RESEARCH

Effect of Coloading Ringer Lactate on Blood Pressure Stability in Patients with Spinal Anesthesia

Richa Noprianty✉*, Togi Riki Rikardo Sijabat*, Muhammad Dwi Satriyanto**,***, Cici Valiani*

*Faculty of Health Sciences, Universitas Bhakti Kencana, Bandung, Indonesia
**Faculty of Medical Sciences, Universitas Abdurrab, Pekanbaru, Indonesia
***Eka Hospital, Pekanbaru, Riau, Indonesia

✉Correspondence: richa.noprianty@gmail.com / richa.noprianty@bku.ac.id

ABSTRACT

Background: The most common hemodynamic complication associated with spinal anesthesia is hypotension, hence the need for fluid coloading.

Objective: The purpose of this study was to determine the effect of lactated ringer coloading fluid on blood pressure stability.

Methods: This study was conducted using a quantitative method with a quasi-experimental design with a one-group pretest-posttest design. This study was conducted at X Hospital in the West Java region from March to April 2024. The research was carried out in the operating room after spinal anesthesia and after the administration of Ringer's lactate. The research instrument used an initial blood pressure observation sheet, blood pressure after spinal anesthesia, and after giving lactated ringer coloading with a calculation of 10 cc/kg of patient weight. The population in this study was all patients who underwent spinal anesthesia, and the sample of this study amounted to 60 patients with non non-probability sampling technique with purposive sampling. Data analysis in this study used univariate and bivariate analysis. This study has carried out data normality tests and research ethics. Bivariate analysis in this study used a Paired t-test.

Results: The results showed that after spinal anesthesia, most (51.7%) patients had hypotension. After being given lactated ringer coloading, most patients (68.3%) had normal blood pressure. Systolic blood pressure increased by 9,750 mmHg, and diastolic also increased by 6,500 mmHg.

Conclusion: This study concludes that lactated ringer coloading has a significant effect on both systolic and diastolic blood pressure stability after spinal anesthesia.

Keywords: blood pressure; coloading; hypotension; lactated ringer; **s**pinal anesthesia

INTRODUCTION

Spinal anesthesia is an economical, safe, comfortable, and effective method of anesthesia that provides a rapid onset. Because of these advantages, this method has been widely applied in the practice of daily anesthesia. The spinal anesthesia procedure involves injecting a local anesthetic drug into the intrathecal space, which then results in analgesia.[1] The most common hemodynamic complication associated with spinal anesthesia is hypotension, which is a physical change that occurs frequently during this procedure. The incidence of hypotension in spinal anesthesia ranged from 8 to 33%. The main cause of hypotension in spinal anesthesia is the result of a blockade of the sympathetic nervous system.[2,3]

The impact of hypotension on surgical patients with spinal anesthesia is that if the anesthesia block is higher, the patient's consciousness decreases, which is accompanied by heavier hypotension, then the work of the heart is heavier. If this event is prolonged, hypoxia can occur so that blood flow to all tissues is reduced, to prevent hypotension is carried out liquid loading of 10-15 ml/kgBW of crystalloid or administration of a bolus vasopressor with efidrin 5-10 mg IV, adequate oxygenation is given to overcome the hypothesis further.[4,5]

The advantages of crystalline liquid can be seen from its affordable price, easy availability in all health facilities, does not require a crossmatch test, does not cause allergies or anaphylactic shock, and has a long shelf life. Some previous studies have stated that colloidal fluids are considered more effective in preventing hypotension compared to crystalloids. Nonetheless, colloids have drawbacks such as high cost, potential for causing allergies, and their effect on the blood clotting process (Made Artawan *et al.*, 2020). The technique of giving intravenous fluids can be done by the preloading or coloading method. Preloading is the act of administering fluid 20 minutes before the implementation of spinal anesthesia, while coloading is the act of administering fluid 10 minutes after the implementation of spinal anesthesia.[6]

The administration of crystalline coloading proved to be effective in overcoming hypotension because the administration of crystalline fluid after spinal anesthesia was said to be more rational to get the maximum effect during the blockade.[7] In addition to Ringer's lactate, patients receiving colloid infusion with prophylactic ephedrine and colloid demonstrated good hemodynamic parameter stability, particularly in elderly patients.[8] A significant difference in blood pressure reduction between fluid loading and no lactate ringer fluid loading of 20 cc/kgBW. The administration of crystalline fluid coloading is less effective in treating hypotension after spinal anesthesia, the incidence of hypotension remains relatively high regardless of the fluid administered, so it requires a vasopressor to overcome the occurrence of hypotension.[9]

