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Original Article

Comparison of the effects of intravenous fluids and vasoconstrictive agents on the hemodynamic response developing in spinal anaesthesia

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Abstract

Aim: The study's aim was to compare the effects of norepinephrine, ephedrine, and 0.9% sodium chloride (NaCl) solution against the hemodynamic response that develops after spinal anaesthesia.

Materials and Methods: The study was conducted on 80 patients who were scheduled for surgery onlower extremity varicose veins, and they were divided into four groups. Group F was started with a 0.9% NaCl solution of 15ml/kg 20 minutes before spinal anaesthesia. For 20 minutes after spinal anaesthesia, Group E received 2mg/min of ephedrine and Group N received 5mic/min norepinephrine as an infusion. Meanwhile, Group C was not given any medication or fluid. Spinal anaesthesia was performed with 0.5% bupivacaine. The systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR), and peripheral oxygen saturation (SPO2) values of the patients were recorded before and after the procedure. Sensorial block levels and degrees of motor block were also recorded after the operation. In addition, side effects other than hypotension that may develop after the surgery were also recorded.

Results: There was no statistically significant difference between the groups in terms of SBP, DBP, SPO2, HR, sensory block level, and degree of motor block (p>0.05). In Group C, the decrease in SBP and DBP values that occurred at the fifteenth, twentieth, and thirtieth minutes of spinal anaesthesia was statistically significant when compared with the control values (SBP: p=0.0274, 0.0028, 0.0036, and DBP: p=0.0132, 0.0210, 0.0041). Hypotension developed in 10 (50%) of the 20 patients in Group C, and a 10mg intravenous (IV) bolus intervened with ephedrine. This result was statistically significant when compared with Group F, Group E, and Group N (p=0.005).

Conclusion: As a result, it has been shown that norepinephrine, ephedrine, and 0.9% NaCl solution are similarly effective in preventing hypotension from developing after spinal anaesthesia.

Keywords: Ephedrine; hypotension; norepinephrine; spinal anaesthesia

INTRODUCTION

Spinal anaesthesia is the process of temporarily eliminating the nerve conduction performed by the blockage of the spinal nerves in the subarachnoid space with a local anaesthetic solution (1). It is mostly performed in the L3–4 or L4–5 interval (2). The anaesthetic agent administered in spinal anaesthesia is effective on the anterior and posterior nerve roots of the spinal cord in the subarachnoid space, the dorsal root ganglion, synapses in the anterior and posterior horn, and the descending and ascending pathways in the spinal cord parenchyma (3). Local anaesthetics slow down the depolarization rate, decrease the impulse conduction velocity, and block conduction completely in the nerve fibers and other excitable cells (4). The bupivacaine used in the study is an amide-based local anaesthetic agent that has a short latent time yet the longest period of efficacy (three–five hours) (5).

Spinal anaesthesia is an anaesthesia method that has a number of advantages over its general counterpart. Its rapidly effective onset and its easy application have made it as a preferred technique in many procedures, which often involve lower abdominal, inguinal, urogenital, rectal, and lower extremity surgery (6). The most important advantages of spinal anaesthesia are that the patient is conscious during the operation, the airway remains open, there is no risk of gastric content aspiration since the cough and swallowing reflex is not lost, the stress response due to surgery and trauma continues, the effect of analgesia takes place in the postoperative period, and

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the risk of thromboembolism is lessened due to early mobilization (7).

In addition to the benefits of spinal anaesthesia, it can lead to some complications, such as hypotension, bradycardia, lower back pain, headache, neurological squeal, nausea, vomiting, meningitis, and urinary retention. Hypotension due to spinal anaesthesia is the most common complication a systemic vascular resistance and cardiac output decline due to a sympathetic blockade. When bradycardia and decreased contractility of the myocardium are added to this, hypotension develops (8). Therefore, the measures taken to prevent hypotension that may occur during and after spinal anaesthesia are as important as treatment. Today, physical methods that increase venous return, intravenous fluid loading, and vasopressor agents, such as ephedrine, phenylephrine, isoproterenol, metaraminol, dihydroergotamine, dopamine, dobutamine, methoxamine, and norepinephrine are used to prevent and treat hypotension that is induced by spinal anaesthesia (9).

