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DESCRIPTION OF TIME AND VOLUME OF HYDROXYETHYL STARCH 130/0.4 (6%) FLUID ADMINISTRATION TO RESTORE HEMODYNAMICS TO NORMAL AFTER SPINAL ANESTHESIA IN CESAREAN SECTION

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ABSTRACT
Hemodynamic variables such as blood pressure, mean arterial pressure (MAP), and pulse can change during cesarean section surgery performed under regional anesthesia. To stabilize the patient's hemodynamic status, colloid fluid treatment is administered because it has a longer half-life in the intravascular fluid. The research aims to understand the timing and volume of administering hydroxyethyl starch/HES 130/0.4 (6%) to restore hemodynamics to normal after spinal anesthesia in cesarean section surgery. The research method employs a quantitative study with an analytical observational design (cross-sectional). Data collection instruments include a hemodynamic observation sheet and a bedside monitor data measurement tool. This research was conducted over two months, from May to June. The sample for this research consists of 40 respondents using total sampling. The research location was conducted at Pusri Hospital in Palembang Indonesia. The study collected data by directly observing the respondents and recording the time and volume of hydroxyethyl starch 130/0.4 (6%) required for the hemodynamic status to return to normal. Data analysis was conducted using univariate analysis techniques. The results of the research analysis indicate that the time required for hemodynamic changes after spinal anesthesia has a standard deviation of 3.363, a mean value of 12.15, a maximum value of 20, and a minimum value of 5. HES 130/0.4 (6%), the amount of fluid given, and changes in blood flow after spinal anesthesia have a standard deviation of 30.783, a mean value of 99.65, a maximum value of 167, and a minimum value of 22.

Keywords: cesarean section; hemodynamics; hydroxyethyl starch; spinal anesthesia

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INTRODUCTION

Spinal anesthesia is the primary choice for cesarean section procedures. Regional anesthesia works by inhibiting pain stimulus conduction pathways before they enter the central nervous system, thereby dulling the pain response and perception. Regional anesthesia in cesarean sections has the following advantages: a lower risk of maternal aspiration, decreased exposure of the fetus to depressant drugs, the ability for the woman to remain conscious during childbirth, and spinal anesthesia with opioids as pain relief after surgery (Rehatta et al., 2019b).

According to Zulkifli (2020), the subarachnoid area is injected with a local anesthetic during spinal anesthesia (subarachnoid), a type of regional anesthesia. Intradural spinal block and spinal/subarachnoid anesthesia are synonyms. As long as the anesthetic block does not reach a high level, spinal anesthesia is a successful procedure that leaves patients satisfied with the method, recovery time, side effects, and respiratory system. On the other hand, there are some potential side effects of spinal anesthesia, such as hemodynamic instability and patients being disturbed by the sounds made by the surgeon during the procedure (Butterworth et al., 2013).

Parameters for measuring blood flow and its correlation with changes in systemic circulation are determined in hemodynamics, the science of blood flow (Dewhirst & Secomb, 2017). The physical characteristics of peripheral blood vessels, the function of the heart, and blood circulation are all investigated in hemodynamics (Hidayati, 2020).

The nurse's responsibilities include post-anesthesia patient care and monitoring of vital signs to reduce the risk of complications. Anesthesia monitoring involves overseeing the patient's vital signs (such as hemodynamics) to ensure that the anesthesia is functioning properly and that any abnormalities can be promptly addressed (Rustiawati & Sulastri, 2021). There are two main approaches to hemodynamic monitoring: non-invasive metrics that are often used to evaluate a patient's hemodynamic status according to (Robert Hotman Sirait, 2020) and CVP monitoring, which is one of the intrusive approaches (Kriswidyatomo et al., 2022). One of the challenges in anesthesiology is managing patients to achieve hemodynamic stability while under spinal anesthesia (Djari *et al*., 2021). Hypotension, caused by low hemodynamics, reduces blood flow to tissues, which in turn decreases the delivery of oxygen and nutrients and, ultimately, the body's metabolism (Triani et al., 2024). Quick actions can be taken to address complications of hypotension due to spinal anesthesia, such as the risk of pulmonary edema from fluid administration or the risk of dysrhythmia from the use of preventive vasopressors (Ningsih et al., 2024).

