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A Comparative Study on The Role of Phenylephrine and Mephentermine in the Treatment of Hypotension During Spinal Anaesthesia for Caesarean Section

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ABSTRACT

Introduction: Spinal anaesthesia used in Caesarean section can cause hypotension a common yet serious problem in anaesthesiology. Preloading with intravenous fluids, left uterine displacement with an aim to shift the pregnant uterus away from the aorta and vena cava and administration of vasopressor drugs are the standard techniques used to counter this spinal anaesthesia. Though various vasopressor agents have been tried but none has been proved to be conclusively better over the others. This study was undertaken to compare the effects of bolus intravenous phenylephrine and mephentermine in the treatment of hypotension during spinal anesthesia for Caesarean Section.

Materials and Methods: This was a Prospective, Randomized, Parallel Group, Double Blind Study with Simple Random Sampling conducted in a 600 bed multi-speciality teaching hospital between April 2018 to March 2019. The study participants included a total of 100 singleton full term pregnant women of age-group 19-38 years planned for elective Caesarean section under spinal anaesthesia and developed hypotension subsequently. The study participants were randomly selected and allocated into 2 groups of 50 participants each. One group received 100 mcg phenylephrine while the other group received 6 mg mephentermine through bolus IV injection. The study was conducted following approval of the Institutional Ethics Committee.

Results: The results were analysed using descriptive statistics, unpaired Student t-test, Chi-square test using SPSS version 19.0. Both the vasopressors maintained SBP above the hypotensive range though phenylephrine had significantly higher SBP at 6 minutes after its administration (p value 0.010) when compared to mephentermine. The DBP was also significantly higher in the group receiving phenylephrine ($p<0.05$). However, the heart rate was significantly higher for the group receiving mephentermine at all time points of comparison. The group receiving mephentermine also required more number of doses.

Conclusion: The study concluded that through both the vasopressors can be used to treat hypotension during spinal anaesthesia for caesarean section, phenylephrine has some advantage over mephentermine.

Key words: Phenylephrine, Mephentermine, Hypotension, Spinal anaesthesia, Caesarean section

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INTRODUCTION

Regional anaesthesia including spinal anaesthesia has gained immense popularity among the anaesthesiologists owing to the ease of administration with lesser doses, less stress response and early patient recovery [1].

August Bier is the pioneer of spinal anaesthesia in obstetric surgery when he administered cocaine into intrathecal space using Quincke's method on August 15, 1898 [2]. Since then, spinal anaesthesia is has become the gold standard in obstetric surgeries.

However, spinal anaesthesia despite its benefits has its limitations too. The common complications of spinal anaesthesia include hypotension, bradycardia, limited duration of anaesthesia and lesser control of level of blockade [3,4]. The incidence of hypotension following spinal anaesthesia can reach as high as 70-80% if pharmacological prophylaxis is not used [5,6]. This continues to be one of the dreaded side effects of spinal anaesthesia despite several attempts to minimise the same.

Hypotension following spinal anaesthesia for caesarean delivery may compromise placental perfusion and resulting in fetal complications like hypoxia, acidosis and neurological injury. Hypotension following spinal anaesthesia can lead to dizziness, loss of consciousness, vomiting or even sudden cardiac arrest in the mother [7].

Though various pharmacologic and non-pharmacologic methods have been adopted till date to manage hypotension following spinal anaesthesia no single method has proved to be conclusively superior [8].

Various pressor agents working on the principles of causing vasoconstriction and increasing cardiac output have been tried to counter this spinal anaesthesia induced hypotension but none has been proved to be conclusively better over the others [9]. Sympathomimetic drugs exerting their effects through adrenergic receptors, acting directly or indirectly by inducing the release of noradrenaline further acting on these receptors are used most commonly to counter the hypotension following spinal anaesthesia. Through, ephedrine, a potent alpha and beta agonist, acting both directly and indirectly is a good option, its use has been restricted as it has the potential to cause supraventricular tachycardia (SVT), tachyphylaxis and fetal acidosis [10-12].

The effect of Ephedrine on vascular resistance is also less pronounced than the other alpha agonists, but ephedrine increases cardiac output and maintains blood pressure [13]. Though, Phenylephrine which is a direct acting potent alpha-1 agonist with no beta activity causing a rapid increase in systemic vascular resistance and blood pressure and is preferred in many recent studies, its disadvantage is that it causes bradycardia. Moreover, its serial dilution for IV administration is a potential source of error [14,15].

