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Efficacy of Prophylactic Phenylephrine in Prevention of Hypotension in Parturient Undergoing Spinal Caesarean Section

Muhammad Salman Maqbool

ABSTRACT:

OBJECTIVE:

To determine the hemodynamic (pulse, blood pressure) stability of prophylactic bolus dose of phenylephrine in caesarean section under spinal anaesthesia.

Study design & Setting: Interventional study was done from 13th Feb 2021 to 07th Oct 2021 at Islam Teaching Hospital, Sialkot.

Methodology: Study approval was taken vide letter no.2021-05/AN dated 26-3-2021, issued by Chairman Ethical Review Board, Islam Medical College, Sialkot. Statistical software(version.3.1.9.2) with (prob of 0.80, critical χ^2 value 15.08), was employed and sample size calculated to be 200 cases i.e. groups-I (injection phenylephrine 100µgm) and group-II (placebo) divided by lottery method into 100 each given at spinal neuraxial block. Primary study variable being heart rate and blood pressure variations. Spearman's Rank correlation statistical test was used to check interdependence between the two variables i.e., systolic blood pressure and pulse rate. SPSS version 21 was used.

Results: In group-II, in 36% cases atropine was given as compared to 24% cases in group-I, thus 150 % more anti-cholinergic was used in group-II. In group-II, in 33% cases top-up of injection Adrenaline 10 microgram was used whereas given in 24% cases in group-I, thus 137.5 % more top-ups of vasopressors in group-II. In group-I, heart rate decreased by value of 9.02 % with respect to baseline value, while comparable reading noted was 3.42% decline in pulse rate in group-II respectively.

Conclusion: Prophylactic phenylephrine at time of spinal injection resulted in stable blood pressure and pulse rate values in caesarean spinal delivery.

Keywords:Caesarean delivery, Hypotension, Phenylephrine, Spinal anaesthesia.

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INTRODUCTION:

In caesarean section, spinal anaesthesia is the anesthesia of choice for elective surgery[1].The intra-thecal block has several advantages, as avoidance for the need of airway control (difficult intubation), lower risk of aspiration pneumonia (full stomach), providing dense and effective block which is easy to place and economical as well, but may be associated with complications such as hypotension, bradycardia[1] etc. Among the various factors implicated in sign and symptoms of hypotension e.g. sudden apprehension, sinking of heart, nausea and altered mental status with neuraxial block, the aorto-caval compression is independent of spinal anesthesia it can aggravate the effects of spinal anesthesia due to gravid uterus particularly in supine posture. The physiologic compensatory response in parturient is the reflex increase in peripheral sympathetic vasomotor tone which help parturient to maintain adequate arterial systolic blood pressure despite high cardiac output, the sympathetic block following spinal or general anaesthesia is additional factor impairing the protective reflex, whereas main aim after sympathetic block is maintenance of mean pulse and blood pressure (for adequate placental perfusion)[2], to counter-act foetal acidosis.

For this purpose, many measures have been proposed such as use of crystalloids and/or colloids[3] with no particular beneficial effect with use of either colloid solution (haemaccel, gelatin solutions, hetastarch) in comparison to crystalloid solutions (0.9% isotonic saline, ringer lactate), the intra-venous fluids either given as preload(given commonly in dose of 10-15ml/kg body weight, 20 minutes prior to placing spinal block) vs co-load[4](intra-venous fluids pushed at time of spinal block when vasodilatory effect is taking place), speed of injection[5,6], wedge placement under right hip[7], use of vasopressors agents via infusion or in bolus form[8] etc to stabilize blood pressure and heart rate following spinal block. Eskandr Ashraf M and colleagues did double

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blind randomized controlled research on vasopressors to prevent hypotension in parturient following neuraxial anaesthesia given in infusion form and noted that norepinephrine and phenylephrine provided better hemodynamic stability and foetal well-being than ephedrine[8].

