IJMRP

International Journal of Medical Research Professionals

Original Article

Comparison of Ephedrine, Mephentermine and Phenylephrine for Maintenance of Blood Pressure during Spinal Anaesthesia

Fauzia Shifaat[1], Sheikh Imran Syed[2], Sudershan Gupta[3], Qazi Danish[4], Hilal Ahmad Wani[4]

[1]Lecturer, Department of Anaesthesiology and Critical care, [2]Head, Department of Physiology,
[4]Research Scientists, Multidisciplinary Research Unit, Government Medical College, Srinagar.
[3]Prof. Department of Anaesthesiology and Critical care, ASCOMS, Jammu, INDIA.

Article History
Received: 17 Feb 2016
Revised: 22 Feb 2016
Accepted: 25 Feb 2016

ABSTRACT

Introduction: Hypotension is an important complication of spinal anesthesia and should be treated promptly and aggressively to minimize patient discomfort, nausea, vomiting and risks of cardiac arrest. It has been accepted that vasopressors are of inestimable value in preventing and correcting hypotension caused by subarachnoid block.

Objective: Comparison of ephedrine, mephentermine and phenylephrine for maintenance of blood pressure during spinal anaesthesia in infraumbilical and lower limb surgeries.

Methods: The present study was conducted in the Department of Anaesthesiology and Intensive Care, Acharya Shri Chander College of Medical Sciences and Hospital, Jammu. Ninety patients of ASA class I and II were randomly distributed into three groups of thirty patients each. Following hypotension, group A received ephedrine 10 mg, group B received mephentermine 10 mg and group C received phenylephrine 100µg as intravenous bolus in 1 ml of 0.9% sodium chloride solution. Vital parameters like blood pressure (systolic, diastolic and mean), heart rate and oxygen saturation were recorded preoperatively as well as intra-operatively. Any side effects observed were also recorded.

Results: Intra-operatively, ephedrine group had a significantly higher mean heart rate than mephentermine group and phenylephrine group. All the three vasopressors were able to maintain blood pressure above the hypotensive values in their respective groups successfully. The number of hypotension episodes was highest in the phenylephrine group. The intraoperative mean systolic blood pressure was significantly higher in the mephentermine group than others. The average number of drug doses required for recovery from hypotension was significantly higher in the phenylephrine group followed by others. The average time required for recovery from hypotension was significantly lesser in the mephentermine group. No side effects were noted in any of the three groups except bradycardia. Bradycardia was observed in higher number of patients in the phenylephrine group than in the mephentermine group and the ephedrine group. The number of episodes of bradycardia was higher in the phenylephrine group than in the mephentermine group and the ephedrine group.

Conclusion: From our data, it can be concluded that intravenous bolus of mephentermine 10 mg is better at maintaining blood pressure during spinal anaesthesia in infraumbilical and lower limb surgeries than intravenous bolus of ephedrine 10 mg and phenylephrine 100 µg. Besides being effective in treating spinal anaesthesia induced hypotension, mephentermine is also associated with reduction in hypotensive episodes, lesser vasopressor doses and a shorter time of recovery from hypotension without any major side effects.

KEYWORDS: Ephedrine, Hypotension, Mephentermine, Phenylephrine, Subarachnoid block.

***Correspondence to:**
Dr. Hilal ahmad Wani,
Research Scientist-I,
Multidisciplinary Research Unit, GMC, Srinagar
hilalbiochm2007@gmail.com

INTRODUCTION

Today, spinal anesthesia has established itself as one of the most popular techniques for lower limb and lower abdominal procedures and the advantage lies mainly in the fact that it is easy to administer, gives profound muscle relaxation and very good analgesia in the affected areas. It offers a fast, profound and high quality sensory and motor block in women undergoing caesarean delivery.[1] The simplicity of the technique, reliable effect and lack of all those complications that are associated with general anaesthesia has made it a safe alternative to general anaesthesia.[2] It has been reported that the fatality rate directly attributed to anaesthesia was approximately 17-fold more frequent with general anaesthesia as compared to regional anaesthesia.[3] Spinal anaesthesia is nowadays being used for chemotherapeutic perfusion with circulatory block. Infact, spinal block has been found to provide faster recovery, superior analgesia and less nausea and vomiting in the immediate postoperative period as compared to general anaesthesia.[4] Thus spinal anaesthesia has emerged as a very effective and popular technique of regional anaesthesia and is being widely employed for a variety of surgical procedures. This procedure, however, is not without its inherent side effects and risk and is frequently accompanied by hypotension. Approximately one-third of patients will suffer from hypotension following an intrathecal anaesthetic.[5] The incidence of hypotension has been reported to be as high as 85% in patients undergoing elective caesarean section under spinal anaesthesia.[6] The hypotension following spinal block is primarily due to preganglionic sympathetic blockade resulting in vasodilation and pooling of blood in the affected areas. This reduces the cardiac preload and hence the cardiac output. Patient leg elevation, head down tilt and use of pressure stockings augment venous return and increase cardiac output and may be sufficient to restore blood pressure to an acceptable level.[7] Lithotomy position five minutes after spinal block attenuates the decrease in systolic arterial blood pressure and does not affect the cephalad spread of analgesia.[8] Manual uterine displacement and pelvic tilt have been used in maternal hypotension during spinal anaesthesia for caesarean section. However all these methods have only limited role in treating persistent hypotension.