Based on observations on 10 patients (100%) or 10 out of 10 patients before the coloading of lactate ringer fluid, the majority experienced hypotension due to sympathetic nervous system blockade. Meanwhile, after the coloading of lactate ringer fluid, it was found that as many as 40% or 4 out of 10 patients still experienced hypotension. The patient's blood pressure drops after spinal anesthesia is performed, ranges from 20-30% of the initial blood pressure before

the induction of spinal anesthesia. At the time before spinal anesthesia, the patient's blood pressure was 125/80 mmHg, and after spinal anesthesia was performed, the patient's blood pressure was 103/55 mmHg, after a lactated ringer was given and the patient's blood pressure was 110/69 mmHg. Based on the background above, the researcher is interested in conducting a study on the effect of coloading Ringer's lactate on blood pressure stability in patients undergoing spinal anesthesia. This research can serve as a reference for its use in hospitals.

METHOD

This research method uses a quantitative research method. The type of research used is quasi-experimental research with a pre- and post-test design. This study was conducted at X Hospital in the West Java region from March to April 2024. The population in this research is all patients who will be operated on with spinal anesthesia. The sample of this study is patients who meet the inclusion criteria, namely patients with normal blood pressure and prehypertension, physical status of American Society of Anesthesiologists (ASA) I-II, age 20-45 years, and weight 40-80 Kg. Exclusion criteria in this study are cito patients, patients with a history of chronic kidney disease (CKD), patients with a history of heart failure, and patients who have been changed from spinal anesthesia to general anesthesia.

The data collection technique in this study uses a non-probability sampling technique with purposive sampling, with the number of samples obtained being 60 patients. The data measurement tool uses a bed site monitor observation sheet. Furthermore, the data obtained from the observation sheet was processed using a software application. At the time of the implementation of the first research carried out, it was to measure the patient's blood pressure while in the pre-anesthesia room. After that, spinal anesthesia is performed in the intra-anesthesia room. After spinal anesthesia was performed, the patient's blood pressure was re-measured and recorded on the observation sheet. The patient was given a lactate ringer coloading with a calculation of 10 cc/KgBW for 15-30 minutes. After the coloading of the lactate ringer, the researcher again measured the patient's blood pressure after the coloading of the lactate ringer and recorded it on the observation sheet.

The data analysis used was univariate and bivariate analysis. Univariate analysis in the form of frequency and percentage on respondent characteristics and research variables. In this bivariate analysis, a data normality test was carried out first. After the normality test was carried out, the data results were normally distributed with a skewness value of < 2. Because the data is normally distributed, the bivariate analysis uses the paired t-test. The ethical permit in this study was carried out at Bhakti Kencana University with a certificate of ethical feasibility No. 047/09.KEPK/UBK/IV/2024. Declared ethically feasible according to 7 (seven) WHO Standards 2011. The researcher provided informed consent to the patients in the preoperative preparation room. The respondents' names will be anonymized using numerical codes to maintain confidentiality.

RESULTS

The research subject is the characteristics of patients as follows:

Table 1. Characteristics of patients

Characterictics	N	%
Age		
20-25 years	17	28.3
26-35 years	27	45.0
36-45 years	16	26.7
Gender		
Man	9	15.0
Female	51	85.0
Weight		
40-50 Kg	1	1.7
51-60 Kg	4	6.7
61-70 Kg	34	56.7
71-80 Kg	21	35.0
ASA		
ASA II	60	100
Type of operation		
Obgyn	51	85
Orthopedic	4	6.7
General Surgery	5	8.3

Based on Table 1, shows that the characteristics based on age are that almost half (45%) of patients are aged 26-35 years. Based on gender, almost all (85%) of patients are female. Most (56.7%) of the patients weighed 61-70 kg. In this study, all (100%) patients had ASA II. Most (85%) of patients undergo obgyn surgery.

