panda BK et al,[11] Khairnar R et al[18] and Singh TH et al[19] they found Apgar scores of 8 & 9, 8.96±0.20 & 9.96±0.20 and 9 & 10 at 1 minute & 5 minutes respectively.

Rescue vasopressors requirement in term of total dose 60 vs 168 mg and also per patient requirement of total number of doses 0.286±0.71 vs 1.74±0.42 and total dose 0.8±1.16 vs 4.8±6.95 mg were significantly less in prophylactic group. Our results were similar to the studies done by Kol IO et al[1], Panda BK et al,[11] Shitemow et al[12] and Vercauteren MP et al[16]. Another study done by Singh et al[19] found rescue vasopressor consumption was reduced in the ephedrine group as compared to the control group, however the results were not statistically significant (p= 0.42).

3 (8.5%) and 1 (2.6%) out of 35 patients in non-prophylactic and prophylactic group developed nausea and vomiting but its correlation with hypotension and other haemodynamic parameters could not be related. Results were similar to previous studies by Kol IO et al1 and Loughrey JP et al[17] but Singh TH et al[19] not found any incidence in both the groups.

Not any incidence of reactive hypertension was found in both the groups in our study. The results were similar to study by Iqbal MS et al[15], Vercauteren MP et al[16] and Singh TH et al.[19] But in an another study by Ngan Kee et al (2000)[20] the incidence of reactive hypertension were higher because of the higher bolus doses (15 mg and 30 mg respectively) in contrast to present study where only 10 mg in IV infusion preoperatively and rescue mephentermine as small bolus dose of 6 mg was used.

Maternal outcome was good, no ICU admission or death was reported in any group. Neonatal outcome was also good in terms of better APGAR score, no need for ICU admission and no death.

Limitations of the study:

We assessed hemodynamic changes with non-invasive measurement of SBP DBP and MBP. Invasive blood pressure measurement was not done, which could show beat to beat variation and would demonstrate hemodynamic changes in the two groups more precisely. The non-invasive method was chosen in order to encourage patients to agree to participate in the study.

We assessed neonatal outcome on clinical basis in terms of birth weight, APGAR score, NICU admission, and mortality. Umbilical cord blood gas analysis was not done to see effect of maternal hypotension on neonatal outcome because of unavailability of necessary equipment (ABG machine) in obstetric OT complex, which would have been more informative.

Conclusion

We concluded that the prophylactic use of 10 mg ephedrine as IV infusion, effectively reduces the incidence of postspinal maternal hypotension during LSCS without any adverse effects.