Bradycardia produced by blockade of cardio-acceleratory nerve fibres of upper thoracic spinal cord segments ($T_1 - T_3$) can be treated with vagolytic drugs like atropine but often the response is erratic and undesirable especially in patients dependent on heart filling and coronary perfusion during diastole.[7] Volume expansion can be done with crystalloid or colloid infusion. Preblock crystalloid administration is time consuming and as 75% of any crystalloid diffuses into the interstitial space, its effect is only transient.[9] Crystalloids may produce pulmonary and peripheral oedema, thus having little effect on plasma volume and can be disadvantageous in certain groups of patients, like those with renal impairments and congestive cardiac failure (CCF). Some of these problems may be lessened by the use of smaller volumes of colloid solutions.[10] However colloid administration is fraught with its own risks and disadvantages. Albumin 5% is probably the most effective colloid solution but it is expensive and not universally available.[11] Other colloids have been shown to be less effective than albumin and also carry a risk of significant anaphylactic reaction.[12] The higher molecular weight dextrans and hydroxyethyl starch (HES) solutions cause an increase in plasma viscosity, red cell aggregation, coagulopathy which is thought to be associated with increased blood loss after surgery.[13]

Thus most of the strategies for decreasing the incidence of hypotension during spinal anaesthesia have proved far from being satisfactory or reliable. This has shifted the focus to various vasopressor agents for the prevention as well as treatment of spinal block induced hypotension. Ephedrine was the first agent to be used successfully to treat hypotension induced by spinal anaesthesia.[14] However, the prophylactic administration of ephedrine in central neuraxial blockade is no longer advocated due to its variable absorption (when used intramuscularly or subcutaneously) and potential for causing reactive hypertension.[15] The role of ephedrine has been challenged because of potential complications like supraventricular tachycardia, tachyphylaxis and fetal acidosis.[16] Various researches have been conducted to examine the effects of other vasopressor drugs including phenylephrine[17] and mephentermine[18] on spinal anaesthesia induced hypotension. Similarly, metaraminol, etilefrine, methoxamine and angiotensin II are also being studied for their vasopressor action in spinal anaesthesia induced hypotension. Intravenous bolus of 0.07 mg/kg of ephedrine is slightly more potent in restoring the mean arterial pressure (MAP) and the diastolic arterial pressure (DAP) as compared to intravenous bolus of 0.03 mg/kg of etilefrine after spinal anaesthesia induced hypotension in elderly patients (aged >65 years) undergoing hip surgery.[19] In other study it was concluded that phenylephrine infusion is associated with a lower incidence of fetal acidosis and maternal nausea and vomiting than ephedrine infusion.[20] However, the use of phenylephrine has been associated with bradycardia.[21] Mephentermine has similarly been used for treating hypotension caused by subarachnoid block and can be used as safely and effectively as ephedrine for the management of hypotension during spinal anaesthesia in patients undergoing caesarean section.[22] Also it was found that the three vasopressors phenylephrine, ephedrine and mephentermine in

intravenous bolus form, are effective in maintenance of arterial pressure within 20% limit of baseline, although phenylephrine has quicker peak effect in comparison to ephedrine and mephentermine.[23] Thus it is clear that the absolute supremacy of one vasopressor over the others has not yet been established unequivocally, though arguments have been extended in favour of each vasopressor from time to time. The current study was undertaken to compare the three vasopressors – ephedrine, mephentermine and phenylephrine for maintenance of blood pressure during spinal anaesthesia.