Ephedrine is a α and adrenergic agonist. It corrects the hypotension caused by spinal anaesthesia by increasing the heart rate, arterial resistance, and heart stroke volume (10). Norepinephrine is a potent α agonist and has less of an effect on receptors. It increases systolic and diastolic blood pressures due to peripheral vasoconstriction and heightens peripheral vascular resistance. Continuous infusion administration is preferred due to its short half-life (2.5 minutes) (11,12). In this study, we aimed to compare the effects of norepinephrine, ephedrine and 0.9% NaCl solution in cases of hemodynamic instability, such as bradycardia and hypotension after spinal anaesthesia.

MATERIALS and METHODS

This prospective and randomized study was carried out in the Eskisehir Osmangazi University Medical Faculty Hospital between November 2010 and 2011 after obtaining the approval of the Faculty of Medicine's Ethics Committee (date: 02.11.2010/no: 10). Informed consent forms were gathered from all of the patients. The study was completed in accordance with the principles stated in the Helsinki Declaration and with ethical standards in mind. It was conducted on a total of 80 patients, including American Society of Anaesthesiologists (ASA) I–II members, 56 female, and 24 male patients between the ages of 18 and 65 who were scheduled for lower extremity varicose vein surgery. Patients with hypertension, coagulopathy, contraindicated spinal anaesthesia, and non-regional anaesthesia were not included in the study.

The completed (simple) randomization was performed using a simple random number table, and 80 patients were each divided into four groups of 20. The groups were named Group C, Group F, Group E, and Group N. Group patients were not given any additional drugs or fluids, except fasting and maintenance liquids, before and after spinal anaesthesia. Before spinal anaesthesia, a 0.9% NaCl solution of 15ml/kg was given to Group F patients for 20 minutes. Meanwhile, in order to prevent the hypotension, Group E patients received 2mg/min of ephedrine, and Group N patients were administered with 5 mic/min of norepinephrine as an infusion for 20 minutes immediately after spinal anaesthesia. A 0.9% NaCl solution was added to the fasting and maintenance fluids of all patients, including the control group. Individuals who were taken to the operating table were monitored with a five-electrode ECG, a pulse oximeter, and an automatic sphygmomanometer. Control values were recorded. SBP, DBP, HR, SpO2 values were also monitored at the beginning of spinal anaesthesia and in the first, fifth, tenth, fifteenth, twentieth, and thirtieth minute of its duration.

Spinal Anaesthesia Application

The patients were turned to the right or left lateral position and the subarachnoid space was entered with the Quincke needle number 22 at the L3–L4 or L4–L5 level. The administration of 0.5% hyperbaric bupivacaine (8mg) was completed following a cerebrospinal fluid flow. Afterwards, the patients were turned to the supine position. Furthermore, the sensorial block level and motor block degree were recorded at the first, fifth, tenth, fifteenth, twentieth, and thirtieth minute after spinal anaesthesia. The sensorial block level was evaluated with a pin-prick method according to dermatomes, and the motor block rating was evaluated according to the Bromage scale. Based on the blood pressure value of the patients before fluid and drug administration, a 20% decrease in blood pressure or a systolic blood pressure <90mmHg was accepted as an indication of hypotension. This condition was intervened by administering 10mg of ephedrine in a fractionated dose. At the same time, side effects other than hypotension (agitation, nausea-vomiting, bradycardia, dizziness, headache, and tremor) that occurred as a result of spinal anaesthesia in all patient groups were recorded at the baseline and in the fifth, tenth, fifteenth, twentieth, and thirtieth minute after it was administered. In addition, other possible adverse effects were monitored and recorded (urinary retention, agitation, low back pain, and dyspnoea).