Mephentermine exerting its effect by indirect stimulation of beta-adrenergic receptors leading to release of norepinephrine from its storage has a positive ionotropic effect on the myocardium. With its mechanism of action similar to ephedrine, Mephentermine has also been used for the treatment of hypotension following spinal anaesthesia [16].

This study was undertaken with the following objectives of studying the effects of bolus IV phenylephrine and mephentermine in maintaining arterial blood pressure in women undergoing caesarean section under spinal anaesthesia, comparison of the effect of these two drugs on the heart rate, comparison of the effect of these two drugs on neurological-behaviour of the new-born, and comparison of the incidence of nausea, vomiting and other effects of these two drugs.

MATERIALS AND METHODOLOGY

Study methodology

This was a Prospective, Randomized, Parallel Group, Double Blind Study with Simple Random Sampling. The study was done in MGM Medical College and LSK Hospital, Kishanganj, Bihar, India which is a 600 bed multi-speciality tertiary care teaching hospital.

The study population included Singleton full term pregnant women of age 20 to 35 years, ASA Grade I and II who were planned for elective caesarean section for delivery and gave consent to participate in the study. The study was conducted during April 2018 to March 2019 following Institutional Ethics Committee Clearance.

Patients who had a resting blood pressure more than 140/90 mm Hg, gave history of hypertension, hypothyroidism, pre-existing neurological, cerebrovascular, cardiological, renal, metabolic, psychiatric, glaucoma or occlusive vascular disorders, were diagnosed with pre-eclampsia/eclampsia, had known fetal anomalies, gave history of hypersensitivity to local anaesthetic agents or were taking medications like MAO inhibitors having the potential to enhance or attenuate the sympathomimetic effect were excluded from the study. Patients having contraindications to spinal anaesthesia were also excluded.

Sample size

The target for recruitment was 100 (50 in each group) patients which was calculated with 80% power of study and 5% probability of Type 1 error and an aim to detect a difference of 6 mm Hg in systolic blood pressure (SBP). All the patients were observed for a period of 3 hours post administration of spinal anaesthesia.

Definition

Hypotension for the purpose of this study was defined as a fall in systolic blood pressure to a value less than 80% of the base value where as hypertension was defined as arterial blood pressure ≥ 160/90 mm Hg during the study period [17,18]. Inappropriate or severe bradycardia was defined as a heart rate less than 60beats/min if the SBP was <80% of base value or heart arte less than 50 beats/min if systolic blood pressure was above the base value or heart rate less than 45 beats/min irrespective of the systolic blood pressure [19]. Scoring for nausea and vomiting was done as 0=None, 1=Nausea without vomiting, 2=Retching, 3=Vomiting.

Plan of study and patient preparation

The study participants were explained in detail about the study in a language and manner they could understand and Voluntary written informed consent was obtained from each one of them. Pre-anaesthetic assessment was done the day prior to the study. The participants received dinner and oral Pantoprazole 40 mgs the previous night. Sips of water was allowed till 3 AM. The patients were kept nil by mouth after 3 PM as according to the trend in the institution, planned Caesarean sections are posted after 9 AM.

Body weight was taken on the morning of surgery, with an aim to compare with earlier values and assess the hydration status. Baseline systolic and diastolic blood pressure along with heart rate were also obtained. With

the patient in supine position and with a 15 degree wedge under right hip to reduce supine aortocaval compression, three readings of blood pressure and heart rate were obtained at three minutes interval. To minimize the influence of anxiety in patients with high initial values, the lowest readings of blood pressure and highest readings of heart rate were taken as baseline values. The baseline taken for Nausea and Vomiting Score was the highest value.

The two drugs under study for treatment of anticipated hypotension during caesarean delivery were prepared by adding 0.9% NaCl solution to make each dose of equal volume and the concentration of mephentermine 6 mg/ml and that of phenylephrine 100 mcg/ml. This was done by an anaesthesiologist who was blind to the study. Identical unlabeled syringes loaded with the drugs were put in labeled tray.

As an intervention to treat hypotension as per the study design, each participant was allocated to receive either bolus IV injection of phenylephrine 100 mcg or mephentermine 6 mg. The allocation was done by opaque sealed envelope technique. The registration number of each participant was kept by the anesthesiologist blind to the study. The investigator was unaware of the specific vasopressor each participant was receiving till the conclusion of the whole trial and collection of data from all the participants.