MATERIALS AND METHODS

The study was conducted in the Department of Anaesthesiology and Intensive care, Acharya Shri Chander College of Medical Sciences and Hospital, Sidhra, Jammu. After obtaining approval of the Institutional Ethical Committee and written informed consent from the patients, ninety (90) patients of ASA grade I and II, aged 18-60 years, of either sex, scheduled for infra-umbilical and lower limb surgeries, were enrolled for this prospective, randomized study. The patients were randomly divided into three groups of 30 patients each. Group A received ephedrine 10 mg, Group B received mephentermine 10 mg and Group C received phenylephrine 100 µg. All the drugs were given as intravenous bolus in 1 ml of 0.9% saline following hypotension after the subarachnoid block. After taking a detailed history, a thorough general and systemic examination of the patient was carried out. All the patients were kept fasting overnight prior to surgery and given a premedication of diazepam 5 mg night before surgery and again on the morning of surgery. A good intravenous line with 16 or 18 gauge cannula and Ringer's lactate solution was established. Vital parameters like non-invasive blood pressure (systolic, diastolic and mean arterial pressures), heart rate, electrocardiogram (ECG) and oxygen saturation (SpO_2) were recorded before the subarachnoid block as the baseline values (taken as average of three values), then every 2 minutes after the administration of spinal anaesthesia for 20 minutes and thereafter at every 5 minute interval till the completion of surgery. Under all aseptic precautions and with the patient in a sitting position 2-3 ml of 0.5% heavy bupivacaine was administered in the subarachnoid space through a 25 or 26 gauge Quincke's needle at either L2-3 or L3-4 intervertebral space after confirming dural puncture with free flow of cerebrospinal fluid (CSF). Immediately after administration of the local anaesthetic solution subarachnoidally, the patient was placed in supine position. All the patients received supplemental oxygen at the rate of 3 litres per minute via a ventimask. The level of sensory analgesia, defined as loss of sensation to pinprick, was recorded bilaterally at two minutes interval till the level stabilized and there was complete loss of sensation. The surgeon was then asked to proceed with the surgery. Whenever hypotension, defined as a fall in systolic pressure ≥ 20% from the baseline value or an absolute value of ≤ 100 mm Hg (24), occurred the study drug was given as intravenous bolus. The number of boluses given and the time taken to recover from hypotension were monitored. Bradycardia (a pulse rate of 60/min or less) was recorded and treated with 0.3 mg bolus of atropine intravenously.

Statistical analysis

All the observations so made, were put to statistical evaluation. A p-value < 0.05 was taken as significant.

RESULTS

Among all three groups included in the study, Group A had an age range of 18-60 years with mean age of 45.9 years; group B had an age range of 23-60 years and mean age of 45.8 years while group C had an age range of 25-60 years and mean age of 46.13 years. However, the difference in age distribution amongst the three groups was not significant. In terms of sex distribution amongst the three groups; Group A had 53.33% females and 46.66% males, group B had 50% females and 50% males and group C had 56.66% females and 43.33% males. There was insignificant variation as far as sex distribution in the three groups is concerned. As far as weight distribution of patients in the three groups included in the study is concerned, Group A had a weight range of 36-91 kgs and a mean weight of 60.5 kgs, group B had a weight range of 37-90 kgs and a mean weight of 58.96 kgs, group C had a weight range of 42-83 kgs and a mean weight of 62.33 kgs. Again there was insignificant difference in weight distribution between the three groups. The mean duration of surgery in Group A was 67.66 minutes, in group B 67.33 minutes and in group C 68.83 minutes. The difference again was insignificant. The most common surgical procedure in group A patients was gynaecological (46.66%) followed by orthopaedic (43.33%), in group B was general surgery (46.66%) followed by gynaecological surgery (30%) and in group C gynaecological procedures were more frequent (46.66%) than general surgery, orthopaedic or urology procedures. The baseline mean heart rate in Group A, group B and group C was 88.3 bpm, 81.96 bpm and 81.23 bpm respectively with insignificant difference of the same amongst the three groups. The baseline mean systolic blood pressure in the Group A, B, C was 123.7 mmHg, 125.23 mmHg and 123.03 mmHg respectively and the difference was statistically insignificant. Similarly, the baseline mean diastolic blood pressure in the three groups was 75.8 mmHg, 80.2 mmHg and 75.26 mmHg respectively with statistically significant difference ($p < 0.05$).The distribution of baseline mean blood pressure among the three groups A, B and C was 91.76 mmHg, group B 93.53 mmHg and 91.23 mmHg respectively and