The assessment of mean arterial pressure (MAP), which involves applying pressure throughout the arterial system in one cardiac cycle, is a simpler way to determine post-hypotension during spinal anesthesia (Aura Nur Illenia & Dwihestie, 2022). The effect on the cardiovascular system is that blood pools in the internal organs and lower limbs due to venous and arterial vasodilation caused by neuroaxial spinal anesthesia. As a result, the heart's ability to pump blood throughout the body declines. The decrease in systemic resistance due to vasodilation of the arterial blood vessels leads to hypotension and a reduction in cardiac output (Rehatta et al., 2019b). The metabolism of different anesthetic drugs will be affected by postoperative hypotension. This is because the enzymes that control organ function and medication duration are very sensitive to variations in blood pressure. When the body reaches a state of equilibrium, the amount of anesthetic distributed throughout it will be higher than it should be. This is due, among other things, to spinal anesthesia causing vasodilation, which in turn lowers vascular resistance, and the accumulation of peripheral venous blood can reduce venous return (Tania et al., 2024).

Hypotension is defined as a decrease in systolic blood pressure of more than 20% or less than 100 mmHg. Uncorrected hypotension leads to a reduction in uterine perfusion. Severe and prolonged hypotension leads to hypoxia and acidosis in the fetus (Rehatta et al., 2019). Colloid solutions can increase intravascular volume and maintain it for a longer time because their half-life in the intravascular compartment is greater. In terms of avoiding hypotension after spinal anesthesia, which can cause sympathetic vasodilation and subsequent blood pressure drops, starch fluids are superior (Butterworth *et al*., 2013).

Anaphylaxis is rarely caused by particles. A person's ability to carry oxygen can be enhanced by giving them packaged red blood cells (PRC). During the interval between PRC doses, fresh frozen plasma can be administered. It is recommended to reheat all liquids before administering them. If maintaining blood pressure during septic shock is more challenging than simply replacing fluid volume, vasopressor medications such as norepinephrine can be helpful. Pulmonary and renal vasoconstriction are potential side effects of these medications; therefore, they should be used with caution (Irmawati et al., 2023). The starch solution is more effective in preventing hypotension after spinal anesthesia, which causes sympathetic vasodilation, thereby maintaining blood pressure and preserving venous return (Butterworth *et al*., 2013).

According to recent research from the World Health Organization (WHO), the number of cesarean surgeries being performed is continuously increasing worldwide. Currently, it accounts for 21% of all deliveries and is expected to continue to rise. On average globally, 5-15% of births involve cesarean operations; public hospitals have an incidence rate of 11%, while private hospitals can have rates of 30% or higher. Cesarean sections are becoming increasingly popular in developing countries. The WHO reports that cesarean sections have surged by 46% in China and 25% in Europe, Asia, and Latin America. There is an increase in cases worldwide, including cesarean sections (WHO, 2021). According to the 2018 national report on basic health research (Riskesdas), the proportion of cesarean section delivery methods among women aged 10–54 reached 17.6% of all deliveries in Indonesia. The Jakarta province recorded the highest rate of cesarean section operations at 31.1%, while the lowest was in Papua province at 6.7%. Meanwhile, in Central Java province, the cesarean section delivery method reached 17.1% (Kemenkes RI, 2019).

Janin was delivered from the womb via cesarean section, a surgical technique that involves opening the vaginal wall or uterus or performing a hysterotomy. If anesthesia for cesarean surgery can be administered safely and effectively, one must have a good understanding of the physiological changes that occur during pregnancy, labor, and delivery. Hormonal shifts in the mother, biochemical changes caused by the placenta, and the metabolic needs of the fetus, along with mechanical tension in the uterus, all contribute to this shift (Rehatta et al., 2019a). According to Oktapia *et al*. (2022), a cesarean section is a childbirth process for a woman, particularly for those who experience difficulties in delivering normally, and it is an action aimed at saving both the mother and the child. Every operation must have an indication; thinking about it implies that everything done must be for the benefit of the mother and the baby.