Statistical Analysis

While evaluating the findings obtained from the study, the Statistical Package for Social Sciences (SPSS) for Windows 16.0 program and Minitab 15.0 package programs were used for statistical analysis. While evaluating the research data, normality and homogeneous variance tests of all of the values were performed. With the calculated Shapiro-Wilk test statistics, a normality assumption and a homogeneous variance assumption was provided according to Levene's test statistics. After providing these assumptions, other descriptive statistics were calculated. While evaluating the data, one-way analysis of variance was used when comparing the groups according to demographic characteristics and measurement times as well as descriptive statistical methods (mean and standard deviation). Moreover, Pearson'schi-squaredtest

was employed when comparing sensory and motor block levels and a two-way analysis of variance along with the Wilcoxon test were used to make comparisons within groups. The results were evaluated at a 95% confidence interval and with the significance level at p <0.05.

RESULTS

This study was performed on a total of 80 patients undergoing lower extremity varicose vein surgery. Twenty-four (30%) were male, 54 (70%) were female, and their ages ranged from 18 to 65 years. The demographic data of the cases participating in the study are given in Table 1. There is no statistically significant difference between the groups in terms of age, weight, and gender (p> 0.05), and the SBP and DBP values of the cases included in our study are given in Tables 2 and 3 and Figures 1 and 2. There was no statistically significant difference between the groups in terms of SBP and DBP measurements (p> 0.05). Meanwhile, the HR and SpO2 values of the cases from our study are given in Tables 4 and 5. There was no statistically significant difference between the groups in terms of HR and SpO2 measurements (p> 0.05).

Table 1. Demographic data

	Group C		Group F		Group E		Group N		p
	n=20	%	n=20	%	n=20	%	n=20	%	
Male	7	35	6	30	5	25	6	30	0.93
Female	13	65	14	70	15	75	14	70	0.92
	Mean ± SD		Mean ± SD		Mean ± SD		Mean ± SD		p
Age	44 ± 11.01		46 ± 10.01		41 ± 12.98		47 ± 7.35		0.23
Weight	68.35 ± 6.61		69.55 ± 6.62		70.9 ± 5.32		68.65 ± 4.31		0.48

SD; Standart Deviation

Table 2. Systolic blood pressure

	Group C (n=20) (mmHg)	Group F (n=20) (mmHg)	Group E (n=20) (mmHg)	Group N (n=20) (mmHg)	p
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
Control values	139.30 ± 13.28	137.65 ± 15.52	128.05 ± 10.72	134.95 ± 20.06	0.11
1st minute	137.35 ± 20.24	137.65 ± 18.43	132.15 ± 14.60	136.30 ± 20.38	0.77
5th minute	129.65 ± 18.41	133.15 ± 14.83	130.50 ± 16.52	137.00 ± 15.44	0.52
10th minute	129.00 ± 22.44	134.30 ± 18.45	130.15 ± 14.21	132.80 ± 19.15	0.78
15th minute	126.80 ± 20.44	132.40 ± 17.74	129.15 ± 14.07	133.95 ± 17.38	0.57
20th minute	122.95 ± 18.63	132.85 ± 19.08	131.10 ± 15.74	131.60 ± 18.21	0.29
30th minute	122.55 ± 20.19	132.75 ± 20.77	128.75 ± 16.29	129.10 ± 16.42	0.37

SD; Standart Deviation

Table 3. Diastolic blood pressure

	Group C (n=20) (mmHg)	Group F (n=20) (mmHg)	Group E (n=20) (mmHg)	Group N (n=20) (mmHg)	p
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
Control values	83.90 ± 10.38	81.05 ± 8.36	79.10 ± 8.52	79.50 ± 10.57	0.36
1st minute	82.80 ± 8.22	80.25 ± 14.00	79.450 ± 8.21	76.65 ± 9.55	0.31
5th minute	78.00 ± 9.95	78.45 ± 12.35	76.30 ± 8.00	80.25 ± 10.37	0.68
10th minute	78.45 ± 10.76	77.30 ± 10.86	75.70 ± 9.43	77.40 ± 11.37	0.87
15th minute	75.80 ± 9.29	77.15 ± 10.70	76.90 ± 7.20	76.60 ± 9.85	0.97
20th minute	76.25 ± 9.70	76.75 ± 12.29	78.80 ± 6.08	76.10 ± 9.41	0.79
30th minute	74.25 ± 9.55	77.20 ± 11.95	76.35 ± 7.36	73.45 ± 9.23	0.58