the difference was not significant statistically. The baseline mean oxygen saturation (SpO2) in the three groups of A,B and C was 99.53%, 98.96% and99.33% respectively and the difference amongst the three groups was not significant statistically. The mean heart rate at '0' minute (immediately after spinal anaesthesia) in the three groups was 90.03 bpm, 82.86 bpm and83.53 bpm respectively and the difference amongst the three groups was not significant. The mean systolic blood pressure at '0' minute (immediately after spinal anaesthesia) in the three groups was 120.3 mmHg, 126.6 mmHg and 125.46 mmHg respectively with significant difference ($p < 0.05$).Similarly, the mean diastolic blood pressure at '0' minute (immediately after spinal anaesthesia) in the three groups was72.93 mmHg, 79.4 mmHg and76.33 mmHg respectively with statistically significant ($p < 0.05$) difference between the three groups.

Also the mean blood pressure (mean) at '0' minute (immediately after spinal anaesthesia) in the three groups was 88.46 mmHg, 94.7 mmHg and92.83 mmHg respectively and the difference was statistically significant ($p < 0.05$).As for as the mean oxygen saturation (SpO2) at '0' minute (immediately after spinal anaesthesia) is concerned, Group A was having 99.66%, group B was having 99% and group C was having 99.43%. The difference in the mean oxygen saturation (SpO2) at '0' minute amongst the three groups was not significant statistically. The intraoperative mean heart rate in the three groups was 84.44 bpm, 76.67 bpm, and 76.3 bpm respectively and the difference in the intraoperative mean heart rates amongst the three groups was statistically significant ($p < 0.05$).The intraoperative mean systolic blood pressure in the three groups was114.85 mmHg, 119.2 mmHg and 117.62 mmHg respectively and the difference in the intraoperative mean systolic blood pressures amongst the three groups was statistically significant ($p < 0.05$).The intraoperative mean diastolic blood pressure in the three groups was69.28 mmHg, 74.46 mmHg and 73.26 mmHg respectively and the difference in the intraoperative mean diastolic blood pressures amongst the three groups was statistically significant ($p < 0.05$).

The intraoperative mean blood pressure (mean) in the three groups was found to be 84.48 mmHg, 89 mmHg and 88.01 mmHg respectively and the difference in the intraoperative mean blood pressures (mean) amongst the three groups was statistically significant ($p < 0.05$).The intraoperative mean oxygen saturation (SpO_2) in the three groups was 99.94%, 99.83% and 99.77% respectively. The difference in the intraoperative mean oxygen saturation (SpO_2) amongst the three groups was not significant statistically.

Table 1: Episodes of Hypotension in the three groups

Episodes of Hypotension	Number of Patients		
	Group A	Group B	Group C
No Hypotension	10 (33.33%)	9 (30%)	10 (33.33%)
1	4 (13.33%)	10 (33.33%)	8 (26.66%)
2-3	15 (50%)	11 (36.66%)	5 (16.66%)
>3	1 (3.33%)	-	7 (23.33%)
Total	30	30	30

Table 2: Time distribution of Hypotensive episodes in the three groups

Group	No. of Patients	No. of hypotensive episodes during various time intervals (mins)			Total
		0-20	21-70	71 & above	
A	30	24	18	-	42
B	30	25	9	2	36
C	30	26	29	2	57

Table 3: Drug Doses required for treating hypotension in the three groups

Group	Patients reporting hypotension	Total no. of Doses	Average no. of Doses (Inj. / Patient)	Variance	F value	P value	Remarks
A	20	42	2.1	0.621	3.438	0.038	S
B	21	36	1.71	0.614	8	7	
C	20	57	2.85	4.765			

S – Significant

Table 4: Time required for Recovery from Hypotension in the three groups

Group	Patients reporting hypotension	Time (mins)		Variance	F value	P value	Remark
		Total	Average				
A	20	138	6.9	10.726	3.7719	0.0288	S
B	21	105	5	12.1			
C	20	207	10.35	97.923			

As depicted in Table 1, no hypotension was observed in 10 patients (33.33%) in both group A as well as group C and in 9 patients (30%) in group B. One episode of hypotension was observed in 4 patients (13.33%) in group A, 10 patients (33.33%) in group B and 8 patients (26.66%) in group C. 15 patients (50%) in group A, 11 patients (36.66%) in group B and 5 patients (16.66%) in group C had two–three episodes of hypotension. 1 patient (3.33%) in group A and 7 patients (23.33%) in group C had more than three episodes of hypotension. None of patients in group B suffered more than three episodes of hypotension.