In the operation theatre, the participant had an IV access established with an 18 Gauge IV cannula as per standard practice. Prior to administration of spinal anaesthesia, each participant was infused with Ringer lactate solution at 10 ml/kg BW rapidly. Thereafter this was continued at a rate of approximately 10-15 ml/min throughout the study period.

A previously calibrated Multi-Parameter monitor with Pulse oximeter probe, ECG electrodes, Automated occilometric pressure cuff and Temperature probe attached was used. The same monitor was used for all the participants and for taking all the readings including the baseline values.

Fetal heart rate was monitored using stethoscope till the dressing and draping of the participant. Fetal heart rate monitoring was not done after this till delivery of fetus. Urinary catheterization was done with Foleys catheter using standard aseptic technique.

The resuscitation and general anaesthesia equipment were checked and kept ready to handle any emergency patient crash situation and as a back up need for conversion from spinal anaesthesia to general anaesthesia if need be. Drugs and spinal needles of same pharmaceutical brand were used for all the participants with an aim towards standardization.

Spinal anesthesia was administered using the midline approach and maintaining standard aseptic precautions using a 26 Gauge spinal needle. Bupivacaine 12.5 mg (2.5 mL of 0.5% bupivacaine with dextrose 8% solution) was used at a rate of approximately 0.2 mL/sec for spinal anaesthesia.

Patient was placed in a supine position with a 15º wedge given under right hip was done and inspired air was supplemented with oxygen using simple face mask at a flow of 2L/min until the umbilical cord was clamped.

The following parameters were monitored during the study period:

Systolic and diastolic blood pressure every 2 minutes after administration of spinal anaesthesia for next 20 minutes; thereafter every 5 minutes till the completion of caesarean section or at least 45 minutes and subsequently every 30 minutes for rest of the study period.

Heart rate and any cardiac rhythm disorder using lead II of electrocardiography.

Nausea, vomiting and other undesirable maternal effects.

The time to first repeat dose of the drug and number of doses.

The time from intrathecal administration of bupivacaine to development of hypotension (SA-Hypo), from spinal anaesthesia to cord clamping and the duration of surgery.

Apgar score of the neonate at 1 minute and 5 minutes of delivery for neurobehavioral assessment. The apgar score monitoring was done by the attending paediatrician who was unaware of the vasopressor used.

Hypotension during the study period was treated with repeated one unit (one ml) solution of the drug which was unknown to the interventionist. Maximum number of doses for both drugs was limited to 20 considering the product insert guidelines of phenylephrine. In case of severe refractory hypotension thereafter, the participant was excluded from the study and managed on intention-to-treat-basis as per institutional protocol after decoding the code.

The usual steps of Caesarean section were followed. Inj. oxytocin 10U in 5% dextrose was administered after cord clamping. During the study, shivering was treated with IV tramadol 0.5mg/ kg BW and nausea, vomiting with IV ondansetron 4mg per episode. Bolus IV injection of atropine 0.3 mg was administered as a treatment for inappropriate or serve bradycardia. Hypertension was treated as per institutional protocol.

The participant, nurses involved in patient care, the group of anesthesiologists involved preoperatively or in administering the spinal anesthesia and monitoring and treating the patient during the study period along with the other treating team members were unaware of the allocation of the participant and the drug being administered.

Data collection and statistical techniques

At the end of the whole study, data was collated and grouped depending on the type of vasopressor: Participants who received Phenylephrine were in Group P while participants who had received mephentermine were in Group M. Data of the participants who had successful spinal anaesthesia (defined as no need of

intraoperative supplemental analgesic or conversion to general anaesthesia) and had hypotension thus requiring any of the vasopressors under study were included for statistical analysis. Data of the other participants like those who had failed spinal anaesthesia or those who did not develop hypotension were excluded as per the aim of the study.

The parameters collected for statistical comparison were:

Age, weight, height.

Baseline values of systolic blood pressure (SBP), diastolic blood pressure(DBP), heart rate(HR) and Nausea and Vomiting Score.

Height of Block achieved following spinal anaesthesia, time between administration of spinal anaesthesia to development of hypotension (SA-Hypo), time between block to cord clamping (SA-Del) and duration of surgery.

SBP, DBP and HR at 0, 2, 4 and 6, 12 and 30 minutes after administration of vasopressor

Maximum Nausea and Vomiting Score.

Apgar scores at 1 and 5 minutes.