Over the years ephedrine (with sympathomimetic agonist effect at α and β adrenergic receptors) has been considered as a drug of choice for immediate management of hypotension following intra-thecal block with a longer time period of action after intravenous bolus dose in comparison to other vasopressor agents[9]. In another study on effects of norepinephrine (with weaker beta and higher alpha adrenergic agonist receptor effect) given as infusion titrated to maintain blood pressure within 20% of initial value at time of sub-arachnoid block showed promising results in managing post-spinal hypotension[10].

Lately phenylephrine[11], alpha-I receptor agonist has been considered vasopressor agent of choice particularly in caesarean section as it is associated with better umbilical arterial blood gas analysis values (low acidosis and base excess values of umbilical vessels) as it does not cross placental barrier. Other vasopressors used include metaraminol and mephentermine with alpha and beta receptor agonist effect with disadvantage of tachyphylaxis. American Society of Anesthesiologist Obstetric Anesthesia Task force advocated that both phenylephrine and ephedrine can be used with better foetal well-being with later agent, similar inference was done in Canadian anaesthesia guidelines[11].Considering above stated facts we working at a peripheral area teaching unit designed study to assess phenylephrine in terms of hemodynamic stability(pulse and blood pressure) effect administered prophylactically at time of spinal block in elective caesarean section cases.

METHODOLOGY:

This interventional (randomized controlled) study with purposive sampling technique was under taken at Islam Teaching Hospital (main obstetric operation room). Study approval was taken vide letter no.2021-05/AN dated 26-3-2021, issued by Chairman, Ethical Review Board, Islam Medical & Dental College, Sialkot.Statistical software (version.3.1.9.2) was utilized for sample size calculation and came out to be 200 cases with (1-β err prob of 0.80, critical χ^2 value 15.08), parturient planned for elective caesarean section under intra-thecal block placed by employing lottery method into 2 prophylactic treatment groups of 100 each, group-I (Injection phenylephrine 100µgm) and group-II (placebo) with degree of freedom value of 5. The time duration of study was approximately 8 months i.e., from 13th Feb 2021 to 07th Oct 2021.The inclusion criteria being American Society of Anesthesiologist12 medically fit parturient, elective caesarean section, age between 18-40 years[5]. The exclusion criteria being parturient with coagulopathy, stenotic valvular heart diseases, eclampsia, emergency caesarean section[5]. Standard pre-anaesthesia evaluation was done based on printed questionnaire proforma with pre-medication ordered as per American Society of Anesthesiologist [12] guidelines and informed written consent was taken. All parturient had co-loading of crystalloids via large bore intravenous lines. Monitoring (electrocardiograph, pulse oximetry, blood pressure, heart rate) was attached and baseline values noted. Sub-arachnoid block was placed using aseptic technique at L3-4 level with 25g quincke spinal needle (hyperbaric 0.75%)1.5ml was given and T_6 sensory level was ascertained prior to start of procedure. Parturient received prophylactic medication according to groups at time of spinal block. The vials were diluted to 4ml solution and given by anaesthetic nurse provided in labelled sealed envelopes at time of spinal injection. The consultant anaesthetist performing block was having no knowledge about type of medication given, being prepared by colleague anaesthetist and both were part of team. Parturient were blinded to grouping. Hemodynamic stability (heart rate, blood pressure both systolic and diastolic) was noted from baseline value till initial 15 minutes at 2-minute interval following spinal block. The primary study variable being heart rate and blood pressure (systolic and diastolic) variations, whereas subordinate variable studied were; number/ percentage of hypotension i.e., mean / standard deviation, bradycardia manifestation (number/percentage of cases in which atropine was administered), the use of colloids and associated complications. Hypotension was labelled in study as a decrease of 15% in systolic blood pressure from baseline or (<100mmHg) and bradycardia categorised by 20-25% decrease from baseline value. Heart rate and blood pressure variations were all correlated in relation to baseline readings. Spearman's Rank correlation was used to check interdependence between the two variables i.e., systolic blood pressure and pulse rate of both groups. Patient confidentiality was kept in check during study. The correlation is significant at the 0.01 level. SPSS version 21 was used.