The number of hypotensive episodes during 0-20 minutes was comparable between the three groups; Group A (24), group B (25) and group C (26). However, there was a significant difference in the number of hypotensive episodes occurring during 21-70 minutes between the three groups; Group A (18), group B (9) and group C (29).

While no hypotensive episode was observed in group A, 2 episodes were observed in group B and group C each after 70 minutes. Highest number of hypotensive episodes were observed in group C (57) followed by group A (42) whereas group B had the minimum number of hypotensive episodes (36) Table 2.

As depicted by Table 3, the average number of drug doses required to treat hypotension in the three groups was 2.85 in group C as compared to 2.1 and 1.71 in group A and group B respectively and the difference in the three groups was statistically significant ($p< 0.05$).

As shown in Table 4, Group C recorded the highest average time required for recovery from hypotension (10.35 minutes) followed by group A (6.9 minutes) and group B (5 minutes) and the difference between the three groups was statistically significant ($p< 0.05$).

As per results shown in Table 5, no bradycardia was observed in 23 patients (76.66%) in group A, 20 patients (66.66%) in group B and 19 patients (63.33%) in group C. One episode of bradycardia was observed in 4 patients (13.33%) in group A and in 7 patients (23.33%) in group B and group C each. Two episodes of bradycardia were observed in 3 patients (10%) in all the three groups. Three episodes of bradycardia were observed only in 1 patient (3.33%) who belonged to group C. Each episode of bradycardia was treated with intravenous bolus of 0.3 mg atropine.

Table 5: Episodes of Bradycardia in the three groups

Episodes of Bradycardia	Number of Patients		
	Group A	Group B	Group C
No Bradycardia	23 (76.66%)	20 (66.66%)	19 (63.33%)
1	4 (13.33%)	7 (23.33%)	7 (23.33%)
2	3 (10%)	3 (10%)	3 (10%)
3	-	-	1 (3.33%)
Total	30	30	30

DISCUSSION

Hypotension caused by subarachnoid block has been the subject of research for decades, yet surprisingly, it still remains an important clinical problem. Spinal block results in a number of physiological changes in the cardiovascular system, all of which contribute to the associated hypotension.[7] It has been realized that hypotension can be a major limiting factor for a more widespread use of spinal anaesthesia. The management of this problem has therefore become important in order that the quality of anaesthesia produced by the spinal block could be matched by its safety and various methods are employed for the management of hypotension. Vasopressors are nowadays becoming one of the mainstays of management of spinal hypotension. There is a controversy about the efficacy, choice, timing, as well as route of their administration. Prophylactic use of vasopressors, intramuscular and subcutaneous routes rule out the possibility of dose titration and may result in either inadequate treatment or, more seriously, hypertension.[25] Intravenous bolus or infusion of vasopressors with side by side monitoring of patient response has a greater margin of safety and better flexibility. Vasopressor infusions, however, have been associated with a large amount of drug being used, increasing the possibilities of side effects and toxicity. Various vasopressors are available for counteracting spinal hypotension, each with different pharmacological profile. The current study was undertaken to study the effectiveness and doses of ephedrine, mephentermine and phenylephrine required in controlling hypotension following spinal anaesthesia in 90 patients undergoing infraumbilical and lower limb surgeries. The commonest procedure in each type of surgery performed was as follows:- General surgery-Meshplasty (50%); Gynecology -Total abdominal hysterectomy with salpingo- -oophorectomy (75.67%); Orthopedics-Bipolar Prosthesis (16.66%); Urology- Transurethral resection of prostate (66.66%). Between the three groups, mephentermine group reported the highest number of general surgical procedures (70%). Amongst the three groups, phenylephrine reported the highest number of urology surgeries (66.66%).