Time to first repeat dose of the vasopressor and number of doses during the study period.

Adverse events.

SPSS version 19.0 was used for data analysis. Descriptive statistical techniques like mean and standard deviation were used to summarize numerical data while categorical data was represented as percentage. Numerical variables between the groups were compared using unpaired Student t-test while Wilcoxon Signed Rank Test was used to compare numerical variables within the groups. Categorical data between the groups was compared by Chi-square test using a two tailed analysis with $p<0.05$ considered significant.

RESULTS AND ANALYSIS

Both Group P and Group M were comparable in terms of mean age, body weight and height. The difference in mean was not statistically significant ($p>0.05$) as was evident in the Table 1.

Table1: Age (in years), body weight (in kilogram) and height (in inches) of the study participants between Group P and Group M.

Variable	n	Range	Min.	Max.	Mean	Std. Error	Std. Dev.	Var.	P*
Age of participants in group P	50	11	24	35	23.026	0.5302	3.5223	12.765	0.46
Age of participants in group M	50	13	20	33	22.445	0.4625	3.0203	11.025	
Weight of participants in group P	50	17	48	65	50.378	0.8856	5.4874	32.455	0.824
Weight of participants in group M	50	23	46	69	51.537	0.9246	5.4392	40.12	
Height of participants in group P	50	9	55	64	61.357	0.2976	2.1465	4.001	0.451
Height of participants in group M	50	10	57	67	62.954	0.35729	2.359	6.532	

*2 tailed unpaired Student t-test

The difference in height of block achieved between the groups was not statistically significant as depicted in Table 2 by Chi-square test ($p>0.05$).

Table 2: In terms of thoracic dermatomes the highest level of sensory block achieved in Group P and Group M*.

Block Height	Group P(n=50)	Group M(n=50)
Up to T6	19(38%)	20(40%)
Up to T7	25(50%)	24(48%)
Up to T8	6(12%)	6(12%)

*(Chi Square test, p=0.456).

Table 3 shows the Comparison between Group P and Group M of the baseline values of systolic blood pressure, diastolic blood pressure, heart rate and duration of surgery. The difference in mean values was not statistically significant ($p>0.05$).

Table 3: The baseline systolic, diastolic blood pressure (in mm Hg) and heart rate (in beats/min) and duration of surgery (in minutes) among Study Participants of Group P and Group M.

Variable	n	Range	Min.	Max.	Mean	Std. Error	Std. Dev.	Var.	P*
Basal SBP in group P	50	28	110	138	125.2512	1.3467	7.9446	6. 992	0.798

Basal SBP in group M	50	32	104	136	119.6542	1.0076	7.9865	71.507	
Basal DBP in group P	50	10	72	82	80.4501	1.0003	4.2098	15.564	
Basal DBP in group M	50	14	66	80	76.6542	0.3876	3.2433	15.022	0.501
Basal HR in group P	50	32	78	110	86.2001	0.7654	14.8624	156.209	
Basal HR in group M	50	42	72	114	90.6783	2.1125	12.7653	181.664	0.396
Duration of surgery in group P	50	32	36	68	42.8762	0.4765	5.1286	41.81	
Duration of surgery in group M	50	30	30	60	44.9876	0.9876	6.204	47.209	0.594
*2 tailed unpaired Student t-test									

The basal Nausea and vomiting Score was depicted in Table 4.

Table 4: Basal Nausea and Vomiting Score for Group P and Group M*.

Severity	Group P(n=50)	Group M(n=50)	Total
None	42(84%)	41(82%)	83(83%)
Nausea	8(16%)	6(12%)	14(14%)
Retching	0	3(6%)	3(3%)
Vomiting	0	0	0
*(Chi square test, p=0.348).			

The systolic blood pressure, diastolic blood pressure and heart rate following SBP decrease by more than 20% was not statistically different between the two groups (p>0.05). The time to onset of hypotension after administration of spinal anaesthesia (SA-Hypo) and time of cord clamping signifying delivery of the fetus(SA-Del) was also comparable between the groups without any statistically significant difference (p>0.05). Analysis of the difference in mean of these parameters by unpaired Student t-test (two tailed) was not statistically significant (p>0.05) as depicted in Table 5.

Table 5: The onset of hypotension (in minutes) from administration of spinal anaesthesia, the systolic, diastolic blood pressures (in mm Hg) and heart rate (in beats/min) among the study participants at to (that is when hypotension occurred and time of cord clamping (in seconds) from administration of spinal anaesthesia (SA).