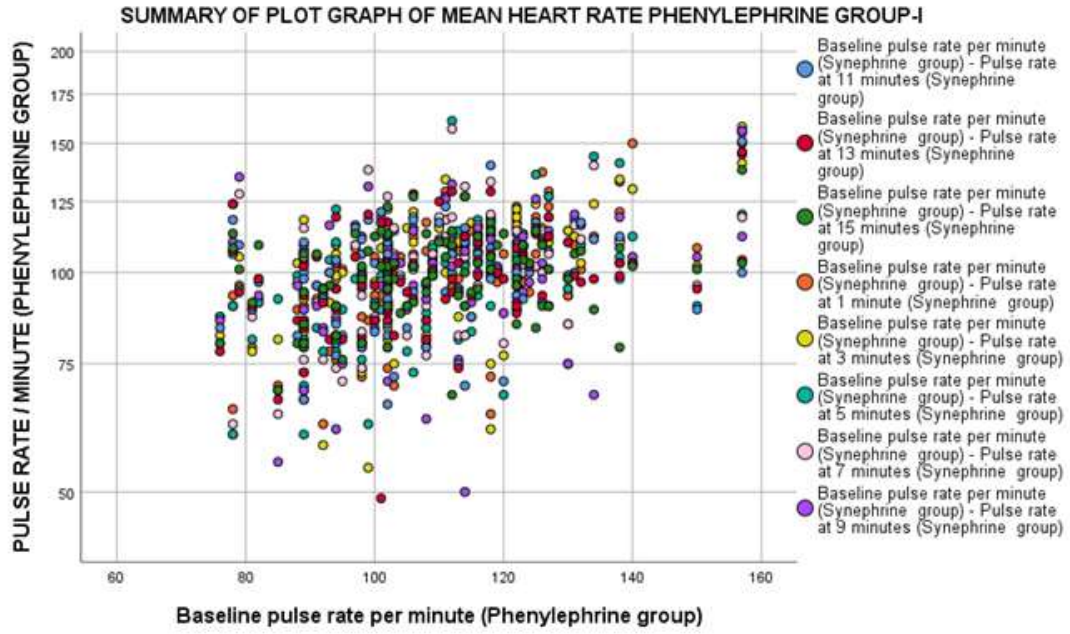
RESULTS:

Hemodynamic data of both groups (blood pressure systolic and diastolic in mmHg) is shown in table-1. The age(years) statistics in group-I(phenylephrine) being mean 26.73(SD of 3.55) with minimum and maximum being 19 and 40 years, whereas in group-II (placebo) the mean age was 26.81(SD of 3.41) with minimum and maximum values of 20 and 38 years respectively. The mean heart rate baseline value and the relative change which occurs at interval of 1,3,5,7,8,11,13 and 15 minutes after placement of sub-arachnoid block in baseline value in group-I(phenylephrine) and group- II (placebo) are presented in graph 1 and 2 respectively. In group-I, in 15 cases (15%) both adrenaline and phenylephrine were given for optimization of post-spinal hypotension whereas in group-2 in 9 cases (9%) both agents were administered respectively. Detailed vasopressor

Table-1: Group-I & II statistics (n=200)