References

1. Kol IO, Kaygusuz K, Gursoy S, Cetin A, Kahramanoglu Z, Ozkan F, Mimaroglu C. The effects of

intravenous ephedrine during spinal anesthesia for caesarean delivery: A randomized controlled trial. J Korean Med Sci. 2009 Oct; 24(5):883–8.
2. Aya AGM, Mangin R, Vialles N, Ferrer JM, Robert C, Ripart J, de La Coussaye JE. Patients with severe preeclampsia experience less hypotension during spinal anesthesia for elective cesarean delivery than healthy parturients: a prospective cohort comparison. Anesth Analg. 2003 Sep;97(3):867-872.
3. Bhattacharya D, Chaudhary M, Biswas B, Gazi N. Comparison of ephedrine infusion with crystalloid administration for prevention of hypotension during spinal anesthesia for elective caesarean section. Indian J Anaesth. 2001; 45(4):290.
4. Ngan Kee WD, Khaw KS, Ng FF, Lee BB. Prophylactic phenylephrine infusion for preventing hypotension during spinal anesthesia for cesarean delivery. Anesth Analg. 2004 Mar;98(3):815-21
5. 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 Oct;103(4):744-50.
6. Dyer RA, Emmanuel A, Adams SC, Lombard CJ, Arcache MJ, Vorster A, Wong CA, Higgins N, Reed AR, James MF, Joolay Y, Schulein S, van Dyk D. A randomised comparison of bolus phenylephrine and ephedrine for the management of spinal hypotension in patients with severe preeclampsia and fetal compromise. Int J Obstet Anesth. 2018 Feb; 33:23-31.
7. Ma G, Bavadekar SA, Davis YM, Lalchandani SG, Nagmani R, Schaneberg BT, Khan IA, Feller DR. Pharmacological effects of ephedrine alkaloids on human alpha(1)- and alpha(2)-adrenergic receptor subtypes. J Pharmacol Exp Ther. 2007 Jul; 322(1):214-21.
8. Shahzadi I, Hanif S, Afridi Y. Role of Ephedrine infusion in spinal anaesthesia induced hypotension. Pak J Physiol 2016; 12:12-5.
9. Dyer RA, Reed AR, van Dyk D, Arcache MJ, Hodges O, Lom-bard CJ, et al. Hemodynamic effects of ephedrine, phenylephrine, and the coadministration of phenylephrine with oxytocin during spinal anesthesia for elective cesarean delivery. Anesthesiology. 2009 Oct;111(4):753-765.
10. Biricik E, Ünlügenç H. Vasopressors for the Treatment and Prophylaxis of Spinal Induced Hypotension during Caesarean Section. Turk J Anaesthesiol Reanim. 2021 Feb;49(1):3-10.
11. Panda BK, Mishra S, Verma P, Pradhan D, Patnaik S, Nayak R. Prophylactic Intravenous Ephedrine to Prevent Spinal Induced Hypotension during Cesarean Section- A Comparative Study. JMSCR Volume 08 Issue 02 February 2020.
12. Shitemaw, Tewoderos; Aregawi, Adugna; Fentie, Fissiha; Jemal, Bedru. Prophylactic Ephedrine to Prevent Postspinal Hypotension Following Spinal Anesthesia in Elective Cesarean Section: A Prospective Cohort Study in Ethiopia. Journal of Obstetric Anaesthesia and Critical Care, Jul–Dec 2019; 9(2): 75-80.
13. Žunić M, Krčevski Škvarč N, Kamenik M. The influence of the infusion of ephedrine and phenylephrine on the hemodynamic stability after subarachnoid anesthesia in senior adults - a controlled randomized trial. BMC Anesthesiol. 2019 Nov 11;19(1):207.
14. Tsen LC, Boosalis P, Segal S, Datta S, Bader AM. Hemodynamic effects of simultaneous administration of intravenous ephedrine and spinal

anesthesia for cesarean delivery. J Clin Anesth. 2000 Aug;12(5):378-82.
15. Iqbal MS, Ishaq M, Masood A, Khan MZ. Optimal dose of prophylactic intravenous ephedrine for spinal induced hypotension during cesarean section. Anaesth Pain Intensive Care 2010; 14(2):71-75)
16. Vercauteren MP, Coppejans HC, Hoffmann VH, Mertens E, Adriaensen HA. Prevention of hypotension by a single 5-mg dose of ephedrine during small-dose spinal anesthesia in prehydrated cesarean delivery patients. Anesth Analg. 2000 Feb;90(2):324-7.
17. Loughrey JP, Walsh F, Gardiner J. Prophylactic intravenous bolus ephedrine for elective Caesarean section under spinal anaesthesia. Eur J Anaesthesiol. 2002 Jan;19(1):63-8.
18. Khairnar R, Sankalecha S. Effects of Ephedrine Infusion for the Prevention of Hypotension during Spinal Anesthesia for Elective LSCS. MVP J. Med. Sci. 2019; 6(1):34-38.
19. Singh TH, Thokchom RS, Sinam M, Nongthonbam R, Devi MB, Singh KM. Prophylactic intravenous ephedrine for prevention of hypotension in cesarean section during spinal anesthesia: A comparative study. J Med Soc 2016; 30:116-20
20. Ngan Kee WD, Khaw KS, Lee BB, Lau TK, Gin T. A dose-response study of prophylactic intravenous ephedrine for the prevention of hypotension during spinal anesthesia for cesarean delivery. Anesth Analg. 2000 Jun; 90(6): 1390-5.