Variable	n	Min.	Max.	Mean	Std. Dev.	P*
SA-Hypotension time in group P	50	3	15	8.1546	2.5867	0.356
SA-Hypotension time in group M	50	4	12	6.6548	2.7547	
SBP at t0 in group P	50	72	100	90.0243	7.2876	0.621
SBP at t0 in group M	50	75	106	92.3326	6.3657	
DBP at t0 in group P	50	42	80	61.6784	8.9765	0.601
DBP at t0 in group M	50	46	84	65.2245	9.1245	
HR at t0 in group P	50	90	135	110.876	12.6578	0.051
HR at t0 in group M	50	80	140	108.6456	16.2827	
SA-Delivery time in group P	50	508	792	605.4555	66.2801	0.796
SA-Delivery time in group M	50	504	784	606.2478	60.9876	
*2 tailed unpaired Student t-test						

Unpaired Student t-test was used to analyze the difference in mean systolic blood pressure between the groups. There was no statistically significant difference between the two groups when vasopressor was administered at 0 minute and 2, 4, 12 and 30 minutes afterwards (p>0.05). However, at 6 minutes after administration of the vasopressor, mean SBP in group P

was significantly higher than that in group M ($p<0.05$) as depicted in Table 6.

Table 6: After vasopressor administration, the comparison of systolic blood pressures (mm Hg) at baseline value, 0, 2, 4, 6, 12 and 30 minutes for Group P and Group M.

Time Point	Group	N	Mean	Median	Min.	Max.	Std. Dev.	P*
Base value	P	50	122.5634	125	102	132	8.34661	
	M	50	124.2474	122	106	136	8.65856	0.796
0 Min	P	50	92.5868	96	70	102	6.87527	
	M	50	90.7869	93	77	104	6.4356	0.601
2 min	P	50	115.9778	118	92	140	12.87654	
	M	50	121.5674	127	94	146	13.27868	0.196
4 min	P	50	124.6675	126	100	158	12.47586	
	M	50	124.9556	127	103	144	9.12358	0.924
6 min	P	50	125.4444	128	105	150	10.12564	
	M	50	118.6578	123	89	138	8.78657	0.01
12 Min	P	50	123.1322	124	107	146	10.01256	
	M	50	120.0765	123	103	141	9.98754	0.312
30 Min	P	50	120.9876	118	98	135	9.23764	
	M	50	119.7765	115	95	137	10.48576	0.724

*2 tailed unpaired Student t-test

The mean SBP at different time points within the group was analysed using Wilcoxon Signed Rank Test. The increased mean SBP at 2, 4, 6, 12 and 30 minutes after administration of the vasopressor when compared to the hypotensive (0 minutes) value was statistically significant in both the groups ($p<0.004$).

Within group P, the mean SBP at 2 minutes was less than the base value while more at 6 minutes ($p<0.05$). At 4 min,12 mins and 30 minutes the mean SBP was comparable to the base value ($p>0.05$). As compared to 2 minutes, the SBP increased significantly at 4 mins, 6 mins and 12 minutes ($p<0.05$) becoming comparable at 30 minutes ($p>0.05$).

Within group M, the mean SBP at 2 mins, 6 mins, 12 mins and 30 mins after administration of the vasopressor was comparable without any statistically significant difference ($p>0.05$). However, statistically significant increase in mean SBP compared to the base value ($p<0.05$) was noted at 4 minutes after administering the vasopressor.

As compared to 2 minutes, the SBP increased significantly at 4 minutes ($p<0.05$) becoming non-significant at 6 mins, 12 mins and 30 minutes ($p>0.05$). This has been depicted clearly in Table 7.

Table 7: Analysis of SBP within the Study Groups using Wilcoxon Signed Rank Test.

Comparison of time points	P value	
	Group P	Group M
0-basal, 2, 4, 6, 12, 30 minutes	0.004	0.004
2-basal	0.05	1.112
2-4 minutes	0.002	0.026
2-6 minutes	0.01	1.246
2-12 minutes	0.024	0.824
2-30 minutes	0.367	0.302
4-basal	0.268	0.028
4-6 minutes	0.052	0.046

4-12 minutes	0.764	0.018
4-30 minutes	0.057	0.01
6-basal	0.007	0.81
6-12 minutes	0.026	0.029
6-30 minutes	0.001	0.089
12-basal	0.776	0.689
12-30 minutes	0.002	0.037
30-basal	0.546	0.301

The difference between the groups in mean diastolic blood pressure was analyzed by unpaired Student t-test (two tailed). At all the points in time after administration of the vasopressors, DBP was significantly higher in group P compared to group M and this was statistically significant ($p<0.05$) as depicted in Table 8.