		Group-I(Phenylephrine)	Group-II(Placebo)
Systolic blood pressure (SBP) & Diastolic blood pressure (DBP) in (mmHg) baseline	Mean	131.85 / 81.86	135.47 / 87.79
	Standard Deviation	16.02 / 12.49	19.06 / 14.83
	Minimum	67 / 37	96 / 45
	Maximum	168 / 114	200 / 127
SBP & DBP at 1 minute	Mean	127.96 / 77.40	132.69 / 83.05
	Standard Deviation	16.40/ 14.21	20.11 / 16.40
	Minimum	78 / 42	64 / 26
	Maximum	166 / 109	192 / 127
	Percent decrease to baseline value	2.95% / 5.27%	2.05% / 5.39%
	P-value	.002 / .005	.000 / .001
SBP & DBP at 3 minutes	Mean	120.28/ 70.18	126 / 76.47
	Standard Deviation	19.14 / 16.10	21.67 / 17.62
	Minimum	71 / 34	65 / 34
	Maximum	171 / 96	175 / 119
	Percent decrease in reference to baseline value	8.8%/ 14.26%	7% / 12.89%
	P-value	.012 / .691	.385 / .632
SBP& DBP at 5 minutes	Mean	117.95 / 66.40	122 / 73.51
	Standard Deviation	18.24 / 16.94	21.66 / 19.27
	Minimum	74 / 28	53 / 23
	Maximum	175 / 126	166 / 115
	Percent decrease in reference to baseline value	10.5% / 18.8%	9.9% / 16.26%
	P-value	.598 / .148	.506 / .591
SBP & DBP at 7 minutes	Mean	112.85 / 60.64	120.73 / 71.20
	Standard Deviation	18.49 / 16.41	20.94 / 19.07
	Minimum	61 / 26	55 / 22
	Maximum	161 / 113	171 / 110
	Percent decrease to baseline value	14.4% / 25.92%	10.9% / 18.89%
	P-value	.282 / .094	.055 / .076
SBP & DBP at 9 minutes	Mean	112.65 / 62.16	120.59 / 71.86
	Standard Deviation	17.82 / 15.69	20.70 / 18.23
	Minimum	72 / 32	61 / 25
	Maximum	157 / 106	174 / 130
	Percent decrease to baseline value	14.6% / 24.06%	11% / 18.14%
	P-value	.006 / .126	.009 / .187
SBP & DBP at 11 min.	Mean	114.73 / 62.45	118.20 / 70.36
	Standard Deviation	17.59 / 16.40	18.13 / 15.95
	Minimum	80 / 30	72 / 31
	Maximum	188 / 124	162 / 106
	Percent decrease to baseline value	12.98% /23.46%	12.74% / 19.85%
	P-value	.029 / .027	.122 / .395
SBP & DBP at 13 min.	Mean	113.39 / 62.08	117.58 / 68.86
	Standard Deviation	17.70 / 16.61	15.88 / 14.64
	Minimum	62 / 26	75 / 34
	Maximum	177 / 115	164 / 100
	Percent decrease in reference to baseline value	14% / 24.2%	13.20% / 21.56%
	P-value	0.018 / .048	.081 / .615
SBP & DBP at 15 min.	Mean	114.30 / 62.05	118.40 / 68.38
	Standard Deviation	16.66 / 15.84	15.96 / 15.15
	Minimum	79 / 31	78 / 37
	Maximum	164 / 112	168 / 100
	Percent decrease in reference to baseline value	13.31% / 24.19%	12.60% / 22.10%
	P-value	.356 / .038	.430 / .121