Based on the preliminary survey results conducted by researchers in 2023, a total of 1,484 surgeries were performed at Pusri Hospital in Palembang from May to October 2023. Each month, about 60 patients underwent spinal anesthesia for a cesarean section, with more than 50% experiencing hypotension and an increased heart rate. To avoid problems that could be dangerous, it's important to know exactly how to give hydroxyethyl starch 130/0.4 (6%) to get blood flow back to normal after a spinal anesthesia-assisted cesarean section at Pusri Hospital in Palembang. This study aims to determine the timing and volume of hydroxyethyl starch 130/0.4 (6%) fluid administration to restore hemodynamics to normal following spinal anesthesia in cesarean section surgery.

METHOD

The research methodology used a quantitative study with an observational analytic design and a cross-sectional approach (Abduh *et al*., 2023). Data collection instruments included hemodynamic observation sheets and bedside monitor data measurement tools. The study was conducted over two months, from May to June 2024. The survey involved forty people as part of the overall research sample. The study was conducted at Pusri Hospital in Palembang, Indonesia. Data were examined using descriptive analysis method. The researcher determined the population of all patients undergoing surgery with spinal anesthesia for sectio casarea surgery who experienced hemodynamic changes. The average number of patients who underwent surgery with spinal anesthesia technique for sectio casarea surgery at Pusri

Hospital Palembang every month in 2023 was approximately 60 patients. The sample in this study, researchers used all patients who underwent sectio caesarea surgery using spinal anesthesia techniques who experienced hemodynamic changes. The sampling technique in this study was total sampling. Total sampling is a sampling technique where the number of samples is the same as the population (Sugiyono & Lestari, 2021). The reason for taking total sampling is because the population is less than 100 of the entire population is used as a research sample.

RESULTS

Hemodynamic profile (blood pressure, pulse, MAP)

Hemodynamic picture before administration of hydroxyethyl starch fluid 130/0.4 (6%)

Table 1.
Distribution of hemodynamic frequencies (blood pressure, pulse, map) before administering hydroxyethyl starch 130/0.4 (6%) at Pusri Hospital.

		Mean	Median	Std.Deviation	Min	Max
BP	Sistole	82.18	81.00	4.46	70	90
	Diastole	57.80	60.00	3.13	50	62
Pulse		118.38	120.00	11.55	100	146
MAP		65.90	66.60	2.35	60.00	69.30

Hemodynamic profile after administration of hydroxyethyl starch 130/0.4 (6%)

Table 2.
Distribution of hemodynamic frequencies (blood pressure, pulse, map) after administering hydroxyethyl starch 130/0.4 (6%) at Pusri Hospital

		Mean	Median	Std.Deviation	Min	Max
BP	Sistole	111.80	110.00	7.52	96	120
	Diastole	70.65	70.00	5.81	60	80
Pulse		76.28	78.00	10.83	60	97
MAP		84.34	83.30	4.47	76.60	93.30

Description of the timing of administration of hydroxyethyl starch 130/0.4 (6%) on hemodynamic changes after spinal anesthesia at Pusri Hospital.

Table 3.
Frequency distribution of time to administer hydroxyethyl starch 130/0.4 (6%)

	Mean	Median	Std.Deviation	Min	Max
Delivery time	12.15	12.00	3.36	5	20

Description of the volume of hydroxyethyl starch 130/0.4 (6%) on hemodynamic changes after spinal anesthesia at Pusri Hospital.