Table 8: Comparison of diastolic blood pressures (mm Hg) at baseline, 0, 2, 4, 6, 12, and 30 minutes after administration of the vasopressors in Group P and Group M.

Time Points	Group	n	Mean	Med.	Min.	Max.	Std.Dev.	P*
Base value	P	50	80.6	80	72	87	3.97676	0.396
	M	50	78.42	79	73	87	3.56444	
0 min	P	50	61.46	62	48	82	9.76487	0.576
	M	50	61.89	62	50	84	9.98768	
2 min	P	50	75.02	77	59	88	8.76489	0.047
	M	50	71.54	73	57	86	8.87539	
4 min	P	50	74.76	75	60	87	8.07642	0.009
	M	50	70.67	72	59	89	7.76453	
6 min	P	50	74.96	73	67	86	6.08538	0
	M	50	68.46	74	57	83	7.00918	
12 min	P	50	76.13	77	65	85	5.75337	0
	M	50	68.17	68	57	84	6.98754	
30 min	P	50	74.94	75	64	87	6.84634	0.003
	M	50	69.76	71	59	85	7.84634	

Unpaired Student t test was used to analyze the difference in mean heart rate between the groups. Heart Rate was significantly higher in group M in comparison to group P ($p<0.05$) after administration of the vasopressor at all points of time. This is depicted in Table 9.

Table 9: Comparison of heart rate (beats/min) baseline, 0, 2, 4, 6, 12, and 30 minutes after administration of the vasopressors in Group P and Group M.

Time Points	Group	n	Mean	Med.	Min.	Max.	Std.Dev.	P*
Base value	P	50	92.262	89	75	122	12.95876	0.414
	M	50	90.764	90	70	124	12.6458	
0 min	P	50	112.461	108	90	137	13.5385	0.05
	M	50	104.96	102	77	138	14.0629	
2 min	P	50	85.7655	87	64	100	9.4653	<0.001
	M	50	105.6757	102	85	121	9.7645	
4 min	P	50	86.84575	86	65	106	9.0184	<0.000

	M	50	100.8575	100	79	122	9.0147	
	P	50	80.8745	85	58	100	9.4023	
6 min	M	50	102.3199	96	60	124	12.0945	<0.000
	P	50	81.8876	85	62	100	10.5489	
12 min	M	50	101.6864	100	84	123	8.9864	<0.001
	P	50	84.9876	84	58	100	8.8556	
30 min	M	50	99.6537	98	77	120	11.7454	<0.000
*2 tailed unpaired Student t-test								

Table 10 depicts the mean time of first repeat dose of the two drugs Phenylephrine and Mephentermine in the two groups from the time of administration of the two drugs following onset of hypotension and this difference was not found to be statistically significant (p>0.05).

Table 10: Comparison of time first repeat dose of vasopressor.

Group	N	Mean	Std. Deviation	Std. Error Mean	P*
	10(22.22%)	52.8765	26.09876	8.49675	
P M	14(31.11%)	35.8765	16.76544	4.87546	0.121
*2 tailed unpaired Student t-test					

Table 11a depicts 38 (76%) of the study population in the Group receiving Phenylephrine required a single dose, while only 8 (16%) and 4(8%) required two and three doses. While in the Group receiving Mephentermine, 32 (64%) of the study population required a single dose and 12(24%) and 6(12%) required two and three doses.

As highlighted in Table 11b, there is a significant difference in the administered doses of the two vasopressors between the two groups. Participants in Group P required less number of doses compared to participants in Group M.

Table 11a: Comparison of number of doses of the vasopressor.

Number of doses	Group P(n=50)	Group M (n=50)
1	38 (76%)	32 (64%)
2	8 (16%)	12 (24%)
3	4 (8%)	6 (12%)

Table 11b: Significant difference in the administered doses of the two vasopressors between the two groups.

Group	N	Mean	Std. Deviation	Std. Error Mean	P*
P	50	1.6543	0.58765	0.08765	0.033
M	50	1.9876	0.87655	0.14876	

There was no statistically significant difference between the Nausea and Vomiting Scores of the two groups as was depicted in Table 12.