Graph-1: Mean heart rate at time intervals group-I



Graph-2: Mean heart rate at time intervals group-II

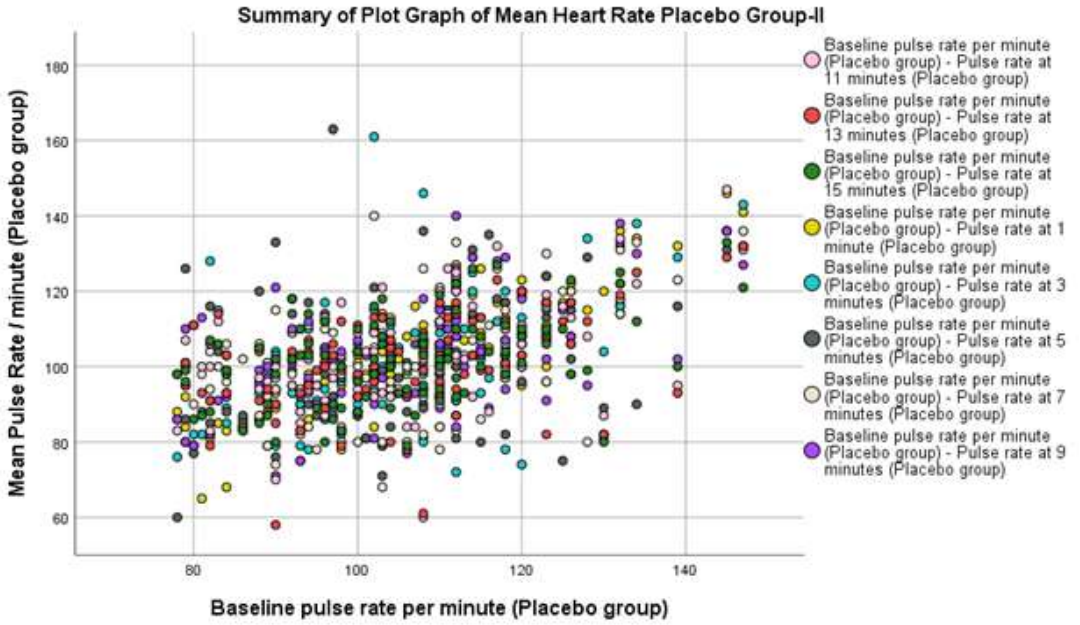


Table-2: Vasopressor / Anticholinergic consumption(n=200)

		Group-I	Group-II
		Number / Percent	
Injection. Phenylephrine (100µgm)	Used	40 / 40%	33 / 33%
	Not given	60 / 60%	67 / 67%
Injection. Adrenaline (10µgm)	Used	24 / 24%	33 / 33%
	Not used	76 / 76%	67 / 67%
Injection. Atropine(0.5mg)	Used	24 / 24%	36 / 36%
	Not used	76 / 76%	64 / 64%

Table-3: Spearman's Rank correlation.

		SBP at 15 minutes in mmHg (Placebo group-II)	Pulse rate at 15 minutes (Phenylephrine group-I)	Pulse rate at 15 minutes (Placebo group-II)	SBP at 15 minutes in mmHg (Phenylephrine group-I)
Systolic blood pressure at 15 minutes in mmHg (Placebo group-II)	Pearson Correlation	1	.264**	.052	.148
	Sig. (2-tailed)		.008	.606	.143
	N	100	100	100	100
Pulse rate at 15 minutes (Phenylephrine group-I)	Pearson Correlation	.264**	1	-.035	.231*
	Sig. (2-tailed)	.008		.729	.021
	N	100	100	100	100
Pulse rate at 15 minutes (Placebo group-II)	Pearson Correlation	.052	-.035	1	-.154
	Sig. (2-tailed)	.606	.729		.126
	N	100	100	100	100
Systolic blood pressure at 15 minutes in mmHg (Phenylephrine group-I)	Pearson Correlation	.148	.231	-.154	1
	Sig. (2-tailed)	.143	.021	.126	
	N	100	100	100	100

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

and atropine used in both groups of study are depicted in table-2. Spearman's Rank correlation between the two variables i.e., systolic blood pressure and pulse rate of both groups is shown in table-3 and is significant at the 0.01 level.