Table 4.
Frequency distribution of volume of administration of hydroxyethyl starch fluid 130/0.4 (6%)

	Mean	Median	Std. Deviation	Min	Max
Delivery time	99.65	100.00	30.783	22	167

DISCUSSION

There are a total of forty observations in this study, as shown in Table 1 above. All the lowest, maximum, average values, and standard deviations of those variables are shown in the test results above. Based on the analysis of the blood pressure (systolic) variable, the data distribution is closer to the average value (82.18), while the standard deviation of 4.46 is smaller than the average value. With a range of 70-90, this variable (diastolic) has a standard deviation of 3.13, which is smaller than the average value (57.80) and indicates that the data distribution is more tightly clustered around the average value. Fifty and sixty-two are the extreme values of this variable's possible values. The data distribution approaches the average value, with a standard deviation of 11.55 for the pulse rate variable, which is smaller than the average value of 82.18%. This variable can have values ranging from 100 to 146. With a standard deviation of 2.35 for MAP (mean arterial pressure), the data distribution is closer to the average value of 65.90. In this variable, 69.30 is the maximum value and 60.0 is the minimum value. The findings of this research differ from previous studies by (Permatasari & Jatmiko, 2013). The average ± standard deviation of the systolic rate of patients before treatment is 121.85 ± 15.25 beats per minute in this study, which includes a group of patients undergoing cesarean section with spinal anesthesia who were administered 500 CC Hydroxylethyl Starch 130/0.4/6%. Meanwhile, the diastolic average ± SD is 67.04 ± 15.61 before the patients were given 500 CC Hydroxylethyl Starch 130/0.4 (6%). Along with its effects on microcirculation, which can lower viscosity and, in turn, blood pressure, hydroxyethyl starch also has effects on regional blood flow, which can bring blood back to places like the kidneys and splanchnic vessels. However, that's not all: sympathetic blockade during spinal anesthesia can also lead to hypotension.

This fits with the study (Alimian *et al*., 2014), that talks about the changes in blood flow after hydroxyethyl starch 130/0.4 (6%) fluid was given. According to research conducted by (Muliawa & I Wayan, 2022). Approaching the 5-minute mark after spinal anesthesia, the majority of SC patients (90 out of 100) showed hypotensive blood pressure, according to his research. The average systolic blood pressure is 89.07 mmHg, and the diastolic is 52.89 mmHg. In the first few minutes, spinal anesthesia causes hemodynamic abnormalities because the anesthetic agent takes 5-10 minutes to produce a certain level of nerve blockage. Hypotension is a common side effect of spinal anesthesia because it decreases systemic vascular resistance (SVR) and cardiac output (Hofhuizen et al., 2019).

Based on data analysis carried out on the blood pressure (systole) variable, the data distribution is closer to the average value (111.80) with a standard deviation of 7.52. With a range of 60 to 80 for this variable (Diastole), a standard deviation of 5.81 indicates that the data distribution is somewhat close to the mean value of 70.65. The data distribution moves closer to the mean value, as the standard deviation of the heart rate variable is 10.83, which is smaller than the mean value of 76.28. This variable can have values between 60 and 97. With a standard deviation of 4.466 less than the mean value of 84.34, the data distribution for MAP (mean arterial pressure) moves towards the mean value. This variable can have values between 76.6 and 93.3. Contrary to previous research (Halida, 2013), diastole increased to 54.44 ± 8.02 after loading with 500 CC Hydroxylethyl Starch 130/0.4 (6%). Statistically significant differences in systole and diastole patients after administration of a loading dose of 500 CC Hydroxylethyl Starch 130/0.4 (6%). This is consistent with the findings (Haisch et al., 2010). that caesarean section causes an increase in blood pressure, both systolic and diastolic. During abdominal surgery, using hydroxylethyl starch actually increases blood pressure. There are many things that can change systolic and diastolic blood pressure, including peripheral vasodilation, increased capillary wall permeability, and the amount of intravascular fluid ejected into the interstitial space. Despite the extensive intravascular retention and long half-life of HES colloid fluid, its use in cesarean sections causes hypovolemia, a decrease in blood pressure, as a result of excessive blood loss.