SD; Standart Deviation

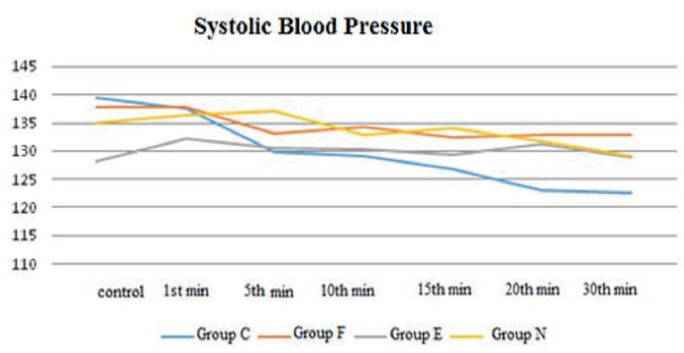

Figure 1. Systolic blood pressure (mmhg)

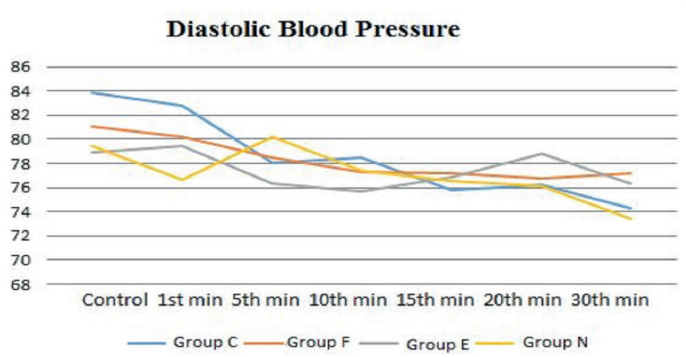

Figure 2. Diastolic blood pressure (mmhg)

Table 4. Heart rate

	Group C (n=20) (Beats/minute)	Group F (n=20) (Beats/minute)	Group E (n=20) (Beats/minute)	Group N (n=20) (Beats/minute)	p
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
Control values	79.55 ± 14.91	76.80 ± 12.46	79.40 ± 10.79	82.75 ± 13.67	0.17
1st minute	78.15 ± 16.47	77.30 ± 13.73	78.70 ± 13.02	80.50 ± 12.56	0.90
5th minute	76.05 ± 16.70	77.90 ± 14.80	77.75 ± 9.91	82.30 ± 13.25	0.43
10th minute	76.40 ± 14.16	74.15 ± 12.60	76.30 ± 9.52	80.05 ± 12.83	0.51
15th minute	75.50 ± 13.45	71.25 ± 11.54	73.95 ± 10.92	79.25 ± 12.29	0.17
20th minute	74.00 ± 15.45	70.05 ± 11.21	73.50 ± 11.68	78.35 ± 12.38	0.20
30th minute	73.80 ± 16.20	70.45 ± 10.21	72.05 ± 9.91	78.55 ± 12.717	0.21

SD; Standart Deviation

Table 5. Peripheral oxygen saturation

	Group C (n=20) (SpO_2 %)	Group F (n=20) (SpO_2 %)	Group E (n=20) (SpO_2 %)	Group N (n=20) (SpO_2 %)	p
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
Control values	98.85 ± 2.300	97.50 ± 1.585	97.05 ± 1.669	96.10 ± 1.832	0.06
1st minute	97.50 ± 1.572	97.85 ± 1.598	97.50 ± 1.308	96.95 ± 1.394	0.25
5th minute	97.10 ± 1.682	98.10 ± 1.252	97.45 ± 1.431	97.20 ± 1.399	0.12
10th minute	97.40 ± 1.729	97.75 ± 1.482	97.25 ± 1.585	96.95 ± 1.605	0.34
15th minute	97.35 ± 1.496	98.20 ± 1.196	97.40 ± 1.660	97.40 ± 1.569	0.17
20th minute	97.80 ± 1.507	97.80 ± 1.765	97.20 ± 1.704	97.80 ± 1.361	0.61
30th minute	97.40 ± 1.569	97.70 ± 1.657	97.60 ± 1.535	97.60 ± 1.500	0.89