Bradycardia was observed in 36.66% of patients in the phenylephrine group, 33.33% of patients in the mephentermine group and 23.33% of patients in the ephedrine group. Total number of episodes of bradycardia in the ephedrine, mephentermine and phenylephrine groups were 10, 13 and 18, respectively. The results of our study are in accordance with the pharmacological actions of the vasopressor agents used. Ephedrine stimulates the alpha- and beta- adrenergic receptors directly as well as indirectly by causing release of endogenous norepinephrine. This dual action greatly increases its inotropic and chronotropic effects on the heart, resulting in a significant increase in the force of contraction and heart rate. Mephentermine is an indirect acting vasopressor whose pharmacological action largely results from endogenous release of catecholamines. Through its positive inotropic effect it increases the force of contraction of heart. It also produces a positive chronotropic effect at the sinoatrial node but this effect is usually overcome by increased vagal activity occurring as a reflex to increased blood pressure. Thus, heart rate may be increased, decreased or unchanged. Phenylephrine, on the other hand, is a direct-acting synthetic noncatecholamine that principally stimulates the alpha$_1$- adrenergic receptors with minimal effect on the beta- adrenergic receptors. The alpha- mediated vasoconstriction leads to increase in peripheral vascular resistance. The rise in blood pressure causes baroreceptor mediated reflex sinus bradycardia.The results of our study are in accordance with another study that found a significant reduction in heart rate in the phenylephrine group.[23] In other study phenylephrine and ephedrine infusions for treatment of hypotension after spinal anaesthesiawere compared and a decrease in heart rate caused by phenylephrine while restoring the systolic, diastolic and mean blood pressures was found.[26] Our findings are in accordance with other studies.[20,27] Intraoperative hypotension was observed in 66.66% of patients in the ephedrine group, 70% of patients in the mephentermine group and 66.66% of patients in the phenylephrine group which was comparable in all the three groups. A single episode of hypotension was observed in 13.33%, 33.33% and 26.66% of patients in the ephedrine, mephentermine and phenylephrine groups, respectively. The highest number of patients having more than three episodes of hypotension belonged to the phenylephrine group (23.33%) followed by the ephedrine group (3.33%). None of the patients in the mephentermine group had more than three episodes of hypotension intrao-peratively. The results obtained in our study can be explained on the basis of the cardiovascular effects of the three vasopressors used to maintain blood pressure during spinal anaesthesia. Ephedrine causes an increase in the heart rate, myocardial contractility and cardiac output (β_1-mediated), thus increasing the blood pressure.[27] It has been seen that ephedrine is not a completely reliable drug as it does not always produce a satisfactory pressor response.[28] Tachyphylaxis with repeated injections is a marked feature of ephedrine.[29] Mephentermine has a positive inotropic effect on the myocardium increasing the force of contraction, the cardiac output and consequently the blood pressure. It also causes vasoconstriction and an increase in the total peripheral resistance, increasing both systolic as well as diastolic blood pressures. Phenylephrine, a direct acting α-agonist, causes an increase in blood pressure by virtue of increasing peripheral vascular resistance and has little or no direct effect on cardiac output or force of contraction. As compared to the other two vasopressors, it has a relatively short duration of action of about 5 to 10 minutes.[29] The systolic blood pressure at 2, 4 and 6 minutes post study drug was less in ephedrine group as compared to phenylephrine group. The diastolic blood pressure at 6 minutes was also significantly less in ephedrine than in the phenylephrine group. In our study the intraoperative systolic as well as diastolic blood pressures in the phenylephrine group were significantly higher than those in the ephedrine group and the findings are similar to the previous study depicting the similar results.[23]

We observed a higher mean systolic blood pressure in the phenylephrine group vis-à-vis the ephedrine group in our study. In one of the study,[30] it was concluded that there was no difference in the treatment of maternal hypotension between the two groups and similar conclusions were drawn in other study.[31] The higher mean systolic pressure in the phenylephrine group as compared to the ephedrine group in our study is possibly the result of using a far higher dose of phenylephrine (100 µg) than that used in the above mentioned two studies. In our study, the total as well as average time of hypotension was higher in the phenylephrine treated group than in the ephedrine treated group. These findings reflect those of previous study,[32] which also documented significantly higher total time of hypotension in phenylephrine treated patients than in ephedrine treated patients. We found that both ephedrine as well as mephentermine was able to maintain blood pressures above the hypotension values in their respective groups successfully which is in accordance with the previous study that concluded that both ephedrine and mephentermine are efficacious for the management of maternal hypotension during spinal anaesthesia.[22] The mean oxygen saturation in the three groups was comparable throughout the study. This finding is in consonance with previous other studies,[22,31] which did not report any difference in the oxygen saturation or any episode of desaturation with the use of these vasopressors. In our study we did not observe any

of the side effects except bradycardia (heart rate < 60/ min) which occurred variably in all the three groups and was promptly treated with 0.3 mg intravenous bolus of atropine as and when required. Our findings are in consonance with various other studies,[23,26,33] which have also reported bradycardia during spinal anaesthesia. The absence of nausea and vomiting in our patients was probably the result of treating hypotension, immediately and effectively with vasopressor boluses used in judicious doses, as both spinal block as well as high doses of vasopressors have been known to cause nausea and vomiting.[20] Use of vasopressors in judicious doses also prevented any central nervous system stimulation. The absence of post-spinal headache in our study can be attributed to the use of small bore spinal needles (25 G or 26 G).