Table 2. Comparison of blood pressure

	Normal		Hypotension	
	N	%	N	%
After spinal anesthesia	29	48.3	31	51.7
After lactate ringer coloading	41	68.3	19	31.7

The blood pressure analysis after spinal anesthesia showed that most patients (51.7%) experienced hypotension. It is said to be hypotension because there is a 20% drop in initial blood pressure. Blood pressure analysis after the administration of lactate coloading ringer showed that the blood pressure after the administration of lactate ringer coloading most (68.3%) patients had normal blood pressure. It is said to be normal because there is no 20% drop from normal blood pressure.

Table 3. Difference in mean blood pressure

Blood pressure	Before spinal anesthesia			After spinal anesthesia			After lactate ringer coloading		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Systole	122.4	100	134	95.63	80	113	105.38	87	130
Diastole	76.9	61	90	58.30	40	78	64.80	47	90

The results of the analysis of the mean blood pressure before and after spinal anesthesia showed that the mean blood pressure of the systole before the spinal anesthesia was 122.4 mmHg, and the diastole was 76.9 mmHg. The mean blood pressure of the systole after spinal anesthesia was 95.63 mmHg, and the diastole was 58.30 mmHg. The mean blood pressure of the systole after being given coloading ringer lactate was 105.38 mmHg and diastole 64.80 mmHg.

Table 4. Effect of lactate coloading on blood pressure stability

	Paired Differences					t	df	Sig. (2-tailed)
	Mean Difference	SD	Standard Error of the Mean Difference	Lower	Upper			
Pair 1 Systole after coloading-systole after spinal	9.750	5.300	0.684	8.381	11.119	14.25	59	.000
Pair 2 Diastole after coloading-diastole after spinal	6.500	3.820	0.493	5.513	7.487	13.18	59	.000

The results of Table 4 analysis show the results of the statistical test with paired t-test P values < 0.05, meaning that the alternative hypothesis is accepted and the null hypothesis is rejected. It can be concluded that there is a significant influence on the administration of lactate ringer coloading on blood pressure stability before and after the intervention in patients with spinal anesthesia.

DISCUSSION

At the beginning of the study, we measured the initial blood pressure using acuran in accordance with the study's inclusion criteria, namely, patients with normal blood pressure and prehypertensive blood pressure. Before spinal anesthesia was performed, the mean blood pressure of systole was 122.4 mmHg, and the mean blood pressure of diastole was 76.9 mmHg. After spinal anesthesia, the mean blood pressure decreased to 95.63 mmHg and 58.30 mmHg diastolic blood pressure.

From the results of the research that has been carried out, the patient at the time before the spinal anesthesia procedure was performed, the lowest systole blood pressure was 100 mmHg, and the diastolic blood pressure was 61 mmHg. After spinal anesthesia, the patient's blood pressure decreased. This is in accordance with the theory that spinal anesthesia can cause hemodynamic

complications. This decrease in blood pressure is the result of a blockade of the sympathetic nervous system as a result of the effects of spinal anesthesia drugs.[10]

This blockade of the sympathetic nerve affects the regulation of smooth muscle tone in the blood vessels and causes vasodilation in the veins, resulting in a decrease in blood flow back to the heart.[11] Based on the interviews conducted, when performing spinal anesthesia, the important thing to do is to observe the patient's blood pressure. The patient's blood pressure at the time after spinal anesthesia tends to decrease as a result of the spinal anesthesia action. Spinal anesthesia has complications, especially in the hemodynamics of patients who undergo performed under spinal anesthesia.[12] There are several complications that patients can experience when spinal anesthesia is performed, namely: hypotension, bradycardia, nausea, and vomiting. This hypotension occurs as a result of the blockade of the sympathetic nervous system, which causes vasodilation of blood vessels.[13]

Based on the observations made, the decrease in blood pressure in patients varies from 3 to 10 minutes after spinal anesthesia is performed.[14] The decrease in blood pressure in these patients can be caused by the height of the sympathetic block, the puncture site, prehydrated fluids, and body mass index.[15,16] When there is a drop in blood pressure, this must be addressed immediately because it can cause other adverse consequences, such as hypoxia. Hypoxia can occur as a result of higher anesthesia blocks and heavier hypotension.

At the time before the coloading of the lactate ringer, the mean blood pressure of the cysteine was 95.63 mmHg, and the diastole was 58.30 mmHg. The mean blood pressure of systole and diastole after spinal anesthesia has increased after the coloading of the lactated ringer. Her mean systolic blood pressure rose to 105.38 mmHg, and her diastolic blood pressure was 64.80 mmHg after the administration of lactated ringer coloading.