DISCUSSION:

In group-II (placebo) in 36(%) cases atropine was given as compared to 24% cases in group-I (phenylephrine) thus 150 % more anti-cholinergic was used in group-II. In another study[13] atropine given initially due to bradycardia depicts as initial cautionary symptom following intra-thecal block, which results in elevated systolic blood pressure apart from increase in heart rate. Similarly in group-II (placebo) in 33% cases top-up of injection adrenaline 10 microgram was used whereas given in only 24% cases in group-I, thus 137.5 % more top-ups of vasopressors needed in group-II. In group-I (phenylephrine)heart rate decreased by value of 9.02 % with respect to baseline value, while comparable reading noted was 3.42% decline in pulse rate in group-II (placebo) respectively, as lower value can be attributed to additional administration of atropine as stated above. In study in 2 cases (1%) colloid (Heamacel) was given along with left table tilt, in 2 cases (1%) bradycardia with pauses was noted, settled with anti-cholinergic administration. Pre-mature ventricular contractions and post-partum hemorrhage requiring B-lynch suturing was noted in 1 case (0.5%) respectively. In group-I (phenylephrine)systolic and diastolic blood pressure (mmHg) decreased by value of 15.34% and 31.92% with respect to baseline value, while comparable reading were 12.60% and 22.10% respectively in group-II (placebo). Though the systolic blood pressure fall was not statistically significant and in study as per standard taken of was 15% decline from baseline value the group-II value was within desired limits and group-I was insignificantly just over stated value. In another study it was stated that due to lack of consensus classification on allowable hypotension (systolic blood pressure) following sub-arachnoid block in parturient which is up to 20% decrease in majority of case studies and in our study as well was within 20% value mark[14]. In another study vasopressors infusion was utilized to counter act sympathetic block hypotension rather than prophylactic employing bolus dosage[15,16.17](regimen used in our study) and in another study infusion of phenylephrine was found to be less effective[18]. In another study the wide-ranging variables implicated in maternal hypotension seen following sympathetic block, were evaluated related to (anaesthesia practices as well as to parturient), they were identified as important ones[19,20]. In a review study done on current vasopressor given for hypotension in spinal caesarean delivery with phenylephrine the reflexive lowering of heart rate being main concern, researchers have looked for various alternatives like nor-epinephrine, ephedrine etc though evidence still favours it's use[21]regimen used in our study. In another review article suggested a multi-modal approach to address post spinal lowering of blood pressure which should be cost effective and development of simple protocol to follow[22].

As under anaesthesia a reduction in sympathetic tone occurs which causes hypotension , a study was done which concluded that at induction time intra-venous dose of 100microgm phenylephrine was effective to counter act hypotensive effect even during general anaesthesia ,similar protective stability effect of phenylephrine on systolic and diastolic blood pressure(cardiac output) was observed in spinal anaesthesia induced hypotension in parturient with no systemic diseases[23], similar study results were noted in our study as well. In another study, it was inferred that in caesarean spinal delivery cases phenylephrine infusion was compared to its bolus administration to prevent sympathetic block hypotension and was noted to be more effective[24].

However, another study failed to demonstrate any clinical beneficial effect of variable rate or fixed rate of phenylephrine infusion in prevention of spinal block hypotension and with bolus dose regimen of phenylephrine less dose is required and maintains stable post-spinal blood pressure[11]. The result in our study also showed favourable effect of prophylactic bolus dose of phenylephrine on blood pressure in the initial 15 minutes following spinal block. In Study done by Maqbool MS and colleagues[25] phenylephrine in dose of 100microgm was administered to counter spinal induced hypotension effectively, same dose regimen was adopted in our study also.

Limitations of our study, was that no measurement was done of speed of spinal injection[5,6], and also of timing (spinal injection till start of procedure), emergency caesarean section were not included and further research is warranted as to foresee efficacy of drug with only alpha agonist or a drug combination in control of spinal block hypotension.

CONCLUSION:

In the study prophylactic bolus administration of phenylephrine at time of spinal injection resulted in stable blood pressure and pulse rate values in caesarean section under spinal anaesthesia

Authors Contribution:
Muhammad Salman Maqbool: Concept & Design of Study, Drafting, Revisiting Critically, Data Analysis, Final Approval of version.