CONCLUSION

From our study, it can be concluded that intravenous bolus of mephentermine 10 mg is better at maintaining blood pressure during spinal anaesthesia in infraumbilical and lower limb surgeries than intravenous bolus of ephedrine 10 mg and phenylephrine 100 µg. Besides being effective in treating spinal anaesthesia induced hypotension, mephentermine is also associated with reduction in hypotensive episodes, lesser vasopressor doses and a shorter time of recovery from hypotension without any major side effects.

ACKNOWLEDGEMENTS

The authors acknowledge the support provided by Department of Anaesthesiology and Intensive Care, Acharya Shri Chander College of Medical Sciences and Hospital, Jammu. The support from patients is also appreciated.

REFERENCES

1. Vercauteren MP, Coppejans HC, Hoffman VH, Mertens E, Adriaensen HA. Prevention of hypotension by a single 5 mg-dose of ephedrine during small-dose spinal anesthesia in prehydrated caesarean delivery patients. Anesthesia and Analgesia 2000; 90: 324-330.

2. David LB. Spinal, epidural and caudal anaesthesia; Eds; Millers Anaesthesia: Elsevier Churchill Livingstone; Sixth editions; 2004: 43: 1653-1684.

3. Hawkins JL, Koonin LM, Palmer SK, Gibbs CP. Anesthesia-related deaths during obstetric delivery in the United States, 1979-1990. Anesthesiology 1997 Feb; 86 (2):277-284.

4. Carron M, Freo U, Innocente F, Veronese S, Pilati P, Jevtovic-Todorovic V, Ori C. Recovery profiles of general anesthesia and anesthesia for chemotherapeutic perfusion with circulatory block (stop-flow perfusion). Anesthesia and Analgesia 2007; 105: 1500-1503.

5. Butterworth J. Physiology of spinal anaesthesia: what are the implications for management? Reg Anaesth pain Med 1998; 23: 370-373.

6. Riley ET, Cohen SE, Rubenstein AJ, Flanagan B. Prevention of hypotension after spinal anesthesia for caesarean section: six percent hetastarch versus lactated Ringer's solution. Anesthesia and Analgesia 1995 Oct; 81 (4): 838-842.

7. Greene NM, Brull SJ. The cardiovascular system. Physiology of spinal anaesthesia, 4th ed. Baltimore: Williams and Wilkins 1993; 85: 85-199, 177-181, 309-343 and 357-380.

8. Miyabe M, Sonoda H, Namiki A. The effect of lithotomy position on arterial blood pressure after spinal anesthesia. Anesthesia and Analgesia 1995 Jul; 81(1): 96-98.

9. Carey JS, Scharsmidt BF, Culliford AT et al. Haemodynamic effectiveness of colloid and electrolyte solution for replacement of stimulated operative blood loss. Surg Gynecol Obstet; 1970; 131: 679-686.

10. Wennberg E, Frid I, Haljamae H, Noren H. Colloid (3% Dextran 70) with or without ephedrine infusion for cardiovascular stability during extradural caesarean section. British Journal of Anaesthesia 1992; 69(1): 13-18.

11. Mathru M, Rao TL, Kartha RK, Shanmugham M, Jacobs HK. Intravenenous albumin administration for prevention of spinal hypotension during cesarean section. Anesthesia and Analgesia 1980; 59: 655-658.

12. Stoelting RK. Allergic reactions during anaesthesia. Anesthesia and Analgesia 1983; 62: 341-356.

13. Freyberger G, Dubreuil M, Boisseau MR, Janvier G. Rheological properties of commonly used plasma substitutes during preoperative normovolaemic acute haemodilution. British Journal of Anaesthesia 1996 Apr; 76 (4): 519-525.

14. Ockerblad NF, Dillon TG. The use of ephedrine in spinal anaesthesia. Journal of the American Medical Association 1927; 88: 1135-1136.

15. Frolich MA, Caton D. Baseline heart rate may predict hypotension after spinal anesthesia in prehydrated obstetrical patients. Canadian Journal of Anaesthesia 2002; 49 (2): 185-189.

16. Mercier FJ, Riley ET, Frederickson WL, Roger-Christoph S, Benhamou D, Cohen SE. Phenylephrine added to prophylactic ephedrine infusion during spinal anaesthesia for elective cesarean section. Anesthesiology 2001 Sep; 95 (3): 668-674.