With hydroxylethyl starch, it is possible to modulate normovolemia and hemodynamic stability by controlling blood pressure, central venous pressure, heart rate, and diuretic rate. To ensure that the patient's condition remains stable during spinal cesarean section anesthesia, it is safe to use 500 CC hydroxylethyl starch 130/0.4 (6%). Giving this fluid has a different effect on blood pressure but is still classified as mild hypotension.This is different from research conducted by (Permatasari & Jatmiko, 2013). After 30 minutes of loading with 500

CC Hydroxylethyl Starch 130/0.4 6%, the average pulse rate in this study sample increased to 93.19 ± 11.70 from 85.41 ± 10.95 before the findings were taken. Meanwhile, this study's findings show an increased heart rate. However, data from all sources shows that the increase in heart rate is not too high.

The amount of data from this research is 40 observation data, as can be seen from table 3 above. All lowest, maximum, average, and standard deviation values of these variables are shown in the test results above. Based on data analysis carried out on the effect of administration time of hydroxyethyl starch 130/0.4 (6% fluid) on hemodynamic changes, the data distribution is closer to the average (12.15) with a standard deviation of 3.36. This variable can have values between 5 and 20, inclusive. Table 4 shows that there were a total of forty observations in this investigation. All the lowest, maximum, average, and standard deviation values of the variables are shown in the test results above. The results of the above data analysis show how the different amounts of hydroxyethyl starch 130/0.4 (6%) fluid that were given changed the patient's blood flow. The data distribution is close to the average value (99.65), because the standard deviation is 30.783, which is smaller than the average value. For this variable, 22 is the highest value and 167 is the lowest value.This is different from research conducted by (Permatasari & Jatmiko, 2013)). After 30 minutes of loading with 500 CC Hydroxylethyl Starch 130/0.4 6%, the average pulse rate in this study sample increased to 93.19 ± 11.70 from 85.41 ± 10.95 before the experiment began. Meanwhile, this study's findings show an increased heart rate. However, data from all sources shows that the increase in heart rate is not too high. According to (Heriwardito, 2010). there is a correlation between changes in blood pressure and loading with 500 CC Hydroxylethyl Starch 130/0.4 (6%). On average, the blood pressure difference persisted until the twentieth minute after spinal anesthesia. This is due to the pharmacological and physiological effects that spinal anesthesia has on the nervous system and blood circulation. In addition, there is a redistribution of blood volume where vasodilation occurs, with blood volume being redistributed to the lower parts of the body due to gravity, reducing the return of blood to the heart. This causes a decrease in cardiac output, which also contributes to a drop in blood pressure.

CONCLUSION

The following findings come from research conducted at Pusri Hospital: Hemodynamics before administering HES fluid 130/0.4 (6%) blood pressure (Systole) standard deviation value 4,460, mean 82.18. Maximum value 90, minimum value 70, (Diastole) standard deviation value 3.131, mean value (57.80). The maximum value is 62, the minimum value is 50, and the pulse variable standard deviation value is 11.553. The mean value is 82.18. Maximum value 146 and minimum value 100; MAP (mean arterial pressure) standard deviation value 2.3465; mean value (65.903). Maximum value 60.0 and minimum 69.3. Hemodynamics after administration of Hes 130/0.4 (6%) with Blood Pressure (Systole) standard deviation value 7.522, mean value (111.80), maximum value 120, minimum value 96, (Diastole) standard deviation value 5.807, mean value (70.65). maximum value 80, minimum value 60, pulse variable standard deviation value 10.830 mean value 76.28, maximum value 97, minimum value 60. MAP (mean arterial pressure) standard deviation value 4.4661, mean value (84.337), maximum value 93.3, and minimum 76.6. Time to administer Hes fluid 130/0.4 (6%); regarding hemodynamic changes after spinal anesthesia, it was found that the time required for hemodynamic changes had a standard deviation value of 3.363, a mean value of 12.15, a maximum value of 20, and a minimum 5. The volume of HES fluid administered was 130/0.4 (6%); the hemodynamic changes after spinal anesthesia were found in the volume given; the hemodynamic changes had a standard deviation value of 30.783, a mean value of 99.65, a maximum value of 167, and a minimum of 22.

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