SD; Standart Deviation

Table 6. Sensorial block levels

	Group C		Group F		Group E		Group N		p
	n=20	%	n=20	%	n=20	%	n=20	%	
1st min.									
T12	4	20.0	7	35.0	6	30.0	7	35.0	0.29
L1	6	30.0	6	30.0	11	55.0	6	30.0	
T10	10	50.0	7	35.0	3	15.0	7	35.0	
5th min.									
T10	8	40.0	14	70.0	14	70.0	12	60.0	0.17
T12	12	60.0	6	30.0	6	30.0	8	40.0	

10th min.									
T10	11	55.0	9	45.0	12	60.0	14	70.0	0.44
T12	9	45.0	11	55.0	8	40.0	6	30.0	
15th min.									
T10	10	50.0	9	45.0	13	65.0	15	75.0	0.19
T12	10	50.0	11	55.0	7	35.0	5	25.0	
20th min.									
T10	10	50.0	8	40.0	12	60.0	14	70.0	0.25
T12	10	50.0	12	60.0	8	40.0	6	30.0	
30th min.									
T10	10	50.0	7	35.0	12	60.0	14	70.0	0.14
T12	10	50.0	13	65.0	8	40.0	6	40.0	

min: minute, T12: Thorocal 12, T10: Thorocal 10, L1: Lomber 1

Table 7. Motor block levels

	Group C		Group F		Group E		Group N		p
	n=20	%	n=20	%	n=20	%	n=20	%	
1st min.									
0	6	30.0	7	35.0	2	10.0	4	20.0	0.69
1	14	70.0	13	65.0	18	90.0	16	80.0	
5th min.									
1-2	11	55.0	11	55.0	8	40.0	10	50.0	0.75
3	9	45.0	9	45.0	12	60.0	10	50.0	
10th min.									
2	6	30.0	3	15.0	2	10.0	5	25.0	0.37
3	14	70.0	17	85.0	18	90.0	15	75.0	
15th min.									
2	4	20.0	1	5.0	2	10.0	3	15.0	0.63
3	16	80.0	19	95.0	18	90.0	17	85.0	
20th min.									
1-2	3	15.0	0	0.0	2	10.0	3	15.0	0.34
3	17	85.0	20	100.0	18	90.0	17	85.0	
30th min.									
1-2	3	15.0	1	5.0	2	10.0	3	15.0	0.71
3	17	85.0	19	95.0	18	90.0	17	85.0	

min; minute

Additionally, the sensorial block levels, motor block levels and side effects after the administration of spinal anaesthesia to the subjects that occurred during this research are shown in Tables 6 and 7. There was no statistically significant difference between the groups in terms of sensorial block levels and motor block levels and after spinal anaesthesia (p> 0.05). The nausea-vomiting seen after spinal anaesthesia was observed more frequently (40%) in patients in Group C. This ratio is statistically significant when compared with other groups (p=0.010). There was no statistically significant difference in terms of common (Nausea-vomiting, bradycardia, dizziness, headache and tremor) and other side effects (urinary retention, agitation, low back pain, and dyspnoea) (p> 0.05).

In-Group Comparisons

Group C

According to the baseline values measured before spinal aesthesia in the control group, the changes in the mean values at the first, fifth and tenth minute to SBP and DBP are not statistically significant (p> 0.05). However, a statistically significant decrease was detected in the averages at the fifteenth, twentieth and thirtieth minutes

of SBP (p< 0.05). The results are shown in Table 8. In the control group, there were no changes to HR and SpO2 at all measurement times in comparison with the baseline values before spinal anaesthesia (p> 0.05).

Group F

According to the initial values checked before spinal anaesthesia, there were no statistically significant changes to SBP, DBP, HR, and SPO2 at all of the measurement times (p> 0.05).

Group E

According to the initial values checked before spinal anaesthesia, there were no statistically significant changes to SBP, DBP, HR, and SPO2 at all of the measurement times (p> 0.05).