Table 12: Comparison of Nausea and Vomiting Score between the groups after administration of spinal anaesthesia*.

Severity	Group P(n=50)	Group M(n=50)
None	38 (76%)	35 (70%)
Nausea	8 (16%)	8 (16%)
Retching	3 (6%)	5 (10%)

Vomiting	1 (2%)	2 (4%)

The incidence of Bradycardia including inappropriate bradycardia and shivering was 16%, 6% and 12% respectively in the Group receiving Phenylephrine while in the Group receiving Mephentermine, the incidence of Bradycardia including inappropriate bradycardia and shivering was 8%, 4% and 16% respectively (Table 13).

Table 13: Comparison of incidence of other effects between Group P and Group M.

Event	Group P(n=50)	Group M(n=50)
Bradycardia	8 (16%)	4 (8%)
Inappropriate Bradycardia	3 (6%)	2 (4%)
Shivering	6 (12%)	8 (16%)
Hypertension	0	0
Dysrhythmias	0	0
Fetal Bradycardia	0	0
None	33(66%)	36 (72%)

In both the Groups receiving Phenylephrine and Mephentermine, Apgar Score at 1 minute and 5 minutes was normal as is evident from the table above.

Table 14: Apgar score comparison at 1 and 5 minutes between Group P and Group M.

Apgar Score	Group P(n=50)		Group M(n=50)	
	At 1 min	At 5 min	At 1 min	At 5 min
7	2	0	8	3
8	17	12	12	7
9	17	24	10	12
10	14	14	20	28

DISCUSSION

Spinal anaesthesia causes sympathetic blockade causing peripheral vasodilatation leading to hypotension. Management of hypotension during spinal anaesthesia is of paramount importance as organ perfusion is dependent on the blood flow. This study was conducted with an aim to compare the efficacy of the two vasopressors commonly used for maintaining arterial blood pressure.

After administration of the vasopressor drugs under study, the SBP was comparable between the groups always except at 6 minutes when the mean SBP was significantly higher in group P. Studies by Sharma et al., Sahu et al. and Kamalakannan et al. have reported similar findings while other studies by Patel et al. reported mean SBP to be significantly higher after 2 minutes following administration of phenylephrine [18,20-22].

In our study, we observed that mean diastolic blood pressure was always higher in Group P receiving Phenylephrine while other studies by Sahu et al. and Mohta et al. observed that it was comparable [20,23].

After administration of phenylephrine, the mean heart rate decreased significantly in comparison to the mean heart rate at the onset of hypotension while it remained high in participants receiving mephentermine. This finding was in consonance with similar studies by Kaur et al [24].

It was observed that within the group, the effect of phenylephrine was at its peak at 6 minutes while for Mephenteremine the peak effect was noted at 4 minutes. The mean number of doses was also significantly greater for mephentermine. This was in contrary to studies by Das et al [25]. The incidence of nausea and vomiting and other effects including the Apgar score at 1 minute and 5 minutes was comparable between the two groups [24,26,27].

Both phenylephrine and mephentermine maintain systolic blood pressure above hypotensive range, however, phenylephrine is superior because of the less number of doses needed. Moreover, the rise in diastolic pressure and thus mean arterial pressure is more in phenylephrine indicating that phenylephrine is better than mephentermine in enhancing organ blood flow. Again, as mephentermine increases heart rate, it is better to avoid it in patients where this may have a detrimental effect. Both the vasopressors are otherwise comparable in terms of other effects like Nausea and Vomiting Score,

Apgar Score and is thus not contraindicated in the study population.

LIMITATIONS OF THE STUDY

The current study was not able to assess the end measures of adequacy of fetal circulation like umbilical artery flow velocity or umbilical artery pH. However, we tried to overcome this limitation with assessment of Apgar score of the neonates.

Another limitation of the study was its applicability to population other than that presenting at M.G.M. Medical College & L.S.K. Hospital, Kishanganj and since the sample was selected after subjecting to exclusion criteria, hence the results may not be applicable to wider population.

CONCLUSION

We can conclude from the study that both phenylephrine and mephentermine can be used to treat hypotension during spinal anaesthesia for caesarean section, however, phenylephrine has some advantage over mephentermine.

Considering the limitations of the study further studies on management of hypotension during spinal anaesthesia for caesarean delivery in varied population is needed.

CONFLICT OF INTEREST

The authors declare there is no conflict of interest.

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