REFERENCES:

1. Iddrisu M, Khan ZH. Anesthesia for cesarean delivery: general or regional anesthesia-a systematic review. Ain-Shams J Anesthesiol 2021; 13:1. https://doi.org/10.1186/s42077-020-00121-7
2. Bobet M, Joachim J, Gayat E, Bonnet A, Sievert K, Barnichon C, Fischler M, Le Guen M. Blood pressure measurement during cesarean delivery: Evaluation of a beat-to-beat noninvasive device NexfinTM). Medicine (Baltimore). 2021;100(22): e26129. doi:10.1097/MD.0000 000000026129
3. Gousheh MR, Akhondzade R, Asl Aghahoseini H, Olapour A, Rashidi M. The Effects of Pre-Spinal Anesthesia Administration of Crystalloid and Colloid Solutions on Hypotension in Elective Cesarean Section. Anesth Pain Med 2018;8(4): e69446. doi:10.5812/aapm.69446
4. Ni HF, Liu HY, Zhang J, Peng K, Ji FH. Crystalloid Coload Reduced the Incidence of Hypotension in Spinal Anesthesia for Cesarean Delivery, When Compared to Crystalloid Preload: A Meta-Analysis. Biomed Res Int. 2017; 2017:3462529. doi:10.1155/2017/3462529
5. Maqbool MS, Draz MU. Colloid preload and Coload versus crystalloid preload in spinal cesarean delivery: The effect of injection speed. Medical Forum Monthly. 2017; 28:102-105.
6. Chiang CF, Hasan MS, Tham SW, Sundaraj S, Faris A, Ganason N. Injection speed of spinal anaesthesia for Caesarean delivery in Asian women and the incidence of hypotension: A randomised controlled trial. J Clin Anesth. 2017; 39:82-86. doi: 10.1016/j.jclinane. 2017.03.025.
7. Hasanin A, Soryal R, Kaddah T, Raouf SA, Abdelwahab Y, Elshafaei K, Elsayad M, Abdelhamid B, Fouad R, Mahmoud D, Hassabelnaby Y. Hemodynamic effects of lateral tilt before and after spinal anesthesia during cesarean delivery: an observational study. BMC Anesthesiol. 2018;18(1):8. doi: 10.1186/s12871-018-0473-0.
8. Eskandr Ashraf M, Ahmed Ali M, Bahgat Eldin NM. Comparative Study Among Ephedrine, Norepinephrine and Phenylephrine Infusions to Prevent Spinal Hypotension During Cesarean Section. A Randomized Controlled Double-Blind Study. Egypt J Anaesth 2021; 37:295-301. doi: 10.1080/11101849.2021.1936841
9. Shitemaw T, Aregawi A, Fentie F, Jemal B. Prophylactic ephedrine to prevent postspinal hypotension following spinal anesthesia in elective cesarean section: A prospective cohort study in ethiopia. J Obstet Anaesth Crit Care 2019; 9:75-80. DOI: 10.4103/joacc.JOACC_49_18
10. Abd Elraziq, B., Ali, S., Abotaleb, U., Alqassas, M. Norepinephrine versus Ephedrine in Prevention of Hypotension after Spinal Anesthesia. Al-Azhar Intern. Med. J 2020; 1(10): 37-4. doi:10.21608/aimj. 2020.39968.1308
11. Nag DS, Samaddar DP, Chatterjee A, Kumar H, Dembla A. Vasopressors in obstetric anesthesia: A current perspective. World J Clin Cases. 2015;3(1):58-64. doi: 10.12998/ wjcc.v3.i1.58.
12. Practice Guidelines for Preoperative Fasting and the Use of Pharmacologic Agents to Reduce the Risk of Pulmonary Aspiration: Application to Healthy Patients Undergoing Elective Procedures: An Updated Report by the American Society of Anesthesiologists Task Force on Preoperative Fasting and the Use of Pharmacologic Agents to Reduce the Risk of Pulmonary Aspiration. Anesthesiology 2017; 126:376–393 doi: https://doi.org/10.1097/ALN.0000000000001452
13. Ferre F, Martin C, Bosch L, Kurrek M, Lairez O, Minville V. Control of Spinal Anesthesia-Induced Hypotension in Adults. Local Reg Anesth. 2020; 13:39-46. doi:10.2147/LRA.S240753
14. Kinsella SM, Carvalho B, Dyer RA, Fernando R, McDonnell N, Mercier FJ, Palanisamy A, Sia ATH, Van de Velde M, Vercueil A; Consensus Statement Collaborators. International consensus statement on the management of hypotension with vasopressors during caesarean section under spinal anaesthesia. Anaesthesia. 2018;73(1):71-92. doi: 10.1111/anae.14080.
15. Goel K, Luthra N, Goyal N, Grewal A, Taneja A. Comparison of norepinephrine and phenylephrine infusions for maintenance of haemodynamics following subarachnoid block in lower segment caeserean section. Indian J Anaesth. 2021; 65:600-605. doi: 10.4103/ ija.IJA _185_21.