17. Greiss FC Jr., Crandell DL. Therapy for hypotension induced by spinal anesthesia during pregnancy. Journal of the American Medical Association 1965; 191: 793-796.

18. James FM III, Greiss FC Jr., Kemp RA. An evaluation of vasopressor therapy for maternal hypotension during spinal anaesthesia. Anesthesiology 1970; 33: 25-34.

19. Taivainen T. Comparison of ephedrine and etilefrine for the treatment of arterial hypotension during spinal anaesthesia in elderly patients. Acta Anaesthesiologica Scandinavica 1991 Feb; 35 (2): 164-169.
20. Cooper DW, Carpenter M, Mowbray P, Desira WR, Ryall DM, Kokri MS. Fetal and maternal effects of phenylephrine and ephedrine during spinal anaesthesia for Cesarean delivery. Anesthesiology 2002; 97: 1582-1590.
21. Hall PA, Bennett A, Wilkes MP, Lewis M. Spinal anaesthesia for caesarean section: comparison of infusions of phenylephrine and ephedrine. British Journal of Anaesthesia 1994; 73: 471-474.
22. Kansal A, Mohta M, Sethi AK, Tyagi A, Kumar P. Randomized trial of intravenous infusion of ephedrine or mephentermine for management of hypotension during spinal anaesthesia for caesarean section. Anaesthesia 2005 Jan; 60 (1): 28-34.
23. Sahu D, Kothari D, Mehrotra A. Comparison of bolus phenylephrine, ephedrine and mephentermine for maintenance of arterial pressure during spinal anaesthesia in caesarean section – a clinical study. Indian Journal of Anaesthesia 2003; 47 (2); 125-128.
24. Corke BC, Datta S, Ostheimer GW, Weiss JB, Alper MH. Spinal anaesthesia for caesarean section. The influence of hypotension on neonatal outcome. Anaesthesia 1982; 37: 658-662.
25. Rolbin SH, Cole AFD, Hew EM, Pollard A, Virgint S. Prophylactic intramuscular ephedrine before epidural anaesthesia for caesarean section: efficacy and actions on the foetus and newborn. Can Anaesth Soc J 1982; 29: 148-153.
26. Brooker RF, Butterworth JF 4th, Kitzman DW, Berman JM, Kashtan HI, Mckinley AC. Treatment of hypotension after hyperbaric tetracaine spinal anaesthesia. A randomised, double-blind, cross-over comparison of phenylephrine and epinephrine. Anesthesiology 1997 Apr; 86 (4): 797-805.
27. Critchley LAH. Hypotension, subarachnoid block and the elderly patient. Anaesthesia 1996 Dec; 51 (12): 1139-1143.
28. Aviado DM. Cardiovascular effects of some commonly used pressor amines. Anesthesiology 1959 Jan-Feb; 20: 71-73.
29. Vickers MD, Morgan M, Spencer PSJ. Drugs in Anaesthetic Practice, 7th ed. Oxford: Butterworth-Heinemann Ltd. 1991: 301-353.
30. Moran DH, Perillo M, LaPorta RF, Bader AM, Datta S. Phenylephrine in the prevention of hypotension following spinal anesthesia for cesarean delivery. Journal of Clinical Anesthesia 1991 Jul-Aug; 3 (4): 301-305.
31. LaPorta RF, Arthur GR, Datta S. Phenylephrine in treating maternal hypotension due to spinal anaesthesia for caesarean delivery effects on neonatal catecholamine concentrations, acid base status and Apgar scores. Acta Anaesthesiologica Scandinavica 1995 Oct; 39 (7): 901-905.
32. Hall PA, Bennett A, Wilkes MP, Lewis M. Spinal anaesthesia for caesarean section: comparison of infusions of phenylephrine and ephedrine. British Journal of Anaesthesia 1994; 73: 471-474.
33. Thomas DG, Robson SC, Redfern N, Hughes D, Boys RJ. Randomized trial of bolus phenylephrine or ephedrine for maintenance of arterial pressure during spinal anaesthesia for caesarean section. British Journal of Anaesthesia 1996; 76: 61-65.

Source of Support: Nil.

Conflict of Interest: None Declared.

Cite this article as: Fauzia Shifaat, Sheikh Imran Syed, Sudershan Gupta, Qazi Danish, Hilal Ahmad Wani. Comparison of Ephedrine, Mephentermine and Phenylephrine for Maintenance of Blood Pressure during Spinal Anaesthesia. Int J Med Res Prof. 2016, 2(2); 51-58.