Group N

According to the initial values checked before spinal anaesthesia, there were no statistically significant changes to SBP, DBP, HR, and SPO2 at all of the measurement times (p> 0.05). In terms of the amount of ephedrine used during the presence of hypotension, 10mg of ephedrine was employed with 10 patients in Group C and two patients in Group F, yet it was not needed in Group E and Group N. A statistically significant difference was found between Group C and the other groups in terms of ephedrine requirement (p =0.005).

Table 8. Arterial blood pressure data of Group C

	Systolic blood pressure (mmHg)		Diastolic blood pressure (mmHg)	
	Mean ± SD	p	Mean ± SD	p
Control values	139.30 ± 13.28		83.90 ± 10.381	
1st minute	137.35 ± 20.24	0.0754	82.80 ± 8.22	0.0786
5th minute	129.65 ± 18.41	0.0690	78.00 ± 9.95	0.0712
10th minute	129.00 ± 22.44	0.0671	78.45 ± 10.76	0.0698
15th minute	126.80 ± 20.44	**0.0274***	75.80 ± 9.290	**0.0132***
20th minute	122.95 ± 18.63	**0.0028***	76.25 ± 9.700	**0.0210***
30th minute	122.55 ± 20.19	**0.0036***	74.25 ± 9.557	**0.0041***

*Statistically significant p values calculated according to the control value

DISCUSSION

Spinal anaesthesia is a regional anaesthesia method that can be applied easily, has a fast onset, and provides a good level of muscle relaxation (13). Its applications involve very safe anaesthesia processes and it is preferred to general anaesthesia, especially in operations involving the lower abdomen, perineum, and lower extremities. Nevertheless, some complications are linked to its usage. The most common and most important of these is hypotension (14). Vasodilation develops in the arterial and venous system with a sympathetic blockage following spinal anaesthesia. As a result of the pooling of blood in the periphery, venous return to the heart decreases and relative hypovolemia and hypotension occur (15). Researchers consider hypotension to be indicated when systolic blood pressure is below 90 or 100 mmHg, a decrease of more than 20–30% from the initial value occurs, or a sudden decrease in systolic blood pressure of more than 30 mmHg takes place (16).

Carpenter et al. examined 952 patients under spinal anaesthesia without booting and found that the incidence of hypotension after this form of anaesthesia was 33% (17). Also, Critchley et al. discovered that hypotension was present in 70% of patients in the study they conducted in relation to spinal anaesthesia in elderly patients (18). During our research, the blood pressure values of participants before fluid and drug administration were based on a 20% decrease in blood pressure, or a systolic blood pressure <90mmHg was considered to be indicative of hypotension. In parallel with the above studies and with regard to the group that went without preloading before spinal anaesthesia in our investigation, it was observed as a result of the comparisons made within the group that SBP and DBP values decreased at 15 minutes, 20 minutes, and 30 minutes after spinal anaesthesia was applied.

Hypotension during spinal anaesthesia is a significant cause of morbidity and mortality that can have very important and serious consequences; therefore, it is even more vital to take and apply precautions before the condition develops. Among the methods used to prevent hypotension or reduce its incidence and severity are intravenous fluid administration and the use of vasopressor substances. Intravenous fluid administration improves stroke volume and cardiac output, and it may prevent ponding in the venous bed. Crystalloid and colloid fluids are used for this purpose (19).

Many studies have been conducted on booting with crystalloid and colloid fluids before spinal anaesthesia, and different results have emerged as a consequence. Nevertheless, discussions still continue about the

quality, amount and time of the administration of the liquid to be used (20,21). Rout et al. utilized a 20ml/kg crystalloid solution as a bootstrap in one group in their study on patients who were to undergo caesarean section with spinal anaesthesia, but they did not apply booting to the other set of participants. They noted that while 66% developed hypotension in the booted group, 71% developed hypotension in the non-booted group. As a result, they suggested that the administration of crystalloids could not prevent hypotension (22). Our study does not reflect these findings. They gave crystalloid solution at 20ml/kg before spinal anaesthesia and found no difference with the non-prehydrated group in terms of preventing hypotension. Conversely, during our research, we found the hypotension rate to be 10% in the fluid group where we gave NaCl solution of 0.9% at 15ml/kg for 20 minutes before spinal anaesthesia and 50% in the non-booted group. The number of hypotensive patients in Group C who were treated with 10mg of ephedrine was statistically significant. As a result, we concluded that booting with crystalloid fluid is a more effective method of reducing the frequency of hypotension than non-booting.