16. Shah PJ, Agrawal P, Beldar RK. Intravenous norepinephrine and mephentermine for maintenance of blood pressure during spinal anaesthesia for caesarean section: An interventional double-blinded randomized trial. Indian J Anaesth. 2020; 64:235-241. doi: 10.4103/ ija. IJA _91_20
17. Ferre F, Marty P, Bruneteau L, et al. Prophylactic phenylephrine infusion for the prevention of hypotension after spinal anesthesia in the elderly: a randomized controlled clinical trial. J Clin Anesth 2016; 35:99–106. doi: 10.1016/j.jclinane.2016.07.020
18. Doherty A, Ohashi Y, Downey K, Carvalho JCA. Phenylephrine infusion versus bolus regimens during cesarean delivery under spinal anesthesia: a double-blind randomized clinical trial to assess hemodynamic changes. Anesth Analg. 2012;115(6):1343–50. doi:10.1213/ANE. 0b013e31826ac3db
19. Fakherpour A, Ghaem H, Fattahi Z, Zaree S. Maternal and anaesthesia-related risk factors and incidence of spinal anaesthesia-induced hypotension in elective caesarean section: A multinomial logistic regression. Indian J Anaesth. 2018;62(1):36-46. doi: 10.4103/ija. IJA_416_17
20. T. Shitemaw, B. Jemal, T. Mamo, L. Akalu. Incidence and associated factors for hypotension after spinal anesthesia during cesarean section at Gandhi Memorial Hospital Addis Ababa, Ethiopia PLoS One 2020;15 (8): e0236755. PubMed PMID: 32790681.
21. Ngan Kee WD. The use of vasopressors during spinal anaesthesia for caesarean section. Curr Open Anesthesiol 2017;30(3):319-25. doi:10.1097/ACO. 0000000000000453.
22. Hasanin A, Mokhtar AM, Badawy AA, Fouad R. Post-spinal anesthesia hypotension during caesarean delivery, a review article. Egypt J Anaesth 2019; 33(2):189-93. DOI: 10.1016/j.egja.2017.03.003
23. Imran M, Khan FH, Khan MA. Attenuation of hypotension using phenylephrine during induction of anaesthesia with propofol. J Pak Med Assoc. 2007;57(11):543-7. PMID: 18062519.
24. Khurana S, Kashmiri Z, Malik S, Riasat MI, Javaid H, Sultan SF. Prevention of hemodynamic instability: A comparative double blind study with phenylephrine on patients with un-booked cesarean section. J Surg Pakistan.2021;26(2):51-5. Doi:10.21699/jsp.26.2.3.
25. Maqbool MS, Shahid A, Shafqat H. To Evaluate and Compare Clinical Effects of Varying Bolus Doses of Oxytocin in Patients Undergoing Caesarean Spinal Delivery. J Bahria Uni Med Dental Coll. 2020; 10(4): 261-265. Doi: Org/10.51985/jbumdc2020018