Based on observations made during the coloading study, the fluid was given after spinal anesthesia. The coloading is carried out in an effort to prevent hypotension in patients who have undergone spinal anesthesia.[17,18] The administration of coloading must also be acknowledged carefully and in accordance with the patient's condition and appropriate medical indications. Too much coloading given in excess can have risks, including pulmonary edema or excess fluid. Coloading is given as much as 10 cc/kgBW for 15-30 minutes after spinal anesthesia is performed.[19] This coloading aims to prevent hypotension. In this study, on mean, most of the patients weighed between 61-70 Kg, so that the mean coloading given was 600-700 cc.

After coloading, lactate ringer was found that almost half (31.7%) of the patients had hypotension, after coloading, it was found that most (68.3%) of the patients had normal blood pressure. The mean increase in systolic blood pressure was 9,750 mmHg with a standard deviation of 5,300 after spinal anesthesia and after the administration of lactate ringer coloading, while the mean diastolic blood pressure also increased by 6,500 mmHg with a standard deviation of 3,820 after the administration of lactate ringer coloading. The largest increase in

systolic blood pressure was 11.119 mmHg, and the largest increase in diastolic blood pressure was 7.487 mmHg. Meanwhile, the smallest increase in systolic blood pressure was 8.381 mmHg, and the smallest increase in diastolic was 5.513 mmHg.

The researcher monitored the coloading of the fluid given by the anesthesiologist. Changes in blood pressure due to fluid coloading can be significant in patient management, especially in situations where low blood pressure or hypovolemia is a major concern. Coloading of fluids will usually lead to an increase in blood pressure.[20] In this study, the mean age of the patients was the highest, which was between 26-35 years. Based on the inclusion characteristics in this study, the age of the patients is in the age range of young adults. Age is one of the risk factors for hypotension in spinal anesthesia where a decrease in blood pressure in younger patients will experience a milder decrease in blood pressure compared to older patients. As we age, the volume of the subarachnoid and epidural space decreases. Young adults (26-35 years) recover faster from the effects of anesthesia due to optimal organ function to the metabolism of anesthetic drugs, but the incidence of hypotension increases progressively at age 50 years with the same height of spinal anesthesia. However, in some cases of spinal anesthesia during cesarean section, Voluven is preferred over Ringer's lactate due to its lower blockade level and reduced incidence of nausea and vomiting.[21]

This may be due to the higher autonomic tone of blood vessels remaining after sympathetic denervation and due to a more active compensatory reflex.[2] Based on the type of surgery, almost all patients from this study underwent obgyn surgery. Based on the results of observations made during obgyn surgery, not a few patients lost blood. Blood loss of more than 15% of the total amount of blood in the body can cause tissue 7 hypoperfusion and lead to a state of shock. If the volume of blood reaches >500 ml, then bleeding is said to be abnormal.[22] The administration of crystalline coloading is proven to be effective in overcoming hypotension because the administration of crystalline fluid after spinal anesthesia is said to be more rational to get the maximum effect during the blockade. Crystalline fluid coloading was less effective in treating hypotension after spinal anesthesia, the incidence of hypotension remained relatively high regardless of the fluid given, so it required a vasopressor to overcome the hypotensive event.[9]

The occurrence of hypotension is caused by sympathetic nerve blockade that affects the regulation of smooth muscle tone in blood vessels. The blockade of the sympathetic nerve fibers causes vasodilation of the veins, resulting in changes in blood volume, especially in the lower extremities and splanchnics, causing a decrease in blood flow back to the heart.[23] This hypotensive event can be prevented by administering fluids. The administration of this fluid has a rational basis because it aims to increase the volume of blood circulation to compensate for the decrease in peripheral resistance.[5] This study can serve as a reference for coloading fluids commonly used in hospitals. However, it has limitations as it lacks a control group for comparison.

CONCLUSION

It can be concluded that there is a significant effect on the administration of lactate ringer coloading on blood pressure stability in patients with spinal anesthesia at Sumedang Hospital, this is due to the increase in the patient's blood pressure after spinal anesthesia and after the administration of lactate ringer coloading. It is suggested that it can be used as basic data and a comparison for future researchers to be able to develop and continue research related to the effect of coloading ringer lactate on blood pressure stability in patients with spinal anesthesia.

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