Ephedrine is the most commonly used vasoconstrictor agent in the prevention of hypotension and the treatment of it when it occurs during spinal anaesthesia (23). Marcel et al. compared 5 mg of IV prophylactic ephedrine with a placebo in their study on 50 patients undergoing caesarean section with spinal anaesthesia. They gave 1000ml of Ringer's lactate and 500ml of hydroxyethyl starch (HES) 6% solution to both groups before spinal intervention. As part of their research, they found that hypotension in the ephedrine group was 8% and 42% in the placebo group. They concluded that low-dose ephedrine administered in combination with prehydration is effective in preventing hypotension caused by spinal anaesthesia. In this study, ephedrine was given prophylactically as a 5 mg IV (24). In our study, an ephedrine bolus was not administered. Instead, immediately after spinal anaesthesia, 2mg/min was given as an infusion for 20 minutes and prehydration was not applied. Indeed, in terms preventing hypotension, an ephedrine infusion has been found to be as effective as low-dose bolus ephedrine being given with prehydration.

In their study of 42 patients who underwent a cesarean operation under spinal anaesthesia, Ozdemir et al. gave prophylactic ephedrine (0.5 mg/kg IV ephedrine, one minute after spinal anaesthesia) to the first group and crystalloid (for one minute) to the second group. They compared the rate of maternal hypotension, nausea-vomiting, and bradycardia after spinal anaesthesia. They also gave 15ml/kg of crystalloid solution to all three groups before spinal injection. As a result, they found the incidence of hypotension to be 18% in the crystalloid group and 8% in the ephedrine group. They found the incidence of nausea and vomiting to be 12% in the crystalloid group and 4% in the ephedrine group. The presence of bradycardia was 3% in the crystalloid group and it never occurred in the ephedrine group. Consequently, they seemingly highlighted that prophylactic ephedrine was more effective than crystalloids in preventing hypotension, nausea-vomiting, and bradycardia (25). Our own study correlates to these findings as complaints of nausea and vomiting were observed to be at 40% in the control group, 10% in the fluid group, 5% in the ephedrine group and 15% in the norepinephrine group. At the same time, the incidence of bradycardia was 10% in the control group and 5% in the fluid group. We did not find any occurrence of bradycardia in the ephedrine and norepinephrine groups.

Norepinephrine relates to vasoconstriction and cardiac stimulation by directly affecting alpha and beta receptors. Because of these effects, it can be used to prevent and treat hypotension that occurs during spinal anaesthesia (26). In a study conducted by Lecoq et al. on 44 patients, an investigation was undertaken in relation to the effects of norepinephrine and ephedrine on the cutaneous microcirculation, which is increased by spinal anaesthesia. A colloid solution of 7 ml/kg per hour was given 20 minutes before spinal anaesthesia induction. After spinal anaesthesia, 0.3mg/h of a norepinephrine infusion was administered to the first group and 10mg of bolus ephedrine was given to the second group. As a result of the study, they concluded that the two drugs did not impair cutaneous microcirculation and were successful in preventing hypotension (27). During our research, the norepinephrine infusion dose used mirrored that in the study performed by Lecoq et al., but no fluid was administered for prehydration. Hypotension, bradycardia and tachycardia were not found in the norepinephrine group. Side effects other than hypotension were also found at a similar rate to the ephedrine group. According to these findings, we ascertained that norepinephrine infusions can be used as effectively and reliably as ephedrine in the prevention of hypotension caused by spinal anaesthesia. However, it is necessary to study norepinephrine in different doses and in relation to larger patient groups.

CONCLUSION

In this study, which investigated the efficacy of norepinephrine, ephedrine, and preloaded fluid (0.9% NaCl) treatment used to prevent hemodynamic instability after spinal anaesthesia, it was shown that their efficacy in terms of protecting against hypotension was similar. In addition, with regard to side effects other than hypotension, it can be asserted that norepinephrine and an ephedrine infusion can be used more effectively and reliably than fluid loading.

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